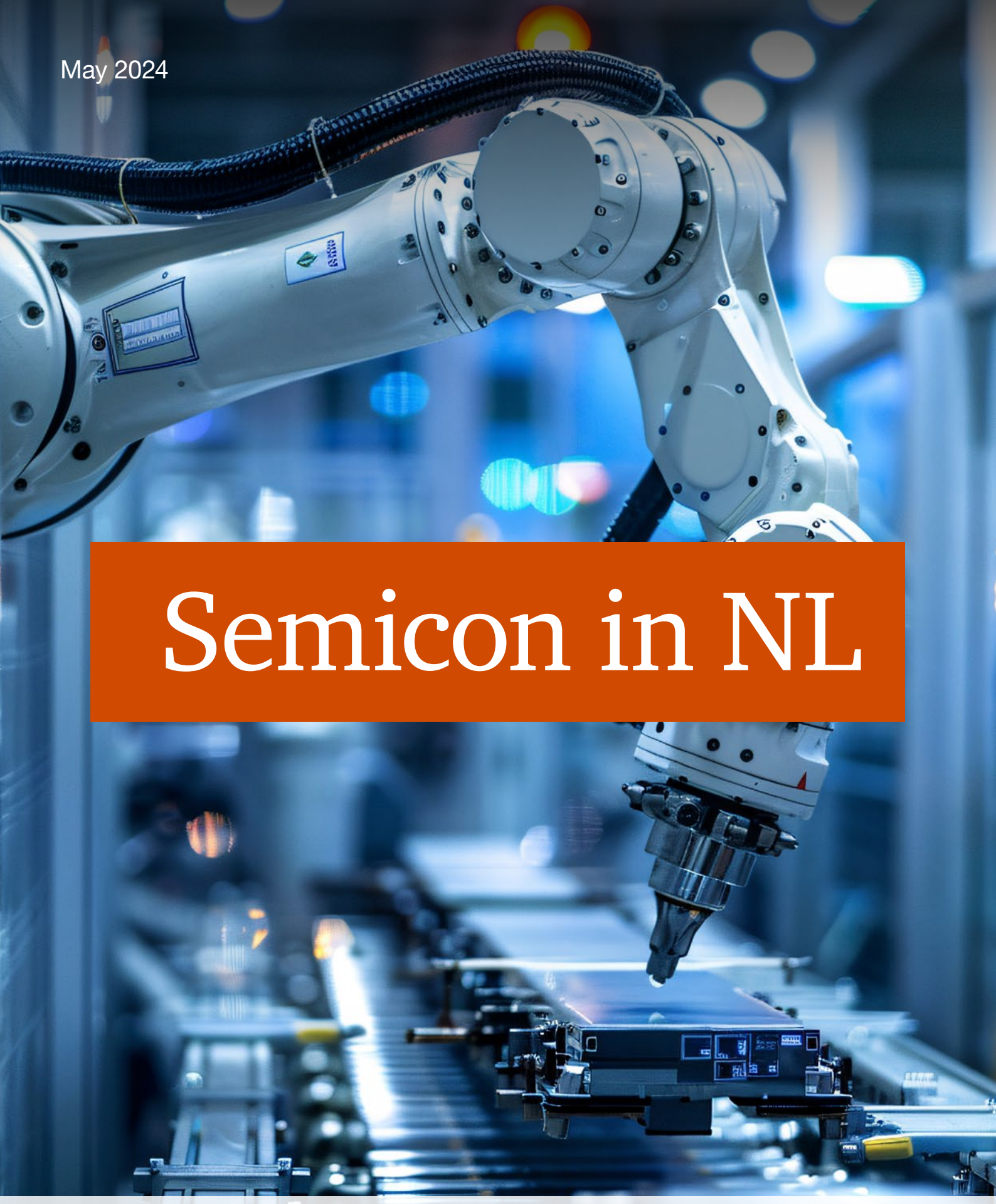
May 2024

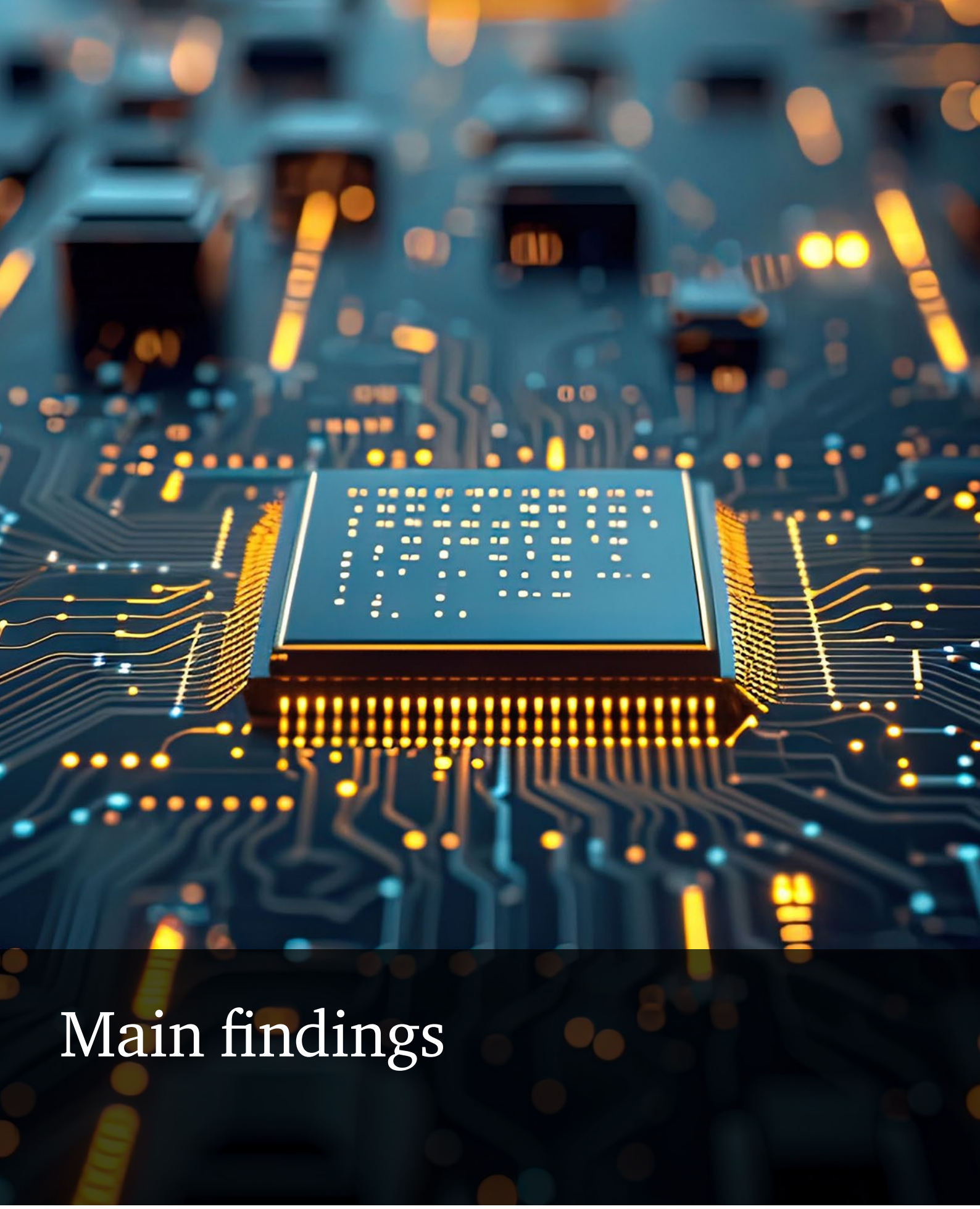


Semicon in NL

pwc

strategy&

Contents

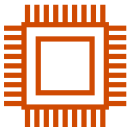


Main findings

The world is digitizing in an accelerated pace and chips are the building blocks of this digital world. The Netherlands plays an important role in the global semicon value chain that is at the heart of this digital transition. Backbone of this Dutch supremacy is the unique ecosystem of more than 300 companies that is built up through close collaboration and 'co-opetition' over more than 40 years and which cannot be copied easily. What connects many of these companies, is that they share the same 'DNA'. Many of them are direct or indirect spin-offs from the Dutch technology company Philips (e.g. ASML, ASM, NXP, VDL). As a result, many of the (senior) employees currently active in the Dutch semicon ecosystem share a way of working, characterized by close collaboration, longer-term partnerships, and give-and-take.

Currently this ecosystem employs around 60,000 jobs and generates close to €30 billion in revenue in the Netherlands. By housing a few crucial control points and frontrunning in specific technology, the Netherlands is punching above its weight in the global semicon value chain (in a way it fits into the list of areas in which the Netherlands excels internationally, like water management, agriculture and trade).

In this report we therefore focus on the Netherlands only, appreciating the strong global interdependencies of the semicon sector. The report sheds a light on the sector in the Netherlands in its full width, highlighting the key challenges and opportunities, in a geopolitical complex world. We have interviewed more than 40 decision makers in the Dutch semicon ecosystem to check the pulse of the industry, discuss the most pressing challenges they face, and explore promising opportunities they see. The report is further complemented by our extensive research and analyses of the evolution and contribution of the sector in the Netherlands. Key takeaways of our study entail:



Diverse ecosystem with many small(er) players: Besides the 'Big 5' (the five biggest global Dutch semicon players: ASML, ASM, NXP, Nexperia, Besi), there are more than 300 other players in the rich and diverse Dutch semicon ecosystem that represent 41% of total semicon revenue in the Netherlands, including many small companies (62% has a revenue of less than €10 million).

Leading role in three domains: The Netherlands has a leading role in the domain of Equipment (representing ~85% of the Dutch semicon workforce), Specialty Integrated Device Manufacturers (IDMs) (~5% of the Dutch semicon workforce) and Photonics (~2%[1] of the Dutch semicon workforce).

Semicon serves as a powerful 'halo' for other markets: The capabilities in semicon are very advanced (e.g., precision manufacturing of suppliers) and require state-of-the-art R&D and manufacturing capabilities. The high-end and advanced technology segment of some other adjacent markets (e.g., med-tech, defense, automotive and agri-tech) require similar high-precision manufacturing capabilities (including miniaturization/nanotechnology, vibration control, advanced metrology, extreme quality control). In addition, being a supplier of ASML serves as a unique and international quality trademark that serves as an entry ticket for new market opportunities. Hence, the exceptional capabilities and continuous innovation of semicon serve as a powerful 'halo' that offers significant potential for spillover effects to other markets. The strong growth and high margins of semicon can also fund such expansion.

Significant growth challenges are shrinking the halo: The Netherlands is facing major practical growth inhibitors including grid congestion, and a lack of space and talent. These constrains are already hampering suppliers in their growth (i.e., these Dutch suppliers are growing less fast than the markets in which they operate and are losing market share to foreign players). These growth constraints compel suppliers to make strategic decisions where to allocate their limited capacity, generally prioritizing semicon over other markets. As a result, suppliers are increasingly relying on semicon (supplier dependency increased from 28% to 38% over the last 4 years) and semicon is growing at the expense of related advanced (tech) sectors. Dutch suppliers are therefore not capitalizing on the potential spillover effects.

Lost (growth) opportunity: Not addressing these growth challenges in the Netherlands will further increase the dependency on semicon and erosion of the halo for Dutch suppliers. If suppliers would be able to grow with the market, this would result in additional cumulative revenues of up to €6 billion and €800 million cumulative R&D by 2030 (more than half is with companies below €200 million in revenue, which is striking). Other implications of a continued shift towards a monoculture entail not fully exploiting R&D synergies, reducing the effect of semicon as a steppingstone, decreasing (portfolio) resilience, and deteriorating the technological leadership of the Netherlands.

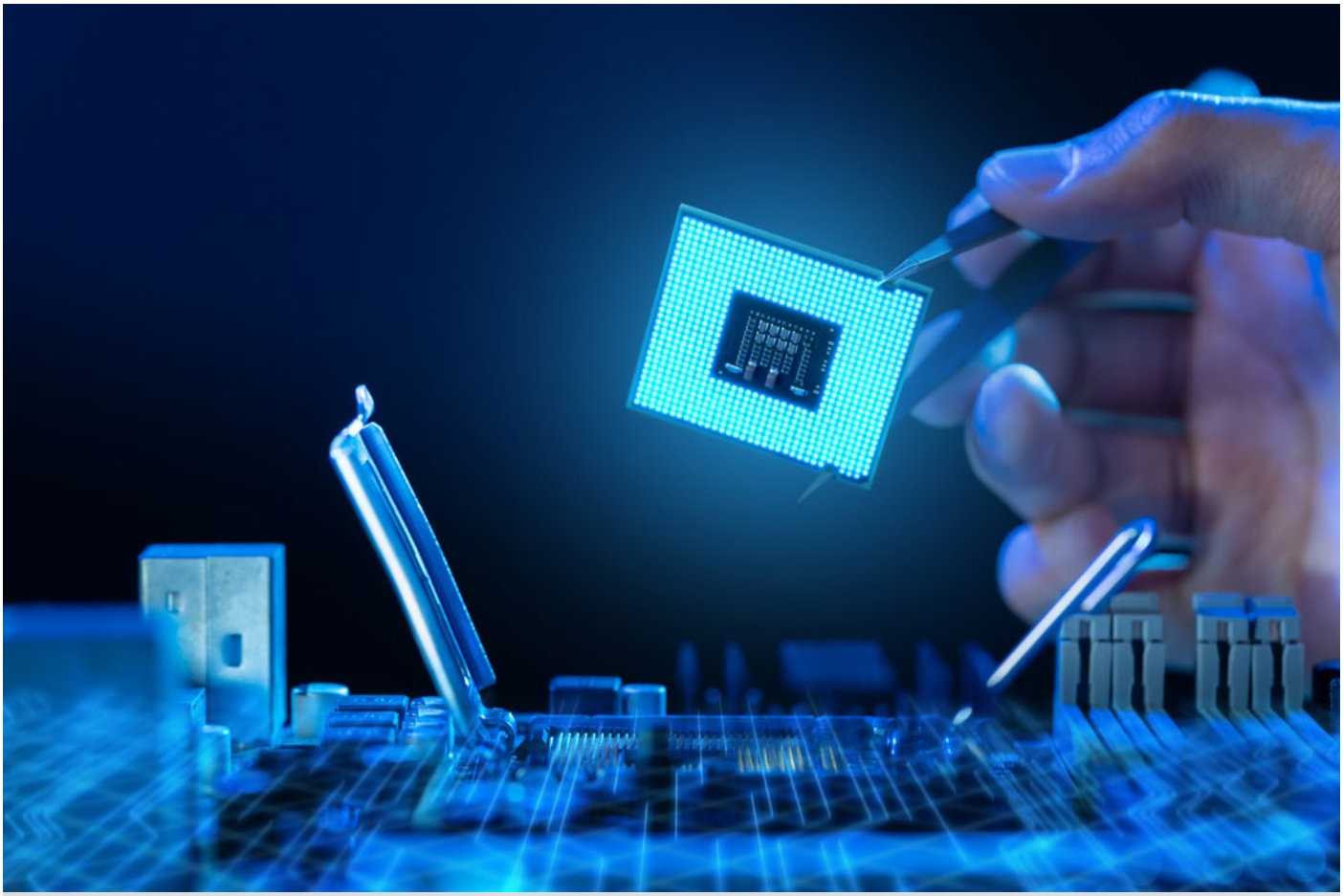
1 There is another ~8% in end-user applications, design and start-ups

Key factors for sustainable success and growth of semicon in the Netherlands: The semicon industry in the Netherlands has been thriving and is facing a bright future. However, maintaining the leading position in semicon and growing the halo of semicon is a challenge under current growth constraints. To foster sustainable success in the Netherlands, we see three major themes that need to be addressed:

1. *Create a stable and attractive business climate including critical infrastructure and access to power, space and talent.* Semicon has recently been labeled as a priority sector, however, this is not felt across the industry (this is particularly flagged by the midsized to smaller companies). Solving this requires a clear roadmap and action plan to address the most pressing and structural issues first (e.g., energy), and a better orchestrated coordination and effectuation of the semicon priority status across all touchpoints with the government and public institutions (e.g., permit application process).
2. *Maximize productivity within the existing constraints.* With growth and increased scale come opportunities for synergies. However, many companies struggle to realize these benefits. A company-wide effort to standardize, professionalize and re-think the current ways of working is paramount to unlock those scale benefits. Effectively embracing technologies (such as AI, IoT, and digital twins) in day-to-day operations may further increase the output within current resource constraints.
3. *Operate as one business.* The value chains in semicon are characterized by their complexity, multiple layers (tiers) and global nature. Minor and last-minute changes to demand and/or timing can create large fluctuations down the chain. Stop-and-go of production, especially for smaller players, results in ineffective use of resources. While steps have been taken to increase transparency and coordination, many suppliers are still facing unnecessary demand shocks. End-to-end value chain management could help to create a more stable and predictable demand pattern both downstream and upstream – the tight-nit network of the Dutch semicon ecosystem is a strong foundation to further build upon.

As the semiconductor industry is on the verge of a new wave of growth (with generative artificial intelligence (GenAI) as one of the growth contributors), these growth challenges become even more precarious. Hence, all parties involved must take action to unlock the full potential of the semicon ecosystem in the Netherlands. In today's fiercely competitive world, Dutch semiconductor companies need to prepare themselves to capitalize on this growth, while also weather the storms along the way.

In chapter 1 we first unpack the Dutch semicon ecosystem, highlighting the key Dutch semicon domains (and its crown jewels along the value chain). Additionally, chapter 1 reveals the richness of the Dutch sector, showcasing that it encompasses much more than 'just' a few global giants, and unveiling the key success factors of the unique supplier ecosystem. In chapter 2 we deep dive into the major growth challenges that the supplier ecosystem faces and their implications. Finally, in chapter 3 we present our view – as a call for action – on how each stakeholder can contribute to the sustainable growth and success of this unique industry in the Netherlands.



The growing importance of semicon

In an increasingly interconnected and technology-driven world, the importance of semiconductors as a foundational pillar of innovation cannot be overstated. Technological disruptive developments such as GenAI are further merging the digital and physical universes. Semicon is at the heart of these megatrends, unremittingly pushing the limits of connectivity, automation, and intelligence.

The application of, and hence demand for semiconductors is broadening, ranging from consumer electronics (phones and wearables), communications and connectivity (5G/6G, IoT), computing and data storage (data centers, cloud computing, AI), automotive (electric vehicles, autonomous driving), green energy (solar, wind power) and industrial electronics (power converters, industrial robots). Innovations across all these various sectors are driving the continuous demand for more, smaller, more powerful, and more energy efficient chips. Given its strategic value, semiconductors have essentially become the 'oil' of the 21st century and, as an unintended consequence subject to increasing geopolitical tensions.

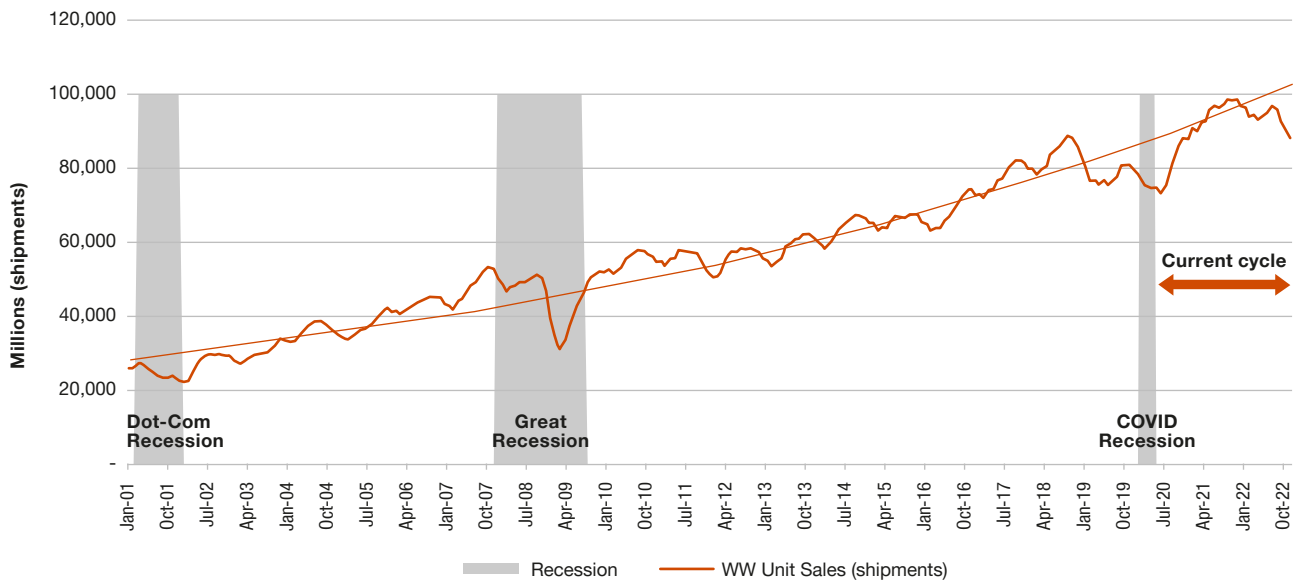
Figure 1 Key semicon end-markets

The dynamic nature of semicon

The semiconductor industry is characterized by its dynamic nature as it is subject to various fluctuations, both temporary and structural. New developments and technology shifts in end products trigger waves of demand. Geopolitical factors also contribute to disrupted value chains. Additionally, the industry experiences 'normal' cyclicity by the supply and demand of its end products. In parallel, the sector is characterized by a continuous search for balance between supply and demand (due to the capital intensity and high innovation pace of the industry), creating a typical pig cycle.

The chart below shows some of the major shocks and waves of this millennium. The Covid-19 pandemic changed the way we live, work and communicate, accelerating demand and leading to a dramatic upturn after an initial dip (eventually normalizing to the expected trend). In addition, global supply chain disruptions, geopolitical tensions (triggering trade restrictions and "friendshoring"), and the current hyper growth in GenAI are posing new challenges for the industry. The industry recently experienced a significant downward trend that started in 2022 due to inflation, macroeconomic uncertainty, geopolitical unrest and supply chain disruptions.

Figure 2 Despite short-term shocks and cyclical downturns, the semicon market shows a strong trajectory and outlook



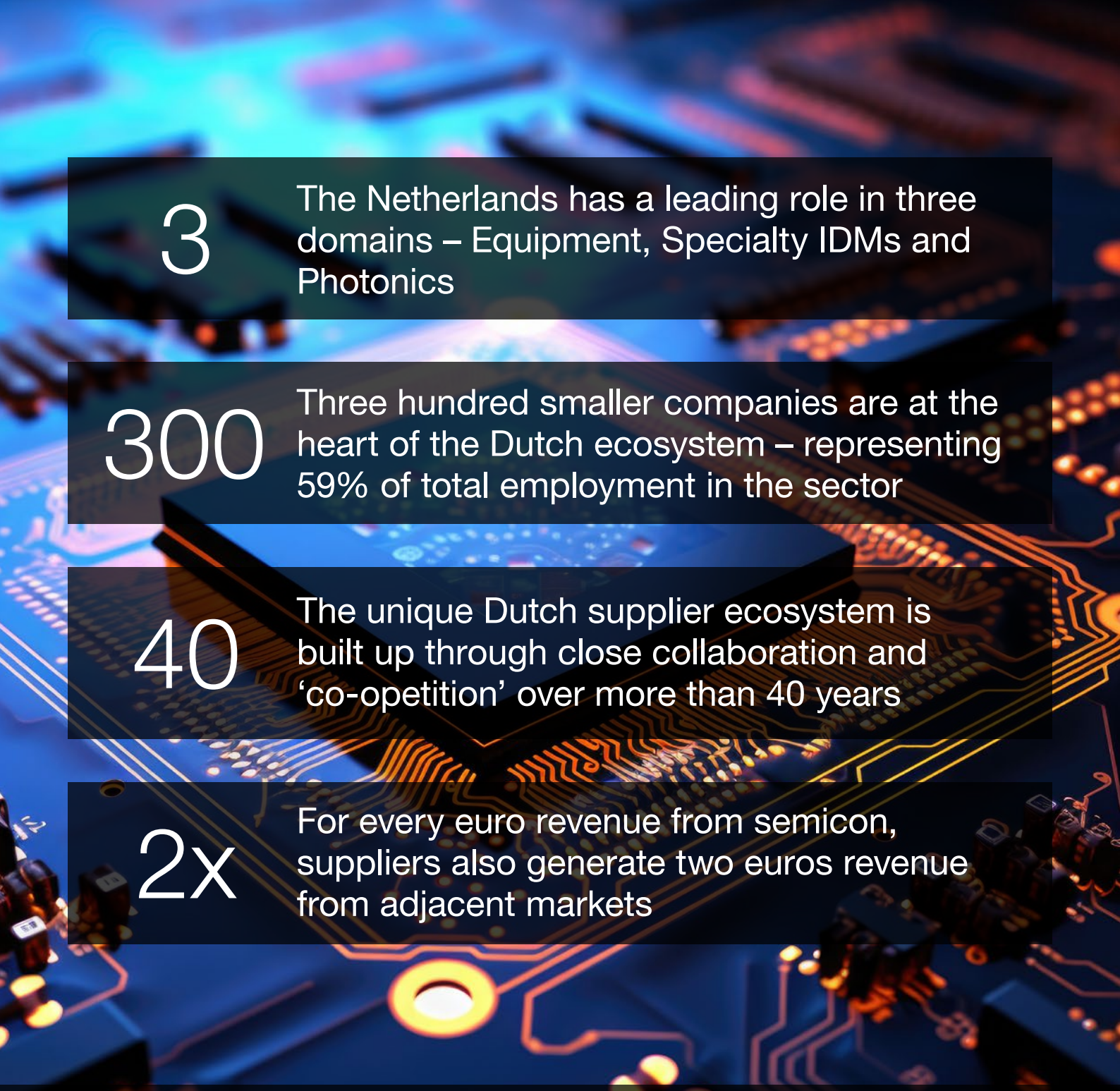
Note: Worldwide Semicon Unit Shipments 3 month moving average January 2001 - November 2022

Source: Semiconductor Industry Association (SIA) and World Semiconductor Trade Statistics (WSTS)

Despite the shocks and short-term cyclical downturns, the semicon market has been growing and it's long-term outlook is strong. Currently, the demand for GenAI is one of the key growth drivers in semicon, but other semicon segments are also showing improvement. The unique aspect of the AI trend is that it is concept-based rather than product-based (previous growth waves were related to e.g. laptops and smartphones), impacting multiple industries and products. As a result, AI semiconductor revenue is expected to continue experiencing double-digit growth, doubling the size of the 2023-market by 2027, reaching €100+ billion.[1]

As reflected in the graph above, semicon is also prone to shocks and stop-and-go, just like many other industries such as automotive. However, despite these stop-and-go dynamics, semicon's overall strong trajectory requires continuous investment and growth from semicon companies to stay relevent.

1 Omdia, PwC Strategy& analysis



3 The Netherlands has a leading role in three domains – Equipment, Specialty IDMs and Photonics

300 Three hundred smaller companies are at the heart of the Dutch ecosystem – representing 59% of total employment in the sector

40 The unique Dutch supplier ecosystem is built up through close collaboration and ‘co-opetition’ over more than 40 years

2x For every euro revenue from semicon, suppliers also generate two euros revenue from adjacent markets

1. The leading global position of the Netherlands

1.1 The Netherlands has a leading role in three domains

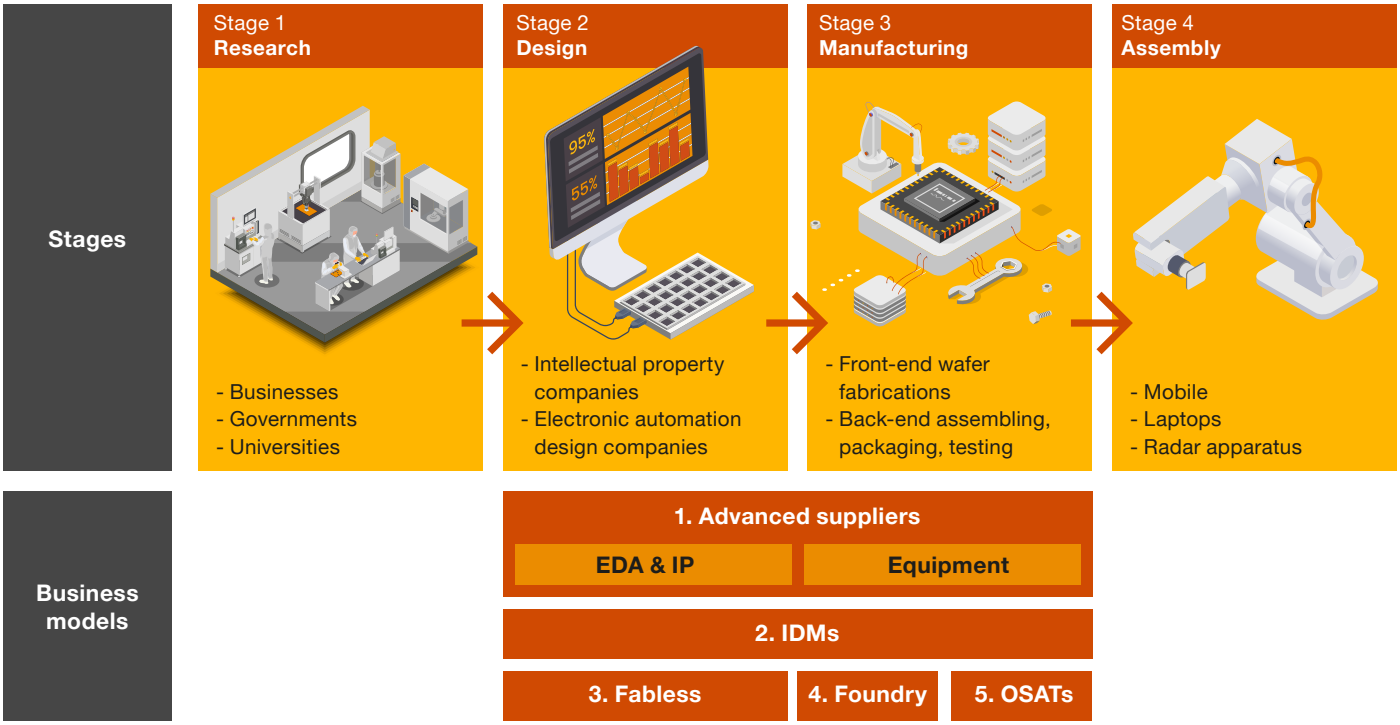
The value chain includes many stages and most companies in the value chain are highly specialized

The semiconductor value chain is multidimensional and includes many stages. Simplified, there are four main stages: research, design, manufacturing (split into front-end and back-end manufacturing) and assembly (see Figure 3).

The semiconductor industry's landscape is shaped by the specialized and capital-heavy nature of its production processes. In pursuit of economic efficiency most companies choose to specialize in particular process (sub)steps. Broadly, the industry distinguishes five primary business models:

1. **Advanced suppliers**, including vendors of specialty equipment (Equipment), EDA (Electronic Design Automation) & IP, and materials
2. **Integrated device manufacturers (IDMs)** are involved in nearly all aspects of the production process (from design to manufacturing)
3. **Fabless** firms focus exclusively on the design of chips
4. **Foundries** (or Fabs) specialize in the manufacturing phase (the go-to for chip manufacturing)
5. **Outsourced Assembly and Testing (OSAT)** companies take charge of the back-end manufacturing

Figure 3 Global semicon value chain and five main types of business models



Source: RaboResearch

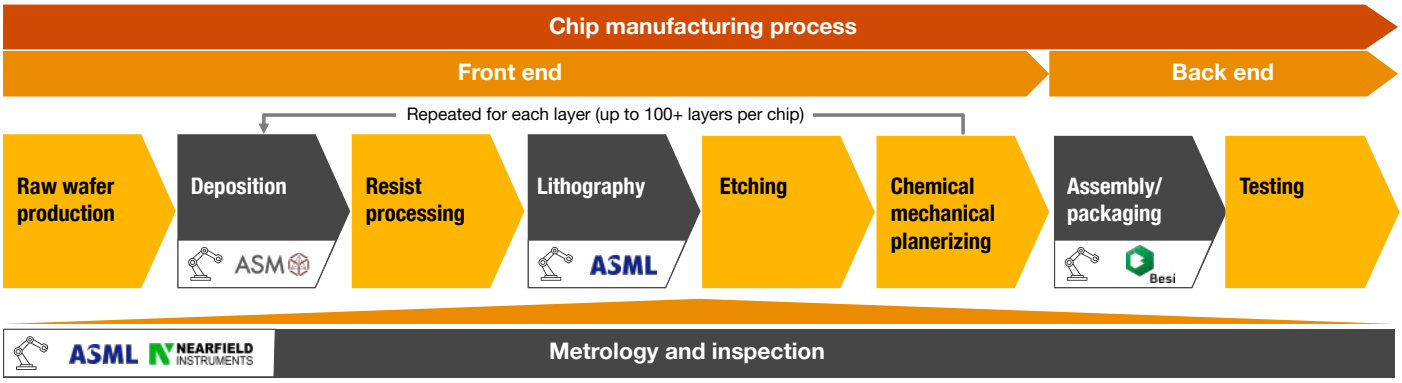
While no country / region has the entire end-to-end production in its own territory, the value chain is highly concentrated and defined by only a few markets (Taiwan, South Korea, Japan, US, Europe and China). The majority of the Fabless segment (chip design) is located in the US. Manufacturing has shifted to Asia (although the US and Europe now aspire to re-establish their sovereignty in chip production), currently representing 80% of front-end production and over 90% of back-end manufacturing.

The Netherlands has a leading role in three domains

The Dutch semicon industry has unique knowhow and control points within the global value chain and has a leading role in three domains. The first domain is specialty equipment ('Equipment'), part of business model one (advanced suppliers). The second domain relates to business model two and entails 'specialty IDMs' - IDMs focussed on special application domains (for example Ampleon is market leader in Radio Frequency power). The third domain relates to the emerging photonics technology ('Photonics'). Each domain also has a few 'crown jewels', including the Big 5 (ASML, ASM, NXP, Nexperia, Besi).

1. **Equipment (representing ~85% of workforce)**: The Netherlands is home to a thriving semiconductor equipment manufacturing sector, which plays a pivotal role in the global technology landscape. The Dutch expertise in high-precision engineering, significant investments in research and development, and an attractive climate for skilled talent contribute to the country's special status in this field. Notably, its capabilities in terms of 'photolithography' (ASML), 'atomic layer deposition' (ASM), 'metrology' (ASML and Nearfield), and 'packaging' (Besi) stand out as world leading – see Figure 4 for the positioning of these steps in the manufacturing process. The Equipment segment is the most important in the Dutch semiconductor ecosystem (based on earnings capacity and FTE).
2. **Specialty IDMs (representing ~5% of workforce)**: The Netherlands also houses multiple specialty IDMs with world-class capabilities, a strong global presence, and a reputation for innovation (although majority of their production footprint is outside of the Netherlands). These IDMs design, manufacture and sell integrated circuit products that have special capabilities and are essential for certain industries. For example, NXP is known for its high-performance mixed-signal electronics that play a critical role in the automotive and secure connectivity markets, and power semiconductors crucial for the energy transition and e-mobility. Nexperia is a leading expert in the high-volume production of basic analog and logic chips for the automotive industry. Ampleon is a leading global manufacturer of radiofrequency products.
3. **Photonics (representing ~2% of workforce[1])**: The Netherlands is a frontrunner in (integrated) photonics. Photonic chips use light signals, photons (instead of electrons), on a nanoscale to pass on information, and are quicker and more energy efficient than electronic chips. Hence, a lot is expected from this technology and many countries are doubling down on it. However, currently it is still a small emerging market, and it is unclear which variants and applications the market will embrace. The industry currently distinguishes three major photonics platforms, with different base materials and complementary characteristics and features (Indium Phosphide (InP), Silicon Nitride (SiN) and Silicon Photonics (SiPh)). In terms of applications, photonic chips are expected to be used in different kind of sensors (Lidar), in the communications industry (datacom and telecom), in biosensing (healthcare & agrifood), and in the automotive industry.[2] The Dutch photonics ecosystem currently houses the end-to-end value chain, from design to small-scale production, assembly, testing and packaging. The Netherlands is frontrunner in two of the three platforms: InP, with SMART Photonics, and SiN, with Lionix.

Figure 4 Simplified overview of chip manufacturing process and role of major Dutch Equipment companies



Source: CSET 2021

1 There is another ~8% in end-user applications, design and start-ups
2 PhotonDelta

Crown jewels

Equipment

Current status

- **ASML** is the world's exclusive maker of cutting-edge chip equipment, known as the extreme ultraviolet (EUV) lithography machines – enabling production of the most advanced semiconductors with node sizes of only a few nanometers (the newest High-NA EUV technology is shaping the future of sub 2 nanometer chips), making it one of the most crucial control points in the global chip industry. In addition, ASML is a key supplier of adjacent process technologies such as metrology equipment.
- **ASM** specializes in semiconductor wafer processing equipment and is a leading provider of Atomic Layer Deposition (ALD) systems. Their expertise in ALD plays a vital role in the front-end manufacturing process.
- **Besi** is a leading supplier of back-end equipment for leadframe, substrate, and wafer level packing applications. Besi is in the forefront of innovation in die-to-wafer hybrid bonding (advanced packaging), a technology to stack and bond different chips that is critical to the next generation of chips.
- **The Dutch Equipment supplier ecosystem** is renowned worldwide for its excellence. It comprises a cluster of diverse small and large suppliers, offering a wide range of high-end advanced precision manufacturing capabilities (covering all domains, including mechatronics, optics, and lasers).

Outlook

- The Equipment ecosystem is expected to benefit from the anticipated growth and new investments in the semicon industry towards 2030 (for example the building of new foundries in view of ongoing reshoring efforts will boost demand for new equipment).
- ASML's 'installed-based-service business' will benefit from the growing installed machine base across the world and the increased demand for upgrades of existing machines (ASML has already sold over 5000 devices since 1984 and more than 90% of this installed machine base is still in operation). In parallel, there is an opportunity for ASML's suppliers to benefit from ASML's efforts to localize its repair and service business. Increasing geopolitical tension and export restrictions could impact ASML's growth trajectory.
- ASM is also expected to benefit from the anticipated growth and new fab investments towards 2030. It is well placed to support its leading logic/foundry customers in the upcoming transition to the most advanced chips with an upgraded 'gate-all-around' (GAA) transistor structure. Next-generation semicon devices are increasingly enabled by complex 3D architectures and new materials, playing to ASM's strengths.
- Besi is very well-positioned in die-to-wafer hybrid bonding and heterogenous integration. Heterogeneous integration in semicon refers to the process of combining different types of semiconductor materials, devices, or technologies onto a single chip or package (into 2.5D or 3D chiplets). This integration allows the combination of chips to function as a single product. While the demand for transistors in applications such as high-performance computing and artificial intelligence continues to grow exponentially, the ability to shrink transistors is getting more difficult and expensive (the industry's view on the continuity of 'Moore's Law' is divided). Heterogeneous integration addresses this challenge by providing a solution to improve chip performance, power efficiency, cost, and time to market.

Specialty IDMs

Current status

- **NXP** generated over 50% of its revenues in 2022 from the automotive market and ~20% from industrial and internet of things (IoT) applications. NXP is also strong in communication infrastructure (including security and authentication) and mobile markets.
- **Nexperia** is a global leader in Discretes, Logic, and MOSFETs devices. They address power efficiency, protection and filtering and miniaturization trends. Nexperia is a leader in the automotive sector, serving a global customer base and shipping over 100 billion products annually. Nexperia is an NXP spin-off.
- **Ampleon** is a leading global partner in RF (radio frequency) power, offering a broad portfolio of LDMOS and GaN (gallium nitride) technologies. The company is active in market segments such as wireless infrastructure (4G LTE and 5G NR), navigation and safety radio, broadcast, and industrial, scientific and medical. Ampleon is an NXP spin-off.

Outlook

- Key growth drivers for these specialty IDMs in the Netherlands are IoT, security, enhanced telecommunications (5G and 6G), EV and autonomous driving, and green tech.
- NXP is well positioned through its strategic choice to focus on more advanced chips with product groups that are focused on four end-markets that are characterized by long-term growth opportunities: (1) automotive (with autonomous driving, electrification and the 'service-oriented' car), (2) industrial & IoT (driven by demand of smart, energy-saving and connected electronic equipment using various sensors, processors, connectivity, analog and security chipsets that align well with NXP's ability to provide a complete range of processing, connectivity and secure solutions), (3) mobile (leveraging NXP's focus on mobile wallet, Ultra-Wideband (UWB) and specialty custom analog solutions), and (4) communication infrastructure (transition to 5G networks and cloudification, and increased demand for secure edge identification solutions). NXP differentiates itself in these markets through its technology leadership.
- Nexperia is expected to benefit from growth in key segments including automotive and industrial. Megatrends such as digitization and electrification will continue to support demand of Nexperia's products (particularly Power Discretes). Likewise, as one of the key RF semicon manufacturers, Ampleon is well positioned to benefit from the steady growth of the RF power semiconductor market and the increasing demand for wireless communication technologies.

Photonics

Current status

- **Smart Photonics** is a fast-growing pure-play foundry in the production of photonics chips with Indium Phosphide (InP) as the semiconductor material basis. It is one of the biggest companies in Europe that can produce photonic chips upon request.
- **LioniX** is a leading global provider of customized microsystem solutions, particularly integrated photonics-based, in scalable production volumes. They focus on developing new technology for communication, sensing and biophotonics applications. LioniX's TriPleX technology is based on Silicon Nitride (SiN), allowing the creation of high-performance photonic integrated circuits.
- **PHIX** is a world leading packaging and assembly foundry for photonic integrated circuits. They build optoelectronic modules based on all major technology platforms (InP, SiN, SiPh) in scalable manufacturing volumes.
- **The Dutch photonics ecosystem** is an emerging cluster of around 50 companies, ranging from small start-ups to SMEs, supported by state-of-the-art R&D and industry associations.

Outlook

- Photonics is currently still a small and emerging market. However, demand is expected to accelerate within the next three to five years (but industry-wide adoption will ultimately depend on the cost, scalability, and use-cases).
- Photonic chips could help create smaller, faster and more energy efficient devices. Global data usage will drastically increase with the rise of IoT and GenAI, putting pressure on energy consumption. Energy-efficient photonic chips can therefore play a major role in reducing the energy impact of these technologies (and limit the impact on the climate). In addition, the strong sensor capability of photonic chips could drive new innovations and improvements across the health, automotive and agriculture industry.
- Heterogeneous integration of electronic chips and photonic chips is an example where photonics could help push the boundaries of chip capabilities and performance.
- The Dutch government has designated photonics as a 'strategic technology' and there are public-private initiatives to invest more than €1 billion to try and keep this technology in the Netherlands.

1.2 Three hundred smaller companies are at the heart of the Dutch semicon ecosystem

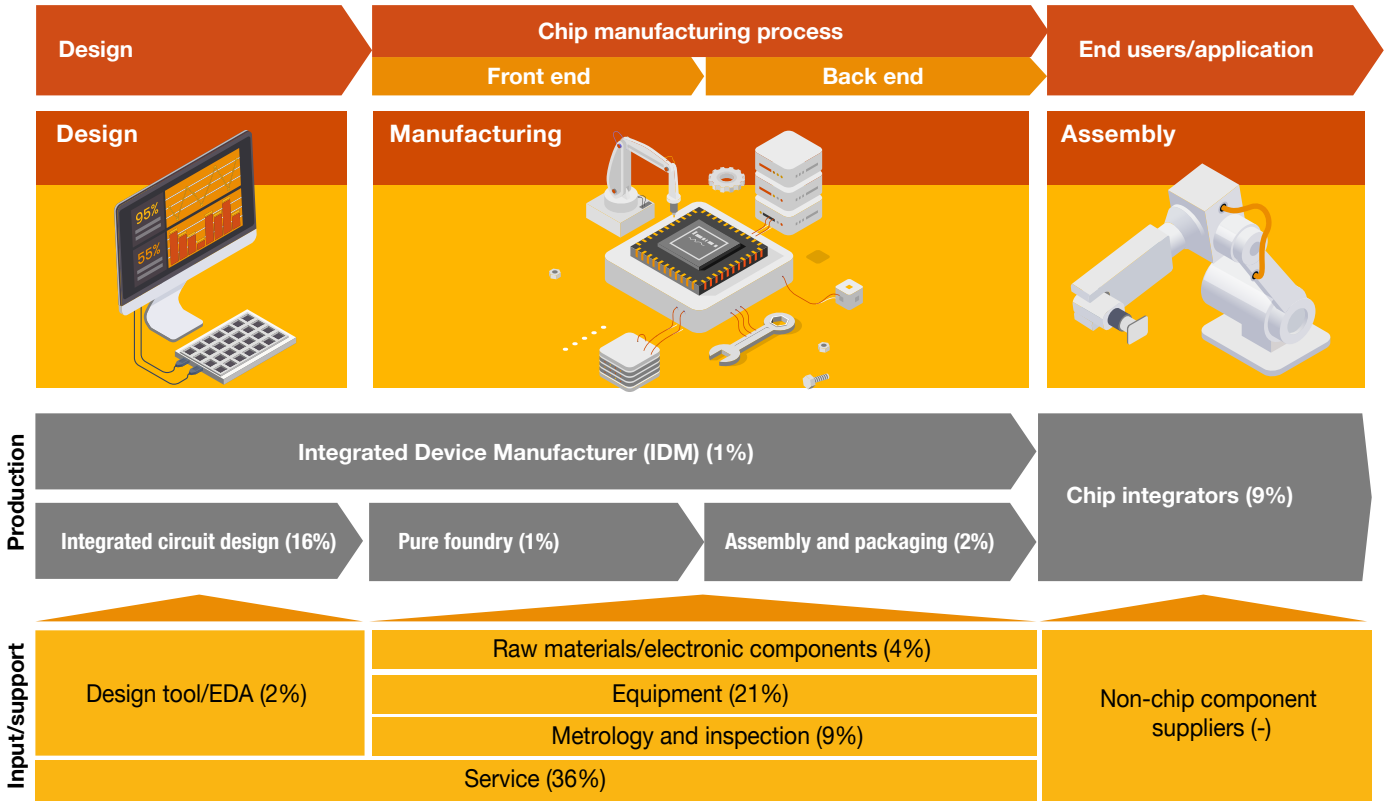
A world-class ecosystem

The leading position of these three domains (Equipment, Specialty IDMs and Photonics) in the global value chain is co-enabled by a broader ecosystem with a good mix of:

1. Dutch original equipment manufacturers (OEMs) and suppliers driving quality and high productivity (e.g. Prodrive Technologies, Neways, NTS)
2. Superior knowledge institutions driving R&D and talent (e.g. TNO, and technical universities in Eindhoven, Twente and Delft)
3. Promising start-ups and incubator vehicles driving disruption and sharp innovation (e.g. Axelera AI and HightechXL)
4. This ecosystem is further supported by important industry associations such as Brainport, High Tech NL and PhotonDelta

The Dutch semicon value chain contains more than 300 companies spread across the value chain – mapped below in Figure 5. Without all these (many smaller) players, the ecosystem would stutter and potentially slow down. Hence this diverse mix needs to be given sufficient breathing room and support to prosper.

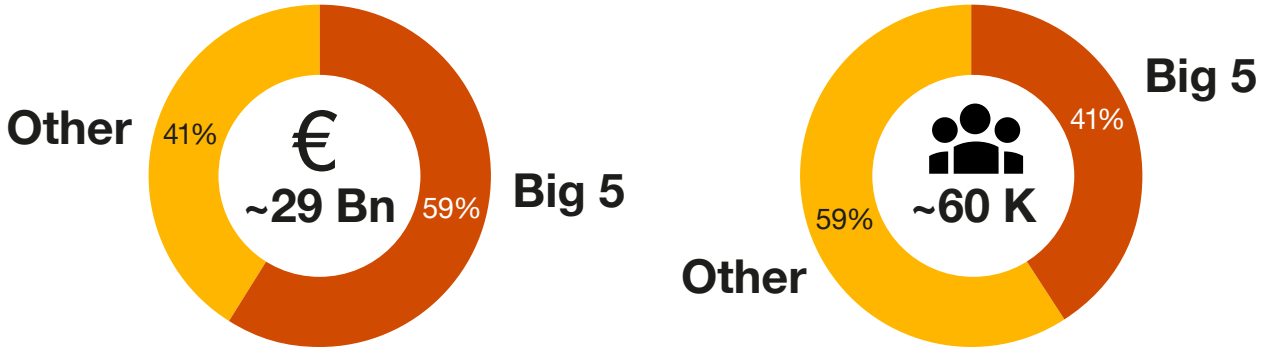
Figure 5 Mapping of Dutch companies in the semiconductor value chain (% representing the share of total, in terms of number of semicon companies the Netherlands)[1]



Source: PwC Strategy& analysis

1 RVO

Figure 6 Total revenue and FTE of the Dutch semicon industry in the Netherlands

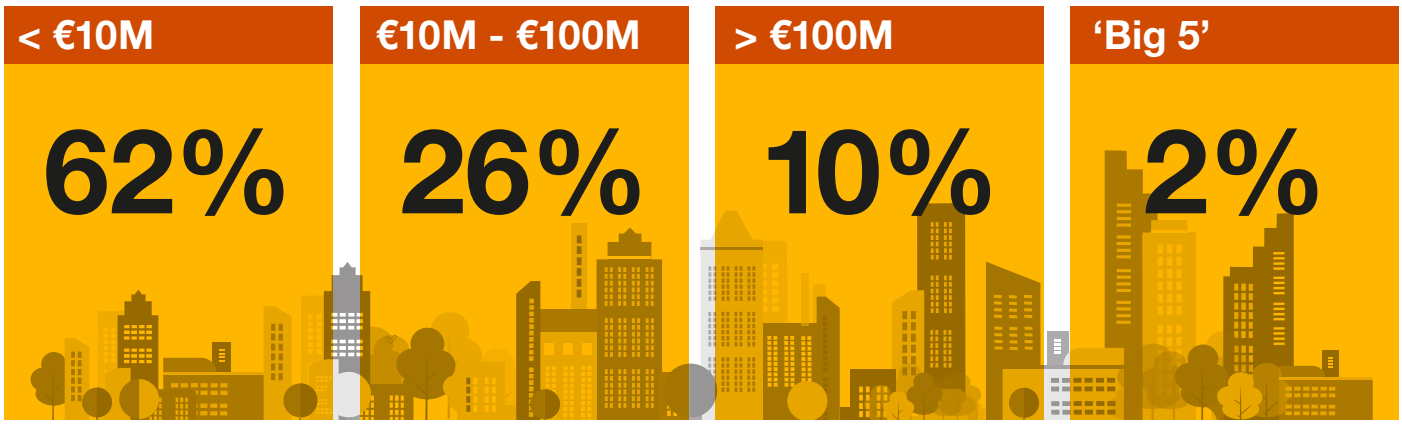


Source: PwC Strategy& analysis

In total, the size of the Dutch semicon market currently amounts to €29 billion in revenue and employs around 60,000 FTE. The Big 5 represents 59% of the total Dutch revenue and 41% of the total FTEs. Employment in the period from 2017 to 2022 in the Dutch semiconductor sector nearly doubled, growing six times faster than general employment trends.

The rest of the Dutch ecosystem (i.e., non-Big-5 companies), represent 41% of Dutch semicon revenue. As Figure 7 shows, this group consists of a striking 62% small companies with revenue less than €10 million, another 26% of mid-sized companies with revenue up to €100 million, and only 10% larger companies with revenue of more than €100 million.

Figure 7 Reflecting four clusters of companies in the Dutch semicon ecosystem (in terms of revenue size), and their share (%) of total in terms of numbers of Dutch semicon companies in the eocystem.

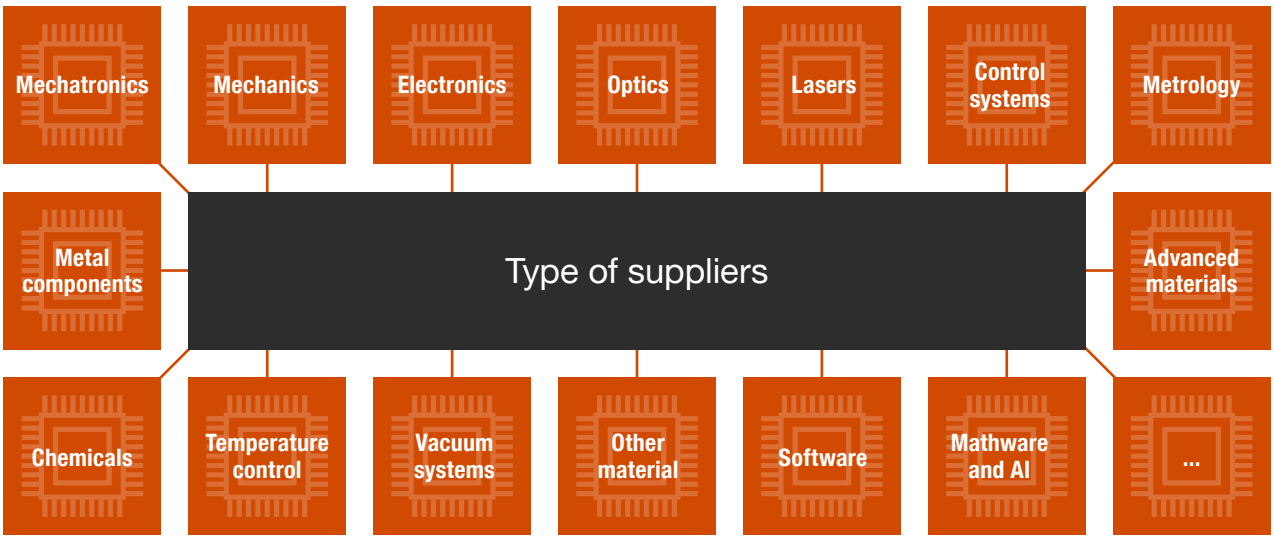


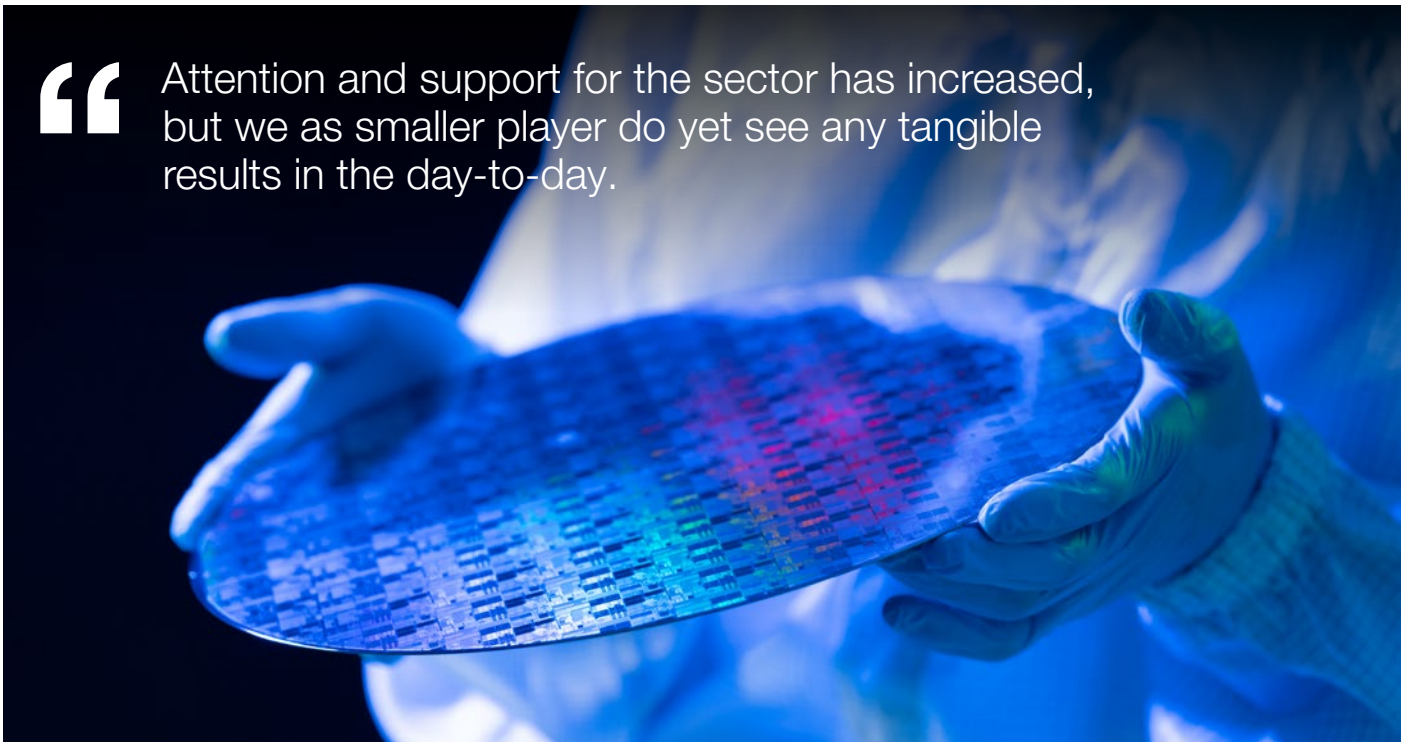
A cluster of suppliers with special advanced capabilities

The Netherlands is home to a fascinating mix of type of suppliers with special precision manufacturing capabilities. This group consists of both small and large suppliers, ranging from a few million euros to more than €500 million in revenue. Their capabilities are world-class, highly specialized, and very diverse (indicated by Figure 8). These high-end capabilities position suppliers to work for multiple markets with similar expectations (high-value and high-end precision manufacturing).

This cluster is also attracting external investors and private equity, with the emergence of groups and holdings to combine capabilities and fund the next wave of growth.

Figure 8 Different type of suppliers (non-exhaustive)





1.3 The unique Dutch supplier ecosystem is built up through close collaboration and 'co-opetition' over more than 40 years

The Dutch supplier ecosystem is unique and has been built up through close collaboration and 'co-opetition' over more than forty years, which cannot be copied easily. In our interviews we have identified the following four success factors: (1) long-standing collaboration and sharing of the same DNA, (2) outsourcing based on a co-opetition model, (3) a drive for continuous improvement, and (4) long-term partnerships and stability. These success factors, however, should not be taken for granted as new developments (e.g., the entrance of new stakeholders, and persisting practical growth inhibitors) are putting pressure on this ecosystem. It will take hard work to maintain and foster this rich and cohesive network of suppliers going forward.

Long-standing collaboration and shared DNA

What connects many of the companies in the Dutch semicon ecosystem is that they share the same DNA. Many of them are direct or indirect spin-offs from the Dutch technology company Philips (e.g., ASML, ASM, NXP, VDL). As a result, large part of the (senior) employees currently active in the Dutch semicon ecosystem are legacy Philips people. This group of people share a way of working, characterized by close collaboration, longer-term partnerships, high-pace innovation, and give-and-take.

The majority of all the Dutch suppliers are already working together for many decades. This has created a unique and cohesive ecosystem that serves as one of the most critical pillars of the success of the Dutch semicon industry.

Co-opetition model

Historically, before the success of EUV, ASML already relied heavily on specialist suppliers (this was also a necessity due to its capital restraints back then). Currently, ASMLs EUV machines are even more complex and comprise more than 100,000 parts. ASML produces only 15% of components for an EUV machine itself, outsourcing 85%. Overall, it relies on a broad global network of around 800 suppliers for the EUV machine only (and around 5,000 partners and suppliers in total), of which ASML leverages many suppliers in proximity in the Netherlands.

Foundation of the innovative supplier ecosystem is strong collaboration and outsourcing based on a 'co-opetition' model: collaborating with suppliers (based on a culture of trust and transparency) but promoting competitive elements among suppliers to maintain a drive for excellence, value creation and cost-efficiency. This close and long-term collaboration has led to a world-class ecosystem of suppliers with very high standards, exceptional capabilities, and state of the art technologies.

Due to increased complexity and high standards, ASML is also creating strategic partnerships with critical suppliers through single sourcing, creating a mutual dependency.

In addition, in order to streamline the supply chain, ASML is increasingly delegating end-to-end operational responsibilities to its tier-1 suppliers, while still retaining strategic control over supplier selection for tier 2 and tier 3. For tier-1 suppliers this creates a complex stakeholder landscape to navigate, monitor and manage.

This thriving ecosystem has been built up over forty years through goodwill, close collaboration, and mutual support in times of need, and the search for win-win opportunities. However, new generations are taking over, and new investors (including Private Equity) are stepping in. These 'newcomers' may not share the same legacy and could bring a more 'at-arms-length' mindset to the table. This could put pressure on the current (informal) dynamics, pricing, and partnerships.

Continuous improvement

Companies like ASML keep tightening their demands on suppliers based on QLTC targets (Quality, Logistics, Technology, Costs), striving for continuous improvement, and further increasing the barriers to entry. ASML is also asking for more transparency of supplier's costs and way of working. More recently, sustainability has been added as a key supplier criterion as semiconductor companies are focusing on their suppliers' emissions (scope 3 of the Corporate Sustainability Reporting Directive focuses on the emissions in the wider value chain).

This sustainability trend, combined with the growing base of installed machines, also results into an increased demand for repairs and spare parts. This puts additional pressure on the regular cadence of the production supply chain. ASML and suppliers need to up their supply chain capabilities and establish a dedicated and flexible model for this re-use / repair business.

While these tightening demands keep elevating the entire ecosystem, it asks continuous improvement and professionalizing of its suppliers, enhancing of (ESG) compliance, and not least of all, heavy investing (including new machines, technology, advanced clean rooms, and talent).

Stability is the critical enabler for R&D of smaller companies

Semicon R&D in the Netherlands consist of both direct R&D investments (by larger semicon companies) and specialty R&D (contract R&D and innovation with partners). Longstanding relationships form the basis for the ability to invest and innovate together. This also enables smaller companies to innovate and invest. The extremely high expectations and standards in semicon push the entire set of players to a unique league, making it difficult for new players to replicate. Semicon is one of the most R&D intensive industries, spending around 13% of revenue on R&D.

In addition, R&D cycles within the semiconductor industry can be very long (sometimes extending beyond ten years). Semicon companies and suppliers are therefore teaming up, collaborating in conducting research and co-creating new products and innovations (ASML's EUV machine is also a product of such close collaboration with, and investments by Intel, Samsung and TSMC; taking seventeen years and spending about USD 7 billion).

In 2023, The Netherlands ranked seventh in innovation globally and is considered an innovation leader in the EU.[1] Much of this success can be attributed to the public-private partnerships and collaborative ecosystems in which the high-tech manufacturing industry plays a crucial role. Many of these companies are located or active in the high-tech industrial clusters in the south of the Netherlands. Brainport Eindhoven, which is at the heart of this cluster, is a region where knowledge institutions, universities, start-ups, high-tech manufacturing companies and the government collaborate to foster innovation – a true example of the triple-helix model of innovation.

Looking at R&D investments and share of Dutch patent applications, semicon is a genuine innovation engine in the Netherlands. It represents almost a third (32%) of total R&D investments and almost half (47%) of all Dutch patent applications (see Figure 9 and 10).

Key requirements for R&D investments are availability of talent in terms of quality, availability of talent in terms of quantity, and quality of research at universities.[2] As R&D investments clearly follow semiconductor talent, for the Netherlands to foster its innovative climate (which is a magnet and catalyst for the broader semicon ecosystem), it needs to secure and retain access to brainpower and human capital.

> "The majority of all the Dutch suppliers are already working together for many decades. This has created a unique and cohesive ecosystem that serves as one of the most critical pillars of the success of the Dutch semicon industry.

Figure 10 Share of Dutch patent applications to the European Patent Office by industry in 2020

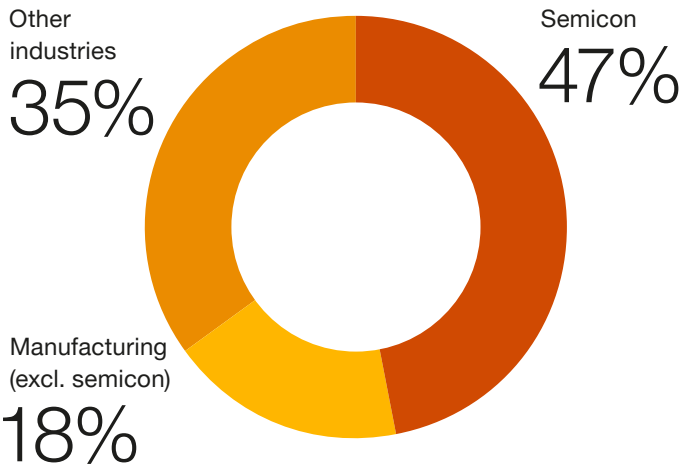
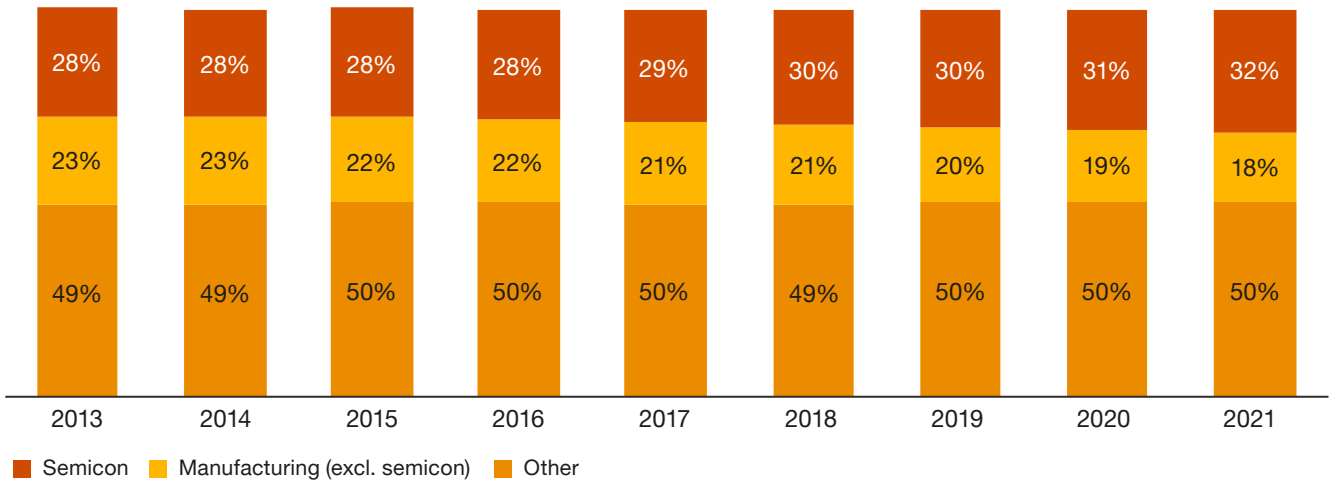


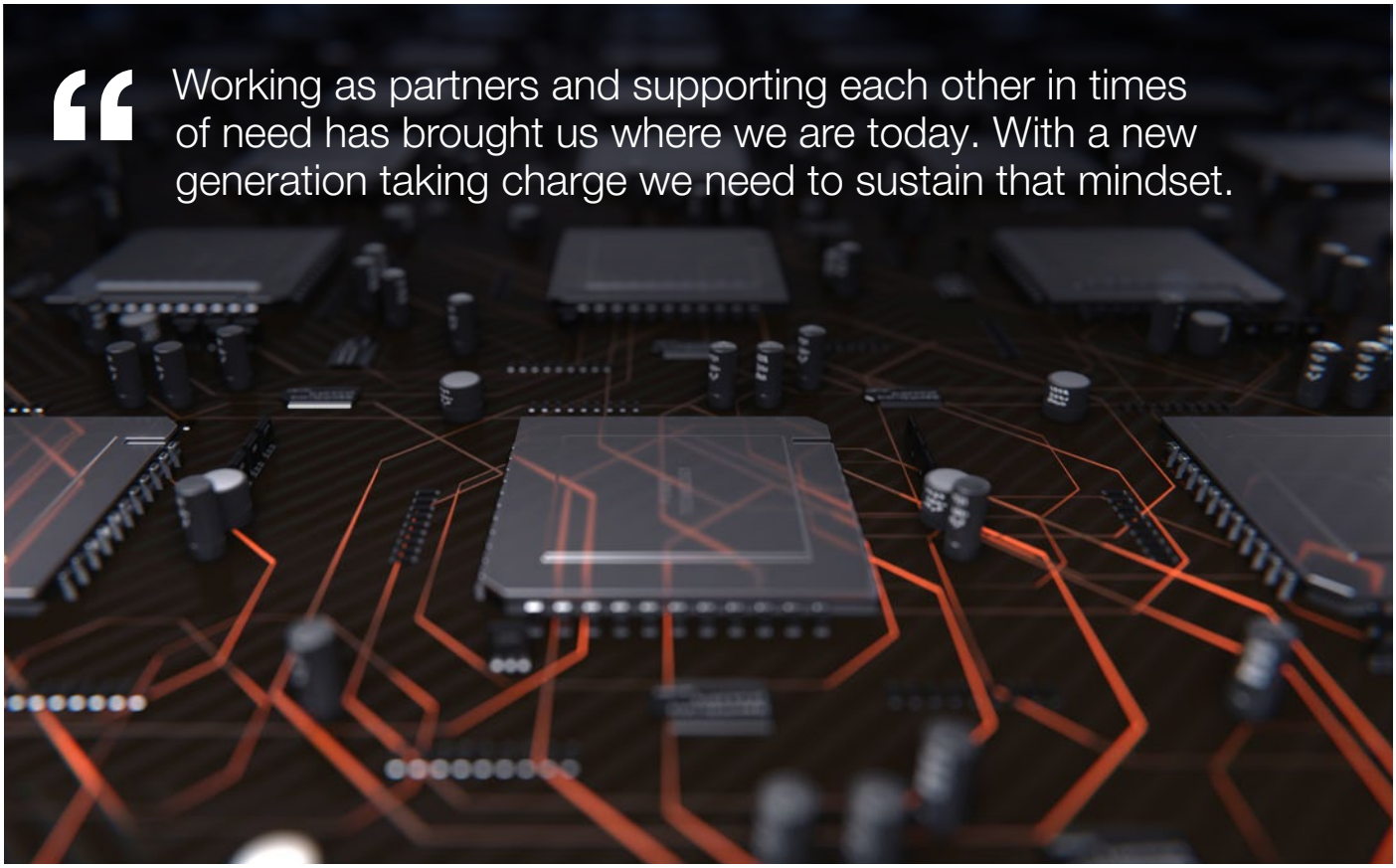
Figure 9 R&D investment by industry in the Netherlands



Source: CBS, OECD and PwC Strategy& analysis

1 NFIA (2023)
2 VNO-NCW R&D Barometer 2023

Figure 11 Key criteria for R&D investment climate

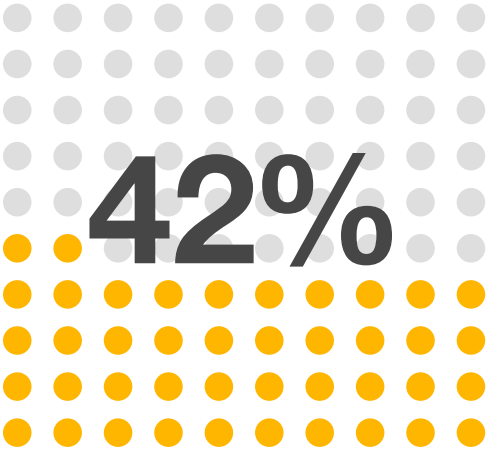


1.4 Semicon as an accelerator

Semicon's strong growth and exceptional capabilities offer many opportunities, even for smaller companies. It can be used as growth accelerator, steppingstone to expand internationally, and can be capitalized on to grow in adjacent markets. What is particularly remarkable about this industry, is its capacity to offer relatively small companies the opportunity to expand globally (beyond Europe).

Growth engine

Semicon serves as a step-up opportunity for Dutch companies to gain scale and develop high-end capabilities. Strong growth in semicon can be leveraged as growth accelerator for smaller companies to stay relevant. We have analyzed a set of 135 core suppliers that are headquartered in the Netherlands and are active in the semicon Equipment ecosystem. 42% of Dutch suppliers managed to double their revenue over the last five years through organic growth (the share of these 'hyper growers' is equally distributed over small and larger companies).

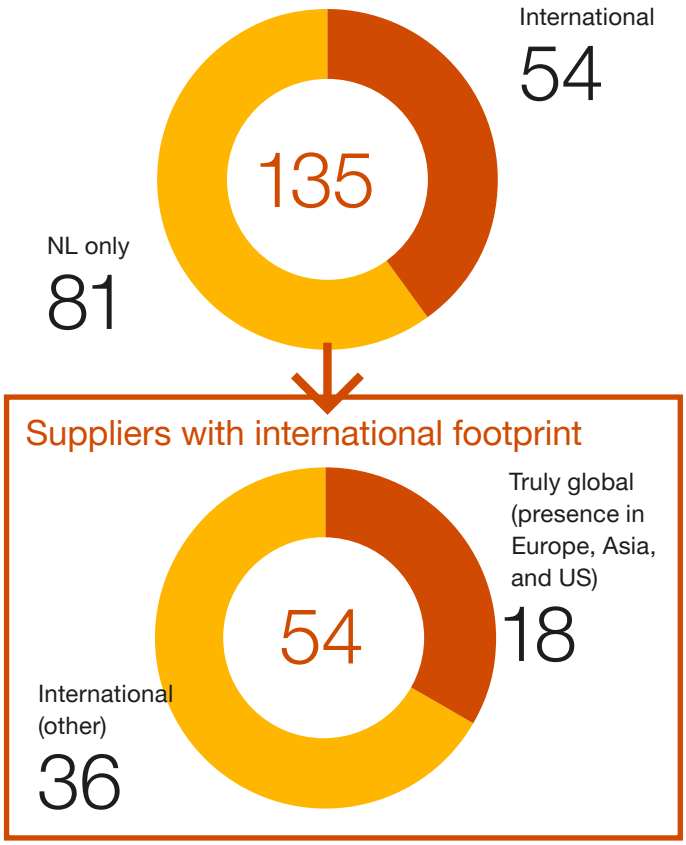


of Dutch suppliers doubled in size in last five years

Entry ticket to international arena

This strong growth of semicon has allowed smaller players and suppliers to reach critical mass and enter the international arena. In terms of footprint, 54 of the 135 Dutch headquartered suppliers (40%) already have a presence outside of the Netherlands, of which 18 have a full global presence (i.e., a presence in Europe, Asia, and US).

Figure 12 International footprint of Dutch headquartered suppliers



The continued growth of the sector should enable additional suppliers to expand their footprint outside of the Netherlands as they gain in prominence. In this context, there are two emerging trends that these companies can capitalize on to internationalize:

1. **'Glocalization'**: Recent global disruptions (including Covid-19 and the war in Ukraine) initiated a trend toward so-called "local-for-local": a distribution of the global supply chain to regional production centers across the world, with its own local subcontractors. This trend is now further fueled by geopolitical tensions around semicon, warranting an expansion globally to be closer to end-customers on different continents (having a presence in the US, Europe and Asia) – often driven by request of the customer (e.g., Automotive customers demanding two fab locations on different continents). As a result, suppliers are expanding their footprint globally and setting up hubs locally ("glocalization"). Some suppliers already have a presence in China to serve the large Chinese market, others are opening new (production) branches in China to be able to serve Chinese clients (also as China demands that majority of the chip manufacturing equipment is sourced from China). Other suppliers that are establishing new hubs or expanding in Asia are choosing for alternative locations in Southeast Asia (e.g. Vietnam, Malaysia, Singapore).
2. **Re-use/repair and the emergence of new business models**: As the semicon market is growing, the installed-machine base is growing. This installed base is predominantly located in Asia. Additionally, the interest for re-use and repair (incl. upgrades) of these machines is growing. In that context re-use and repair activity is taking an increasingly important role in the business. This spare-parts business is characterized by two elements: (1) **intermittent nature** (including time-critical delivery, ad-hoc demand, bespoke solutions) and (2) **local approach** at the customer premises (the need to diagnose, analyze, ship, install and return (whatever you don't use)).

   This spare-parts business is therefore quite a complex chain and interrupts the continuous flow of day-to-day production activities. Hence this requires the set-up of dedicated supply chain management. Manufacturers are also exploring new business models to capture the value and cover the costs of these activities. For their repair business, companies are for instance making the shift to managed services.

   To run this business more efficiently and sustainably (reducing the shipment of resources and parts around the world), ASML is for instance establishing service hubs closer to its end customers to orchestrate repairs, while the spare parts are often provided directly by the suppliers. The creation of these local supply ecosystems offers an opportunity for Dutch suppliers to grow and expand their footprint.

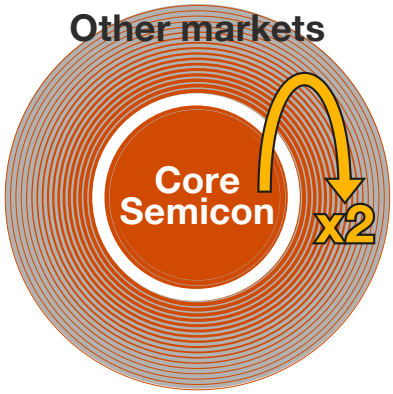
Many suppliers start with mirroring the international presence of their key OEMs, as OEMs like to have their development and engineering close. Once established in the region, suppliers can grow along with the OEM and find new local customers to reduce their dependency. A successful internationalization requires a fundamental rethink of the way of working, operating model, and business model. Careful strategizing upfront, whether to build organically or acquire a local player for an accelerated entrance is also part of the international growth code.

Impact beyond: semicon serves as a strong ‘halo’ (spillover effects)

The capabilities (e.g., precision manufacturing by suppliers) in semicon are very advanced and require state-of-the art R&D and manufacturing capabilities. The high-end and advanced technology segment of some other adjacent markets (e.g. in med-tech, defense, automotive and agri-tech) require similar high-precision manufacturing capabilities (including miniaturization / nano-technology, vibration control, advanced metrology, extreme quality control). In addition, being a supplier of ASML serves as a unique and international quality trademark that serves as an entry ticket for new market opportunities. Hence, the exceptional capabilities and continuous innovation of semicon serve as a powerful ‘halo’, offering significant potential for spillover effects to other markets. The strong growth and margins from semicon can also fund such expansion.

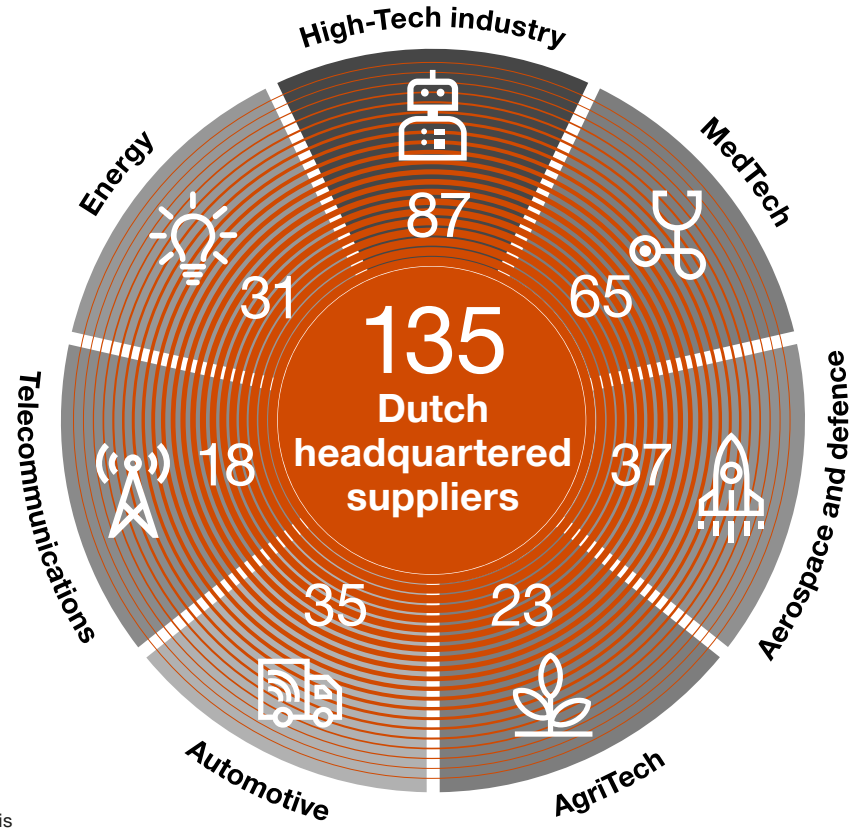
The halo also has a significant R&D component. Suppliers with a more diversified portfolio of multiple synergetic growth markets benefit from R&D spillover effects, where the success and innovations in semicon permeate and stimulate advancements in other fields (and vice versa). In addition, suppliers can deploy and amortize their heavy R&D investments across a broader portfolio.

Figure 13 The halo of semicon



The halo effect of semicon (measured by semicon vs. non-semicon precision manufacturing revenue for suppliers) is significant and was on average ‘**2x**’ over the last few years (i.e., for every euro revenue from semicon, suppliers also generate two euros revenue from adjacent markets). Looking at the 135 Dutch headquartered semicon suppliers, many of them are active in multiple other adjacent growth markets, see Figure 14.

Figure 14 Semicon ‘halo’ with adjacent growth markets for semicon suppliers (reflecting the number of Dutch semicon suppliers currently active in each market)



Source: PwC Strategy& analysis

Due to growth constraints in the Netherlands, the halo of semicon is shrinking – from 2.5x to 1.6x since 2019

Looking ahead, deterioration of the halo effect will further accelerate if we do not address these growth challenges – from 1.6x to 0.7x in 2030

Up to €6 billion cumulative revenue and €800 million cumulative R&D at stake by 2030 – more than half is with companies below €200 million in revenue

The government needs to intervene to tackle practical growth constraints down to the smallest players – suppliers can squeeze productivity in the meantime

2. The shrinking halo of semicon

2.1 Due to growth constraints in the Netherlands, the halo of semicon in is shrinking

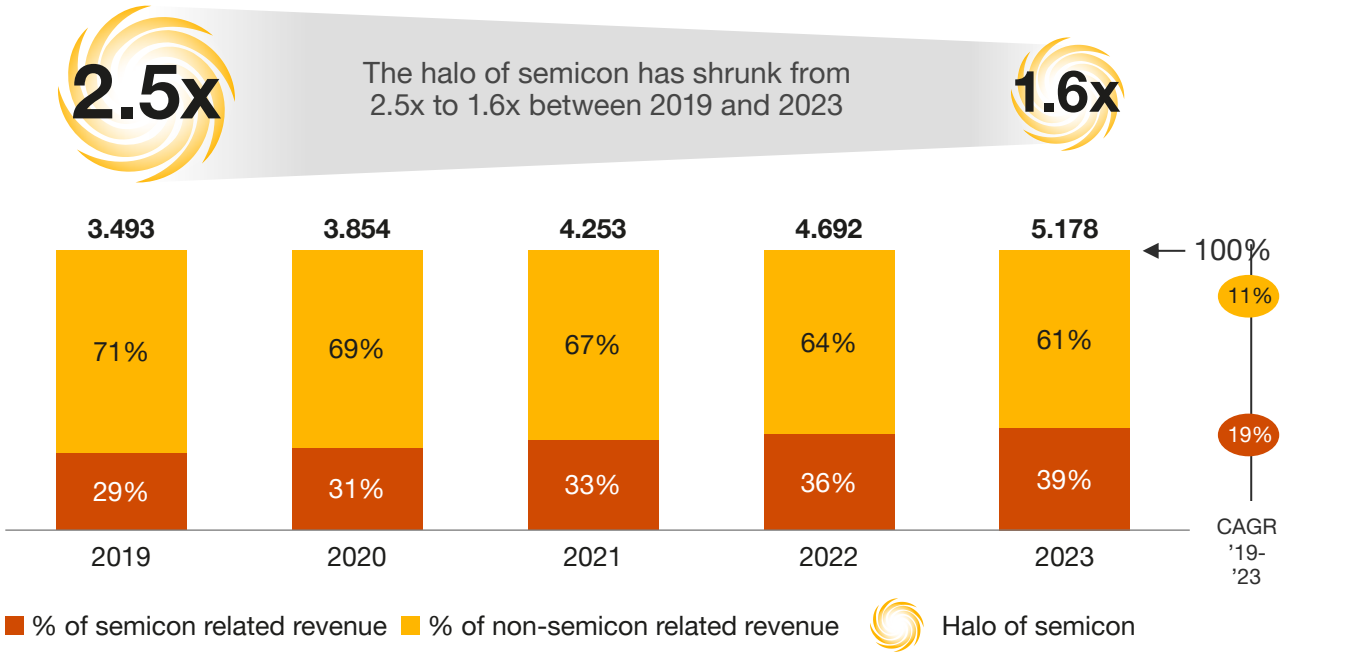
The halo of semicon is shrinking

As we all know, the Netherlands is facing major practical growth inhibitors (primarily power grid congestion, and a lack of space and talent). To investigate the effects of these growth constraints, we have tried to identify as exhaustively as possible the group of core suppliers in the semicon Equipment ecosystem headquartered in the Netherlands (in total 135 companies). Majority of these suppliers are part of the high-tech industrial cluster in the south of the Netherlands (around Eindhoven). According to our analysis, growth of these suppliers is below market growth.

While semicon has the potential to serve as a strong halo, these practical growth constraints in the Netherlands force suppliers to make strategic decisions where to allocate their limited capacity, as they are not able to grow with the market. When faced with such choices, the semicon industry is prioritized. As a result, semicon is currently growing at the expense of related advanced (tech) sectors that are also important and Dutch suppliers are not capitalizing on the spillover effects. As these Dutch suppliers are growing less fast, an increasing share of these adjacent markets is taken over by foreign players. Our interviews with many semicon executives have also revealed this challenge.

The halo of semicon (i.e., semicon vs. non-semicon precision manufacturing revenue for suppliers) already declined from 2.5x to 1.6x in the last four years (Figure 15). Suppliers are increasingly relying on the semicon industry and dependency on ASML is growing (initially ASML had a policy to limit this dependency). For some suppliers this dependency has been growing gradually over many years, for other (smaller) suppliers it has grown from nearly zero to over 50% in only a few years. Our research suggests that overall dependency on semicon went up from 29% (2019) to 39% (2023) in just four years, and this is expected to further increase towards 2035.

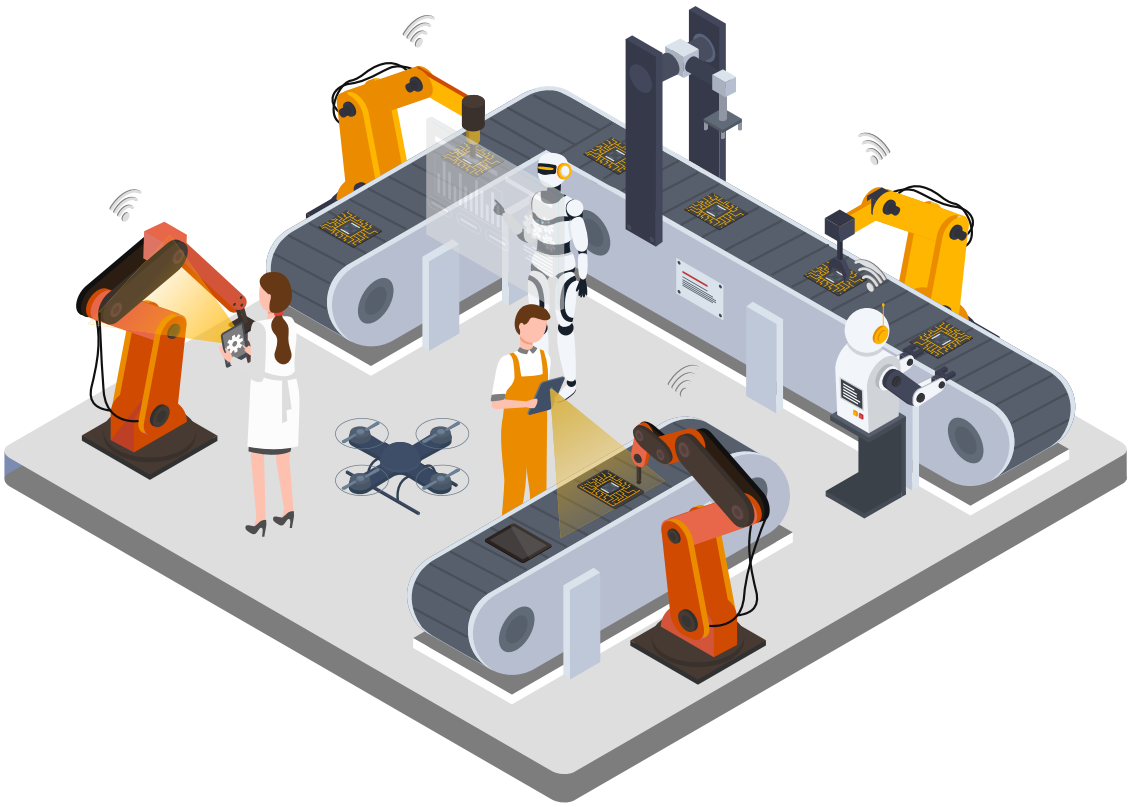
Figure 15 Halo of semicon and Dutch supplier's dependency on semicon (2019-2023), in % and million €



Methodology for Figure 15 – We identified a set of 135 core semicon suppliers that are headquartered in the Netherlands and are active in the semicon Equipment ecosystem. We analyzed the historical revenue progression over the period 2019 to 2023. We focused on organic growth and filtered out effects from inorganic growth and effects of double-counting of pass-through spend in the tiered supply chain (i.e., if a semicon player procures a semi-finished product, we only count for the additional value add to avoid doubling counting). Growth of semicon related revenue reflects the growth rate of ASML's spend on product-related suppliers in the Netherlands specifically during the period 2019 to 2023. 2.5x reflects the share of non-semicon related revenue (71%) divided by semicon related revenue (29%).
This report focusses on the semicon industry in the Netherlands. Since not all data was consistently available across all organizations and sources, we are using estimates and assumptions (with revenue scaled to Dutch employees where needed). We used a combination of annual reports, self-reported data, Gain.pro, Orbis, KvK. For FTE data we relied on annual reports, LinkedIn, and self-reported data.

The increasing dependency of suppliers is not without reason. Working for semicon, and ASML specifically, has many benefits. ASML is a loyal, fast growing, and well-paying customer. As a result, many suppliers have been comfortably surfing the growth wave of ASML. Semicon's more consolidated supplier base and outsourcing based on a 'co-opetition' model is also attractive (long-term commitments require less business development), versus the sometimes harder supplier relationships in order sectors. Then there is also the 'networking effect' in semicon, as it becomes easier to work with people in the same community.

From the interviews we further learned that in some situations the ASML's partnership has the potential to inadvertently push out other business opportunities for suppliers. Firstly, because some customers become reluctant to work with these suppliers given ASML's dominance that can pose a risk to such customer's delivery. Secondly, suppliers potentially become out of reach for (legacy) customers with more basic requirements due to increased prices and increasingly advanced products.

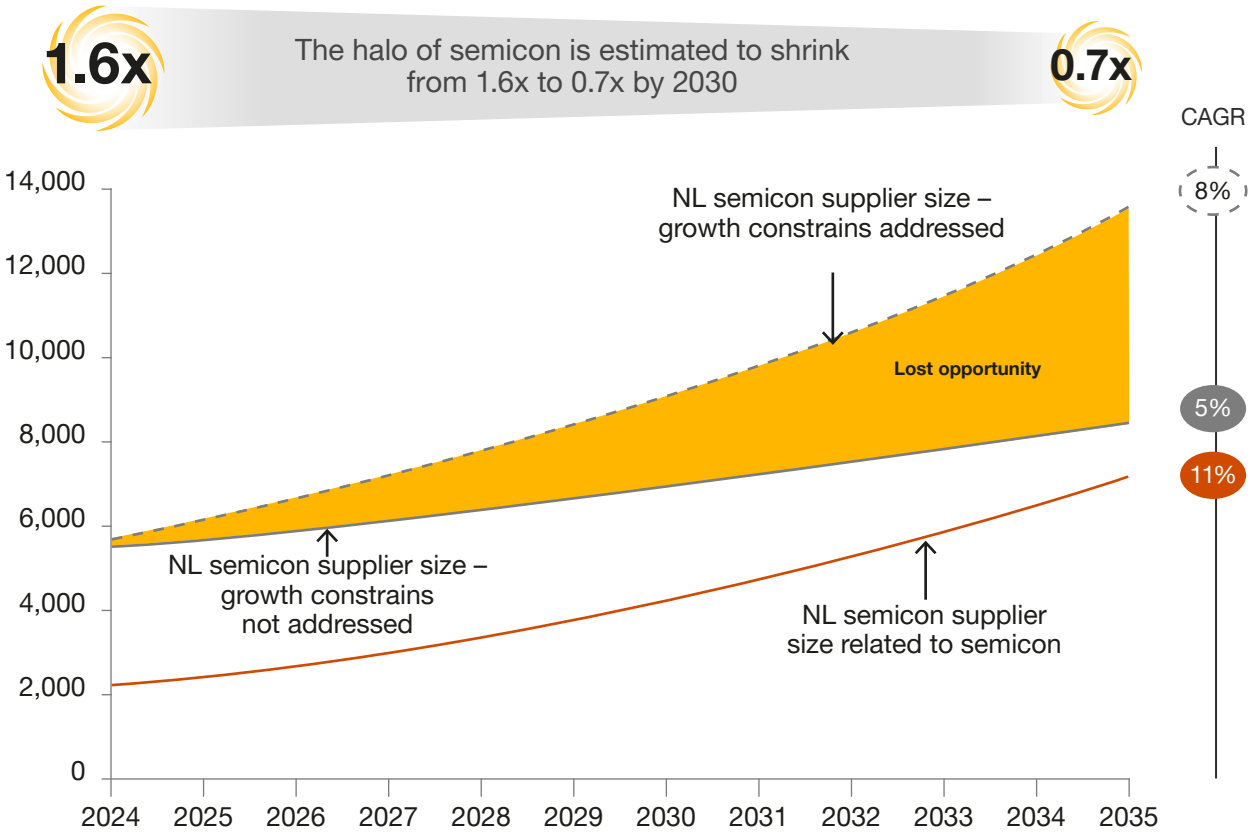


2.2 Looking ahead, deterioration of the halo effect will further accelerate if we do not address these growth challenges

Looking ahead, we expect that the share of semicon for suppliers will increase and growth in adjacent markets will further deteriorate. The speed of that deterioration depends heavily on whether and how fast the Netherlands can neutralize the pressing growth inhibitors.

If suppliers are still facing substantial growth constraints, the halo of semicon could further decline to 0.7x by 2030. In this scenario, suppliers' dependency on semicon will grow to 59% by 2030 and 78% by 2035.

Figure 16 Halo of semicon and Dutch supplier's dependency on semicon (future outlook), in % and million €



Methodology for Figure 16 – *The dotted grey line* (baseline) reflects the securing of the current Dutch position of suppliers in the various growths market (i.e., growing with the market at 8% CAGR in aggregate). We calculated market growth (8% CAGR) based on the weighted average of semicon (11% CAGR) and non-semicon (5.5% CAGR). The latter is calculated as a supplier-revenue-weighted average for 7 different end markets (high-tech industry, med-tech, aerospace and defense, agri-tech, automotive, telecom, energy), each with their own growth rate.
The fixed grey line represents suppliers' revenue with growth constraints (growing below the market at 5% CAGR in aggregate). This expected trajectory is based on the 8% CAGR base line and is discounted for growth restrictions in the Netherlands. This discounting is based on an extrapolation of the growth trajectory of semicon suppliers in the Netherlands over the last 5 years, corrected for incidental growth spurts (i.e., one-off revenue step-ups of 20% or more that is sustained in subsequent years). These growth jumps hinge on one-off solutions to increase capacity in terms of space and power supply, which are becoming increasingly difficult to pursue. This has also been confirmed through our interviews. Under such restricted conditions Dutch suppliers' growth is estimated at 5% CAGR – the slower growth-rate (below market growth) implies a further loss of share and position to companies abroad.
The orange line represents the growth of suppliers' semicon-related revenue (11% CAGR). This reflects the expected growth rate of ASML's spend on product-related suppliers in the Netherlands – in line with ASML's announced growth target of doubling (8%) to tripling (11%) of its business by 2030.

Source: PwC Strategy& analysis

2.3 This will have massive impact on midsized Dutch suppliers

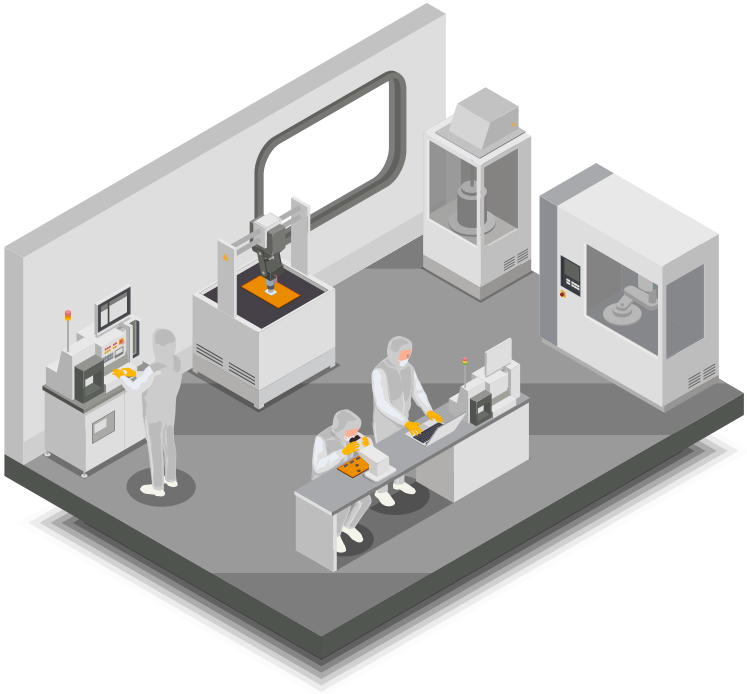
While a focused strategy on serving the semiconductor industry is encouraged, inadvertent overconcentration because of practical growth restrictions is a huge miss for the semicon supplier ecosystem in the Netherlands. We identified the following lost opportunities:

Direct quantifiable lost opportunities – If suppliers would be able to grow with the market, this would directly result in the following benefits over the next 6 years until 2030:

- €6 billion cumulative revenues for the supplier ecosystem by 2030 (i.e., this trend stifles growth for non-semicon).
- Up to €800 million in R&D spend, cumulative over the next 6 years for suppliers only.
- Up to a 26% increase of supplier workforce, across all skill levels.
- More than half of these lost opportunities is with companies below €200 million revenue. Especially for the smaller companies this additional revenue is a lifeline for additional R&D investments.

Indirect implications – Heading to a monoculture where suppliers' depedency on semicon (and ASML) is increasing also has the following indirect implications:

- **Not exploiting R&D synergies**: A more diverse portfolio offers the opportunity to deploy R&D for multiple markets. In addition, exposure to multiple adjacent markets also stimulates R&D and leads to cross-pollination.
- **Reduced effect of semicon steppingstone**: Limited growth will reduce the opportunity of semicon to serve as a growth accelerator and steppingstone for smaller Dutch companies to expand internationally (as they will lack the critical mass).
- **Decreased resilience**: If ASML sneezes, the entire ecosystem may catch a cold. To be shockproof, suppliers must strive for a better balance between serving existing value chains and actively seeking and tapping into new ones. Such portfolio diversification serves as a safeguard and hedge against market volatility.
- **Detriment to technological leadership of the Netherlands**: While semicon is a key contributor to the technological leadership of the Netherlands (ASML is currently the largest Tech company in Europe), continuing growth and innovation in other advanced tech markets is paramount to secure a technological leadership position. Through our interviews, many examples were mentioned where business opportunities in adjacent industries were not pursued and eventually fulfilled by international competitors, resulting in a lost opportunity for the Netherlands.



2.4 To solve this both suppliers and the government need to take action

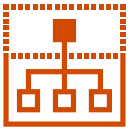
So what does it take to fix this and reverse the monoculture trend (i.e., that supplier's revenue is increasingly depending on semicon), where semicon's growth is no longer a zero sum game (i.e., that growth of semicon no longer comes at the expense of growth in other precision manufacturing growth markets outside of semicon)? This requires all parties involved to fire all cylinders. First and foremost, the government should take a leading role in alleviating practical growth inhibitors to pave the way for increased supplier capacity. In addition, suppliers need to explore two avenues in parallel. One is maximizing productivity in the Netherlands within the Dutch constraints. Secondly, suppliers can leverage talent pools and capacity in other European countries. The latter allows Dutch suppliers to capture the full market potential, rather than leaving it to foreign competitors to fulfill that market demand.

The government needs to alleviate practical growth constraints

Based on our interviews we have identified the most pressing growth constraints that need to be addressed. While Project Beethoven has mobilized critical resources to address some of the pressing challenges in the Brainport region, the following constraints also need to be alleviated.

Power supply: Congestion of the electricity grid in the Netherlands is currently limiting the supply of existing connections and causing significant delays of new connections. Some suppliers have been able to curb the impact so far by taking proactive and creative collective solutions with neighboring businesses. However, this is one of the most pressing inhibitors of growth. In the short term, the government should focus on offering local (mutualizing) arrangements and offer individual priority to companies active in strategic industries (such as semicon). In the mid-term, the government should centrally and structurally fix the power supply in the Netherlands.

Space (square meters and buildings): Especially in the Brainport region there is a lack of space. So far, suppliers have tried to alleviate this constraint by for instance taking over adjacent buildings from neighboring companies and one-off renovations and optimizations of exisiting production facilities. However, suppliers are reaching their limits in terms of physical breathing room. Suppliers are also frustrated by the rigid approach of local governments, who are only offering relocations to fixed business parks (which are not necessarily in sync with the nature and required network of the supplier's business). The government should therefore proactively collaborate and give priority to individual companies active in strategic industries, aiming for customized solutions.



Fragmented public decision-making: Expansion in semicon requires major investments. As semicon generally comes in waves, these investments require synchronized and concerted decision making across many procedures and permits. Synchronization across all these decision points is important, as delay/lacking one process can halt the entire process. In other countries like Germany and the US the government is orchestrating and synchronizing application procedures to facilitate and accelerate decision making for semicon (a genuine priority status that is effectuated at all decision making levels). The bottom-up way of working and multiple decision-making levels that are not well coordinated in the Netherlands are a key driver of delays and cancellation of growth plans (e.g., relating to new permits and subsidies needed for new investments).

Talent: There is a structural lack of talent and practical skilled workforce. As many other industries, semicon is experiencing significant labor shortages. In the recent Strategy& study "*Bridging the talent gap*" concerning the European semiconductor talent market, it was found that Europe is likely to experience a shortfall of 350,000 professionals by 2030.
While many suppliers are still able to fill the gaps by increasing the pay and hiring international talent, it is becoming more and more difficult to recruit and retain people (although the 30% expat ruling is not an issue for these suppliers). There is a general shortage of technically (STEM; science, technology, engineering and mathematics) trained people, but there is also a disconnect between the existing STEM curricula and what is needed in semicon. Key enabler for talent is also the facilitation of good living conditions - including sufficient and affordable housing (which is currently under pressure in regions like the Brainport area).

Suppliers need to maximize their productivity and gain access to additional capacity abroad

In parallel, suppliers can focus on strategic measures to further enhance their productivity and efficiency. Based on our interviews and industry experience, we identified the following key opportunity areas for suppliers:

Optimizing supply chain and integrated business planning:
While transparency has already improved substantially, there is a clear demand for more clarity and improved coordination in the chain. Especially in the tiered semicon supply chain, clear and correct (real-time) communication is essential for accurate business planning, inventory management, and to mitigate unnecessary shocks throughout the chain.

Suppliers are seeking better alignment within the supply chain to optimize operations and mitigate disruptions (reducing financial pressure and working capital issues). Suppliers are therefore also focusing on digitally connected supply chains. This encompasses the effective deployment of next-generation Enterprise Resource Planning (ERP) systems, integrated IT systems, sharing real-time data, and leveraging predictive analytics. Such measures are aimed at proactively managing logistics and warehouse planning, as well as preparing for supply chain shocks before they occur. To harness the full potential of advanced analytics and AI, the quality of data is paramount. This requires substantial investment in data management and analytics modernization solutions.

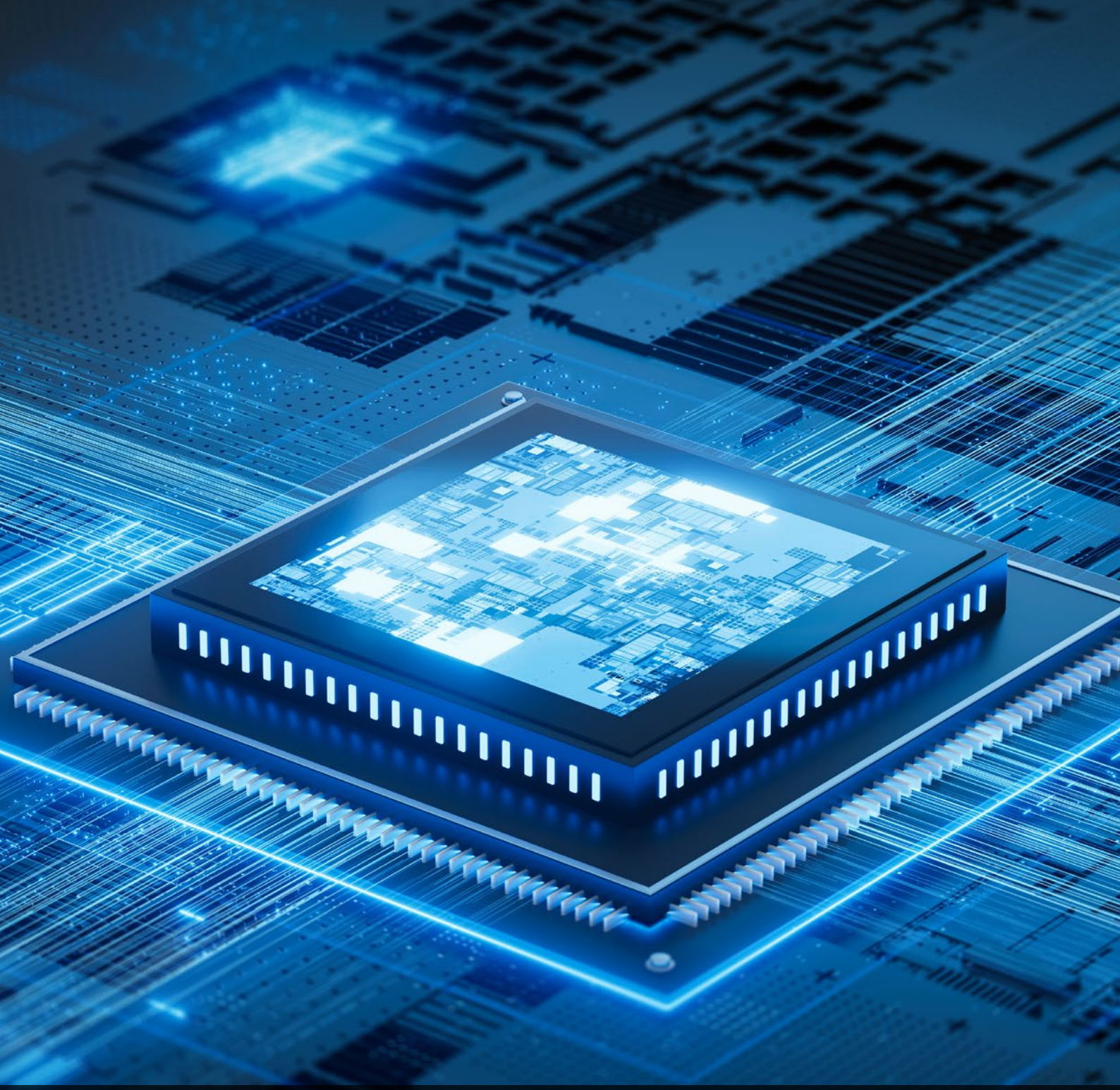
Unlocking scale benefits:
With growth and increased scale come opportunities for synergies. However, many companies struggle to realize these benefits. Underlying reason is that the processes and procedures, operating model, set-up and governance is not evolving with the scale of the company. A company-wide effort to standardize, professionalize and re-think the current ways of working is paramount to unlock those scale benefits. Even interviewees of the larger suppliers mentioned that throughout their growth benefits of scale were often overrated, while the complexity of scale is often underestimated. In hindsight some of the executives would have liked to address some of these issues earlier.

Using technology to up productivity:
There is a wide array of technology tools available in the market from established vendors, ranging from RPA, ERP, AI and Machine Learning-tooling, augmented reality applications, remote monitoring and IoT, to digital twins. Embedding and effective use of these technologies may further increase the output within current resource constraints. Effectively embracing these technologies and their benefits in day-to-day operations is becoming a table-stake in high-tech manufacturing.

Enhancing R&D effectiveness:
In terms of R&D, suppliers are striving for greater effectiveness given the high capital expenditures and limited capacity. This involves creating transparency in their portfolio and performance metrics, which is crucial for informed decision making. It also involves balancing short-term returns with long-term big bets. This necessitates a clear R&D strategy and roadmap.

Securing additional funding and freeing up working capital:
Inventory is an important part of working capital in semicon. Financial resources stuck in working capital cannot be invested to fund additional growth. This can be optimized by both the tightening of working capital monitoring and launching working capital improvement initiatives (such as predictive S&OP planning). Moreover, suppliers may consider exploiting additional sources of funding including bank factoring, project subsidies (e.g., EU subsidies), joint project funding, and attracting additional (minority) investors and PE.

Leverage talent pools and capacity in other European countries:
From the interviews we gained that it may be impossible to accommodate all growth in the Netherlands given the constraints mentioned above. To not let market demand evaporate to foreign competition, Dutch suppliers will have to build up or expand facilities in other European countries. To do this successfully, Dutch suppliers need to join forces and identify which regions are most promising in terms of available or retrainable talent pools.



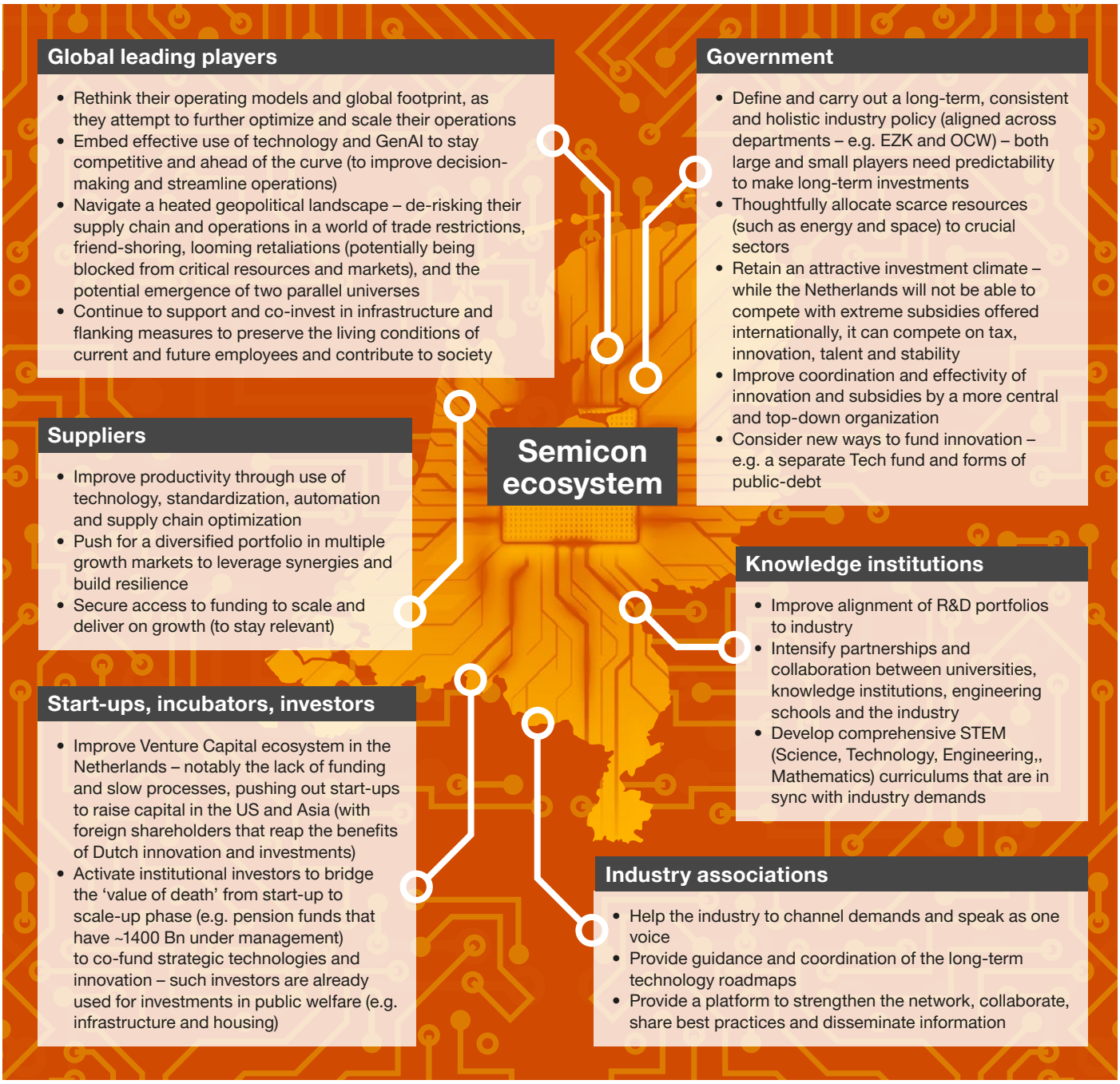
3. Call for action

Finally, zooming out and looking at the sector as a whole. At first glance, the semicon industry in the Netherlands appears to be 'the place to be' right now, with strong revenue and profitability growth over the past decade. The industry also has huge potential to keep thriving in the Netherlands.

However, behind the scenes, the industry is facing a number of challenges in an international complex context. Through a series of in-depth interviews we explored what sustainable success in the Netherlands takes. Currently many acceleration initiatives are launched across Europe (for example the Dresden initiative in Germany – see our report *German semicon market*.

The Netherlands, with its leading position in Europe and the specific nature of the Dutch ecosystem, merits a different approach – we identified the following themes that need to be addressed. This requires all stakeholders to act together. In addition, we have also conducted a *study* on the broader Dutch manufacturing landscape.

Finally, as food for thought, in our interactions with non-industry stakeholders we have felt a genuine interest and eagerness to learn more about the industry, especially about facts and figures. We think that getting this organized in a structured and ongoing basis by the industry will help key stakeholders to better understand and contextualize stakes of the industry.



Global leading players

- Rethink their operating models and global footprint, as they attempt to further optimize and scale their operations
- Embed effective use of technology and GenAI to stay competitive and ahead of the curve (to improve decision-making and streamline operations)
- Navigate a heated geopolitical landscape – de-risking their supply chain and operations in a world of trade restrictions, friend-shoring, looming retaliations (potentially being blocked from critical resources and markets), and the potential emergence of two parallel universes
- Continue to support and co-invest in infrastructure and flanking measures to preserve the living conditions of current and future employees and contribute to society

Government

- Define and carry out a long-term, consistent and holistic industry policy (aligned across departments – e.g. EZK and OCW) – both large and small players need predictability to make long-term investments
- Thoughtfully allocate scarce resources (such as energy and space) to crucial sectors
- Retain an attractive investment climate – while the Netherlands will not be able to compete with extreme subsidies offered internationally, it can compete on tax, innovation, talent and stability
- Improve coordination and effectivity of innovation and subsidies by a more central and top-down organization
- Consider new ways to fund innovation – e.g. a separate Tech fund and forms of public-debt

Suppliers

- Improve productivity through use of technology, standardization, automation and supply chain optimization
- Push for a diversified portfolio in multiple growth markets to leverage synergies and build resilience
- Secure access to funding to scale and deliver on growth (to stay relevant)

Knowledge institutions

- Improve alignment of R&D portfolios to industry
- Intensify partnerships and collaboration between universities, knowledge institutions, engineering schools and the industry
- Develop comprehensive STEM (Science, Technology, Engineering,, Mathematics) curriculums that are in sync with industry demands

Start-ups, incubators, investors

- Improve Venture Capital ecosystem in the Netherlands – notably the lack of funding and slow processes, pushing out start-ups to raise capital in the US and Asia (with foreign shareholders that reap the benefits of Dutch innovation and investments)
- Activate institutional investors to bridge the 'value of death' from start-up to scale-up phase (e.g. pension funds that have ~1400 Bn under management) to co-fund strategic technologies and innovation – such investors are already used for investments in public welfare (e.g. infrastructure and housing)

Industry associations

- Help the industry to channel demands and speak as one voice
- Provide guidance and coordination of the long-term technology roadmaps
- Provide a platform to strengthen the network, collaborate, share best practices and disseminate information

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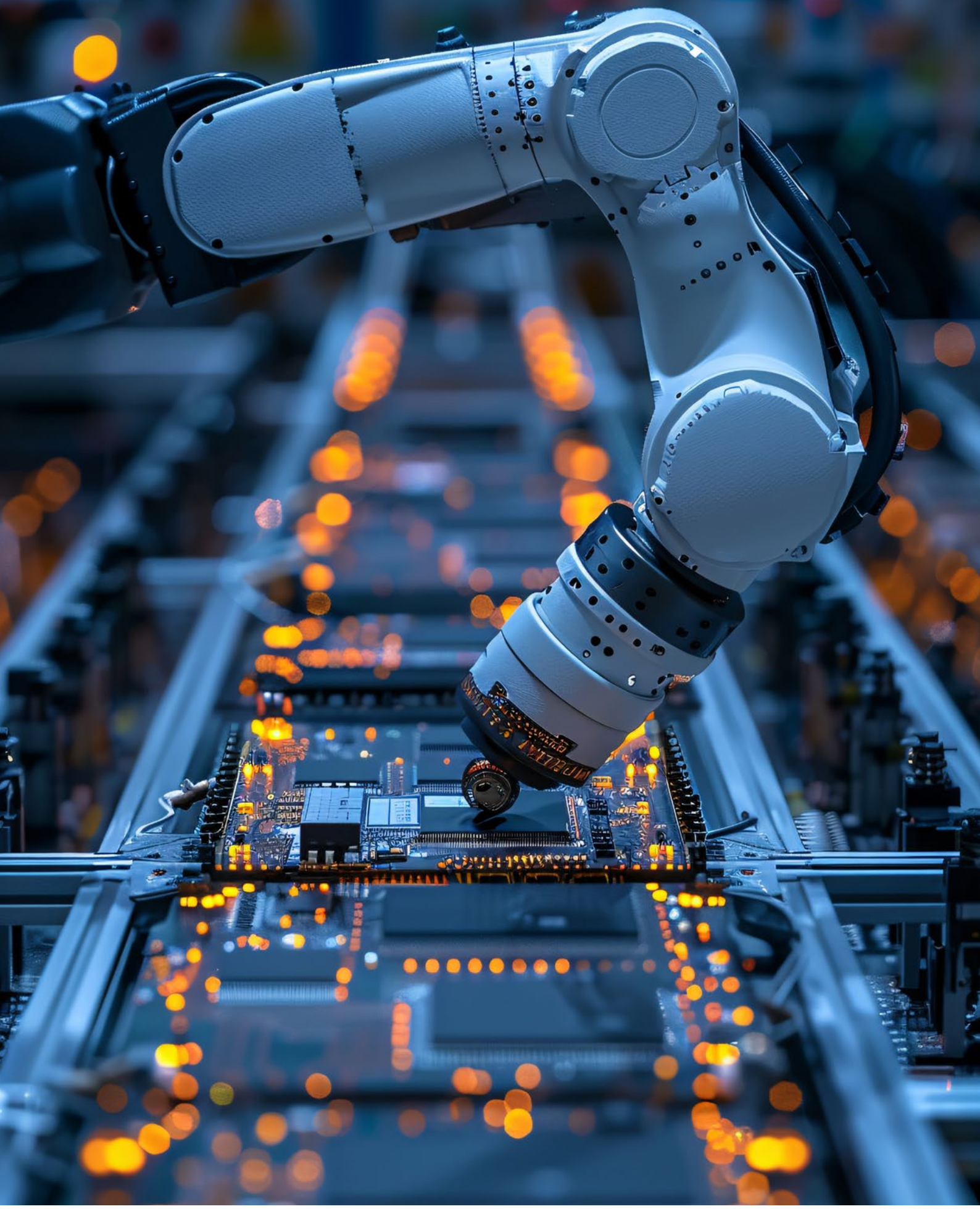
Glossary of abbreviations

ALD	Atomic Layer Deposition, is an advanced deposition method to create atomic scale ultra-thin films of exceptional material quality, uniformity, and conformality
Big 5	The 5 biggest Dutch semicon players: ASML, AsM, NXP, Nexperia and Besi
CSRD	Corporate Sustainability Reporting Directive, are the EU rules requiring large companies and listed companies to publish regular reports on the social and environmental risks they face, and on how their activities impact people and the environment
EDA	Electronic Design Automation, is a category of hardware, software, services and processes that use computer-aided design to develop complex electronic systems like printed circuit boards, integrated circuits and microprocessors
ERP	Enterprise Resource Planning, are software systems for integrated business process management
GAA	Gate All Around Transistor, is an upgraded transistor structure where the gate can come into contact with the channel on all sides, which makes continuous scaling possible
GenAI	Generative artificial intelligence (AI), is a type of AI that generates images, text, videos, and other media in response to user prompts
High NA EUV	High Numerical Aperture (0.55 NA) Extreme Ultraviolet, is a type of photolithography used for creating patterns on silicon wafer, which is a significant improvement over previous EUV technologies (0.33 NA)
IDMs	Integrated Device Manufacturers, are involved in all stages of production, including design, planning, manufacturing, as well as sale of integrated circuits (ICs)
LDMOS	Laterally Diffused MOSFET, is an asymmetric power MOSFET designed for low on-resistance and high blocking voltage
LIDAR	Light Detection and Ranging, is an active remote sensing system that can be used to measure ground elevation across wide areas
OSAT	Outsourced Assembly and Testing companies package and test the wafers from foundries
RPA	Robotic Process Automation, is the use of software to emulate and human actions for repetitive jobs
UWB	Ultra-Wide Band, is a short-range radio technology for high precision and secure communication in application such as IoT



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