SEMICONDUCTORS INDUSTRY IN **POLAND**

2025

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Semiconductors represent our shared opportunity – for a stronger economy, technological independence, strategic security, and a better future. In today's world where technologies are becoming the foundation of national defense and resilience, investing in the domestic semiconductor ecosystem is not only a driver of economic growth but also a safeguard of sovereignty. Achieving this goal requires unity. We need cooperation across all sectors– government, business, academia, and society. Now is the time to build a team that will lead Poland toward becoming a European leader in modern technologies.

Michał Jaros
Secretary of State
Ministry of Economic Development and Technology

EUROPEAN **CHIPS ACT**

Over the past decade, the global significance of the semiconductor industry has grown substantially. The COVID-19 pandemic further exposed strategic vulnerabilities in supply chains, underscoring the critical need for a robust, localized semiconductor sector. Both the United States and the European Union have recognized the imperative of increasing domestic chip production to safeguard economic and technological security.

In response to these challenges, on **July 25, 2023,** the European Council approved the **European Chips Act**, which officially took effect on September 21, 2023. This initiative is part of a broader effort to advance digital innovation in Europe, with the goal of boosting semiconductor production and expanding the presence of European microprocessors in the global market.

It is important to highlight that, despite its significant role in manufacturing electronic devices, the **European Union's share in the global semiconductor sector remains limited.** EU policymakers have voiced concerns about an economy heavily reliant on imports. In her 2021 State of the Union address, President Ursula von der Leyen emphasized that Europe must achieve leadership in the semiconductor field, a crucial step toward 'technological sovereignty'.

The European Chips Act sets ambitious goals for the next decade, aiming to **double the EU's share in global semiconductor production from the current 10% to 20%**. However, with global demand for chips expected to double by 2030, even a significant increase in EU production will not suffice to meet future demand. Consequently, the EU plans to invest **€43 billion** from community funds, providing subsidies to the semiconductor sector through 2030. With this financial support, the European Union aims to reduce the high market-entry barriers, striving to make the industry self-sufficient by the end of the decade.

The ECA itself is structured around three key pillars. The first, the 'Chips for Europe' initiative, directly addresses the primary objective of increasing semiconductor production within Europe. This section of the Act aims to facilitate the transfer of knowledge from laboratories to manufacturing facilities, promoting the industrialization of innovative technologies by European companies. The initiative will receive **€3.3 billion** in funding from the EU, which is expected to be complemented by contributions from member states. Under the first pillar, the Act will support activities such as the establishment of advanced pilot production lines, the development of a cloud-based design platform, the creation of competence centers, the advancement of quantum chips, and the establishment of dedicated financial instruments.

EUROPEAN **CHIPS ACT**

The second pillar of the European Chips Act encourages both public and private investment in semiconductor manufacturing facilities supporting small and medium-sized enterprises (SMEs) by reducing financial barriers to entry in the semiconductor industry. However, when the ECA proposal was initially presented, the Commission made it clear that aid would only be granted to innovative facilities, described as 'first-of-a-kind'.

The third pillar of the ECA establishes a coordination mechanism between member states and the European Commission to enhance collaboration, monitor semiconductor supply chains, assess demand, predict shortages, and, if necessary, implement corrective measures. The first step in this process was the launch of a semiconductor supply chain disruption reporting system on April 18, 2023.

Overall, **the European Chips Act aims to position the European Union as an attractive location for semiconductor production by offering funding and facilitating rapid business development.** The ECA also outlines in detail long-term plans to maintain the EU's competitiveness through innovation, primarily achieved by investing in innovation centers and startups using both private and public funds. The EU already has programs like Digital Europe and Horizon Europe in place, which will receive €15 billion for semiconductor-related research and development.

Europe is preparing a new Chips Act 2.0, which is being developed by countries such as the Netherlands, France, Germany, Italy, and Spain. Specific proposals are expected to be presented to the European Commission in 2025. The initiative directly addresses the expectations of chip manufacturers and semiconductor manufacturing tool suppliers, who have been calling for a second round of funding. **Leading European semiconductor companies, as well as equipment manufacturers such as Bosch, Infineon, NXP, STMicroelectronics, ASML, ASM, Carl Zeiss, and Air Liquide, have been involved in the development of Chips Act 2.0.** The industry expects Chips Act 2.0 to provide a broader range of support than the previous program. ESIA and SEMI Europe are calling for the new funding to cover **not only the construction of integrated circuit factories but also design centers, material and equipment suppliers, and research and development initiatives.** According to parties engaged in Act's update, the European Union has strong competences in areas such as research and development and the production of tools for the production of integrated circuits, as evidenced by the market position of companies such as ASML, ASM International, Carl Zeiss SMT and SUSS MicroTec.

Although many view the EU legislation as a response to the US CHIPS Act, both initiatives are actually efforts to **reduce dependence on supplies from Taiwan, South Korea, and China.** The latest data show that 87% of semiconductors were produced in these three countries, with Taiwan accounting for over 60% of the market. For the EU and the US, there is a clear risk in this heavy reliance on the region, particularly given the rising tensions in the Indo-Pacific. While the European Chips Act is widely seen as a step in the right direction, it also faces several challenges, including the need to rapidly scale up production capacity and attract the talent necessary to operate advanced semiconductor technologies. Additionally, the EU must navigate a complex global environment, where other powers, such as the US and China, are also heavily investing in their chip industries.

POLISH **LAW** AND SUPPORT FORMS FOR INVESTORS

Both the European Chips Act and manufacturers like Intel are focused on selecting locations that not only provide **access to a skilled workforce** but also benefit from **environmentally friendly and economically viable energy sources.** Poland is undertaking various initiatives to reduce the environmental impact of its energy sector, with the development of renewable energy sources being a key factor. By 2030, more than half of the country's electricity is expected to come from renewable sources, primarily from PV and wind energy. According to the strategy developed in **PEP2040,** reducing the emissions of the energy sector will lead to increased competitiveness of the economy.

The global semiconductor market has experienced significant disruptions due to the COVID-19 pandemic and the war in Ukraine. The resulting **reconfiguration of the global semiconductor market** opens up opportunities for the entire Europe, including Poland - *there has been a diversification in shifting semiconductor production from the Far East to other locations, primarily in the USA and Europe. This goes beyond mere plans or announcements. We are talking about actual programs that financially support the development of large research institutes and semiconductor companies. These initiatives, backed by specific budgets, are being implemented both in Europe and the United States. This trend is already irreversible and appears highly favorable from Polish and European perspectives. Secondly, looking at economic indicators, we are in a phase of gradually emerging from the crisis. If no further unforeseen events occur, we should see moderate but dynamic growth* - says DSc Mariusz Sochacki, professor at the Institute of Microelectronics and Optoelectronics at Warsaw University of Technology, in an interview with tek.info.pl [1].

- When engaging in semiconductor production, it is also essential to prioritize collaboration. This opportunity has become more evident than ever, as U.S. restrictions on Chinese participation in the supply chain have created additional space. For example, GlobalFoundries has developed numerous joint ventures worldwide—such as with Qualcomm in New York and STMicroelectronics in France—to reduce investment expenditure and rapidly scale up chip production. Chip manufacturers should similarly pursue joint ventures within the European Union. Ones, that facilitate quicker establishment of new sites with lower financial outlays than operating independently, notes Łukasz Wiśniewski, a consultant from Kearney's Warsaw Office [2].

A detailed description of the state administration's support for the semiconductor sector is included in the supplement ***PAIH Support for Entrepreneurs in the Semiconductor Sector*** (page 59), instruments stimulating scientific research are included in the **NCBR Support Offer** (page 66)

[1] *Source: https://tek.info.pl/article/3716/wyzwania_i_osiagniecia_polskiego_przemyslu_polprzewodnikowego*
[2] Kearney on the Semiconductor Market: Europe Enters the Competition. 2023, Kearney

POLISH **LAW** AND SUPPORT FORMS FOR INVESTORS

The government program aimed at boosting investments that enhance the innovation and competitiveness of the Polish economy shall be a subject of semiconductor sector revitalization. This project, titled **'Program for Supporting Investments of Significant Importance to the Polish Economy for 2011-2030'**, was initiated by the **Ministry of Development and Technology.** Within its framework, the program offers funding in a form of **grants** for both large-scale strategic investments and medium-sized innovative projects. Rewarded are initiatives that adopt modern technologies and plan research and development activities, which directly contribute to the development of the semiconductor sector.

A significant step towards strengthening the Polish semiconductor sector is also the **'National Framework for Supporting Strategic Semiconductor Investments'** project, proposed by the Ministry of Digital Affairs with an intended **$1.5 billion** budget. The program's objectives cover the entire semiconductor value chain—from design phases to production capacities. The goal is to support projects developing semiconductor manufacturing in Poland with an emphasis on investments enhancing the EU's economy competitiveness, supporting sustainable economic growth, and creating new jobs. The program outlines the rules for granting public aid to investors planning to start production or open semiconductor factories in Poland that comply with European Union standards. To obtain assistance, the **investor must invest at least PLN 850 million** in an integrated production facility or an open EU factory within a maximum of **20 years**, and create and maintain at least **100 new jobs** throughout the entire project duration. Furthermore, the program requires investors to collaborate with research and academic institutions.

On February 6, 2025, the Ministry of Digital Affairs presented **Poland's development strategy for the semiconductor industry**. The government's strategy is based on seven pillars designed to create favorable conditions for the development of the semiconductor industry in Poland: **infrastructure** (investments in modern laboratories, production plants, and research and development centers), **state support** (supporting Polish innovation, initiating projects, implementing new technologies, and developing exports), **international cooperation** (building partnerships with global industry leaders), **investment and financing** (raising funds and providing funding for domestic projects and attracting large international investors), **human resources training and education** (developing human resources in the semiconductor sector), **water and energy availability** (ensuring the necessary resources for production), and the **availability of chemicals and raw materials** (stabilizing the supply chain of key materials).

COOPERATION WITH **TAIWAN**

In 2022, PAIH and Poland have been actively competing for Intel's $4.6 billion investment in an advanced integration and testing facility, which turned out to be a breakthrough year for Poland's emergence in the global semiconductor industry. The year **2022 also marked** the first exploratory mission to Poland by **Taiwania Capital**, a national investment fund from Taiwan which became an important long-term partner for PAIH in Taiwan. In September 2022, a **high-profile R&D semiconductor mission** came from Taiwan to Warsaw and Wrocław, prompting the establishment of the **Poland – Taiwan government working group for semiconductors**.

Since 2022, PAIH has been taking up numerous initiatives aimed at promoting the Polish semiconductor ecosystem in key markets for the global semiconductor industry with special focus on Taiwan. In **2023**, PAIH launched its flagship promotional activity in Taipei - **National Pavilion at the Semicon Taiwan trade fair**. Since then, the National Pavilion has become an annual tradition with the accompanying event, the **Poland – Taiwan Business Forum** held in partnership with SEMI, the global semiconductor industry's representation. PAIH's regular presence in Taiwan has already brought tangible results - a global player, **Compal Electronics** located its new automotive electronics factory in the city of Czeladź (Poland).

Business and government contacts laid the foundation for today's bilateral cooperation between companies and institutions in Poland and Taiwan. In 2024, three new organisations appeared in the ecosystem: Semicon Supply Poland, Polish-Taiwanese Chamber of Commerce and Industry and Taiwanese-Polish Chamber of Commerce TAIPO, which are now actively fostering partnerships betwen companies from both countries.

TSMC's decision to invest in Europe has significantly intensified mutual interest between Poland and Taiwan. The location of its chip factory in Dresden - just 100 kilometers drive from the Polish border - has implied new development opportunities for both Polish and Taiwanese businesses. In March 2025, **TEEMA**, the largest representation of Taiwan's electronics industry, visited Katowice and Wrocław. In a special report published by TEEMA after the visit, Poland was captured as an integral part of Europe's 'Chip Triangle,' playing a strategic role in the ICT ecosystem and emerging as a key future hub for Taiwan's semiconductor and ICT industry.

In September 2025, the Polish Investment and Trade Agency (PAIH) will once again promote Poland and the country's leading industry players at the **Polish National Pavilion during SEMICON Taiwan 2025**. The event, part of the International Semiconductor Week, marks the 30th edition of the exhibition and the third consecutive year of Poland's strong presence in the global semiconductor hub.

- ***Łódź, Katowice and Wrocław form a dynamic ICT triangle.*** *As Taiwan's manufacturing foundation in Central Europe evolves, the Czech-Polish corridor could very well become the next powerhouse axis for the Taiwanese investment in the heart of the EU* - noted TEEMA in its special report following the April 2025 visit to Poland organised by PAIH and Taipei Representative Office.

COOPERATION WITH **TAIWAN**

July 2025: Pomerania Development Agency (ARP) and **TAIPO** signed a letter of intent to assess the possibility of creating a dedicated industrial park in Pomerania for Taiwanese companies from the high-tech, electronics, and semiconductor sectors.

June 2025: The Polish Investment and Trade Agency (PAIH) represented Poland at **Silicon Saxony Day** in Dresden, encouraging companies present at the event, including **TSMC**, to establish cooperation with the Polish industry.

September 2024: Wilk Elektronik and **Phison Electronics** signed a Memorandum of Understanding (MoU) to establish a joint venture focused on developing firmware for SSDs and flash memory.

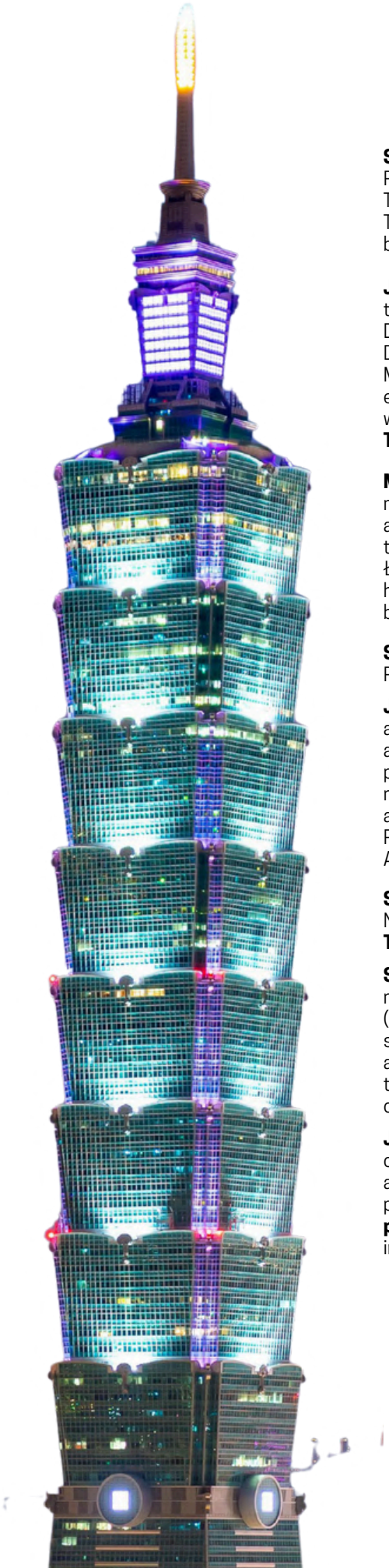
May 2024: The Polish Investment and Trade Agency (PAIH), in cooperation with TeaLA (a Taiwanese organization of TSMC suppliers), organized the Economic Forum *Polish Chemistry for Semiconductors* in Taipei.

April 2024: Advantech announced the opening of a new logistics hub in Poland, supporting the Taiwanese company's European operations.

July 2023: Exatel S.A. and **Chunghwa Telecom Company** signed a Memorandum of Understanding (MoU) to implement joint projects in the fields of cybersecurity, research, and development (R&D), and SDN technologies.

June 2022: Taiwania Capital made its first buisness trip to Poland, marking the beginning of its cooperation with PAIH to explore the potential of the Polish market for Taiwan.

September 2020: Universal Scientific Instruments, part of the Taiwanese ASE Group, acquired the Polish PCBA plant of Chung-Hong near Wrocław.



September 2025: Polish National Pavilion at Semicon Taiwan 2025. The third edition of the Poland–Taiwan Business Forum organised by PAIH in cooperation with SEMI.

July 2025: The largest-ever Polish trade mission to Taiwan led by Deputy Minister of Economic Development and Technology Michał Jaros. During the visit, seven economic cooperation agreements were signed and meetings with **TSMC** and **Foxconn** were held.

March 2025: An official TEEMA mission visited Poland (Katowice and Wrocław), launching in Taiwan the promotion of the ICT Triangle – Łódź, Katowice, and Wrocław – and highlighting its importance in building a supply chain for TSMC.

September 2024: Polish National Pavilion at **Semicon Taiwan 2024.**

July 2024: **Compal Electronics** announced plans to open a new automotive electronics production plant in Czeladź worth PLN 60 million. The project was acquired and supported at all stages by the Polish Investment and Trade Agency (PAIH).

September 2023: 1st Polish National Pavilion at **Semicon Taiwan 2023**.

September 2022: Signing of a memorandum of understanding (MoU) on cooperation in the field of semiconductors between Poland and Taiwan and establishment of the Taiwan–Poland working group on semiconductors.

July 2022 – **XTPL** receivd its first order from Taiwan for the supply of a printing module, part of a prototype device for **advanced packaging** in the semiconductor industry.

GLOBAL SUPPLY CHAIN FOR SEMICONDUCTORS PRODUCTION

There is likely no business more international than semiconductor production. The supply chains of individual companies almost always involve a dozen or more countries across Asia, America, and Europe. Due to the highly complex nature of the process, which requires strict specialization by individual companies, no country or region is entirely independent or autonomous within the entire supply chain [1].

As a result, **different countries or even regions hold leading positions in specific supply chain segments.** Currently, only about 10% of global semiconductor production takes place in Europe, and it is primarily limited to manufacturing chips using 22-nanometer technology or larger. Only two companies in East Asia, Taiwan's TSMC and South Korea's Samsung, are capable of producing the most advanced chips using 2 to 7-nanometer technology. However, the equipment necessary for this production is manufactured exclusively in Europe by the company in the Netherlands. These interdependencies within the international supply chain are in great deal and numerous.

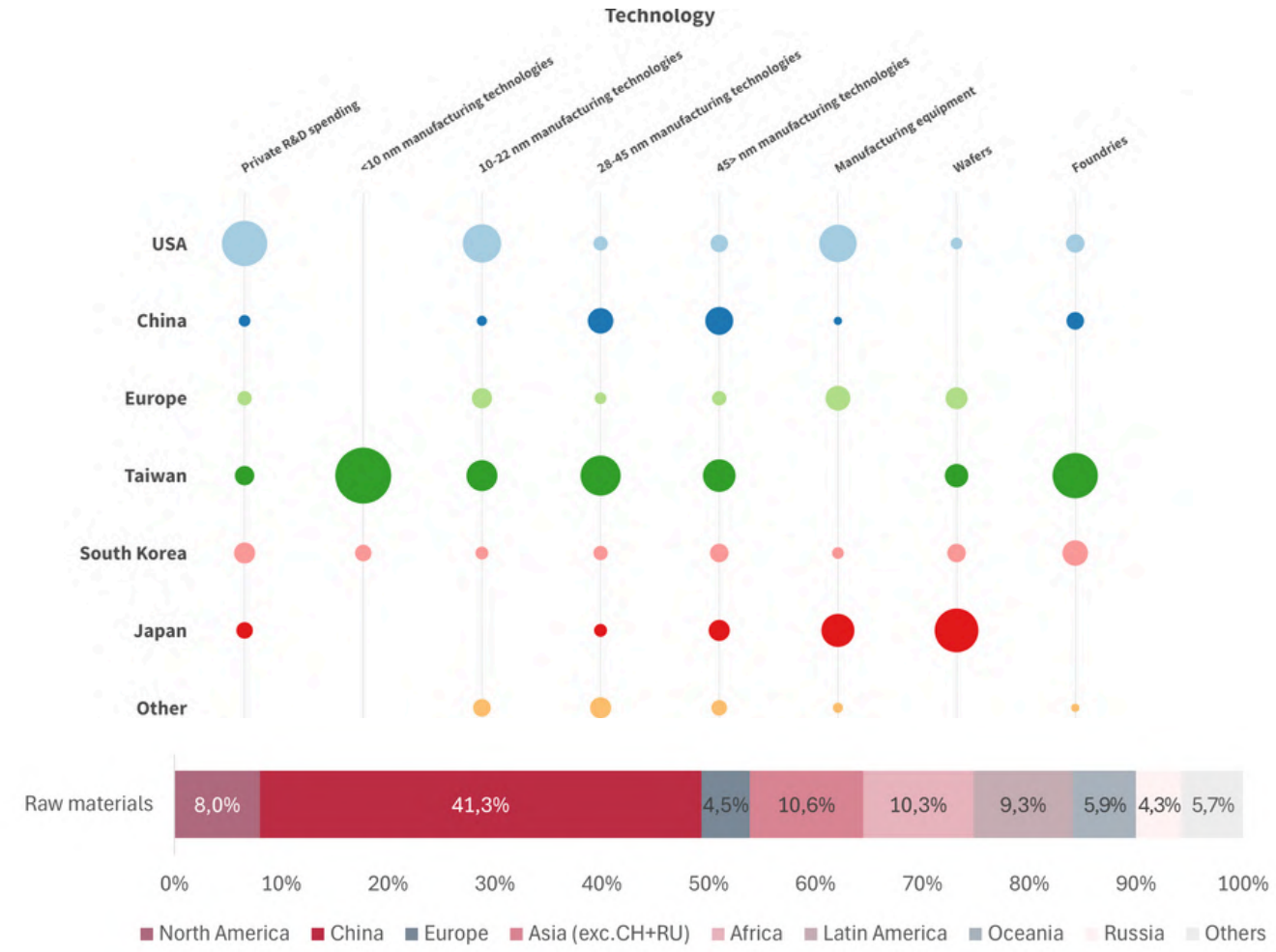
> *No country is self-sufficient when it comes to semiconductors due to the complexity, geographic specializations and deep interdependencies characterizing the supply chain. [...] Figure 1 above and figure 2 on the next page for instance indicate that the US dominates global private R&D spending, Taiwan the foundries and most advanced manufacturing technology, Japan wafer fabrication, and China raw material inputs. Chip making, from design to production, assembly, testing and packaging is comprised of over 1 000 steps using around 300 materials including silicon wafers, gases, and chemicals. Large semiconductor producers rely on up to 16 000 suppliers worldwide. A supply chain crosses the border 70 times before reaching an end user and over 50 choke points where one region holds more than 65 % of the global market share. This makes the supply chain vulnerable to disruptions such as natural disasters, infrastructure failures and geopolitical tensions* - as outlined in the 2024 report by ESPAS analysts for the EU [2].

[1] The position of the EU in the semiconductor value chain: evidence on trade, foreign acquisitions, and ownership. 2024, Joint Research center, Andrea Ciani, Michela Nardo

[2] Global Semiconductor Trends and the Future of EU Chip Capabilities, European Strategy and Policy Analysis System (ESPAS), 2024

GLOBAL SUPPLY CHAIN FOR SEMICONDUCTORS PRODUCTION

Regions share in specific segments of the semiconductor production supply chain



Source: Global Semiconductor Trends and the Future of EU Chip Capabilities, European Strategy and Policy Analysis System (ESPAS), 2024

Data on the supply chain confirms that European semiconductor-producing companies heavily rely on suppliers and customers based outside the EU. Research conducted in 2023 by the Joint Research center indicates that, on average, **nearly 80% of suppliers active in the European semiconductor supply chain have their headquarters outside the EU.** Moreover, EU companies involved in the semiconductor industry supply chain have, on average, only 37% of their clients within the EU. Among these 80% of suppliers outside the EU, the majority are based in the United States (36%), followed by Taiwan (12%), China (11%), South Korea (10%), and Japan (9%). **Awareness of these facts was one of the motivations behind the European Chips Act initiative.** [1]

[1] The position of the EU in the semiconductor value chain: evidence on trade, foreign acquisitions, and ownership. 2024, Joint Research center, Andrea Ciani, Michela Nardo

GLOBAL SUPPLY CHAIN FOR SEMICONDUCTORS PRODUCTION

Front-End vs. Back-End

The entire process of semiconductor production can be divided into two distinct phases, called front-end and back-end. Both phases are marked by significantly different technological processes and require consideration of various factors when determining an optimal location for production sites. **Their unique requirements result in clear differences between the lists of countries and regions best suited for prosecuting such types of production.**

The **front-end** production involves the conversion of silicon into designed silicon wafers, which is a highly technical process requiring high capital expenditures. It also necessitates an appropriate number of highly qualified workers capable of operating highly advanced technical production processes.

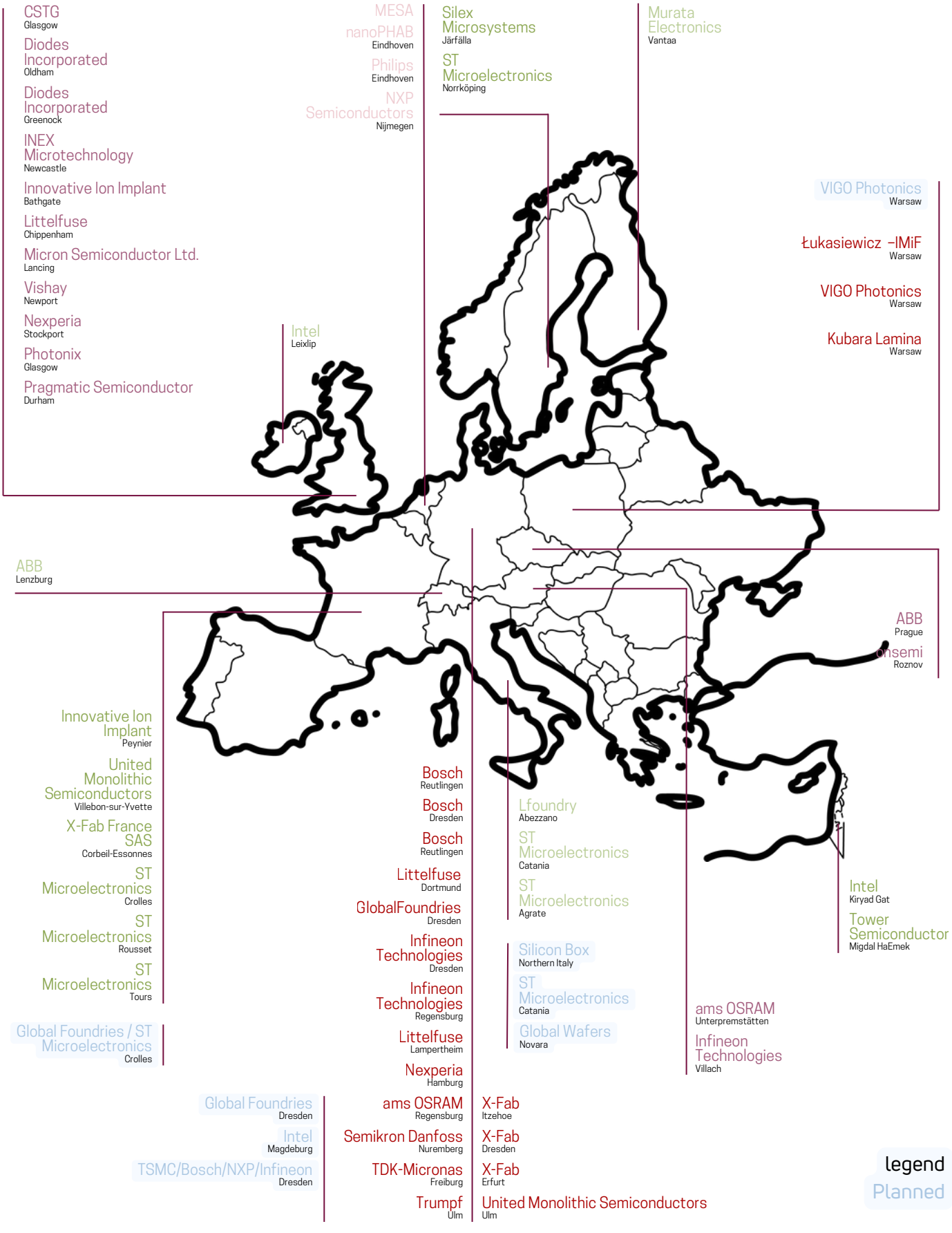
In contrast, the **back-end** production involves testing and packaging of integrated circuits from silicon wafers produced in the front-end process. The back-end production has made significant technological advancements in recent years (2.5D/3D packaging, automation), simultaneously reducing operational costs and pollution levels. Despite technological progress and automation, this phase remains less capital-intensive and imposes relatively fewer requirements in terms of intellectual property protection and the provision of highly qualified labor compared to front-end production. **From Poland's perspective, the back-end industry is a better fit for its already possessed experience and technological competencies acquired in the process of developing the electronic industry in Poland.**

Front-end in Europe

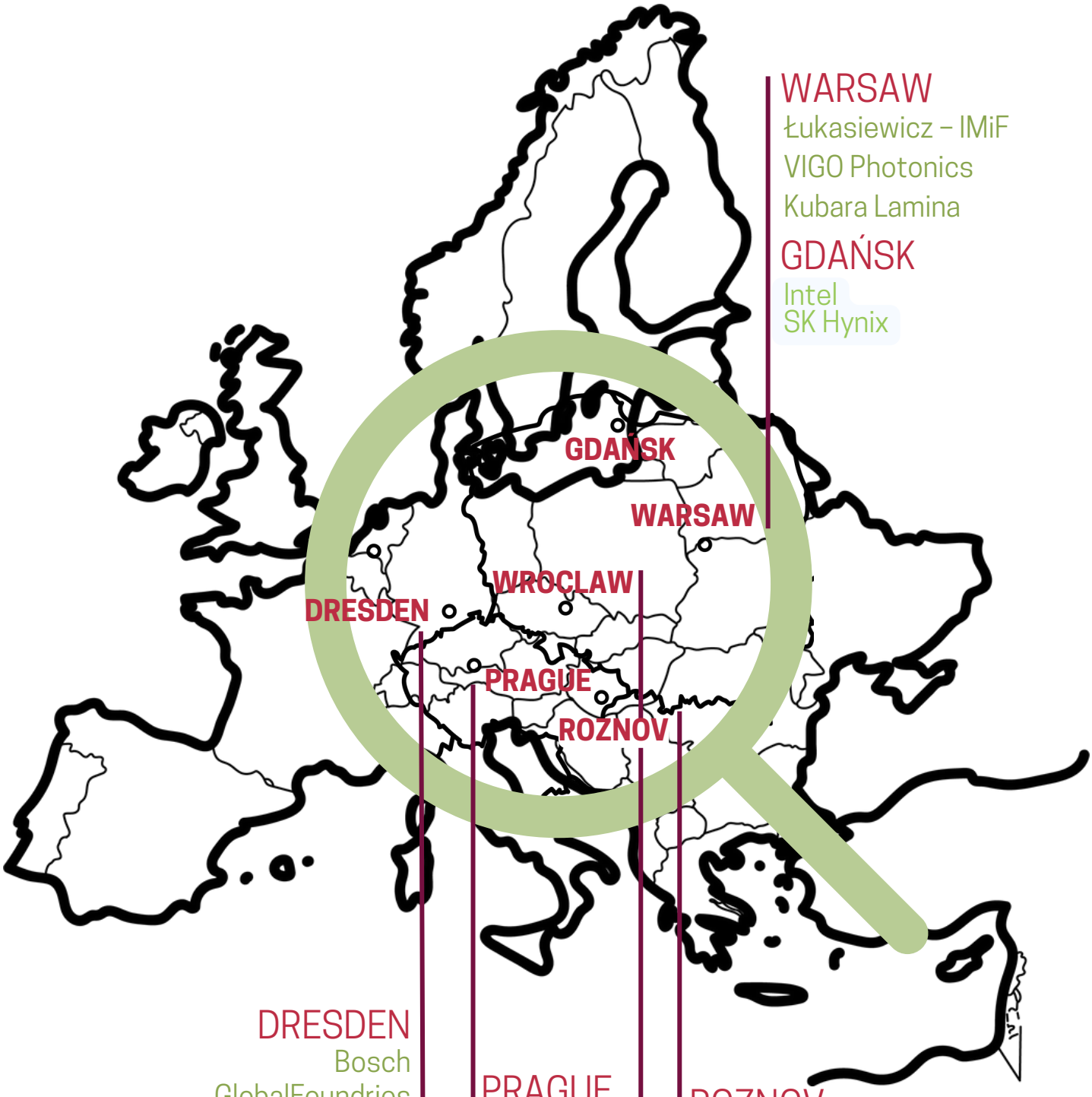
Approximately **55 facilities** involved in front-end processes are located in Europe. Some of these were established decades ago—the history of the oldest ones dates back to the 1950s—when Europe's share in global production was significantly larger than it is today. Currently, **Germany** has the most front-end facilities, with as many as 17, while slightly fewer (11) are located in the **United Kingdom.** Many of the lines located in Europe specialize in niche applications or perform research and development functions.

In the pan-European aspect, the **Saxony and the Czech Republic** regions deserve to be highlighted, especially in light of numerous announcements on production expansion in Dresden and Wrocław. Dresden already hosts factories of **GlobalFoundries** (acquired from AMD), **Bosch, Infineon, and X-Fab,** while in the nearby Czech Republic, **ABB** and **Onsemi** have their plants. Following the semiconductor supply chain crisis caused by the coronavirus pandemic, there have been announcements from semiconductor manufacturers about constructing new plants, with **Dresden frequently mentioned as a potential location. This region could become the European center for semiconductor production in the future.**

EUROPEAN FRONT-END MANUFACTURING PLANT LOCATIONS



POLAND CAN BECOME A BACKUP FOR THE LEADING SEMICONDUCTOR MANUFACTURING CENTER IN EUROPE, LOCATED AROUND **DRESDEN.**



WARSAW
Łukasiewicz – IMiF
VIGO Photonics
Kubara Lamina

GDAŃSK
Intel
SK Hynix

DRESDEN
Bosch
GlobalFoundries
Infineon Technologies
X-Fab

PRAGUE
ABB

ROZNOV
onsemi

WROCŁAW
Intel

Global Foundries
TSMC/Bosch/NXP/Infineon

legend
Planned

Back-end in Europe

The European sector of advanced technology end-of-line assembly constitutes only a marginal share of the global market. **In 2023, the volume of the EU advanced packaging market was estimated at €300 million, accounting for just 1.8% of global production.**

Key European sites with advanced packaging capabilities include Amkor in Portugal, Infineon in Germany, and STMicroelectronics in Malta. These facilities employ approximately 5,200 people combined, focusing on end-of-line assembly technologies such as Fan-Out (FO) and Flip Chip Ball Grid Array (FC BGA). Infineon's plant in Regensburg, Germany, employs 3,000 people and focuses on FO eWLB and embedded die technologies, however most of the company's back-end operations are located in Asia. STMicroelectronics has a plant in Kirkop, Malta, with 1,600 employees working on FC BGA technologies, and a smaller FO production facility near Naples, Italy. In addition, Amkor's plant in Porto, Portugal, employing 600 staff members, utilizes fan-out and wafer-level packaging (WLP) technologies.

Despite the presence of these plants, the EU's contribution to global advanced packaging remains limited. Nevertheless, there are credible prospects for improvement. For example, the joint investment by TSMC, NXP, Infineon, and Bosch in Dresden may include advanced end-of-line assembly technologies. Thales in France also operates advanced packaging operations for the aerospace and military industries, relying on FO and FC BGA technologies.

Global perspective

Advanced back-end technologies, referred to as **advanced packagin**g, require specialized expertise across multiple tiers of the supply chain, thereby offering substantial growth potential. TSMC, the global leader in semiconductor contract manufacturing, derives approximately 20% of its revenue from OSAT activities and consistently makes significant investments in this domain. **The strategic growth potential of the OSAT market is underpinned by three key advantages: accelerated time-to-market for semiconductors, reduced development costs, and well-established customer relationships.**

The market for advanced semiconductor integration technologies is expected to **grow at a compound annual growth rate (CAGR) of 11.4% from 2022 to 2035, subs**tantially outpacing the overall OSAT market. The market size is expected to expand from **€20 billion in 2022 to approximately €80 billion by 2035.**
This growth is driven by rising demand for high-performance computing, the miniaturization of electronic devices, and continued advances in semiconductor technologies that require increasingly sophisticated final assembly solutions.

In terms of key applications, the advanced packaging market is dominated by consumer electronics such as smartphones and PCs, which account for 41% of total applications. The next largest segments are servers and telecommunications infrastructure, representing 21% and 12% respectively. The automotive sector, driven by technologies such as Flip Chip Ball Grid Array (FC BGA) and Fan-Out, accounts for 10% of the market. Other segments including automation, renewable energy, healthcare, aerospace and defense, and security collectively represent 16%.

POLAND RANKS FIFTH GLOBALLY IN TERMS OF ATTRACTIVENESS FOR **BACK-END** MANUFACTURING INVESTMENT

The Kearney Ranking

In September **2024**, **Kearney** analysts assessed 28 parameters determining a country's attractiveness for investment, grouped into three main categories: **business environment** (30% weight), **capital incentives** (20%), and **operating costs and incentives** (50%). The figure on the next page presents the resulting ranking of countries and regions based on Kearney's analysis.

Poland ranks fifth in Kearney's index, the highest position among all European countries. The global leaders in back-end manufacturing (known as the OSAT market) are Taiwan and mainland China, which together account for over 60% of the global market, followed by Malaysia and India. Among the world's ten largest OSAT providers, six are headquartered in Taiwan and three in mainland China.

According to Kearney, however, **the European Union is aiming to strengthen its local semiconductor manufacturing network by complementing front-end production facilities** in Germany, Ireland, and France **with back-end capabilities**. Poland is strategically well positioned in the OSAT landscape due to its relatively low operating costs. **In total, Poland received a score of 5.2 points from Kearney** (compared to 6.0 points for the top-ranked Taiwan), including a notable 3.4 points for its favorable economic environment.

Malaysia holds second place in the ranking and is seen as an independent and secure location for back-end operations. **Its strong 13% share of the global OSAT market is the result of long-standing government efforts to support a resilient and well-developed domestic semiconductor ecosystem**. Malaysia offers a particularly stable business environment compared to other emerging regions and provides a cost-effective and skilled labor force. A wide array of incentives, such as five-year tax holidays and exemptions from import duties on raw materials and components, also plays a key role.

The European Back-End Industry Ecosystem

Europe is home to **back-end hardware and tool manufacturers** such as BESI (Netherlands) and Süss MicroTec (Germany). The EU consortium **Pack4EU** is proposing an investment plan for advanced end-of-line assembly technologies, including a pilot line financed by the European Chips Act, focusing on 3D packaging for RF. IMEC, Fraunhofer, and CEA Leti are among the participants in the project.

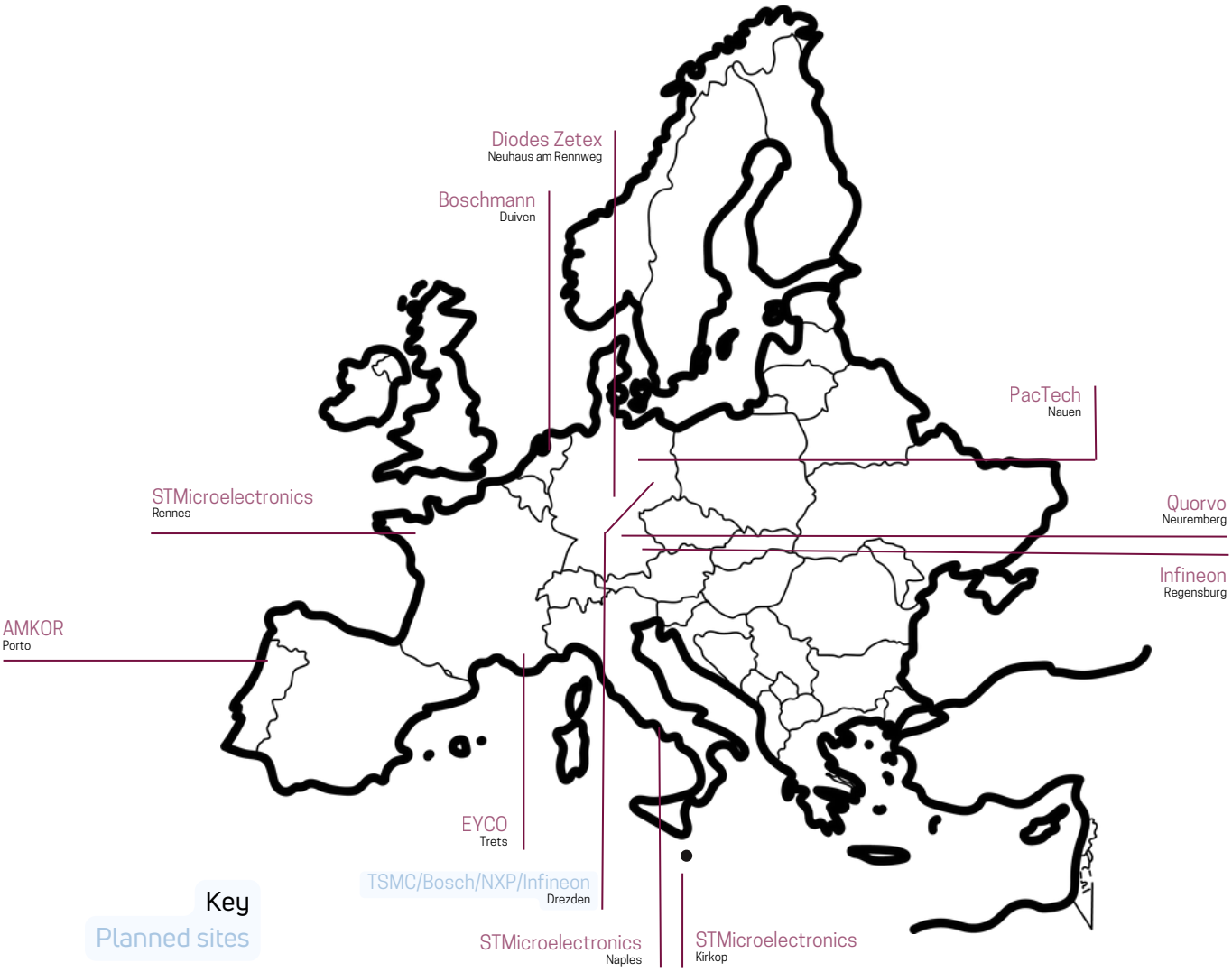
The future of back-end in europe

The EU's advanced back-end technology industry is poised for growth, although significant challenges remain. As the IPC notes in its report, "Securing the European Union's Electronics Ecosystem", investments in new facilities and technologies appear crucial to maintaining and potentially increasing the EU's global market share. Strategic initiatives, collaborations, and continued investment in research and development will play a key role in shaping the future of advanced packaging in Europe.

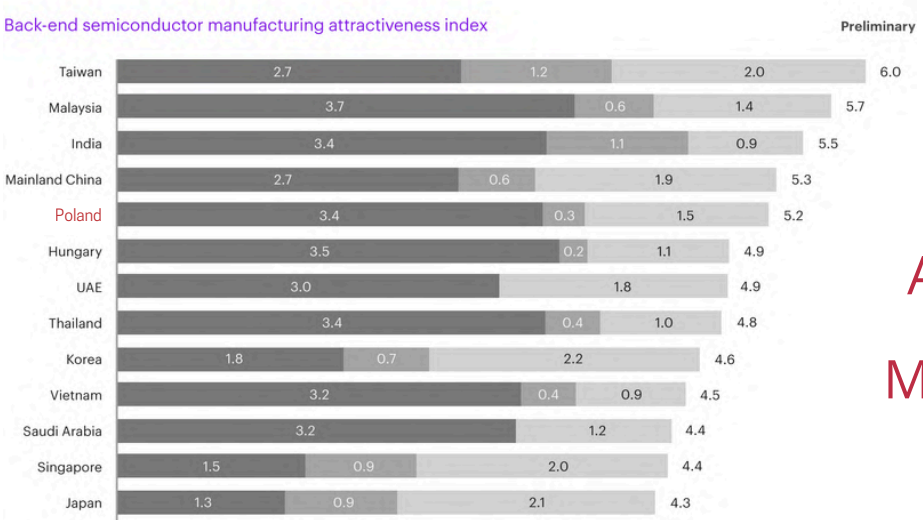
Intel's Unrealized Plan: Back-end Facility in Wrocław

On June 16, **2023**, Intel announced an investment of **$4.6 billion in a semiconductor integration and testing facility in Miękinia, near Wrocław**. The OSAT facility was expected to create approximately **2,000** positions, with production scheduled to begin in **2027**. Due to the company's poor financial condition and declining market demand, Intel suspended further steps for two years in September **2024**. In July **2025**, the project was finally abandoned.

EUROPEAN BACK-END MANUFACTURING SITES



*Source: Securing the European Union's Electronics Ecosystem, IPC 2024



THE KEARNEY RANKING COUNTRIES' ATTRACTIVENESS FOR **BACK-END** MANUFACTURING LOCATION

*Source: Back-End Semiconductor Manufacturing Attractiveness Index, Kearney 2024

About SEMI

SEMI is the global industry association connecting over 3,000 member companies and 1.5 million professionals worldwide across the semiconductor, electronics design and manufacturing supply chain. The organisation accelerates member collaboration on solutions to top industry challenges through advocacy, workforce development, sustainability, supply chain management and other programs.
SEMI develops exhibitions and events organized under the SEMICON and ISS brands (Industrial Strategy Symposium). ***For two years in a row, Sopot (Poland) has hosted this key industry event.***

ISS INDUSTRY STRATEGY SYMPOSIUM Europe

ISS Europe 2025

Sopot (Poland)
12-14 March 2025

219	**35**	**27**
attendees	*speakers*	*sponsors*
24	**2**	**50**
lectures	*panel discussions*	*media partners*

ISS Europe 2026

Sopot (Poland)
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- We must avoid country-centric thinking. Europe's strength lies in its diversity, with different regions excel in different areas, and the challenge is to bring those strengths together. Initiatives like the pilot lines are a great example of this in action, connecting capabilities in photonics, advanced packaging, and quantum technologies across the continent. [...] To truly accelerate Europe's position in the global semiconductor landscape, we need to focus on integration - connecting the dots between regions, institutions, and industries - said **Laith Altimime, President SEMI Europe** in March 2025 in Sopot.

ELECTRONICS INDUSTRY **IN POLAND**

EMS & OEM SECTORS

It is frequently stated that Poland is a manufacturing support of Europe. In the case of the electronics industry, this statement is most certainly true.

Poland has come a long way to achieve this status. After the political transformation on the verge of 80s and 90s, the electronics industry in Poland was represented by only a few companies, often lagging behind the rest of the world in technological advancement. However, Western companies quickly recognized Poland's immense potential, sparking a wave of investments that continues to this day. One of the initial investments was a factory manufacturing **Philips** TV sets, present in Kwidzyn since mid 90s. In 2004, the plant was acquired by EMS producer, Jabil Circuit, which, along with **Lacroix Electronics**, operating since 1998, and **Flex**, present in Poland since 2000, laid the foundations for a modern **EMS** industry in Poland. Today, this industry comprises around 80 entities, which, according to estimates by **in4ma** and **tek.info.pl**, account for between **6.9% and 7.2% of European EMS production.** Poland is the **fifth**-largest EMS production center **in Europe.** [1]

Of course, it wasn't just EMS companies that invested, but also **OEM**s. Other companies specializing in consumer electronics followed in Philips' footsteps. One of the most significant investors in Poland is **LG**, owning one of the largest TV factories on a European scale, located in Mława. TV sets are also manufactured by **Sharp** in Toruń, **TCL** in Żyrardów, and **TVP** in Gorzów. Examples of successful investments include **TRUMPF Huettinger, JOYNEXT, Diehl, TechniSat**, and many others. The development of foreign OEMs also spurred the growth of domestic companies, with a count of approx. 300 operating facilities in Poland, out of which, 10% achieves an annual turnover exceeding 25 million EUR. [2]

> *Poland is the **fifth-largest** EMS production center in Europe, with a market share of approximately **7%** [1].*

[1] tek.info.pl/article/868/polska_branza_ems_na_tle_europy

[2] tek.info.pl/article/781/top_100_polskich_oem_2023

ELECTRONICS INDUSTRY **IN POLAND**

RESEARCH AND DEVELOPMENT CENTERS

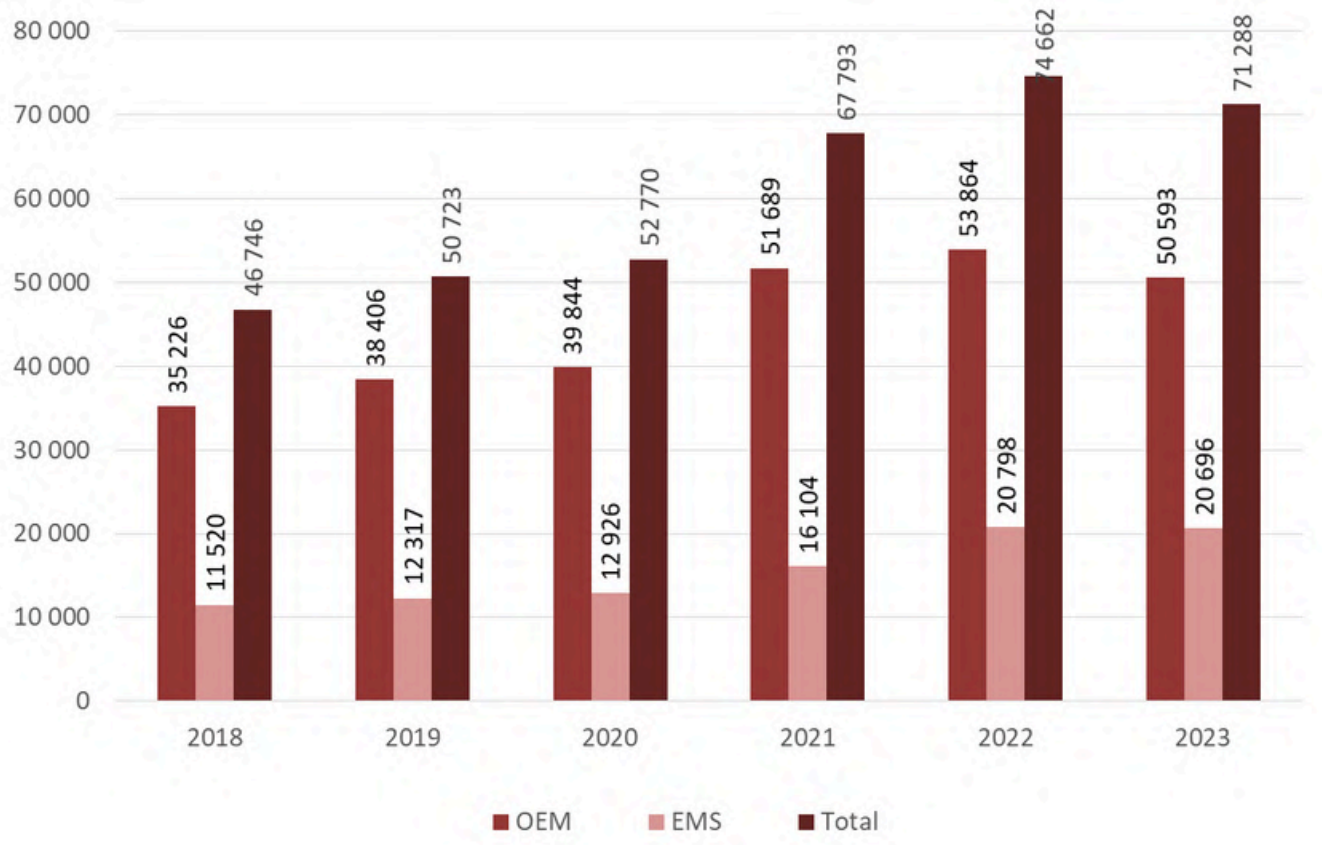
The nature of production in Poland has changed dramatically since the '90s. Initially, it often involved the simplest, strictly mechanical assembly. With constant skills' improvement, Polish factories were entrusted with increasingly complex tasks, including the full NPI and PCBA processes. **However, in recent years, a new trend become noticeable: more and more research and development centers are being established in Poland.** These either complement run in Poland for many years processes (such as Jabil's R&D center in Wrocław or Nippon Seiki's unit in Gdańsk) or are entirely new entities. **From designing electronic systems to manufacturing semiconductors, it's just one step in the electronics industry supply chain, and this sector could become the natural support base for the emerging semiconductor industry.**

The Aptiv R&D Center in Kraków employs over 2,500 people.
Source: Aptiv

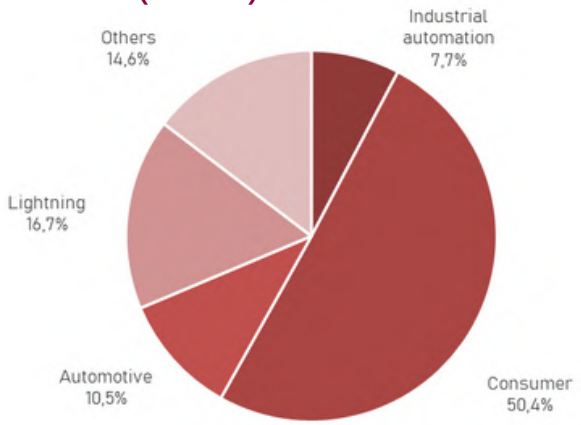
Poland has been particularly favored by the **automotive industry,** which established here its design centers. One of the first and largest at the same time is the R&D unit of the American company **Aptiv** in Kraków, employing around 2,500 engineers. This center works on technologies such as gesture recognition, wireless communication, driver monitoring systems, autonomous driving, and several others. It's also worthwhile to mention that some of these technologies are subsequently produced at the manufacturing facility in Gdańsk. The German conglomerate ZF has established a similar model of presence in Poland, combining production and research functions. ZF owns three research units and two PCBA plants in Poland, working on active safety systems and autonomous driving technologies, with some of these systems being manufactured in specialized plants in Częstochowa and Wrocław. Another important example is **Nippon Seiki** concern, which develops head-up displays (HUD) in Gdańsk and manufactures them in a new factory near Łódź.[1] The automotive industry, of course, does not exhaust the topic of R&D centers' presence in Poland, as there are dozens of them in the country. Among the facilities established in recent years are highly advanced units from companies specializing in measurement equipment (**Rigaku, Pendulum Instruments, Bustec**), industrial applications (**ifm ecolink, voestalpine Signalling, Honeywell**), and many others. Also, we shall not forget the R&D centers belonging to Polish OEM companies, with a count of over hundred units, often employing dozens of people.

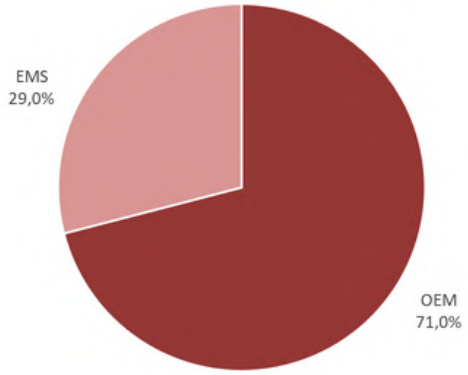
[1] https://tek.info.pl/article/1912/raport_elektronika_motoryzacyjna_w_polsce_2022

Revenues of the EMS and OEM Sectors in Poland (2018–2023) [PLN million]



Composition of the OEM Sector in Poland (2022)





OEM and EMS Sectors' Share in Poland's Electronics Industry Turnover (2023)

Source: tek.info.pl

ELECTRONICS INDUSTRY **IN POLAND**

KEY **OEM** INVESTORS

Aptiv
Diehl
Compal
Glamox
Nice
Heesung Electronics
Ifm ecolink
ismaControlli
Joynext
LG Electronics
LG Innotek
Lumel SA
Mobase Electronics
Scanreco
Sharp
Signify
TCL
Technisat Digital
TPV Displays
Trumpf Huettinger
Voestalpine Signaling
Woodward

Polish unit of TRUMPF Huettinger designs power supplies for lasers used in ASML machines
Source: TRUMPF Huettinger

THE LARGEST POLISH **OEMS**

AC
Apator
Bury
Elektrometal
Lena Lighting
LUG
MEDCOM
Mikronika
PCO
PIT-Radwar
Polon-Alfa
Posnet Polska
SATEL
Sonel
WB Electronics
Wilk Elektronik
Zurad

KEY **EMS** INVESTORS

Bitron
Darekon
E.G.O.
Flextronics
Hanza
Jabil
Kimball
Kitron
Lacroix Electronics
Norautron Electronics
OrbitOne
Scanfil Poland
Universal Scientific Industrial

THE LARGEST POLISH **EMS**

Assel
EAE Elektronik
Elhurt EMS
Fideltronik
InterPhone Service
Nordes
TABEMAX
TS Tronic
Vector Blue Hub

FOREIGN INVESTORS R&D UNITS

ABB
ADVA Optical
Aptiv
Arobs
Becker Avionics
BorgWarner
Bosch
Bustec
CAREL
DGS Diagnostics
Diehl
DIP Draexlmaier
Dynamic Precision
Ericsson
Etteplan
Fluke
Gebauer & Griller
Gigaset
Glamox
Honeywell
IAV
ifm ecolink
ismaControlli
Jabil
Kongsberg Maritime
LTTS
Lumel
Monroe
Nexteer
Nice
Nippon Seiki
Nokia
Pendulum Instruments
Renau
Rigaku
Samsung
Taoglas
Trumpf Huettinger
Verkada
voestalpine Signalling
VOLVO
VW
ZF

SEMICONDUCTORS ECOSYSTEM **IN POLAND**

DESIGN / SOFTWARE

INTEL
SK HYNIX
NORDIC SEMICONDUCTOR
SYNOPSYS
SILICON CREATIONS
ANALOG DEVICES
ALDEC
DCD
PHISON
SII
OPEN CHIP
GRAPHCORE
OMNI CHIP
CHIPCRAFT
SOLIDIGM
PHONEMIC
SEMIQA
GRYFIN

EQUIPMENT

TRUMPF HUETTINGER
INSOPTICS
ASYS
XTPL
INSTYTUT FOTONOWY
SYSTERION
NANORES

IDM/FABLESS

VIGO PHOTONICS
RESQUANT
TELESYSTEM
KUBARA LAMINA
TOPGAN LASERS

CHEMISTRY

PCC ROKITA

MATERIALS

ENSEMBLE3
QNA
PHOTIN
NOCTILUCA

SEMICONDUCTORS ECOSYSTEM **IN POLAND**

Intel Technology Poland		2 445
Trumpf Huettinger		1 524
SK hynix NAND		247
Synopsys Poland		234
VIGO Photonics		220
Kubara Lamina		121
Nordic Semiconductors		112
Silicon Creations		89
XTPL		76
Aldec-ADT		63
TOTAL		**5 131**

Semiconductor supply chain companies employ over **5,000** people in Poland.

As many as **92%** of these employees are employed by international companies.

The total turnover of the Polish semiconductor ecosystem is approximately **PLN 3 billion.**

DESIGN / SOFTWARE FOR SEMICONDUCTORS

Intel R&D center in Gdańsk

Intel's Gdańsk R&D center was established in **1993**. Currently, the Gdańsk facility comprises **3,000 permanent employees, 38 laboratories, and 6,000 square meters of space**, recently expanded with the opening of a state-of-the-art office building called IGK-6 (Intel Gdańsk Campus). **The Gdańsk campus is Intel's largest research and development technology center in Europe** and one of the largest of its kind worldwide, with a **primary focus on software development**.

Initial work focused on developing hardware architectures for cellular networks. Over time, the center expanded its activities to include PC and server software, Software-Defined Networking (SDN), graphics microprocessors, as well as USB, Wi-Fi, and Thunderbolt technologies, along with audio and video processing. In recent years, it has also focused on 5G technologies, cloud solutions, Ethernet products, APIs, and AI & machine learning.

After over 30 years of growth, Intel's Gdańsk R&D center now employs 3,000 people. Source: Intel

- Intel has had a long-standing presence in Poland, which is well-positioned to collaborate with Intel's facilities in Germany and Ireland. ***Poland is also very cost-competitive compared to other manufacturing locations worldwide and offers a great talent pool that we are pleased to help develop*** - Intel CEO Pat Gelsinger said in June 2023. [1]

Analog Devices

The Krakow-based daughter company of Analog Devices began its operations in 2017. In addition to commercial activities, the company's business comprise mixed signal design support, specializing in converter-based products with varying degrees of embedded programmability. All technology designed or developed by Polish branch is exported to Analog Devices Int.

Nordic Semiconductors

Founded in 2014, Nordic Semiconductor branch in Kraków is engaged in the development and research of wireless technologies, particularly Bluetooth Low Energy (BLE) and other solutions for the Internet of Things (IoT). Internationally, the company designs and manufactures integrated circuits, modules, and embedded systems, focusing on low-power technologies. Its development center in Krakow employs 112 people.

[1] Source: https://businessinsider.com.pl/biznes/intel-wybuduje-pod-wroclawiem-wielki-zaklad-polska-wchodzi-do-gry-o-rynek

DESIGN / SOFTWARE FOR SEMICONDUCTORS

Solidigm

Solidigm was established in 2021 following the acquisition of Intel's NAND and SSD design division by the South Korean company **SK Hynix.** Solidigm is a global provider of innovative **NAND flash** memory solutions aimed at unlocking the vast potential of data, enabling customers to accelerate technological progress. The company focuses on delivering mass-storage products that meet the needs of both the consumer and corporate markets. Solidigm's product portfolio also includes a variety of SSDs that were previously part of Intel's offerings.

The company operates in 13 locations worldwide, including Gdańsk. The Polish branch supports the company's global efforts in the development of storage technology and is a key element of Solidigm's growth strategy in Europe.

The memory design process begins with the semiconductor wafer. The company relies on memory with high energy and thermal efficiency, increased durability, and reliability, which allows for storing more data and reading with fewer errors throughout the entire usage period. With the support of SK hynix, Solidigm is able to quickly achieve its technological and strategic goals. The company focuses on innovation and the development of new technologies, enabling it to compete with the biggest players in the semiconductor memory market. Solidigm is committed to developing products that not only meet current market requirements but also lay the groundwork for future innovations in mass memory.

SK Hynix

In October 2024, **SK Hynix**, a global leader in memory chip manufacturing, announced the opening of a new Research and Development Center in Gdańsk. The new SK Hynix branch will specialize in the design and optimization of NAND flash memory technology, a key component of modern electronic devices. These solutions enable long-term data storage without the need for power, making them essential in devices such as smartphones and laptops.

The new Polish branch is located in the same complex as the Solidigm center and will work closely with its sister company. Furthermore, the Polish R&D center will collaborate with SK Hynix Korea and the R&D center in the US.

Both Solidigm and the newly established SK Hynix center are located on the campus created by Intel at the Gdańsk airport. Source: Solidigm

DESIGN / SOFTWARE FOR SEMICONDUCTORS

Sii

Sii Poland is the leading technology consulting, digital transformation, engineering, and business services vendor in Poland. For 20 years, Sii Poland has been developing semiconductor expertise throughout the entire semiconductor value chain by providing solutions in product development, software engineering, quality assurance, and operational optimization. It operates in technological domains such as platform firmware and BIOS, DevSecOps, graphics and display drivers, networking and Ethernet devices, storage and persistent memory, FPGA, lab technical support, and AI in factory integration processes.

With over **7 300 specialists**, Sii Poland combines deep expertise in engineering, R&D, and tailored IT support to deliver projects for more than **200 clients worldwide,** including semiconductor manufacturers, fabless companies, equipment suppliers, and technology innovators in the high-tech industry.

Sii Poland is chosen by hardware-centric companies to bridge the hardware-software gap by delivering complex firmware and application solutions that enhance existing products quickly and efficiently. In particular, Sii Poland has vast capabilities to deliver embedded solutions, which include not only hardware design and prototyping but also the full software development lifecycle, from defining requirements to designing robust, scalable, efficient, and secure embedded systems.

Sii Poland distinguishes itself through comprehensive expertise in project management, Agile methodologies, and AI solutions, ranging from cutting-edge generative AI and NLP applications to predictive analytics powered by data science.

Our expert teams enable and accelerate the adoption of scalable AI innovations that generate measurable business outcomes in the semiconductor ecosystem.

A leading global semiconductor company based in Germany, supported by Sii Poland's specialists, implemented several business-critical and AI-focused initiatives to transform semiconductor fabrication processes across multiple international sites. Among the most impactful initiatives was the launch of a global AI-driven predictive maintenance platform, which significantly reduced downtime across numerous fabs worldwide. Additionally, advanced AI-powered quality control and inspection tools were deployed at various stages of the manufacturing process. These solutions enhanced test accuracy, detection speed, and consistency, while integrating seamlessly into fab operations.

– *Clients in the high-tech and semiconductor sector turn to Sii Poland not only for its technical excellence, but also for its ability to align with business objectives. Sii Poland understands that bringing a product or solution to market is not only an engineering challenge but a strategic race against time and competition. Thanks to its rigorous management practices and proven track record in the semiconductor sector, Sii Poland is well positioned to become a one-stop shop partner to reduce time-to-market, improve product reliability, and maintain a competitive edge in one of the most demanding industries in the world* – says Przemysław Włoczkowski, Head of High Tech, Electronics & Industrial Engineering at Sii Poland.

INTERVIEW
MAX DROPIŃSKI
CEE LEADER AT **SEMI**

For several years, Poland has been striving to attract investment from companies within the semiconductor industry's supply chain. Have these efforts altered the perception of our country within the international semiconductor community?

Yes, Poland has become increasingly active in this field and for several years has been on the radar of semiconductor companies as a potentially attractive investment destination. This is the outcome of coordinated efforts of a broad team, including the ARP, PAIH and MRiT, which for several years has been working to build a supply chain for this industry in Poland. The geopolitical situation is favorable, creating a need for increased regional autonomy, which we seek to strengthen through participation in trade fairs and the organization of missions. Our next planned step is to deliver a presentation at the closing of Expo in Osaka, demonstrating Poland's readiness for semiconductor production, thereby reinforcing the image of Poland as a place where this industry is already established and as a country with ambitions for much more. Historically, the birthplace of the semiconductor industry was Silicon Valley. Over time, thanks to the efforts of Asian governments, production also developed in the Far East, primarily in Taiwan, which is currently the undisputed leader, as well as in Malaysia and South Korea. We make it a priority to maintain visibility in these two key industry hubs, the United States and Asia.

The development of back-end technologies has accelerated significantly in recent years and appears to be gaining increasing importance. What is the current role of this stage within the entire supply chain?

Semiconductor manufacturing is the most complex process in human history. To talk about it freely, you have to use some type of simplification. One such simplification is the division into two essential stages: front-end and back-end. The first of these concepts includes stages such as mask design, designing structures at the silicon wafer level, lithographic processes, etching, ion implantation, doping, electroplating, and finally creating the pathways that connect transistors on the silicon wafer. Back-end, on the other hand, is cutting wafers into individual silicon dies, which are then integrated onto silicon substrates, and advanced packaging techniques—referred to as heterogeneous integration based on interconnecting the dies.

For the past few decades, the market has followed Moore's Law, which predicts that the number of transistors on a microprocessor and consequently its computational capacity doubles approximately every two years. With each new generation more and more transistors have been packed onto processors, and for many years the front-end process was primarily responsible for technological progress. We have now reached a stage where transistors are built from virtually single atoms, making further miniaturization increasingly difficult. At the same time, Moore's Law remains in effect and innovation has been shifting ever more decisively to the back-end. As a result, one could say that in the past the back-end process was far simpler than it is today and typically involved the placement of a single die on a single substrate. Today with the use of heterogeneous integration multiple dies are connected both in the horizontal plane and in 3D. Creating the final assembly in which one die is stacked on top of another requires the formation of a vast number of extremely fine connections at the micro- and nanometre scale. This is an exceptionally challenging field, requiring work in high-purity cleanrooms.

In September 2024, the renowned analyst firm Kearney recognized Poland as the most attractive location for back-end operations among all European countries, awarding us particularly high scores for operating costs and government incentives. What accounts for Poland's high rating?

As mentioned, the focus of innovation and technological complexity is clearly shifting toward the back-end, and we expect this to be a lasting trend. The back-end is becoming an increasingly complex and challenging process, and the fact that Poland is ranked fifth in Kearney's report, the highest position among European countries, is very good news for us. This industry will undoubtedly grow strongly in the coming years, and we have a chance to be part of that change.

What really underlies Poland's high attractiveness rating is technological know-how and people. This is what investors are looking for: people capable of producing the most advanced products in the world. In my view and apparently in the view of the report's authors, these are precisely the kinds of people available in Poland. Furthermore, when thinking about which parts of the supply chain Poland could still be competitive in, it makes sense to look at it from the perspective of building autonomy across Europe and not focus on which market niches to compete in, but on where to complement the existing supply chain. The back-end industry is certainly underrepresented in Europe.

It's often argued that the main obstacle to the actual development of semiconductor production is the lack of skilled personnel. Is that really the case?

When we look at the employees from other, similar Intel facilities, we can see among them male and female experts from a wide range of areas. Since Intel's inception, we have recognized that the greatest innovation comes when we bring together people with diverse experiences and backgrounds—whether in chemistry, physics, microelectronics, or even many specialties that might not seem directly related to semiconductors. The rapid advancements in front-end and back-end processes mean that what students learn today may be outdated in five years. It's only when we hire individuals with varied backgrounds and train them within our manufacturing processes that we create teams capable of developing future technologies. The focus is more on fundamental experience and mindset—it's not critically important for a specific field, like microelectronics, to be highly developed and to have a large number of male and female graduates who completed such studies. It's helpful, but not essential. The rapid advancements in front-end and back-end processes mean that what students learn today may be outdated in five years. It's only when we hire individuals with varied backgrounds and train them within our manufacturing processes that we create teams capable of developing future technologies. The focus is more on fundamental experience and mindset—it's not critically important for a specific field, like microelectronics, to be highly developed and to have a large number of male and female graduates who completed such studies. It's helpful, but not essential.

A single semiconductor factory contains 200 to 300 separate devices that are multidisciplinary and highly specialized. At this technical level, every workday means solving complex problems, which can have roots in many different fields. The team has to quickly and collaboratively come up with precise and effective solutions, so we need people with experience in areas like mechatronics, physics, mathematics, chemistry, and even biology. Semiconductor production is a very creative job, and boredom is simply not an option! We are already working to prepare staff as well as possible for work in the semiconductor industry. We have set up a mechatronics' laboratory at the Wrocław Center for Vocational Education, where we show high school students how a semiconductor factory operates. These skills are also gained at the university level; for example, at Wrocław University of Science and Technology, we ran courses showing the practical aspects of every stage of semiconductor production.

You have been working for Intel for many years. What role does the Gdańsk R&D center play within Intel's structures? What is the unit's specialization, and how does it relate to semiconductor design?

Intel has been growing in Poland since 1993, and over time, established in 1999 Gdańsk campus, has become Intel's largest R&D center in Europe, currently employing around 4,000 people. The branch specializes in software, present in practically every product from Intel's portfolio, being from this perspective incredibly important for the entire company. If you use any Intel product, you can be certain that at least one code line that makes that product work was written in Gdańsk. In Gdańsk, developed are technologies that span the entire software stack, from low-level platform software to client frameworks or workloads. An example of a comprehensive solution developed in Gdańsk is the Intel OpenVINO toolkit, including its free platform available online, allowing anyone to create their own AI applications, even on simple computers. This aligns with Intel's strategy of democratizing technology, and Gdańsk plays here a key role.

What should Poland put emphasis on to attract further elements of the semiconductor supply chain?

A future competency desired by every industry is artificial intelligence. The entire industry is currently considering how to increase the use of AI to boost efficiency. If Poland invests in education in this area, it will be well-positioned to attract more investments. Another area worth exploring is innovation and entrepreneurship. Proper understanding and teaching of these attitudes and values from the earliest stages of education helps later in life, preparing people to be more effective in the workplace.

Innovation means being open, generating and testing different possibilities, and accepting that making mistakes is part of the process. If we are taught from childhood that mistakes are a natural way to find the best solutions, we are more likely to become innovative. People who go through an education system that teaches how to handle failures learn true innovation, not just entrepreneurship understood as starting a business. Entrepreneurship is the ability to make decisions that lead to creative outcomes, and these steps often require multiple mistakes along the way and continuous learning.

This brings us back to the question of the ecosystem. Adding the muscle of innovation to the education system is critically important not only for the investment itself but also for creating new startups. We see that in other countries, our employees, who sometimes decide to leave after several years to start their own businesses, actually create an additional, creative startup ecosystem that strengthens the semiconductor industry.

This brings us back to the question of the ecosystem. Strengthening the innovation muscle in the education system is critically important not only for attracting investment but also for creating new startups. We see that in other countries, our employees, who sometimes leave after a few or even a dozen years to start their own ventures, actually create an additional, creative startup ecosystem that reinforces the semiconductor industry. In Poland, such an ecosystem is just beginning to take shape, and the newly established semiconductor cluster will further strengthen it.

DESIGN / SOFTWARE FOR SEMICONDUCTORS

DCD

Digital Core Design was founded in 1999 in Bytom by the Silesian University of Technology graduates. From the very beginning, the company has focused on designing specialized integrated circuits **(IP Core and SoC),** which are used in practically every industry branch —from consumer electronics and mobile devices to automotive, military, and space sectors. Over its 25 years of operation, DCD has designed more than **100 different architectures, which have been utilized in at least 1 billion electronic devices worldwide.**

Among several employees, you can find both engineers with decades of experience and talented university graduates who, by acquiring unique skills on a national scale and enriching them with their own innovative ideas. Thanks to the mix of experience and freshness, Digital Core Design in over two decades built its brand in the global IT market, delivering its solutions to companies such as **VW, Toyota, Sony, Raytheon, Osram, Bosch, ABB, Siemens, Micron, and Honeywell.** The company's greatest achievements include:

- The first CAN XL interface in the history of Poland, dedicated to automotive apps (data transmission speed up to 20 Mbps; additional capability for implementing Functional Safety).
- 32-bit and 64-bit RISC-V processors, along with a set of peripherals and extensions (DCD is a member of RISC-V International, an organization that brings together companies developing the RISC-V standard).

-The world's fastest 8051 family processor, which, due to its highly popular architecture, is used in IoT, IIoT, and consumer electronics (the DQ80251 is over 75 times more efficient than the standard created by Intel, and with its rich set of peripherals, it is an excellent choice for power/performance projects).

- 100% secure Polish cryptographic system, Crypt-One, offering hardware-based cryptography and so-called lightweight cryptography.

- A holistic portfolio of peripherals, such as USB, I2C, I3C, SPI, and UART, which can be used both in conjunction with DCD's systems and those of external companies.

Grifin Microelectronics

Grifin Microelectronics is a dynamically growing company specializing in the design of advanced integrated circuits. The company designs complete integrated circuits for applications in the consumer, industrial, medical, and automotive sectors. The team consists of experienced engineers and specialists who are passionate about creating cutting-edge technologies.

DESIGN / SOFTWARE FOR SEMICONDUCTORS

ChipCraft

The company was founded in 2016 by individuals associated with the Warsaw University of Technology. The company provides services focused on designing analog and digital building blocks of integrated circuits or entire systems. One of the company's key specializations is designing circuits for **GNSS** navigation, which is exemplified by the development of its proprietary chip, NaviSoC, as well as modules based on this chip. Currently, the company is working on the second generation, NaviSoC2, with funding support from NCBiR. In collaboration with several partners, including **Thales**, ChipCraft is also involved in the European GEONAV project, aimed at developing solutions for precise navigation. The primary goal of the project is the development and industrialization of the second phase of the GEONAV IoT solution, in line with the results of NAVISP Element 2 (TRL7).

Phison / Wilk Elektronik j.v.

In September 2024, during the Computex trade fair in Taipei, the Polish company **Wilk Elektronik**, Europe's only manufacturer of DRAM computer memory, announced a strategic partnership with Taiwan's **Phison Electronics**, a global leader in NAND flash controllers and NAND storage solutions. Both companies plan to create a specialized research and development team focused on developing firmware used in SSDs and flash memory.

The companies are also considering collaboration on **aiDAPTIV+** technology, owned by the Taiwanese company. This technology could enable the creation of local computing centers and data optimization without the need to transfer data to the cloud.

Silicon Creations

The Polish branch of the American company was founded in 2006 with its headquarters in Atlanta. Silicon Creations is a designer of silicon-based IP solutions with offices in the USA and Poland, and sales units worldwide. The company focuses on designing clocking circuits (PLLs), oscillators, low-power, high-performance multi-protocol SerDes communication blocks, and high-speed LVDS I/O circuits. The components developed by the company are used in smartphones and other portable devices, consumer electronics, processors, networking equipment, automotive applications, IoT, and medical devices. Silicon Creations designs semiconductors that are mass-produced using technologies ranging from **3 nm** to **180 nm.**

This project addresses the growing market needs in the area of cybersecurity – cyber threats are increasingly affecting not only the software layer but also hardware, including memory firmware.

-While memory firmware doesn't play a key role in consumer applications, its importance is fundamental in critical infrastructure. An attack on the operating system can often be neutralized by reinstalling or resetting it. However, when a cyberattack affects memory firmware in thousands of infrastructure components – for example, in railway control systems or power grids – commonly used remedial measures cease to work says Monika Wilk, Director of Strategy and Development at the Polish partner [1].

[1] Source:https://tek.info.pl/article/4513

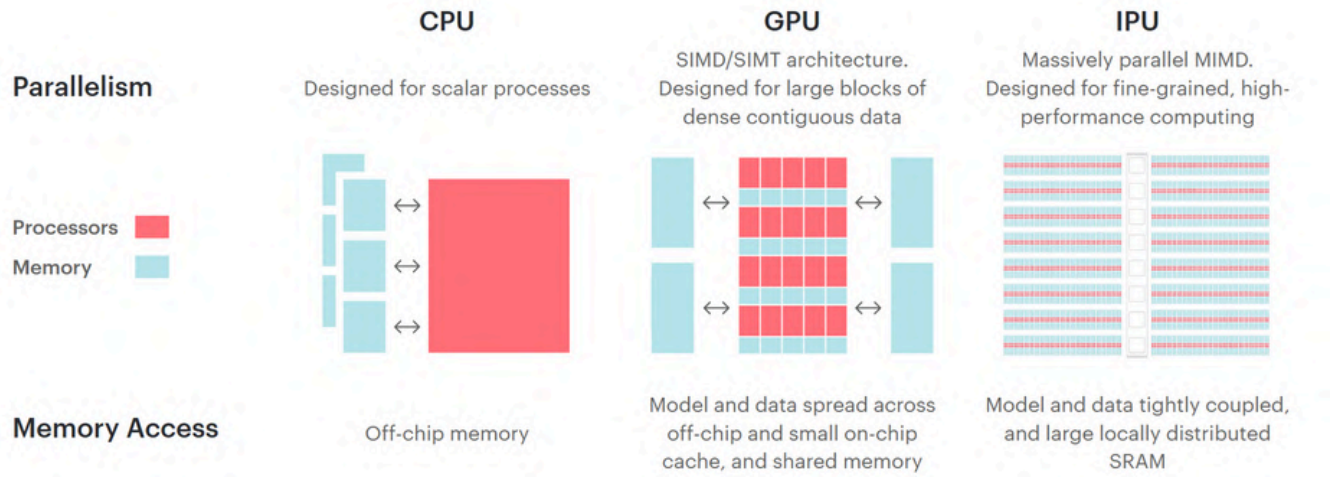
DESIGN / SOFTWARE FOR SEMICONDUCTORS

Openchip

Openchip specializes in designing high-performance computing (HPC) acceleration systems and System-on-Chip (SoC) solutions based on the RISC-V architecture. The company's technologies are used in applications such as genomics, astrophysics, energy, and aerospace. Openchip is headquartered in Barcelona, and also has a branch in Italy. **In March 2025, the company announced the opening of a new R&D center in Gdańsk**, which will focus on creating modern processors and accelerators for data centers and HPC, compliant with European energy efficiency requirements. The company's accelerators will be designed using silicon node technology and an open instruction set architecture for processors (RISC-V). Openchip has announced plans to expand its workforce to several dozen by 2025.

Graphcore

Graphcore, founded in Bristol in 2016 and part of the SoftBank Group since 2024, develops computer systems for artificial intelligence powered by the Intelligence Processing Unit (IPU). This state-of-the-art processor, purpose-built to meet the specific computational needs of AI, enables researchers to explore areas previously inaccessible with conventional technologies. Graphcore systems are deployed across a wide range of AI applications in industries such as pharmaceuticals, financial services, automotive, and consumer internet.
The company's new branch in Gdańsk will serve as its research and development hub. It currently employs 22 specialists, with plans for rapid expansion of the Polish team.



Unique concept combining processor and memory developed by Graphcore Source: Graphcore

DESIGN / SOFTWARE FOR SEMICONDUCTORS

Phonemic

This located in Lublin company carries **RTL** projects and verification, as well as firmware for FPGA and application-specific integrated circuits (ASICs) in applications such as digital signal processing (5G, LTE), cryptography, and system-level design and integration. Among other things, the company focuses on developing IP cores tailored to specific customer needs, from the mathematical and algorithmic levels to microarchitecture, researching hardware architectures, and developing algorithms. Phonemic has developed a range of **proprietary IP cores**, including arithmetic cores (FFT, cryptography, FIR filters), complex radio processing cores (DPD, CFR), and advanced voice interface solutions (VAD).

Synopsys

Synopsys is an American corporation that supports manufacturers of integrated circuits and electronic devices by providing software for electronic design automation (EDA), pre-designed components in the form of so-called IP Core, and devices and software that aid in prototyping and testing. Synopsys solutions cover the design and verification of semiconductor systems, both in hardware and software. Founded in 1987, Synopsys currently employs over 20,000 people. The Gdańsk branch employs around 200 engineers who design integrated circuits (including analog design and layout design, which determines the arrangement of transistors) and support the development of prototyping systems and EDA tools. The engineers in Gdańsk work with technologies as advanced as 2 nm.

OmniChip

The company designs integrated circuits on behalf of foreign semiconductor firms and creates products and IP blocks for its own products. In 2022, the company conducted research as part of the Realholo project, funded by the Horizon 2020 project, which involved the implementation and verification of the digital part of an integrated circuit intended for 3D holographic displays. OmniChip also developed a platform for handling the NFC protocol. The Warsaw-based company performs tasks such as architecture analysis and design, IP design, system verification, and FPGA prototyping.

ALDEC-ADT

Founded in 1998, ALDEC-ADT is a producer of advanced software designed for **FPGA** and **ASIC** integrated circuit design. The company's main products include Active-HDL and Riviera-PRO—integrated design environment packages that support digital circuit design using hardware description languages such as VHDL, Verilog HDL, SystemVerilog, and SystemC. The Polish branch serves as the EDA software development center for the entire corporation.

POWER OF SPECIALIZATION

INTERVIEW WITH
TOMASZ ĆWIENK,
PR MANAGER AT **DCD**

What unique opportunities does Poland have in the semiconductor design industry compared to global competition?

Most Polish companies in this industry are small but highly specialized enterprises, and it is this high level of specialization that can be our competitive advantage. An example of such a company is Digital Core Design from Bytom, which has been designing semiconductor structures for over 25 years. There are few companies on the market with such unique technologies as ours, which allow us not only to offer ready-made digital architectures but also to manage projects from the prototype stage all the way to final integrated circuits. While 99% of our clients come from abroad, we still strive to convince domestic companies to use custom-designed integrated circuits tailored to their needs and capabilities. Many of them are still hesitant to rely on their own designs, opting instead for solutions from foreign corporations… which often contain IP Core developed by DCD anyway. This is why it is so important to create a Polish ecosystem of companies that, in the context of threats (such as wars or pandemics) but also opportunities that are emerging (like the European Chips Act), will enable efficient, secure, and scalable design, testing, and production of semiconductors.

Which main threats does Poland face in the context of global competition in the semiconductor industry?

The main threats that Poland is facing are related to competition within the European Union and technological delays. It is planned within the framework of the European Chips Act initiative to establish competency centers in every EU member state. This means that there will be many initiatives similar to those in Poland, which could lead to the fragmentation of resources and increased competition between countries, ultimately weakening the collective potential. Therefore, it is crucial to create an integrated, unified project at the European level. If each country develops its semiconductor technologies independently, it could lead to inefficiencies. Regionalization could become a threat if there is a lack of cooperation between EU countries. The fragmentation of initiatives and the lack of joint efforts could weaken Europe's position in the global semiconductor market. Excellent confirmation of this thesis is official data on the semiconductor industry worldwide. Just 5-6 years ago, European companies accounted for about 2% of the global fabless IC manufacturer market. Last year, this figure dropped to less than 0.5%. This is why cooperation between EU member states is so important; only through synergy, rather than competition, will they be attractive to global giants from Taiwan, the USA, Japan, or China. Poland is finding its feet not only in EU structures but also in transatlantic relations, which creates opportunities for collaboration with companies from the USA. This can be a significant advantage in the context of global competition. Initiatives like the American Chips Act, which encourage the establishment of semiconductor facilities on the American continent, present an opportunity for Polish enterprises to more easily collaborate and sell licenses and other technological solutions to American partners.

> *Most Polish companies in this industry are small but highly specialized enterprises, and it is this high level of specialization that can be our competitive advantage.*

We cannot forget, however, that Poland has significant technological delays compared to more developed European countries, such as Germany. It is enough to glimpse at the area around Dresden, which is a technological hub for Central and Eastern Europe. Decades of investment, beginning in the 1990s, along with modern factories and experienced engineers, represent an undeniable potential. Therefore, strengthening cooperation at the European level and leveraging international partnerships will be crucial for Poland and Polish companies to become an important part of the European Silicon Valley. If we do not take these steps, we risk further marginalization.

But are government initiatives really the right direction to strengthen the position of Polish companies on the international stage?

Looking at the development of the semiconductor industry in other countries, it's worth considering the example of China. Three decades ago, Beijing focused on producing its own processors and integrated circuits, aiming to become independent of other markets. As a result, their products have improved in quality and now rival those produced in places like the USA. Poland should take inspiration from this example and fully leverage the potential of all domestic companies operating in the semiconductor industry. While Polish companies are doing well both commercially and technologically, government support could be crucial in securing contracts and increasing competitiveness. The Krajowe Ramy Wspierania Strategicznych Inwestycji Półprzewodnikowych program [TN National Framework to Support Strategic Semiconductor Investments] can be the answer to the need for better coordination. It is important that the team responsible for this program has the right competencies and that the institution operates free from political influence. An efficiently functioning and independent institution has the potential to significantly boost the development of technology and semiconductor companies in Poland. Integrated circuits have no political affiliations—they should be treated as a national asset.

In your opinion, in which direction is Poland heading, and does the optimistic or pessimistic vision prevail?

I am an optimist, and I view the future of Poland in the semiconductor industry with great hope. I don't focus on potential threats from other countries, such as Germany or the Czech Republic, where the creation of a Silicon Valley along the Dresden-Prague axis is planned. Instead, I see this as an excellent opportunity for collaboration. Poland can join this project, incorporating our key technological cities such as Wrocław, Katowice, Gdańsk, Kraków, and Bytom, where our company is headquartered. In the past, there was talk of a Polish Silicon Valley along the A4 and A1 highways between Wrocław and Kraków, and I believe this is still possible. Initiatives like the European and American Chips Act and planned investments by Intel create enormous opportunities for the development of the Polish semiconductor sector. Equipment, prototyping capabilities, and licenses for additional software are important, but the key factor is the idea and skills of individual engineers, which ultimately determine the final functionality of a product. In the semiconductor industry, every, even the smallest element, must work reliably because the success of an entire project worth hundreds of millions of dollars can depend on it. We undoubtedly already have the know-how, so it is worth "surrounding" this knowledge and skills with equipment and institutions that will enable us to play an active role on the international semiconductor stage.

MATERIALS

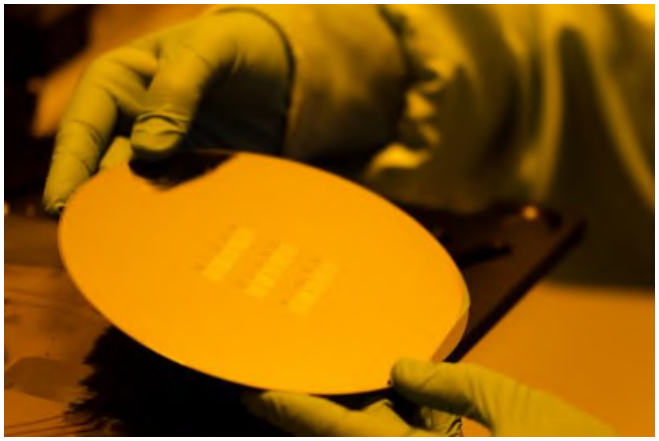
ENSEMBLE³

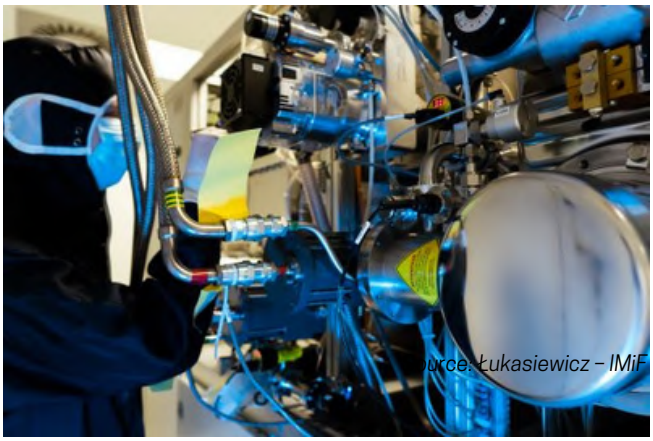
This company was founded in 2020, with its sole shareholder being Łukasiewicz – IMiF. Employing nearly 100 people, the company serves as a center of excellence in the fields of nanophotonics, advanced materials, and modern technologies based on crystal growth. The center focuses on the development of innovative material technologies and modern materials with exceptional electromagnetic properties, which can be applied in fields such as photonics, optoelectronics, telecommunications, solar energy conversion, medicine, and aviation.

ENSEMBLE3 produces AIIIBV monocrystals: gallium arsenide (GaAs), indium arsenide (InAs), gallium phosphide (GaP), indium phosphide (InP), and gallium antimonide (GaSb). The materials produced by ENSEMBLE3 are used in the manufacturing of microwave integrated circuits, various types of diodes (including LEDs), infrared radiation detectors, photodetectors, and more. The company also manufactures silicon carbide (SiC), several types of thermoelectric materials, and oxides used in optics and optoelectronics.

Photonics Innovation Sp. z o.o.

The company, operating under the trade name Photin, provides services in the manufacturing of thin semiconductor layers using MOCVD technology. The company produces indium phosphide in small batches, offering clients worldwide research and development services as well as small-scale production of complex semiconductor devices (InP, GaAs, GaSb, InAs).





Źródło: Łukasiewicz – IMiF

INTEGRATED DEVICE MANUFACTURERS

VIGO Photonics

Vigo Photonics is a global leader in the market for mid-infrared photonic detectors. The detectors currently produced by the company are used in the world's largest research centers (measuring high-temperature plasma parameters in nuclear fusion research, measuring ultra-short infrared radiation pulses emitted by lasers and synchrotrons, spectrometers for measuring extremely low concentrations of substances) and in the development of advanced applications such as railway safety (train fault detection systems and fire detection systems), environmental protection (environmental monitoring), industrial applications (industrial scanners for temperature distribution analysis), military applications (missile guidance systems, laser warning receivers), security (detection of explosives and hazardous substances, passenger baggage screening systems), and the space industry (laser communication in open space, measurement devices for space applications).

VIGO Photonics has also added to its offering epitaxial semiconductor layers. The epitaxial layers produced at VIGO Photonics, based on indium phosphide and gallium arsenide, are the foundation for the production of devices such as quantum cascade lasers, vertical-cavity surface-emitting lasers (VCSELs), and other infrared radiation sources, as well as microelectronic components (transistors, diodes).

All products are based on the company's proprietary, unique technology. The group owns a complete high-throughput production line for semiconductor devices, from the epitaxy of complex semiconductors from groups II-VI (tellurium, cadmium, mercury) and III-V of the periodic table (indium, arsenic, gallium, antimony) through the production of detector and laser chips, to their micro-mounting and integration with electronics. The group also has its own state-of-the-art measurement laboratories, enabling fast and accurate measurements at every stage of production.

In February 2024, **HyperPIC**'s project, valued at **878.6 million PLN**, was added to the list of initiatives eligible for EU funding, with an allocation of 453.7 million PLN. This project is one of the key elements of the company's development strategy announced in June 2021, which extends to 2026. The goal of the project is to develop and implement technology for integrated photonic integrated circuits designed for mid-infrared detection, to build a complete production line, and to establish a full supply chain for these circuits. Other strategic initiatives include improving cadmium-mercury telluride (MCT) technology, developing RoHS-compliant detectors based on indium and arsenic antimonides, and creating miniature low-cost infrared detection modules for broad use in industrial applications and environmental protection.

Another initiative, InGaAs, aims to enter the existing market for short-wave infrared (SWIR) detectors, which have the potential for use in consumer electronics. The company is also advancing the technology for producing cooled and uncooled infrared detector arrays, the epitaxy of III-V semiconductor materials, the production of near-infrared sources (VCSEL lasers), and the production of epitaxial heterostructures using the MOCVD method.

Source: VIGO Photonics

VIGO PHOTONICS UNIQUE PRODUCTION PROCESS

VIGO PHOTONICS

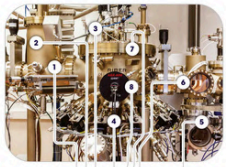
PRODUCTION STEPS
EPITAXY
PROCESSING
DETECTORS PACKAGING
INTEGRATION WITH ELECTRONICS

MBE

For production of InAs and InAsSb RoHS compliant MWIR and LWIR detectors and detection modules.

The molecular beam epitaxy (MBE) growth technology is used for manufacturing bulk InAs, InAsSb and superlattice (SL) InAs/InAsSb detectors. SL detectors made of III-V materials have strong covalent bonds, which results in a higher temperature operating range, better uniformity of the crystal, and better optical and electrical parameters.

REACTOR



1. Growth gauge
2. RGA – Residual Gas Analyzer
3. Manipulator
4. Effusion cells
5. Preparation chamber
6. Buffer chamber
7. Growth chamber
8. RHEED Screen

PROCESS

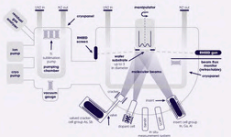
Above the substrate the **heater** that provides the desired growth temperature is placed.

Molecular beam reaches the substrate placed on the rotable holder.

For the proper operation of the MBE, an **ultra-high vacuum** is necessary, which is achieved with the help with a special pump system.

In this way, the amount of **background contamination is minimized** and the ballistic transport between a source and the substrate is possible.

A high-energy electron diffraction **(RHEED)** device allows to control the growth rate and the crystalline layer's quality.

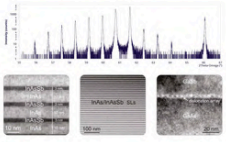


WHAT WE CREATE?

III-V InAs/InAsSb

Material details:

- **Lattice** matched to GaSb
- **Strong covalent bonds** (thermal & mechanical stability)
- **Thicknesses** below critical thickness
- **Possibility to grow** on GaAs substrate via GaSb buffer
- **Strain control** during growth



VIGO PHOTONICS

PRODUCTION STEPS
EPITAXY
PROCESSING
DETECTORS PACKAGING
INTEGRATION WITH ELECTRONICS

MOCVD

For production of HgCdTe MWIR and LWIR detectors and detection modules

The technique used for manufacturing HgCdTe detectors is the metalorganic chemical vapour deposition (MOCVD) method. As a result, multi-layer semiconductor heterostructures are obtained consisting of more than twenty layers as a maximum, varying in terms of thickness, composition, doping and band gap broadening.

REACTOR

Metalorganic Chemical Vapour Deposition

- AIX-200 System
- Interdiffusion Multilayer Process – IMP
- To grow $Hg_{1-x}Cd_xTe$ heterostructures on GaAs substrates with in-situ doping
- (111) or (100) HgCdTe orientations possible

PROCESS

MOCVD reactor: five sources of organometallic precursors, one gas source.

The first stage of MOCVD technology is reactor heating (to remove residues from the previous growth process).

The substrate is heated and rotated, in second heating zone inside the reactor elemental mercury is evaporated.

Hydrogen (carrier gas) is admitted into bubbler cylinders.

During the bubbling process, cadmium and telluride are taken by hydrogen to the growth chamber. The gas flow over the container with mercury is laminar (to keep deposition uniformity).

When the precursors approach the substrate wafer, the pyrolysis process begins (decomposition), and its components build up a semiconductor layer on the substrate layer.

WHAT WE CREATE?

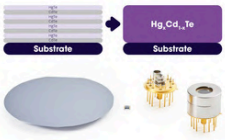
MWIR and LWIR HgCdTe epiwafers

HgCdTe has been used for production of HOT photodetectors – various modifications of PC, PV, PVM, PEM and other devices.

Material details:

- Band gap tunability 0-1.4 eV
- High performance
- Complex 3D heterostructure
- Architecture based on computer simulations
- Graded gap/doping design

IMP



VIGO PHOTONICS

PRODUCTION STEPS
EPITAXY
PROCESSING
PACKAGING
INTEGRATION WITH ELECTRONICS

PROCESS

1 Photolitography

Defines patterns in a thin layer of a photo-sensitive polymer, called a photoresist, by exposing selected areas to UV light. The pattern is transferred onto a semiconductor by etching or secondary material deposition.

- **Spin coater** - coats a semiconductor wafer with a photoresist through spinning
- **Mask aligner** – photolithography device, for alignment of a pattern on a photomask to a pattern on an epitaxial wafer

2 Pattern Etching

- **Chemical Etching (wet)**
  - In chemical solutions (acid-based)
  - Etching solutions dedicated to various materials to achieve a specific result
  - The etching effect depends on the chemical composition of the solution, the ambient conditions, the area of the material to be etched, and the density and dimensions of the pattern.
- **Plasma Etching (dry)**
  - Inductively Coupled Plasma
  - Reactive Ion Etching – ICP-RIE
- **Chemical** (by chemical reaction) **and physical (by ion bombardment) etching** of semiconductors using plasma.

3 Contact formation

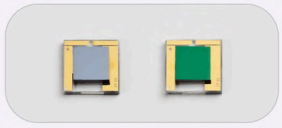
- **Metallization**
  - E-beam evaporation
  - E.g. Ti/Au, Pt/Ti/Pt/Au
  - Allows an electric contact with the semiconductor

4 Indium Bumps

In some cases, an additional medium for the flip-chip mounting.

5 Dicing

- **Dicing Wafer into single devices (chips)**
  - Automatic diamond blade sawing (dicing street 80-100 µm)
  - Manual scribing with a diamond tip
- **Cleaning the chips**
- **Visual inspection and selection**

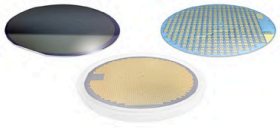


DETECTOR CHIPS

The processing aims to process semiconductor wafers with epitaxial layers into useful devices in the shape of chips.

Growth on 2" and 3" GaAs substrates

- **III-V MOCVD** – growth on substrates **up to 150 mm**
- **Currently, VIGO can process** substrates **up to 100 mm**
- **Typically, VIGO processes** wafer pieces (17 mm × 17 mm)
- **A typical chip** for a hyperhemilmmersive lens takes **up 4 mm²**
  - **2":** has a usable area ≈ 1660 mm², it gives **450 chips**
  - **3":** has a usable area ≈ 3950 mm², it gives **987 chips**



VIGO PHOTONICS

PRODUCTION STEPS
EPITAXY
PROCESSING
ASSEMBLY
INTEGRATION WITH ELECTRONICS

DETECTOR ASSEMBLY

ASSEMBLY PROCESS

1 Immersion Lens Technology

Optical immersion enables improving the detectivity of a detector in the simplest way possible – without losses, without aligning, and at a very small expense. At VIGO Photonics, the optical immersion is created directly with the use of the substrate on which the active layer of the detector is placed. This means the lens is an integral part of the device – no adhesives or other joints that could generate losses are used for its fabrication.

2 Flip-Chip

- **A process of connecting** semiconductor structure with the carrier (sapphire, silicon)
- It allows to obtain a **good electrical connection** between the elements
- Method used in VIGO – **thermocompression**
- Gluing, underfilling

3 Open Detector Assembly

- If detector cooled
  - Mounting on a thermoelectric (TE) cooler (gluing the active structure with carrier on the TE cooler)
  - Assembling the thermistor
  - Absorber container mounting,
  - Anticonvection shield mounting (for low temperature fluctuations)
- Making wire connections
- Open detector measurements
- Window assembly

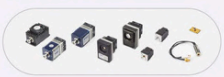
4 Hermetisation

- Absorber container filling with getter
- Detector case and detector cap assembly
- Pumping the air out
- Filling with heavy, noble gases (Kr/Xe) of low thermal conductivity
- Sealing the detector
- Engraving the serial number

INTEGRATION

Integration with electronics

- **Infrared Detection Module Components**
  - Infrared photodetector
  - Signal processing electronics
  - Optics (optional)
  - Heat dissipation systems (optional)
  - Other components



Advantages

- Low noise, transimpedance, voltage PreAmplifier (+reverse bias)
- Less vulnerable to over-bias, electrostatic discharges and electromagnetic interferences
- Improved High Frequency performance
- Output signal standardization
- Effective heat dissipation
- Miniaturization
- Cost reduction
- Fast (GHz) reduction of parasitic impedances

INTEGRATED DEVICE MANUFACTURERS / CHEMISTRY

Kubara Lamina

Kubara Lamina's manufacturing activities are based on two main pillars: the production of **high-power semiconductors** and the production of microwave products. The company produces high-power diodes and thyristors, amplitrons, absorbers, magnetrons, and circulators. The company's products are used in the power electronics and military industries, particularly in the construction of radar devices. Currently, in collaboration with WAT, ITWL, Siltec, and ZM Tarnów, Kubara Lamina is working on a new type of weapon designed to neutralize unmanned airships.

TopGaN

Founded in 2001, TopGaN was the second company in Europe to demonstrate **violet laser diodes**, and since then, it has introduced many innovative technologies in the field of **nitride-based emitters**. TopGaN produces advanced visible and UV GaN light emitters operating in the spectral range of 395-461 nm, including tunable wavelength laser diodes (external cavity laser diodes), semiconductor optical amplifiers, superluminescent diodes, and custom photonic integrated circuits.

Recent achievements of the company include the optimization of violet laser designs in the wavelength range of 415-435 nm. Additionally, by modifying the assembly process and epitaxial structure, the company achieved a lifetime of over 10,000 hours for 421 nm lasers, which is a critical parameter for these devices in the industrial market. The company is also a participant in the European TEAM TECH program, which aims to develop a monolithic, two-dimensional semiconductor laser diode array using GaN materials.

CRW Telesystem Mesko

Company specializes in R&D and production for a defense industry. It develops, implements and manufactures optoelectronic and electronic assemblies for portable anti-aircraft and anti-tank systems. It is the designer and manufacturer of unique InSb and PbS photodetectors, specialized optics and modern hybrid preamplifiers. The company has developed and implemented a number of critical production technologies, including technologies for precise assembly of optical elements and technologies for the production of photodetectors with high detection (D*>10^10 (cm*Hz^0.5/W).

CHEMISTRY

PCC Rokita

PCC Rokita has developed a technology for producing **phosphorus oxychloride (POCl3)** with extremely high purity, making it suitable for use in demanding industries such as pharmaceuticals, organic chemistry, electronics, and fiber optics. The POCl3 Solar Grade product is a response to the growing market demand for solar cells and n-type and p-type semiconductor devices. Phosphorus oxychloride is gaining popularity in the production of emitters and n-type and p-type semiconductors due to its ease of application on production lines, good process control, excellent storage stability, uniformity, and high efficiency. POCl3 Solar Grade is characterized by a very low metal content, with a total not exceeding 1 ppm, resulting in a product with 99.9999% (6N) purity. PCC Rokita SA offers POCl3 Solar Grade in specialized 1-liter containers, ready for direct use in semiconductor production and suitable for use in atmospheric and low-pressure diffusion furnaces.

SEMICONDUCTORS ECOSYSTEM **IN POLAND**

INTEGRATED DEVICE MANUFACTURER

ResQuant

ResQuant is a Polish deep-tech company based in Łódź, specializing in hardware implementations of **post-quantum cryptography (PQC)** standards. Founded in 2020, the company develops cryptographic coprocessors – hardware modules responsible for key generation, secure storage, and encryption operations. Offered under an IP core licensing model, these solutions enable semiconductor manufacturers to easily integrate PQC into their products.

ResQuant cooperates with partners such as AROBS Polska, Creotech Instruments, the Quantum Technology Cluster, ChipCraft, Cybernetica, and the Institute of Communications. In the coming months, the company plans to start producing prototypes in **22 nm technology at GlobalFoundries' facilities in Dresden.**

The key products of the company include:

- **IP Core Licenses for PQC** – proprietary hardware accelerators for post-quantum algorithms (Dilithium, Kyber, SHAKE, AES, XMSS, SPHINCS+), available in variants optimized for chip area, power efficiency, and performance.
- **PQC-enabled FPGAs** – ready-to-use devices with a pre-integrated, NIST-compliant cryptography stack for testing in critical environments.
- **PQC System-on-a-Chip** – currently under development, featuring a secure hardware environment designed for IoT, defense, automotive, and ICT applications, fully developed and manufactured in the European Union.

SemiQa

SemiQa is a pioneer in ANNET (analog neural network) technology, designed for innovative AI applications and delivering up to 50 times faster performance with five times lower power consumption. ANNET technology processes signals continuously in analog form, eliminating the conversion drawback typical of traditional digital systems. By bypassing analog-to-digital and digital-to-analog conversion, ANNET treats time as a continuous variable and enables temporal integration similar to biological neural networks, providing unprecedented real-time efficiency. This breakthrough enables up to 100-fold lower latency for real-time applications.

The company is part of the prestigious NVIDIA Inception program, which supports and accelerates the commercialization of its products.

SEMICONDUCTORS ECOSYSTEM **IN POLAND**

SEMICONDUCTORS MANUFACTURING EQUIPMENT

XTPL

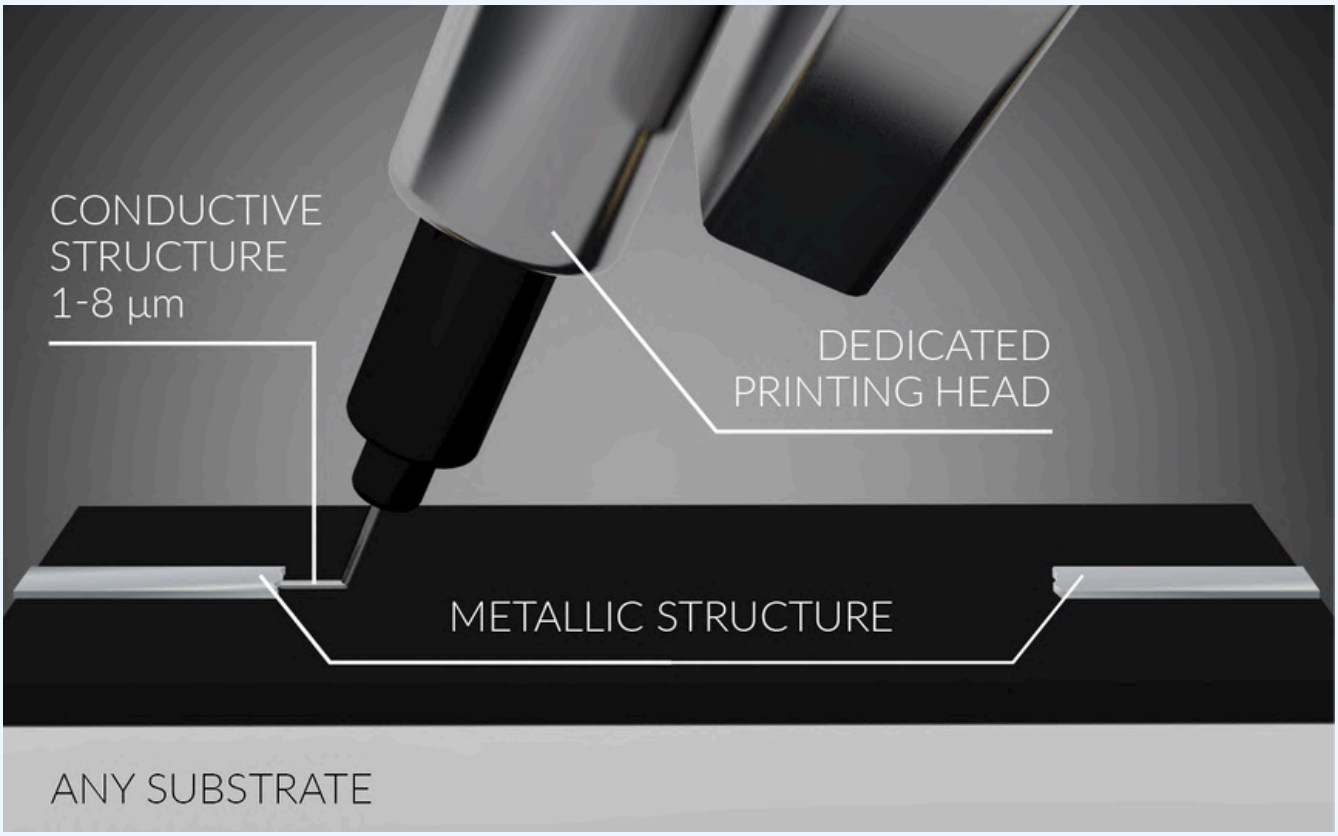
XTPL has developed an innovative printing head and dedicated nano inks that enable **ultra-precise deposition and the creation of nanostructures for applications in the semiconductor sector,** as well as in display, biosensors, and advanced PCBs manufacturing. This solution allows for the creation of structures on a micrometer scale (1–100 μm), which is required by most companies operating in the semiconductor market. XTPL's method enables the addition of material to achieve desired patterns in a single-step process with submicron precision and simplicity. **This solves several key issues associated with the currently standard subtractive semiconductor manufacturing technology—photolithography.** The main drawbacks of photolithography are its complexity and multi-step approach. The process is also expensive, and the need for masking limits its versatility. Photolithography requires an extremely clean substrate and ideal temperature conditions, free from any contaminants, liquids, or environmentally hazardous factors. It can only be used to create appropriate patterns on flat surfaces. XTPL's additive technology eliminates most of the drawbacks of photolithography, as it does not require special external conditions and can be used on most substrates, including uneven ones. Unlike the subtractive photolithographic method, XTPL's additive method is free from complexity. XTPL's solutions meet all the requirements of the modern semiconductor sector: high throughput, miniaturization of spot size, ultra-precision, control over edge roughness, elimination of costly masking, reduction of material usage and waste, reducing process complexity, shortening production time, and reducing overall costs.

When combined with nano inks tailored to the semiconductor sector, XTPL's technology can serve as an alternative to photolithography in various subsectors of the electronics industry, including printed electronics, displays, and biosensors. In January 2022, XTPL announced a collaboration with **Nano Dimension** to develop a new conductive ink formula based on metallic nanoparticles, aimed at the PCB market and Additively Manufactured Electronics (AME). XTPL's printing module is also a crucial component of a prototype industrial device for advanced packaging applications, being developed by a Taiwanese technology company. Similarly, XTPL's technology is currently being evaluated by the Korean display manufacturer HB Technology for its potential use in the construction of next-generation OLEDs. Additionally, it is being tested by an American client, one of the largest producers of industrial machinery for semiconductor and flat panel display (FPD) manufacturers.

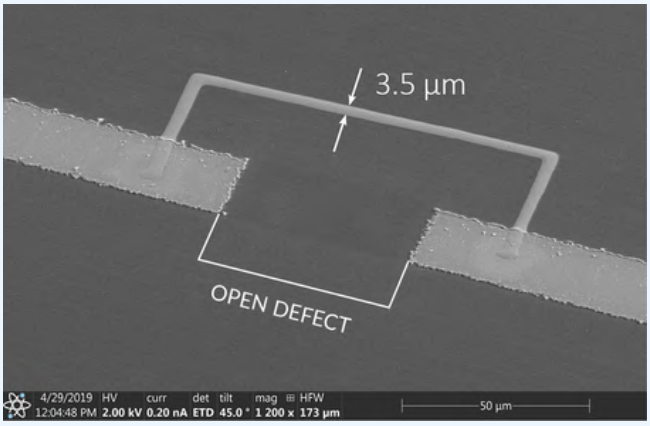
ASYS Polska

ASYS Polska is a subsidiary of a German company that has been producing industrial robots for the semiconductor industry for over 15 years, meeting the highest cleanliness standards and operating even in vacuum conditions. The company supplies robots to clients such as ASML, VDL Groep, and Bosch Polska. In January 2024, ASYS Polska announced that it will invest 20 million PLN to expand its facility with a new production hall and equipment for robot manufacturing.

ULTRA PRECISE DEPOSITION TECHNOLOGY FROM XTPL



A key achievement of XTPL is its innovative **Ultra Precise Deposition (UPD) technology.** The XTPL printing head, equipped with a special nozzle, deposits ink onto the substrate and allows for the creation of designed structures with widths as small as **1 µm.** For comparison, most of the electronic material printing methods available on the market struggle to achieve a resolution of 20 µm, with only a few manufacturers claiming to reach around 10 µm.



Source: XTPL

XTPL's solution can be applied to various types of substrates, including flexible or curved ones. Using UPD technology, it is possible to print different shapes, including simple lines, patterns, and microdots.

Insoptics

Insoptics produces and develops spectroscopy devices for plasma processes such as thin film deposition, plasma etching, PECVD, atmospheric plasma etc. Insoptics offers products such as devices such as monochromators, spectrometers, and spectrographs.

Instytut Fotonowy

A company designs prototypes and unique devices used in semiconductor research and development processes. The company designs semiconductor characterization devices, photoelectrochemistry and electrochemistry equipment and accessories, various types of spectrometers, specialized light sources, etc.

SEMICONDUCTOR MANUFACTURING EQUIPMENT

TRUMPF Huettinger

TRUMPF Huettinger, one of the key investors in the electronics industry in Poland, is collaborating with **ASML**, a leader in semiconductor manufacturing devices, and **Zeiss**, a leading company in optical systems, to develop **laser systems that are the heart of semiconductor manufacturing machines.** With a history spanning over 100 years, the TRUMPF group has been present in Poland since 2007, when it acquired Advanced Converters (AC), a company founded by a group of scientists from the Warsaw University of Technology. TRUMPF now employs nearly **1,700** people in Poland and generates revenues of approximately **1.5 billion PLN.** Integrated circuits with logic and memory systems have structures measured in nanometers and can be produced through complex laser beam exposure processes. The traditional method, using ultraviolet laser beams from excimer lasers, is increasingly proving insufficient. In the future, smaller structures will only be achievable using even shorter wavelengths in the extreme ultraviolet (EUV) range. In Poland, TRUMPF Huettinger develops high-power supplies **(plasma generators)** that precisely control the conditions for plasma excitation in a vacuum chamber, as well as power supplies for TRUMPF lasers and machines. Half of the production in this area in Poland meets the internal demand of the group in Germany, with other partners including companies such as Airbus, Apple, and Japanese (Tokyo Electron) and Korean firms. The plasma generators developed in the group's Polish plants are used in the production of advanced electronics (semiconductors, coatings on smartphones, diamond drills), as well as photovoltaic panels. a production of advanced electronics (semiconductors, coatings on smartphones, diamond drills), or photovoltaic panels.

TRUMPF Huettinger's plasma generators play a paramount role in the actual production of integrated circuits. The quality of the power supply determines the quality and precision of the generated plasma, which is then used for doping (ion implantation), deposition (PECVD, ALD), or removal (plasma etching) of various materials used in the manufacturing of semiconductor integrated circuits. Another challenge in the electronic process chain, following the exposure and formation of interconnections on silicon wafers, is the separation of the wafers into individual integrated circuits. To obtain the smallest possible cutting gaps, high edge quality, and to avoid damaging sensitive integrated circuits due to high temperatures, TRUMPF's ultrashort pulse lasers are used during the separation process.

Systerion

Systerion develops innovative nano-positioning and nano-alignment systems designed for ultra-high-precision tasks in the most demanding industrial environments. These systems are optimized for industries that require extreme accuracy, such as semiconductor manufacturing, optical systems, and advanced production processes. Systerion solutions offer nanometer-level alignment precision and are engineered to deliver sub-nanometer positioning accuracy, even under challenging conditions. Created with stability and repeatability in mind, they are ideal for high-precision operations where even the slightest deviation can affect overall performance.

TESTING

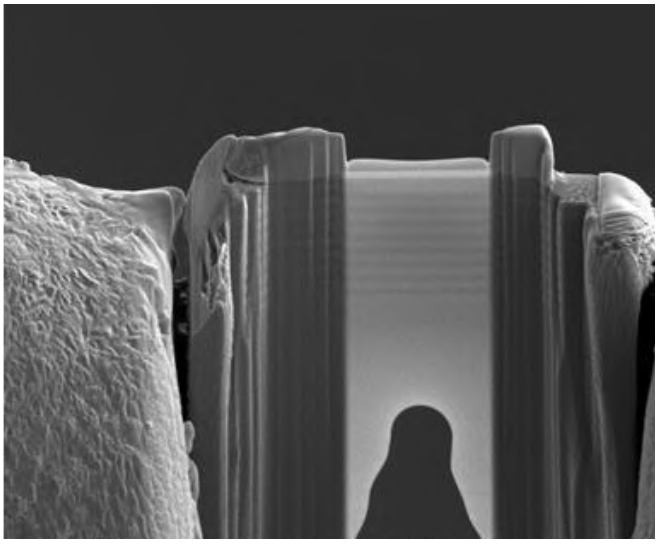
Nanores

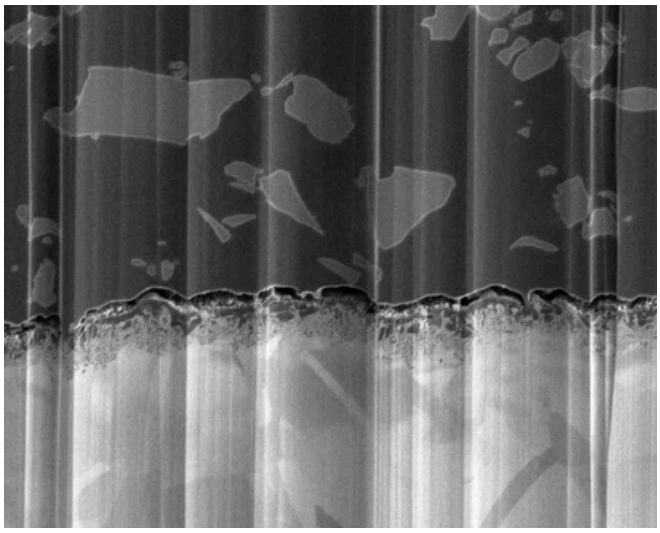
NanoresLAB is a nanotechnology laboratory supporting its clients in the semiconductor industry using tools such as SEM (Scanning Electron Microscopy), FIB (Focused Ion Beam), TEM (Transmission Electron Microscopy), EDS (Energy Dispersive Spectroscopy), CT (Computerized Tomography), and femtosecond laser. These studies provide detailed information about the physical and chemical properties of semiconductor structures.

NanoresLAB's unique competency is the ability to examine entire semiconductor components, from rough tomographic scanning (e.g., to locate potential defects), through cutting using special mechanical saws and a femtosecond laser, microsectioning and optical microscopy, to inspection of single-nanometer-thick layers using SEM/FIB cross-sectioning and transmission microscopy.

Measurements of the topography and morphology of semiconductor structures like nanowires, heterostructures, distributed bragg reflectors, quantum wells, etc. is based on Ultra High Resolution Scanning Electron Microscopy (SEM) combined with Energy Dispersive Spectroscopy (EDS) for elemental analysis and Focused Ion Beam (FIB) for analysis of cross section and Transmission Electron Microscopy (TEM) lamella preparation. These techniques allow for the inspection of semiconductor structures at a microscopic level, ensuring that the structures meet quality standards and helps engineers understand the behavior of the materials and optimize their performance. Detecting defects or irregularities early in the process can prevent costly errors later on. SEM, FIB, TEM and EDS provide detailed information about the physical and chemical properties of semiconductor structures.

The research aims to improve or modify chip connections to correct design errors or test proposed changes before commissioning the costly production of another wafer. The company's clients include universities and institutes, startups, mid-sized companies, and international corporations from various European countries. NanoresLAB has completed over 1,000 projects and research assignments for over 250 clients from more than a dozen European and international countries.





OTHER

QNA Technology

QNA Technology focuses on developing the technology and production procedures for **semiconductor nanomaterials (so-called quantum dots)**, which are free from heavy metals and used in display manufacturing. QNA stands out by its comprehensive approach to the process from the synthesis of nanomaterials to their implementation in industrial applications, therefore the company has developed technologies for quantum dots surface modification and formulations for semiconductor inks basing on quantum dots, enabling customers to print semiconductors on various substrates using a range of printing techniques. A quantum dot is a semiconductor nanocrystal, measured in nanometers, which structure is composed of an inorganic semiconductor core (responsible for generating and absorbing light), a protective shell that shields the core from external factors, and an outer organic shell that serves as an interface between the quantum dot material and the material in which it will be embedded. Subsequently, the quantum dots are delivered in the form of ink, allowing for the printing of semiconductors on various types of substrates, including flexible and transparent ones. QNA Technology's main product is DeepBlue.dots—blue quantum dots free of heavy metals and rare elements, emitting light at a wavelength of 440 nm. The company is currently working on PureBlue.dots, with a peak emission of 455 nm. In August **2022**, the PureBlue.dots quantum dots were used in the construction of a QDEL diode prototype by the German Fraunhofer Institute. The company's technology is also in the validation process with a client in Japan. On February 5, **2024**, QNA completed the construction of the first version of an experimental pilot line for quantum dot synthesis.

Noctiluca

Noctiluca specializes in the development and production of **advanced chemical compounds** (high-performance materials) that are key elements **responsible for luminescence in OLED displays and light sources.** These compounds' parameters determine the efficiency of converting electrical current into light, the quality of images displayed in OLED technology, color saturation, and brightness. These are compounds that emit light through Thermally Activated Delayed Fluorescence (TADF) for use in 3rd and 4th generation OLED technology. Noctiluca also develops dedicated auxiliary materials for these compounds, which make up the majority of the emissive layer in OLED displays, offering its clients a complete solution consisting of an emitter, sensitizer, and hosts. All these elements are encapsulated within a special diode, forming the OLED panel and then the matrix, ultimately resulting in a finished OLED display that emits the image viewed by the user.

Noctiluca boasts of its collaborations with **LG Display, Inkbit, Inuru, TCL,** and **ITRI.** In July 2023, the company signed an Evaluation License Agreement with the world's largest consumer electronics manufacturer from the USA (California). The company maintains and develops relations with 8 of the 10 largest display companies in the world.

In July 2025, the company signed a letter of intent with a leading investment firm to raise USD 3-4 million. The funds raised will be used to expand its engineering resources and establish a Noctiluca technical and commercial center in East Asia, which will enable the company to conduct application projects (MTA and JDP) directly at its Asian factories.

A SECURE TOMORROW STARTS TODAY – TECHNOLOGIES RESISTANT TO **QUANTUM ATTACKS**

INTERVIEW
MICHAŁ ANDRZEJCZAK
CO-FOUNDER
RESQUANT

What exactly are the cryptographic coprocessors developed by ResQuant, and how can they be implemented in electronics systems?
We design processor and integrated circuit components—cryptographic blocks—that are responsible for generating, storing, and securing cryptographic keys, as well as performing encryption functions. These components adapt our clients' products to meet the requirements of emerging PQC (Post-Quantum Cryptography) standards. A typical integrated circuit includes a processor, memory, and other components serving various functions. One of the key elements is the block responsible for security and cryptography. This is precisely the part we design—both as a component within a larger system and as a standalone chip that can be integrated into any device. Such a component may function as part of a processor, a separate chip on a motherboard, or an independent module within an end device.

Post-quantum cryptography sounds like the future to most of us. Could you already list specific applications for your products?
Our portfolio is extensive. However, if we were to focus on the most important projects, we can distinguish two main pillars of our activity. The first is a project currently under development for the European Space Agency. We are working on an encrypted data input module for satellites, responsible for secure communication with Earth. This is an example of a very specific application of our expertise in a demanding environment. The second key area, which forms the foundation of our activity, is the design of so-called cryptographic coprocessors. We create their architecture and offer it in a licensing model to integrated circuit manufacturers. This allows our partners to integrate these solutions directly into their chips, thus gaining full cryptographic functionality resistant to threats posed by quantum computers.

We know that ResQuant products are mature designs, ready for mass production. However, developing the first prototypes required a certain degree of courage – the team was working before official standards even existed. What were the biggest challenges on the path to delivering a mature product?
The biggest challenge wasn't purely technical – the team possessed both the expertise and experience. The biggest challenge was navigating a market that didn't yet have established rules. We began work before an official standard for post-quantum cryptography was established. Over the years, many proposals emerged, but it was unclear which algorithms would be accepted. Therefore, we had to independently decide which solutions to invest time and resources in. Fortunately, we correctly predicted which algorithms would become the standard. This allowed us to build a competitive advantage –before the market was even ready for deployment, we already had advanced knowledge and working prototypes.

A SECURE TOMORROW STARTS TODAY – TECHNOLOGIES RESISTANT TO QUANTUM ATTACKS

INTERVIEW
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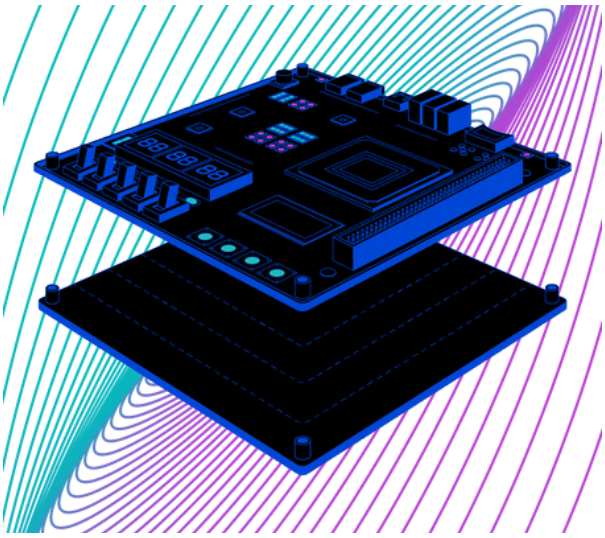


The situation in the post-quantum cryptography market shifted radically after the NSA published guidelines indicating that, by 2030, all systems approved for use in US governments must support PQC algorithms. This means that solutions being developed today must be resilient to threats that will emerge in 10 or 20 years. Why isn't a simple software update sufficient in this situation?

The most common misconception is that migrating to post-quantum cryptography is merely a matter of replacing one algorithm with another—or simply updating software. Indeed, in some applications, such as cloud services or web applications, part of this process will be handled by major technology providers like Google or Microsoft. A browser or library update can actually automatically introduce support for PQC. The problem begins when we enter the world of physical devices—IoT, critical infrastructure, embedded systems. Post-quantum algorithms are much more resource-intensive than classical ones—they require larger keys, generate more data, and require more computing power. This creates specific challenges: where to store such large keys, does the system have enough memory, how long will cryptographic operations take, and will they disrupt other components?" In the case of radio communications, additional issues arise with message size—longer data can exceed packet limits, necessitating more complex synchronization and transmission fragmentation. There's also the issue of compatibility with existing communication protocols, which often have strict limitations. Devices with increased security requirements face additional challenges: protection against physical attacks, power management, and reliable operation in harsh environments. PQC algorithms require more energy, and many devices, such as battery-powered sensors, lack the resources to support them.

What are the key upcoming milestones in your company's development?

We plan to conduct a formal certification process for our products in accredited external laboratories. This will provide independent confirmation that our security measures meet the required security level. From a technological perspective, our priority for the coming months is the production of new prototypes using the 22nm process at the GlobalFoundries factories in Dresden. We aim to launch this in the fourth quarter of 2025 to thoroughly verify parameters such as energy consumption, computational performance, and operational stability. This data will be crucial for both us and our partners. Regarding commercial goals, we are focusing on finalizing negotiations with several key customers. On the one hand, these are manufacturers of integrated circuits for the US defense sector, where post-quantum cryptography is already becoming a requirement. On the other, we are co-creating more complex integrated circuits – incorporating our IP – for one of the largest technology companies in the world. Our goal is for our solutions to be a key element of their products in the coming years.

SEMICONDUCTORS ECOSYSTEM **IN POLAND**

PPTF

An organization that unites and coordinates the efforts of the Polish microelectronics and photonics sector is the **Polska Platforma Technologiczna Fotoniki (PPTF)** [TN Polish Technology Platform for Photonics], established in 2013. The platform was created as a joint initiative of businesses, associations, universities, and research institutes operating in the field of photonics in Poland, aligning with the European Union's approach to the most innovative areas of the European economy. PPTF's mission is to enhance the innovativeness of the Polish photonics industry by coordinating the efforts of Polish entrepreneurs, scientific institutions, government, and local administration, as well as non-governmental organizations in the development of new technologies and optoelectronic products, workforce development, and the broader application of photonics technologies in Poland.

In 2023, PPTF and CEZAMAT initiated the establishment of the Klaster Mikroelektroniki, Elektroniki i Fotoniki (microEPC) [TN Microelectronics, Electronics, and Photonics Cluster]. The founding members of the cluster include 51 companies, universities, institutes, and organizations.

- I think that photonics is simply a technology with immense innovative potential, offering many promises for how we can genuinely make the world a bit better - said Maciej Nowakowski from PPTF, in an interview for Łukasiewicz – IMiF [1].

[1] https://imif.lukasiewicz.gov.pl/maciej-nowakowski/

BETWEEN SCIENCE AND **BUSINESS**

Łukasiewicz – IMiF

The IMiF [TN Institute of Microelectronics and Photonics] is part of the **Łukasiewicz** network, the third-largest research network in Europe, managing **440** R&D laboratories and employing nearly **4,500** research and engineering staff. Łukasiewicz – IMiF develops designs and manufacturing technologies for micro- and optoelectronic devices, including **microwave and photonic discrete devices, detectors, and sensors, integrated circuits, microsystems and electronic components, microelectronic hybrid circuits, power devices,** and **diffractive elements.** Moreover, the institute develops technologies for producing new materials such as **gallium nitride, epitaxial and flake graphene, ceramic-metal composites, glass,** and **advanced ceramics,** and studies their properties for industrial applications. The solutions from Łukasiewicz – IMiF are applied in various sectors, including energy, electronics, photonics, medicine, aerospace, defense, space, automotive, and other industries.

Research works at Łukasiewicz – IMiF is based on four technological lines:

- **Optoelectronic component line**: photolithography, etching, deposition of metallic/dielectric layers, die bonding, wire bonding, and sealing structures in inert gas atmospheres.
- **Silicon component line:** process based on CMOS technology (with 3 µm design rules) and EBL (<1 µm), it includes RCA cleaning, photolithography, thermal processes, plasma and wet etching, metal deposition, ion implantation, micro-assembly operations, 1,200 m² cleanroom
- **Wide-bandgap semiconductor component line**: a complete technological line located in technology cleanrooms compliant with ISO-5 and ISO-6 standards, covering approximately 600 m², dedicated to manufacturing semiconductor devices based on gallium nitride (GaN) on various substrates (GaN, SiC, Si, sapphire), and performing processes for depositing various types of thin metallic, dielectric, and semiconductor layers
- **LTCC technology line**: the LTCC circuits are manufactured in a complexed technological process, starting from ceramic foil production, followed by processes such as foil cutting and hole formation, printing of conductive, resistive, and dielectric layers, module stacking and pressing, final thermal processing, assembly, and securing for final testing. This line allows for the production of three-dimensional electronic circuit structures based on pressed ceramic foils with printed functional layers.

Łukasiewicz – IMiF implements projects and products dedicated to various industrial sectors: from electronics, automotive industry, cybersecurity, medicine, electromobility, and space industry to the defense industry. These include among others:

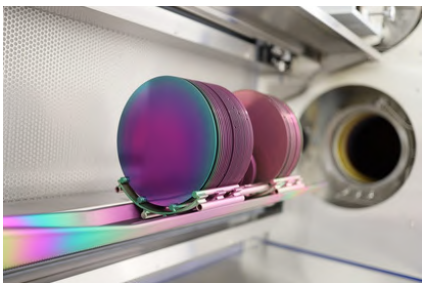
- quantum cascade lasers (QCLs) emitting light in the 4.5-5.5 µm and 8-10+ µm bands, compact and easily controllable. Perfect light sources for applications in the mid and far-infrared range
- microelectronic and photonic systems for targeting systems
- photodiodes for missile and rocket guidance systems
- AlGaN/GaN microwave transistor for S-band radiolocation with GaN-HEMT technology
- specialized integrated circuits for optoelectronic heads
- detectors for proximity sensors.
- cold plasma generator for protection against biological threats

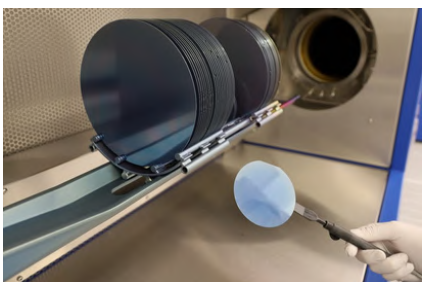
CEZAMAT

Centrum Zaawansowanych Materiałów i Technologii CEZAMAT [TN The Center for Advanced Materials and Technologies] at the Warsaw University of Technology is one of the largest research and development investments in high-tech fields in Poland. CEZAMAT PW is a complex of specialized laboratories where research is conducted on materials used in microelectronics, optoelectronics, nanoelectronics, and bioelectronics. In 2013, the European Union co-financed the investment with €76.6 million, with the total cost amounting to **€90 million.** The foundation stone for the current CEZAMAT headquarters was laid in September 2014. This is a collaborative project involving several Polish universities, with the **Warsaw University of Technology** playing a leading role. The consortium also includes the Institute of Physical Chemistry of the Polish Academy of Sciences, the Institute of Physics of the Polish Academy of Sciences, the Institute of High Pressure Physics of the Polish Academy of Sciences, the Institute of Fundamental Technological Research of the Polish Academy of Sciences, the Institute of Electron Technology, the Institute of Electronic Materials Technology, the University of Warsaw, and the Military University of Technology.

Currently, within CEZAMAT, there is a division dedicated to **Intelligent Semiconductor Systems**, which operates in five teams: Semiconductor and Planar Technology, Integrated Photonics, Optical Structure Technology, Internet of Things, and Micro Energy Generators.

- **The Semiconductor Technology Team** conducts research in the field of semiconductor materials, devices, and systems, not only based on silicon technology but also exploring alternative materials like GaN and SiC. The research focuses on CMOS devices, MOS/MIM tunnel diodes, and memory technologies. The team also works on nanostructure technologies for microelectronics and photonics devices. The technological processes carried out include surface preparation, thin film deposition, shape patterning, layer property modification, and etching.
- **The Integrated Photonics Team** runs development research in the scope of design, simulation, fabrication, and characterization of integrated photonic devices and systems. The team's achievements include integrated photonic elements operating in visible light, produced on material platforms such as silicon nitride, indium phosphide, and SOI. The Integrated Photonics Team specializes in devices used in biosensors, environmental sensors, and scientific applications. Their technological infrastructure allows for the independent production of oxide and nitride layers with precise thicknesses. The use of electron beam lithography in the manufacturing process enables the prototyping of photonic elements and systems without the need for photolithographic masks.
- **The Internet of Things Team** in collaboration with ST Microelectronics, has developed a distributed monitoring system: a self-organizing network of communicating sensors.
- **The Energy Microgenerators Team** focuses on developing new energy production techniques derived from waste sources (e.g., heat, vibrations, motion) or from distributed energy sources (e.g., light).





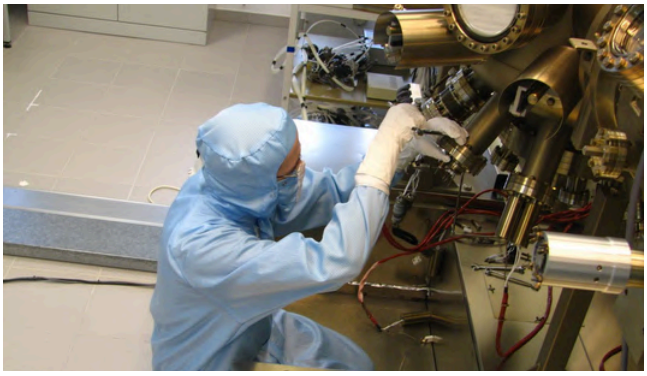
Source: Cezamat

- **The Optical Structures Technology Team** takes care of precise optical components, manufactured using processes typical of semiconductor technology lines, including photolithography, electron beam lithography, layer deposition, and ion etching. The team has also developed technology for fabricating phase structures in grayscale electron beam lithography, enabling the exposure of variable height structures within a single process. Among the team's achievements are Fresnel lenses and kino-forms with thicknesses ranging from 0.5 to 3 μm and diameters in the millimeter range, reflective and transmissive holograms with submicron pixel dimensions, metastructures, diffraction gratings, and microlens arrays. Additionally, the team developed a method for creating transmissive X-ray diffraction structures on silicon nitride membranes, with dimensions below 50 nm.

Unipress

The High Pressure Research Center of the Polish Academy of Sciences, also known as Unipress, is a leading research institute specializing in semiconductor physics, technology, and materials engineering. The institute is particularly renowned globally for its unique expertise in the **crystallization of bulk gallium nitride (GaN) crystals.** Research conducted at the institute covers a wide range of areas, including the physics and epitaxy of nitride semiconductors, biomaterial production, studies on soft matter and glasses, THz radiation physics, and other related fields. Unipress also develops and manufactures high-pressure equipment for research laboratories worldwide.

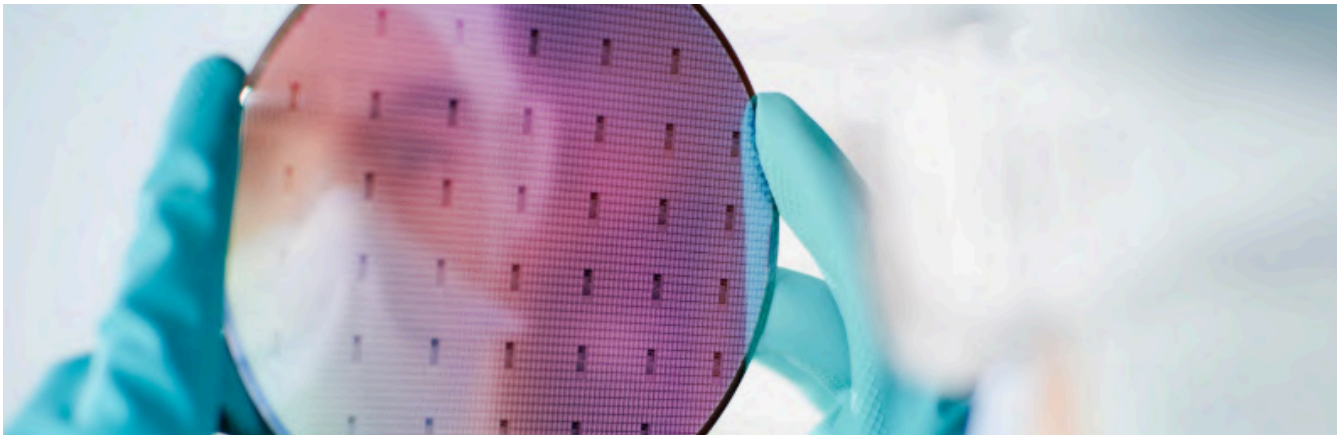
A part of Unipress is the **MBE Epitaxy Laboratory (NL-14), which specializes in the development of blue light-emitting diodes (LED) and laser diodes (LD)** produced using Plasma-Assisted Molecular Beam Epitaxy (PAMBE) technology. The team focuses on fabricating long-wavelength light emitters by theoretically modeling quantum structures and optimizing the optical and electrical parameters of devices manufactured on gallium nitride (GaN) substrates.



Production processes in the MBE Epitaxy Laboratory
Source: Unipress MBE

BETWEEN SCIENCE AND **BUSINESS**

POLISH RESEARCH INSTITUTES IN **EUROPEAN PROJECTS**



Microelectronics and Photonics Competence Center

Announced in May 2024, the Microelectronics and Photonics Competence Center is a joint initiative of three research institutions, funded by the National Recovery and Resilience Plan **(KPO): the Łukasiewicz Institute of Microelectronics and Photonics (leader), the Łukasiewicz Institute of Tele- and Radioelectronics, and Warsaw University of Technology's CEZAMAT Center**. The project has a total value of **PLN 519.7 million**, with EU funding amounting to **PLN 370.0 million**, and is scheduled for completion by **2027**. One of the key objectives is to establish new laboratories that, by leveraging unique expertise in the design and manufacturing of both materials and devices, will enable a significant technological leap in Poland. Covering the full process, from epitaxial layer growth to novel end devices, the project will make it possible to conduct research using state-of-the-art equipment. Advanced measurement systems will further allow for comprehensive characterization of materials and structures at the nanoscale.

As part of the **CEZAMAT**-led activities, the Warsaw University of Technology will acquire and install new technological, diagnostic, and measurement equipment in its existing laboratories. Combined with the planned purchases, the available equipment **will create a unique technological line in Poland for manufacturing photonic integrated circuits and microelectronic devices**. This will be the only facility in this part of Europe fully adapted to **200 mm** substrates. The CEZAMAT investment will exceed **PLN 97 million**, of which **PLN 70 million** will come from EU funding.

In the part carried out by the **Łukasiewicz Institute of Tele- and Radioelectronics**, with a total value of **PLN 25.6 million** (EU funding: **PLN 16.7 million**), new Printed Circuits and Electronic Assembly Laboratory will be established. Research there will focus on developing new solutions in PCB design, material selection, process optimization, and methods for the assembly and disassembly of electronic components.

Meanwhile, the **Łukasiewicz Institute of Microelectronics and Photonics** will build or upgrade several laboratories, including those dedicated to Functional Materials, GaN Devices and Microassembly, Infrared Photonics, Integrated Circuit and Electronic Systems Design, the Center for Graphene and Innovative Nanotechnologies, and the Special Glass and Fiber Optics Laboratory. In early 2025, the first equipment purchased under the project was already delivered to the Institute's Intelligent Materials Laboratory.

BETWEEN SCIENCE AND **BUSINESS**

POLISH RESEARCH INSTITUTES IN **EUROPEAN PROJECTS**

Chips Act - WBG Pilot Line

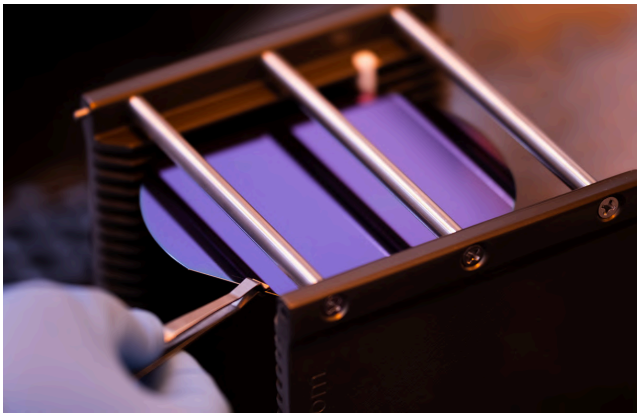
In April 2024, the Chips Joint Undertaking, operating under the **European Chips Act**, selected a team that includes **UNIPRESS** and **Łukasiewicz – IMiF** to implement one of four European pilot lines focused on advanced semiconductor technologies.

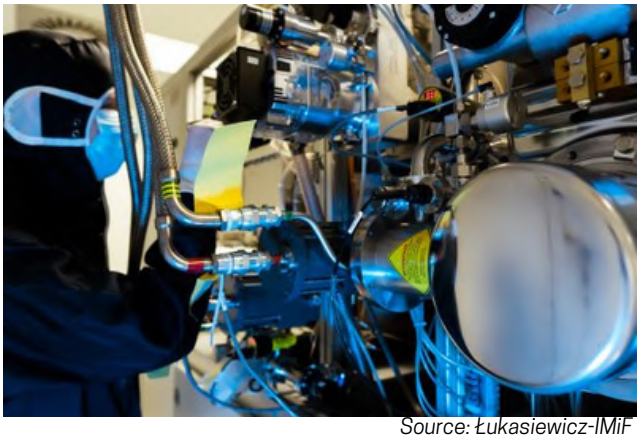
The WBG Pilot Line (Wide Band Gap semiconductors pilot line) aims to develop innovative material technologies and device fabrication methods based on wide band gap semiconductors, such as gallium nitride (GaN), silicon carbide (SiC), and gallium oxide (Ga203). These materials are crucial for industrial applications, automotive, renewable energy, consumer electronics, and defense. The project seeks to launch a pilot line and develop **FD-SOI technology at 10 nm and 7 nm nodes**. This technology, entirely developed within the European Union, is strategic for the advancement of semiconductor technologies in Europe.

As part of an international consortium comprising 22 research institutions and universities from Italy, Sweden, Finland, Austria, Germany, France, and Poland, the **primary task for IWC PAN and Łukasiewicz – IMiF will be the development of techniques for growing GaN substrates and epitaxial layers, as well as advancing the technology for fabricating GaN and Ga2O3-based devices**, including vertical power devices such as diodes and transistors. The construction of the pilot line is set to begin in early 2025, with Łukasiewicz – IMiF and IWC PAN receiving **€50 million** to achieve the project's goals.

PIXEurope

The Warsaw University of Technology (Institute of Microelectronics and Optoelectronics and CEZAMAT) has joined the international consortium of the **PIXEurope** project, which aims to establish the first open ecosystem for photonic integrated circuits (**PICs**). The initiative is part of the European Chips Act and is implemented under the CHIPS Joint Undertaking program. **The project includes the creation of a state-of-the-art pilot line to enable rapid prototyping in photonics** and the assessment of production processes for subsequent industrial scaling. The scope of work also covers the development of integration processes, as well as advanced packaging and testing technologies. PIXEurope brings together partners from Austria, Belgium, Finland, France, Ireland, Italy, Poland, Portugal, Spain, the Netherlands, and the United Kingdom.





Source: Łukasiewicz-IMiF

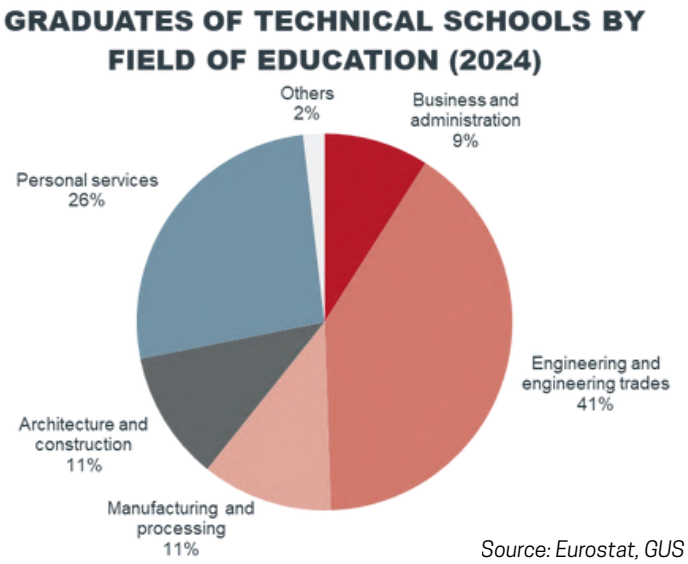
WORKFORCE
FOR THE SEMICONDUCTOR MANUFACTURING INDUSTRY

The fact that Poland currently lacks the necessary workforce is often cited as the primary obstacle to the development of the semiconductor industry in the country. Universities do not train professionals for this sector because there is no demand, and investors are hesitant to enter the market due to the lack of qualified personnel, creating a vicious cycle. However, Intel's investment and the optimism that followed its announcement are likely to break this cycle.

- When recruiting a new employee, whether from other branches of the electronics industry or a recent graduate, we cannot count on them knowing what to do immediately. We assess candidates during their trial period, internships, or training, identify the roles that best suit their abilities, and then start their education process. While part of their development involves external training and conferences, most of the knowledge is provided by our existing employees - says Emil Batorowicz from VIGO Photonics [1]

A very important voice, as emanating from a global perspective, also comes from Intel. This is the prospect of a great business, with unlimited opportunities and extensive experience:

- The greatest innovation comes when we bring together people with diverse experiences - chemistry, physics, microelectronics - but also many specialties that might not seem directly related to semiconductors - says **Max Dropiński** from **SEMI** in an interview with tek.info.pl. *The rapid advancements in front-end and back-end processes mean that what students learn today may be outdated in five years. It's only when we hire individuals with varied backgrounds and train them within our manufacturing processes that we create teams capable of developing future technologies. The focus is more on fundamental experience and mindset— it's not critically important for a specific field, like microelectronics, to be highly developed and to have a large number of male and female graduates who completed such studies. It's helpful, but not essential [2].*



Source: Eurostat, GUS

[1] Source: https://tek.info.pl/article/3865
[4] Source: https://tek.info.pl/article/3847

WORKFORCE FOR THE SEMICONDUCTOR MANUFACTURING INDUSTRY

Science responded very quickly to the needs of Intel's announced investment in the back-end facility on January 31, 2024, Wrocław University of Science and Technology signed a letter of intent with them, which presupposes joint R&D projects, the development and adaptation of educational programs to better align with industry needs, and lectures to be conducted by Intel specialists

- *Program, którego flagowym partnerem stał się Intel, z perspektywy uczelni oznacza chęć ukierunkowanej współpracy z przemysłem półprzewodnikowym. Nieobecność amerykańskiego koncernu na Dolnym Śląsku wcale nie zamyka tego programu, wręcz przeciwnie, w dalszym ciągu utrzymujemy kontakt związany z dydaktyką i bazujemy na materiałach dostarczanych przez Intel. Na pewno część związana z końcowymi etapami produkcji półprzewodników jest i będzie obecna w ramach naszego programu nauczania. Technologie wytwarzania półprzewodników to znacznie więcej niż jedna firma, a same pojęcie półprzewodników to pojęcie znacznie szersze niż procesory* - mówi w sierpniu 2025 roku w wywiadzie dla tek.info.pl **Rafał Walczak**, **dziekan** Wydziału Elektroniki, Fotoniki i Mikrosystemów Politechniki Wrocławskiej. Wydział EFiM PW obejmuje trzy katedry silnie powiązane z zagadnieniami wytwarzania przyrządów półprzewodnikowych: Katedrę Nanometrologii, Katedrę Mikroelektorniki i Nanotechnologii oraz Katedrę Mikrosystemów.

Gdańsk University of Technology, in line with its mission to foster innovation and bridge the academic environment with industry, has initiated collaboration with leading local semiconductor companies, including **Intel** and **Synopsys**. As part of this partnership, the university plans to equip state-of-the-art laboratories that will serve both educational and research purposes. The Department of Microelectronic Systems at the Faculty of Electronics, Telecommunications, and Informatics ETI PG has already received two powerful servers from Intel (each with 96 cores and 256GB of RAM). These servers have been installed in the departmental server room and will be used to support laboratories focused on integrated and programmable circuit design, with students accessing them remotely, reflecting current industry practices.

These initiatives also include internship and apprenticeship programs, providing students with practical experience in real industrial settings. Additionally, an essential aspect of this partnership is the consultation of the curriculum with industry experts and guest lectures by specialists from local companies, ensuring that the educational content is continuously aligned with the evolving demands of the job market. The synergy between Gdańsk University of Technology and the local ecosystem is expected to elevate the standard of technical education and significantly contribute to the development of the regional innovation ecosystem. Thanks to the cooperation between the Department of Microelectronic Systems and SEMI Europe offers students opportunities to enhance their semiconductor competencies through initiatives like the European Chips Skills Academy.

- *Thanks to the direct involvement of semiconductor industry leaders, we can enrich our study programs with the latest technological advancements and provide our students with access to work with world-class companies. Partnerships with Intel, Cadence, and Synopsys enable us to educate future engineers at the highest level while also supporting the development of the regional innovation ecosystem* - says DSc eng. Marek Wójcikowski, Prof. PG, Head of the Department of Microelectronic Systems, Faculty of ETI, Gdańsk University of Technology.

HUMAN RESOURCES FOR THE SEMICONDUCTOR MANUFACTURING INDUSTRY

STEM EDUCATION POTENTIAL IN POLAND

Gdańsk University of Technology
Faculty of Electronics, Telecommunications, and Informatics

Maritime University of Gdynia
Faculty of Electrical Engineering

Koszalin University of Technology
Faculty of Electronics and Computer Science

Poznań University of Technology
Faculty of Electronics and Telecommunications

Wrocław University of Technology
Faculty of Electronics, Photonics, and Microsystems
Faculty of Computer Science and Telecommunications
Faculty of Fundamental Problems of Technology

Kielce University of Technology
Faculty of Electrical Engineering, Automatics, and Computer Science

AGH University of Science and Technology
Faculty of Computer Science, Electronics, and Telecommunications

Kraków University of Technology
Faculty of Computer and Electric Science

Silesian University of Technology
Faculty of Electrical Engineering
Faculty of Automatic Control, Electronics, and Computer Science

Białystok University of Technology
Faculty of Electrical Engineering

Military University of Technology
Faculty of Electronics
Faculty of Optoelectronics

Warsaw University of Technology
Faculty of Electronics and Information Technology

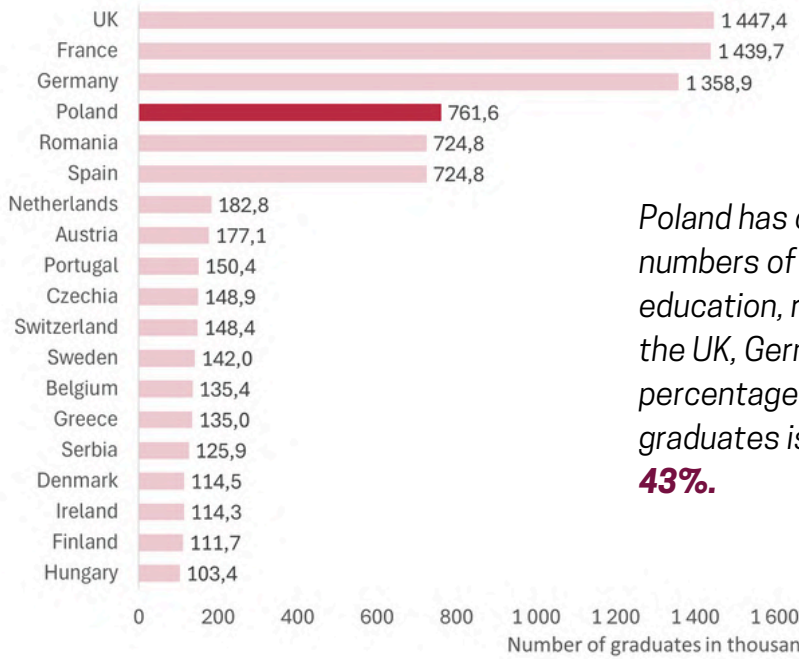
Bydgoszcz University of Science and Technology
Faculty of Telecommunications, Computer Science, and Electrical Engineering

Lodz University of Technology
Faculty of Electrical, Electronic, Computer, and Control Engineering

Lublin University of Technology
Faculty of Electrical Engineering and Computer Science

Rzeszów University of Technology
Faculty of Electrical and Computer Engineering

NUMBER OF **STEM** GRADUATES FROM **2013** TO **2019**



Source: Eurostat

*Poland has one of the largest numbers of people with technical education, ranking **4th** in Europe, after the UK, Germany and France. The percentage of women among STEM graduates is the highest in Europe at **43%.***

SWOT ANALYSIS

OPPORTUNITIES

- The European Chips Act stimulates semiconductor industry growth across Europe
- The COVID-19 pandemic has triggered a noticeable trend of shifting production closer to Europe (nearshoring)
- Positive experience of foreign investors in other electronic market segments
- High level of International connections in the supply chain
- Geographical proximity of European semiconductor supply chain factories
- Established of relations with Taiwanese partners: SEMI, TeaLa, TAIROA, and Taiwania Capital
- Organization of SEMI - ISS Europe in Sopot in 2025 and 2026, and appearance of Poland at SEMICON TAIWAN in 2023 and 2024
- Growing recognition of Poland and our potential as an investment location among global semiconductor companies (e.g. in Taiwan)

THREATS

- Competition from Western European countries
- Other Central and Eastern European countries increasing role on the international stage
- Dominance of certain countries at specific stages of the supply chain, hindering the development of other countries
- Investors' fears of war with Russia

STRENGTHS

- Presence of several companies from the semiconductor production supply chain, including a key investor, Intel
- Well-developed other segments of the electronics market: OEM and EMS
- Well-developed sectors supporting semiconductor development: military, production automation, software
- Strong chemical sector with initial experience in semiconductor chemicals production
- Good level of higher education and academic faculty
- Developed system of incentives for investors from the government

WEAKNESSES

- Small number of higher education programs, including elements preparing students for work in the semiconductor industry
- Limited financial resources of Polish companies compared to the capital needs of the semiconductor industry
- Small number of skilled workforce ready to work in semiconductor production
- Lack of a well-developed supply ecosystem for semiconductors in Poland
- Low participation of Polish companies in the global semiconductor supply chain
- Lack of trade organization dedicated for semicon ecosystem integration

PAIH SUPPORT FOR INVESTORS FROM THE SEMICONDUCTOR SECTOR

Poland offers a wide range of incentives for the semiconductor sector to attract investments in this area and build a supply chain that will contribute to achieving the goals set by the European Union related to reducing reliance on chip imports from third countries. Entrepreneurs in this sector can benefit from both the substantive support of the Polish Investment and Trade Agency S.A. (PAIH) and financial incentives, such as regional investment aid. Additionally, a special program has been created for them in response to the European Chips Act - the National Framework for Supporting Strategic Semiconductor Investments (National Framework).

Departament Wsparcia Inwestycji (DWI) [TN The Investment Support Department] PAIH offers comprehensive support to investors considering locating or expanding their operations in Poland, and each time takes an individual approach to entrepreneurs and their investment plans. The services provided by DWI PAIH include location advisory, organizing site visits, providing information on investment incentives, preparing information packages, identifying potential business partners, collaborating with startups and technology providers, organizing business meetings, assisting in building relationships with research institutes and innovation centers, support in dealings with government authorities, and post-investment care. DWI PAIH also manages a database of investment sites known as the Investment Offer Generator. All PAIH services are offered to entrepreneurs free of charge.

PAIH
PFR Group

*As of the end of August **2025**, the DWI PAIH handles **132** investment projects of declared investment value (CAPEX) equal to **10.2 mld EUR**, and nearly **24,000** new jobs.*

PAIH SUPPORT FOR INVESTORS FROM THE SEMICONDUCTOR SECTOR

EUROPEAN CHIPS ACT

The European Chips Act aims to support investments in semiconductor production, the development of advanced technologies, and the promotion of research and innovation in this field. This act is designed to help European companies gain a competitive position in the global market.
Poland's response to the above was the enactment of the **National Framework** under which a semiconductor sector entrepreneur can obtain support for a project aimed at establishing an integrated production facility or an open EU factory, as defined by the European Chips Act. The maximum allowable support for a project is determined based on the identified funding gap relative to the project's costs. The investor must commit to an **investment input** of at least **850 million PLN** during the project implementation period, which must not exceed **20 years,** and to creating at least **100 new jobs**, and maintaining them until the project's end.
PAIH is an institution that provides information about this form of public assistance, supports investors in the process of assessing project eligibility, and helps prepare the application documentation. In parallel with the National Frameworks, Poland is working on further implementing the European Chips Act. According to the European Chips Act, Poland will designate a contact point to serve as a liaison to ensure cross-border cooperation with other member states.

GOVERNMENT **GRANT**

Investors looking to undertake new semiconductor projects in Poland can apply for a government grant under the regional aid package. PAIH consults with businesses on preparing their applications and supporting documents. During these consultations, PAIH specialists provide support and guidance on the application process. An investor is assigned a project manager who leads and coordinates the project, maintains ongoing contact with the investor, and supports them at every stage of the project.

SUPPORT **TYPES**

Within the Program, support will be provided under two categories:

1. Eligible investment costs **(CAPEX)**
2. Eligible costs for **creating new jobs**

Entrepreneurs can receive support for projects classified as "initial investment" according to Commission Regulation (EU) No 651/2014 of 17 June 2014, which declares certain categories of aid compatible with the internal market under Articles 107 and 108 of the Treaty. In the case of large enterprises undertaking investments in the regions of Lower Silesia, Greater Poland, and parts of Masovia (Warsaw agglomeration), they can receive support for projects classified as an "initial investment that creates a new economic activity" according to the aforementioned Regulation.

PAIH SUPPORT FOR INVESTORS FROM THE SEMICONDUCTOR SECTOR

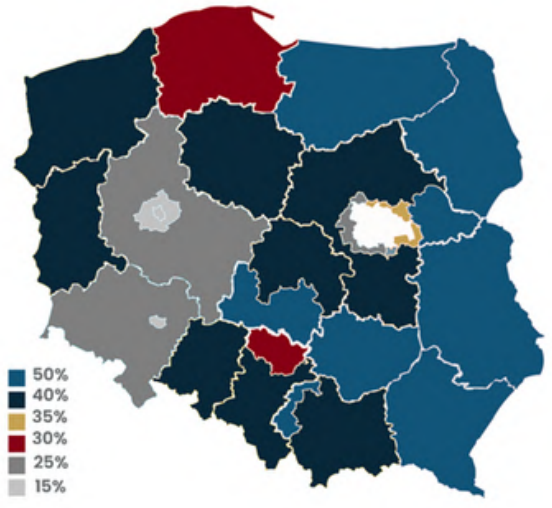
FORM OF SUPPORT

Support is granted in the form of a subsidy based on a bilateral agreement between the Minister responsible for economic affairs and the investor.

LEVELS OF **REGIONAL STATE AID** IN POLAND - HOW MUCH CAN BE RECEIVED?

Poland has adopted a new regional aid map that specifies the percentage limits of support for **large companies** in different regions of the country (from **15%** up to **50%**). **Medium-sized and small companies** can benefit from an additional increase in regional aid intensity by **10** and **20** percentage points, respectively. On the other hand, for large investments amounting to **55 million euros and more**, the maximum state aid is adjusted—calculated based on the "adjusted aid amount" formula as defined in Regulation 651/2014.

REGIONAL AID INTENSITY MAP



Obligation to Collaborate with Higher Education and Research Institutions

As part of the government grant support, a large enterprise is required to incur costs during the implementation or maintenance of the investment, specifically for collaboration with higher education and research institutions or secondary schools, amounting to at least 15% of the value of the granted support.

Requirement to meet qualitative criteria according to the Program

When applying for a government grant, an investor must not only meet quantitative criteria but also declare compliance with qualitative criteria, most of which are verified during the maintenance period. In the qualitative assessment of the investment, a company can earn up to 10 points. The minimum number of points required depends on the project's location and ranges from at least 4, 5, or 6 points, depending on the location.

Increased support for employee training

The amount of support related to the costs of creating new jobs or investment costs can be increased if the company offers training to its employees.

INVESTMENT COSTS SUPPORT (INVESTMENT GRANT)

To apply for investment cost support entitles, implementation of the following investments:
1. Strategic,
2. Innovative,
3. R&D Service center,

compliant with the criteria outlined in the below table

Minimum quantitative criteria table — investment expenditures and employment for investment projects undertaken by large enterprises applying for an investment grant

Investment type	Minimum investment xxpenditures (million PLN) [1]	Minimum employment [1]	Maximum support (as a % of eligible costs) [2]
Strategic	160	50	-micro-entrepreneur / small entrepreneur: up to **25% / 15%** - medium-sized entrepreneur / scaling entrepreneur: up to **20% / 10%** -large entrepreneur: up to **15% / 5%**
Innovative	7	20	
R&D Service center	1	10	up to **25% / 15%**

[1] The minimum investment expenditures and employment refer to large enterprises and are proportionally lower for micro, small, medium-sized, and scaling entrepreneurs, or if the investment is located in an area at risk of exclusion; minimum employment requirements are reduced in the case of reinvestment.
[2] Depending on the location of the investment

PAIH SUPPORT FOR INVESTORS FROM THE SEMICONDUCTOR SECTOR

SUPPORT FOR **JOB CREATION COSTS** (EMPLOYMENT GRANT)

To apply for investment cost support entitles, implementation of the following investments:

- Business Service Centers,
- R&D Service Centers,

compliant with the criteria outlined in the below table

Table of minimum quantitative criteria - investment expenditures and employment for service projects applying for an employment grant

Investment type	Minimum investment expenditures (million PLN) [1]	Minimum employment [1]	Maximum support (per job, in PLN) [2]	Process type
Business Service Centers	1	100	15.0 K / 7.5 K	Intermediate, advanced, and highly advanced services (as specified in Annex 2 of the Program)
R&D Service Centers	1	10	up to 40 K / up to 30 K / up to 20 K / up to 15 K	Research and development services (as specified in Annex 2 of the Program)

[1] The minimum investment expenditures and employment requirements refer to large enterprises and are proportionally lower for micro, small, medium-sized, and scaling entrepreneurs, or when the investment is located in an area at risk of exclusion.
[2] Depending on the location of the investment and the number of new jobs created.

PAIH SUPPORT FOR INVESTORS FROM THE SEMICONDUCTOR SECTOR

GOVERNMENT CASH GRANT **PROCEDURE**

The application process for a government grant is regulated by the Program. To obtain the grant, the entrepreneur must submit the following documentation:

To **PAIH:**

- A completed application form in Polish (Information about the project),
- The incentive effect analysis (concerns large and developing entrepreneurs),
- Attachments specified in the Information about the project,
- A copy of the application submitted to the relevant Minister of Economy.

To the **relevant Minister of the economy:**

- A public aid application form with necessary attachments.

Work on the investment can only begin after submitting the application for public aid, including attachments, to the relevant Ministry of the economy (an analysis of the incentive effect is required only for projects carried out by large and developing enterprises), as described above.

The government grant is one of the more popular forms of support. The key to successfully completing the application process is to properly structure the project and accurately prepare the documentation.

INCOME TAX EXEMPTION

It is currently possible to benefit from income tax exemption across all of Poland, where regional aid is available. The period for which the support decision is issued depends on the intensity of public aid for the location of the investment and can be 12, 14, or 15 years. The decision is issued on behalf of the Minister responsible for the economy by the Special Economic Zone managing the area in question.

TAX RELIEF

Tax reliefs for entrepreneurs are special entitlements that allow for the reduction of the amount of taxes that businesses would otherwise have to pay. These reliefs enable companies to save funds, which increases profitability and the ability to invest in the company's growth.

- **R&D relief** stands for incentive supporting entrepreneurs engaged in R&D activities. It allows the deduction of eligible costs associated with R&D activities from the taxable income base for business revenue (PIT) or other than capital gains income (CIT). Thanks to this relief, costs incurred for R&D can be counted twice when calculating the due income tax.
- **Innovative employee relief** complements the R&D relief. If the eligible costs for R&D activities exceed the entrepreneur's income for a given tax year, the entrepreneur can reduce the PIT tax advance payments, which should be paid on salaries paid to innovative employees, by the amount of those costs.
- **Robotization relief** allows entrepreneurs to make an additional deduction from the tax base for income tax purposes up to a maximum of 50% of the costs associated with investments in robotization.
- **Prototype relief provides** supports investors at the pre-mass production stage, enabling them to deduct from the tax base the costs of trial production of a new product and the costs of bringing a new product to market.

POLISH **LAW** AND SUPPORT FORMS FOR INVESTORS

Agencja Rozwoju Przemysłu S.A. (ARP) [TN Industrial Development Agency] either directly or indirectly through its subsidiaries, manages four of the fourteen special economic zones in Poland, where it provides comprehensive services for investors, including support in selecting locations, obtaining available investment incentives, therein decisions on support, as well as ongoing assistance at every stage of the investment operation. Regardless of the above, ARP supports the PAIH (TN Polish Investment and Trade Agency) and other special economic zones' administrators (SEZs) in preparing comprehensive investment offers, even outside the areas managed by ARP.
Leveraging its experience and resources, ARP, in collaboration with local authorities and other SEZ administrators, prepares grounds dedicated to strategic investments, ranging from changes in spatial development plans to the investment surrounding infrastructure implementation. ARP has the capacity not only to implement but also to manage industrial parks, an example of which is the industrial park in Kobierzyce near Wrocław, dedicated to the **electromobility** sector with the largest electric vehicle battery production facility in Europe. This translates, among other things, into ARP's key importance in financing and construction of an industrial park in Miękinia, targeting the **microelectronics industry.**

PAIH (TN Polish Investment and Trade Agency) offers comprehensive support to investors considering locating or expanding their operations in Poland, taking each time an individual approach to entrepreneurs and their investment intentions. The services provided by DI PAIH include, among others, location consulting, organization of location visits, information on investment incentives, preparation of information packages, identification of potential business partners, collaboration with startups and technology providers, organization of business meetings, assistance in building relations with research institutes and innovation centers, support in contacting administration, and post-investment care. DI PAIH also maintains a database of investment plots known as the Generator Ofert Inwestycyjnych (TN Investment Offer Generator). All PAIH services are offered to entrepreneurs free of charge.

Polski Fundusz Rozwoju [TN Polish Development Fund] is a group of financial and advisory institutions that support entrepreneurs, local governments, and private individuals, that invests in the sustainable social and economic development of the country. The PFR operating model was developed in 2017 as part of the Strategy for Responsible Development implementation. Today, PFR S.A. serves as an integrated information center for entrepreneurs, local governments, and individuals interested in development instruments. The fund assists in selecting from over 100 products, previously scattered across various Polish development institutions. PFR focuses on implementing infrastructure investments, fostering innovation, promoting entrepreneurship, supporting exports and foreign expansion of Polish enterprises, supporting local governments, executing the Employee Capital Plans program, and handling foreign investments.

NCBR OFFER FOR SEMICONDUCTORS

The National Centre for Research and Development (NCBR) has been actively supporting the advancement of semiconductor technologies for many years by funding research and development projects under both national and international programs. Its international portfolio features numerous initiatives in the field of semiconductor technologies in which Polish researchers have secured funding.

1.Initiatives under Horizon Europe and Horizon 2020 include:

- **The Chips Joint Undertaking** and its predecessors: the ENIAC and ARTEMIS Joint Undertakings, the ECSEL Joint Undertaking (Electronic Components and Systems for European Leadership), and the Key Digital Technologies Joint Undertaking (KDT JU).
- The **Eurostars** initiative, part of the European Partnership for Innovative SMEs, in which NCBR acts as the national program operator.

2.ERA-NET programs supporting the development of a European research network:

- **M-ERA.NET** – a European network funding research in materials science and engineering, in which the National Centre for Research and Development (NCBR) has participated since 2015.
- **ERA-NET Photonics Based Sensing Cofund** – an international research funding program focusing on projects in the field of photonics, with particular emphasis on photonics-based sensors, active from 2016 to 2021.
- **ERA-NET QuantEra Cofund in Quantum Technologies** – an international program supporting research and innovation in quantum technologies in Europe.
- **ERA-NET MNT** (European Research Area Network on Materials and Nano-Technologies) – a network of organizations funding research in materials science and engineering, including nanotechnology, active from 2004 to 2011.
- **ERA-NET MATERA (Materials)** – a network of organizations financing research in materials engineering and materials science, in which NCBR participated from 2020 to 2021.

3.Other initiatives:

- **EIG CONCERT-Japan** – an international initiative supporting scientific and technological cooperation between Europe and Japan.
- **V4-Japan and V4-Korea** – cooperation between research funding institutions from the Visegrad Group countries and Japan/Korea.
- **EUREKA** – an international initiative aimed at enhancing the innovation, productivity, and competitiveness of European industry.

4.Bilateral Cooperation

The National Centre for Research and Development (NCBR) has implemented projects in semiconductor technologies and electronics with partners from various countries. Of particular importance is the cooperation program with **Taiwan**, the global leader in semiconductor production. It is one of the longest-standing and most consistently conducted bilateral programs in NCBR's portfolio.

NCBR OFFER FOR SEMICONDUCTORS

In 2025, the thirteenth edition of the call for international R&D projects, coordinated by NCBR and Taiwan's National Science and Technology Council (NSTC), was announced. Over the 13 years of collaboration, 12 bilateral calls for research projects have been launched and completed. These calls have resulted in **72 projects carried out by Polish–Taiwanese consortia** of research institutions and enterprises, including at least six in the field of semiconductors, with funding exceeding **PLN 5 million**. The total amount of NCBR funding under Polish–Taiwanese cooperation exceeds **PLN 31 million**.

As part of the cooperation agreement, NCBR and NSTC also organize annual scientific seminars combined with study visits, held alternately in Poland and Taiwan. To date, eleven such seminars have taken place, each attended by a selected group of researchers from both countries. During the visits, participants had the opportunity to explore research centers and scientific institutions in the host country and gain insights into ongoing research. Each visit concludes with a seminar dedicated to priority research topics identified for bilateral collaboration.

In 2023, a seminar on semiconductors was held, hosted by the Taiwanese side, represented by TSRI (Taiwan Semiconductor Research Institute), part of the National Applied Research Laboratories (NarLabs), Taiwan's leading network of research institutes. The visit was academically coordinated by Dr. Mei Yu Chang from the NARLabs International Affairs Office, and Dr. Chang-Hong Shen, Deputy Director of TSRI. On the Polish side, the academic coordinator was Prof. Izabella Grzegory, PhD, DSc, Deputy Director for Scientific Affairs at the Institute of High Pressure Physics, Polish Academy of Sciences. Five distinguished Polish researchers in physics, optoelectronics, and semiconductor technology also participated in the seminar.

The topic of semiconductors appears in many national initiatives supported by the National Centre for Research and Development (NCBR). While not always directly targeting a specific technology, semiconductors often fall within broader categories such as materials science, digital technologies, or microelectronics. Examples include strategic R&D programs like **TECHMATSTRATEG** and **INFOSTRATEG**, which support technological innovation in advanced electronics and digital security.
Among the competitions funded by European programs, three initiatives stand out:

- Important Projects of Common European Interest (**IPCEI**) – Microelectronics/Communication Technologies (ME/CT) is a competition under Measure 2.10 FENG, aimed at companies implementing IPCEI projects. It covers microelectronics and communication technologies. In 2024, NCBR signed an agreement with semiconductor industry leader Vigo Photonics S.A., enabling the implementation of the "HyperPIC – Photonic Integrated Circuits for Mid-Infrared Applications" project. The project received funding exceeding PLN 440 million, with a total value of over PLN 853 million. HyperPIC is a multi-year investment program that will advance the Polish photonics technology cluster, create numerous jobs both directly and within the partner ecosystem, attract engineering talent to Poland, and introduce globally innovative products for AI, IoT, Industry 4.0, and Agriculture 4.0.
- European Funds for a Modern Economy (**FENG**) supports research, development, and implementation projects under Measure FENG.01.01 in advanced technologies, including electronics, microelectronics, and semiconductors.
- **STEP** – Strategic Technologies for Europe Platform is implemented under Measure FENG.05.01. Its R&D track promotes projects in deep tech, digital technologies, and strategic components, which may include semiconductors as a key element of the EU's technological sovereignty.

AUTORS

The report was prepared by the team of the **tek.info.pl,** portal dedicated to people professionally involved in the design and production of electronics.

We invite you to the cyclical electronics industry meeting **TEK.day, September 11, 2025, Gdańsk**.

The achievements of the Polish semiconductor sector will be presented by PAIH at the Semicon Taiwan trade fair at the national stand, **September 10-12, 2025**

The achievements of the Polish semiconductor sector will be presented by PAIH, Invest in Pomerania and the Pomeranian Special Economic Zone at the Semicon Europa trade fair, **November 18-21, 2025.**

Annual international meeting of semiconductor sector leaders in Sopot, organized by SEMI, under the patronage of Invest in Pomerania, **March 11-13, 2026**