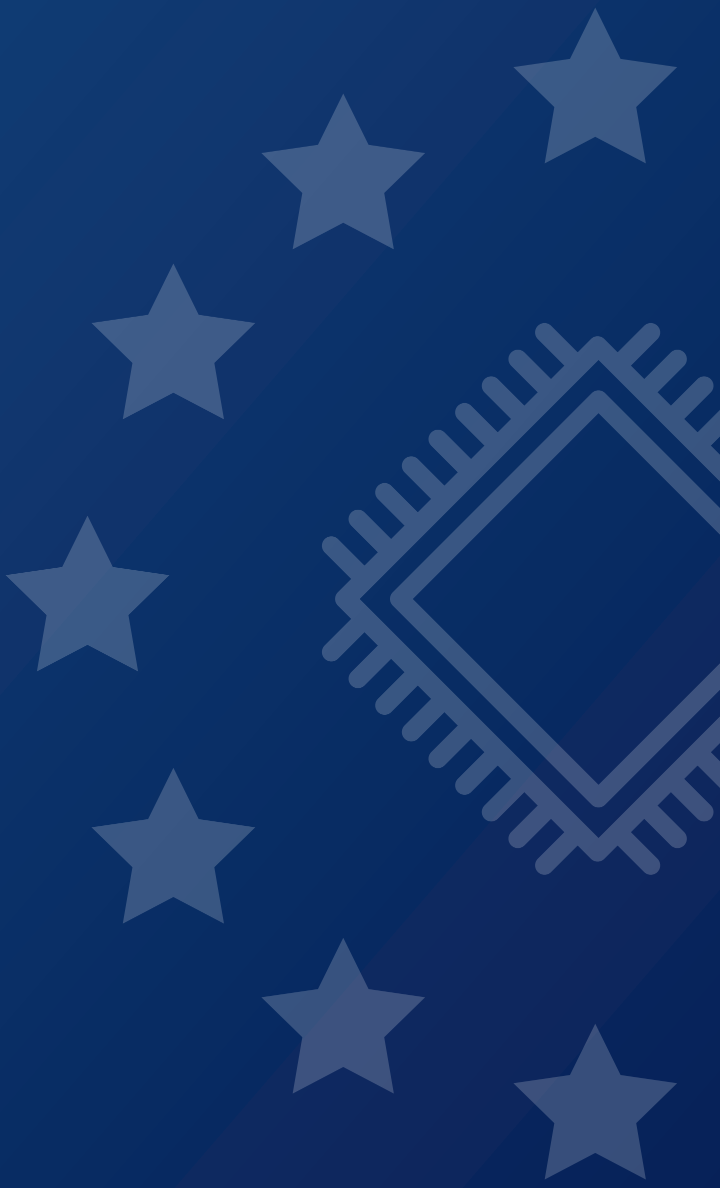
FME

zvei
electrifying
ideas

Europe's Semicon Business Case

A Demand-Driven Perspective for a Competitive and Resilient Microelectronics Ecosystem



In Zusammenarbeit mit strategy&
Part of the PwC network

Verband der Elektro- und Digitalindustrie

Sponsors

This study has been commissioned by ZVEI, FME, the German Federal Ministry of Economic Affairs and Energy (BMWE), and the Dutch Ministry of Economic Affairs and Climate (EZ). The study was conducted by Strategy& in its role as advisor to the commissioning parties. Numerous member companies of FME and ZVEI contributed to the study's design and the validation of the data.

Bundesministerium
für Wirtschaft
und Energie

Ministry of Economic Affairs
and Climate Policy

Contents

Summary of findings

Microelectronics is the key enabling technology behind Europe's most competitive industries. From the powertrains of electric vehicles to the control systems of automated factories, from the inverters managing renewable energy grids to the sensors guiding surgical instruments, chips determine the performance, efficiency, and differentiation potential of European products in global markets. As the semiconductor content per product rises and new domains such as artificial intelligence, autonomous systems, and the energy transition drive additional demand, the strategic importance of a strong microelectronics ecosystem continues to grow.

This study sends a clear message. Despite the persistent debate about whether Europe generates sufficient semiconductor demand to warrant large-scale investment, the demand is there. It exists across all major technology categories, provides the foundation for future innovation and commercialisation, and will remain strong in both the medium and long term.

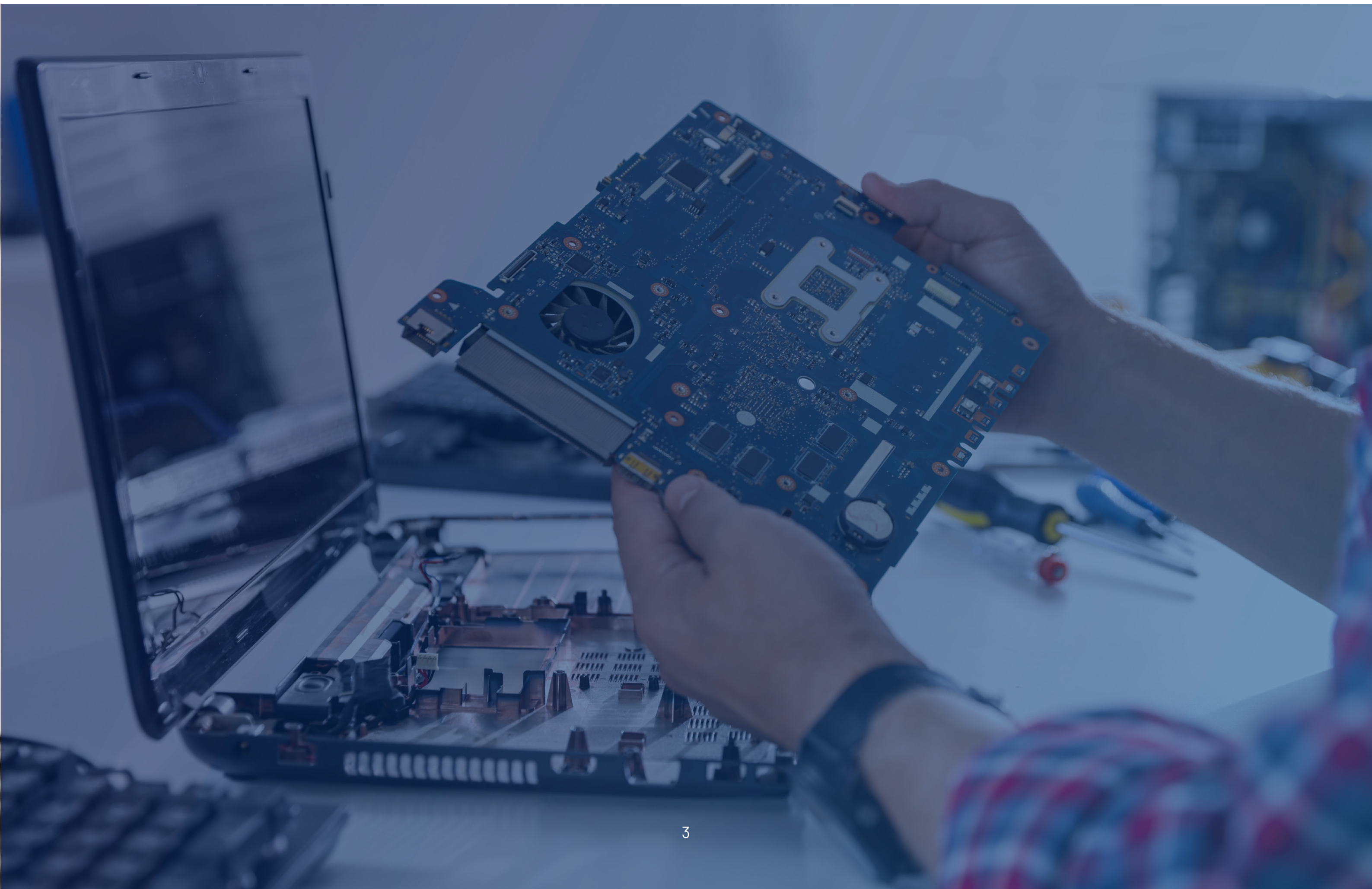
The question is therefore no longer whether Europe has the necessary demand base, but whether it will act decisively enough to translate this demand into industrial strength, innovation leadership, and economic resilience. Moreover, Europe already has a well-established microelectronics base built over decades, including globally leading equipment and materials suppliers, strong semiconductor manufacturers, world-class research institutions, and a highly interconnected industrial ecosystem of suppliers and customers. This foundation is a major strategic asset. It gives Europe the credibility, capabilities, and industrial relevance to compete globally, provided it now builds on these strengths with focus and ambition.

What is needed next is clear. Europe must now focus on strengthening existing positions, closing targeted gaps, improving investment conditions, and creating the right framework for the next wave of innovation and industrial scale-up. This includes complementing supply-side instruments with targeted demand-side measures that create predictable demand signals, reduce investment risks, and support the utilisation of new capacity. With the right choices, Europe can reinforce its leadership in key segments of microelectronics while also shaping the next generation of technologies and value chains. Getting this right is not only an industrial priority. It is a precondition for Europe's long-term economic growth and welfare, technological sovereignty, and the resilience of the industries and infrastructure on which its citizens depend.

- **The demand for microelectronics in Europe is large, growing, but requires strategic investment priorities.** European semiconductor consumption demand roughly doubles by 2040, driven by the electrification of transport and energy systems, the digitalisation of industrial production, the build-out of AI and data centre infrastructure, and the growing chip intensity of healthcare and defence applications. Industry demand, which captures the semiconductor pull generated by manufacturers producing in Europe for global markets, grows even faster at a factor of x2.4. Power semiconductors, sensors, microcontrollers, and communication chips sit on robust growth trajectories at nodes where European fabs hold established global positions, putting them in a strong place to serve not only European demand but also to capture a significant share of the global markets. The demand growth extends across the broader value chain, with semiconductor equipment, printed circuit boards, and electronics manufacturing services all following the upward trajectory. These segments need continued and broadened public and private funding to defend and expand existing strengths. At the same time, GPUs, memory, and advanced logic are growing at the highest multiples but fall almost entirely outside European production. A phased approach to building capabilities in these areas, starting with chip design and advanced packaging, is needed to address this gap. Emerging technologies such as silicon photonics, edge AI, quantum chips, and neuromorphic computing build on European research strengths and require dedicated scale-up financing to reach industrial maturity. For defence and critical infrastructure applications, regulatory frameworks that channel demand towards European-sourced chips and components, including local content requirements for defence and critical infrastructure procurement, would create a predictable and policy-supported demand signal. Rebuilding PCB and EMS capabilities for strategically sensitive segments addresses a further vulnerability in the downstream value chain.

- **Producing in Europe comes at a cost premium, but targeted measures can reduce the gap.** Across all front-end fab archetypes examined, semiconductor manufacturing in Europe is 15 to 30% more expensive than in the most competitive Asian locations. The gap is driven primarily by higher energy costs, higher labour costs, and elevated construction costs. Reducing energy costs for semiconductor production through grid fee exemptions, electricity tax reductions, and state-facilitated power purchase agreements is the single most impactful structural lever, narrowing the gap by 3 to 6 percentage points. Productivity improvements through smart manufacturing and automation contribute a further 2 to 5 percentage points. The remaining difference requires compensatory instruments such as accelerated depreciation, CAPEX tax relief, and R&D tax credits across the microelectronics value chain. Advanced packaging presents a particular opportunity, with a cost gap comparable to semiconductor manufacturing at 15-20% and a strategic relevance that is growing rapidly as chiplet-based architectures become the industry standard. The cost comparison also reveals meaningful variation within Europe, allowing the EU to present a differentiated set of location profiles to prospective investors.

- **Europe offers strong location fundamentals that need to be protected from fixable weaknesses.** In a structured comparison across nine global semiconductor regions, Europe generally scores competitively, with top marks for infrastructure quality and strong positions in political stability, IP protection, and rule of law. These are structural advantages rooted in decades of institutional development that competing regions cannot replicate quickly. The assessment also identifies three areas where improvement is needed and achievable. Talent availability is the most pressing constraint, requiring dedicated semiconductor education programmes, a fast-track EU talent visa, and industry-led reskilling initiatives. Incentive processes are too slow, with application-to-approval timelines of 12 to 24 months that need to be reduced significantly. Fast-track permitting for fab construction, including critical infrastructure status and pre-permitted microelectronics-ready zones, would bring European construction timelines closer to Asian benchmarks. Regulatory complexity, created by overlapping requirements at EU, national, and regional level, adds cost and delays. Streamlining reporting obligations and harmonising semiconductor policy across member states would remove friction and ensure that the collective European effort achieves strategic coherence rather than fragmented duplication.



Rationale for the study

Microelectronics have become a defining factor in the competitiveness of European industry. The chips for cars, factories, energy systems, medical devices, and defence platforms are no longer auxiliary components. They determine performance, efficiency, and increasingly the ability to differentiate in global markets. European manufacturers in automotive, industrial production, energy, and healthcare hold world-leading positions that depend on reliable, technologically advanced, and increasingly specialised microelectronics supply. As the chip content per product rises and new application domains such as artificial intelligence, autonomous systems, and the energy transition create additional demand, increasingly also for more advanced chip types. In this context, the question of whether Europe can sustain and expand a domestically controlled microelectronics ecosystem has moved from a technical discussion to a strategic one.

The previous ZVEI Microelectronics Study established the economic case for public support. It demonstrated that subsidies for European semiconductor production generate a return on investment of 30 to 40% per annum once facilities reach full operation, create approximately 65,000 jobs across the value chain, and contribute around EUR 33 billion per year in additional gross value added to the European economy.[1] The conclusion was clear. Investing in European microelectronics is economically reasonable and delivers measurable returns for society. This study takes the next step. It moves from the question of whether it is worth investing to the question of where exactly to invest, under what conditions, and what needs to change to make those investments succeed.

That question has become more urgent. Three forces are converging that make the coming years decisive for Europe's microelectronics trajectory. First, the geopolitical landscape has shifted fundamentally. Supply chains are fragmenting along geopolitical lines, export controls are tightening, and subsidy competition is intensifying across the United States, China, Japan, South Korea, and India. The assumption that open global markets will reliably deliver the chips Europe needs is no longer tenable without qualification. Second, a technological shift is underway. Artificial intelligence, Physical AI[2], edge computing, and the electrification of transport and energy systems are driving a structural change in what types of chips are needed and in what volumes. This shift creates both opportunities for European strengths and risks where critical capabilities are absent. Microelectronics sit at the centre of a global competition for technological leadership that will shape future prosperity, security, and the success of the green and digital transitions. Third, the economic stakes for European core industries are rising. Automotive, industrial production, energy, and defence all depend on semiconductor supply. Losing access to key technologies or falling behind on next-generation chip capabilities translates directly into lost competitiveness in the sectors that form the backbone of European economic output. Alongside these economic considerations, sovereignty requirements are growing. The semiconductor content of defence systems, critical infrastructure, and secure communications carries implications that go beyond commercial procurement and demand a degree of domestic control over supply.

The policy environment reflects this urgency. The European Chips Act, national semiconductor strategies across member states, and the formation of the Semiconductor Coalition Europe have laid the groundwork for a new phase of European microelectronics policy. Public investment commitments have grown substantially. Yet as these instruments enter their next cycle, the decisions ahead require a sharper compass. Where should the next wave of funding be directed? Which gaps are most consequential? What structural conditions need to change for investment to flow? And critically, what is holding companies along the microelectronics value chain back from investing more in Europe, and what would it take to shift that calculation? The answers to these questions cannot rest on geopolitical ambition alone. They require a systematic, evidence-based assessment of the underlying demand, costs, and location conditions. This study assembles the analytical foundation for a demand-driven assessment of Europe's microelectronics business case.

Objectives and scope of the study

The objective of this study is to develop a comprehensive, demand-driven business case for microelectronics in Europe. The aim is to provide a factual basis for the formulation of measures by European policymakers and for investment decisions by industry stakeholders, grounded in a forward-looking assessment of where demand is heading, what it costs to produce in Europe, and what conditions need to be in place for investment to succeed. The analysis is built on three pillars, supplemented by a concluding chapter that synthesises the findings and derives recommendations (see Figure 1.1).

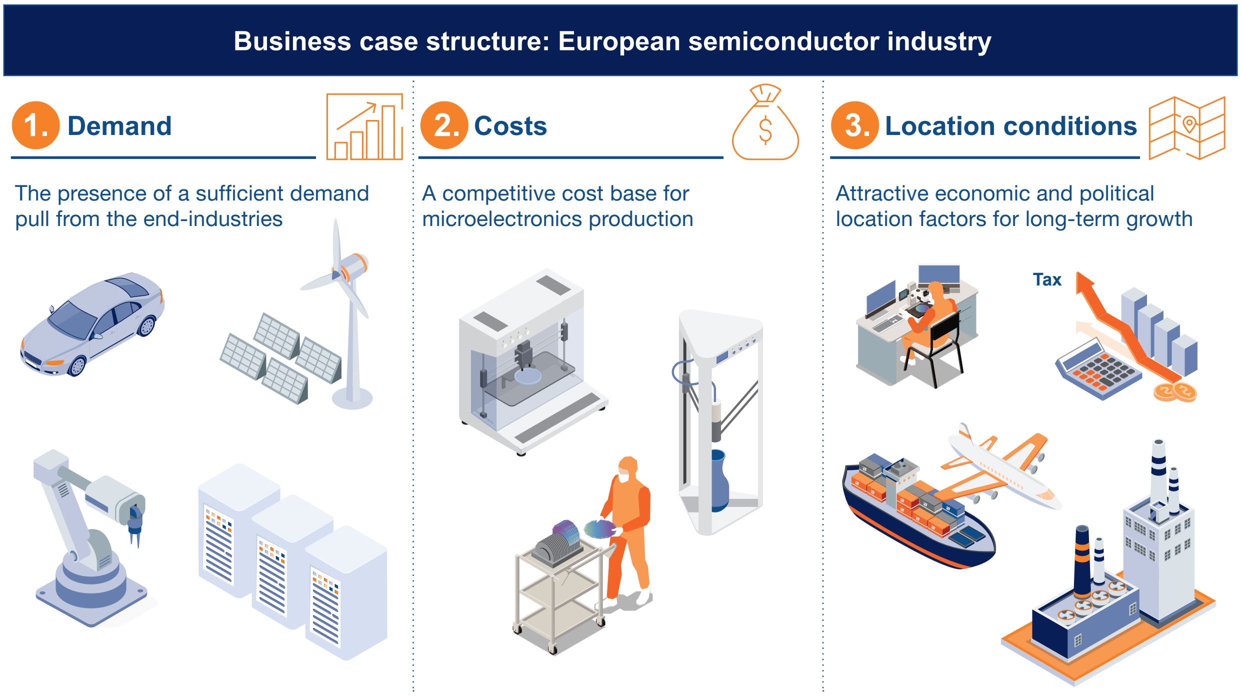
Chapter 1 provides a comprehensive European microelectronics demand assessment, quantifying demand from European end-industries out to 2040. The analysis is structured by end-market vertical, semiconductor type, and process node. The chapter extends the analysis to semiconductor equipment, printed circuit boards, and electronics manufacturing services, and concludes with a prioritisation framework that identifies where along the value chain Europe should focus its efforts.

Chapter 2 presents a semiconductor cost comparison, benchmarking the cost of front-end and back-end manufacturing in Europe against major global regions. Using Germany as the primary European reference point, supplemented by intra-European comparisons with Portugal, Poland, and the Netherlands, the analysis breaks down the cost gap by its underlying drivers and quantifies the extent to which structural measures and compensatory instruments can narrow it.

Chapter 3 delivers a location conditions assessment, evaluating the broader business and operating environment that shapes investment decisions beyond pure cost. The framework covers talent availability, ecosystem and infrastructure quality, government incentives, regulatory conditions, and political stability, benchmarking the EU against the same set of global regions. The assessment identifies where Europe holds structural advantages and where specific bottlenecks need to be addressed.

Chapter 4 synthesises the evidence from the three preceding assessments into an integrated view of the European microelectronics business case. On this basis, it derives a set of concrete recommendations for policymakers and industry, organised across six action fields that address the levers identified in the analysis.

Fig. 1.1: Dimensions of the business case for microelectronics



Business case structure: European semiconductor industry

1. Demand

The presence of a sufficient demand pull from the end-industries

2. Costs

A competitive cost base for microelectronics production

3. Location conditions

Attractive economic and political location factors for long-term growth

Source: Strategy& analysis

1 European microelectronics demand assessment

Any investment case starts with the market. Before asking whether production costs are competitive or whether the business environment is conducive, the prior question is whether the underlying demand justifies the commitment. For semiconductors, that question carries particular weight. A modern semiconductor fabrication plant (fab) typically requires three to five years from planning to commissioning, with additional time to reach full capacity, and then operates for two decades or more. Microelectronics is inherently a global business, and European fabs and companies compete in and supply world markets, not just regional ones. Yet understanding local demand is crucial, because proximity to end-customers enables the co-development of application-specific solutions, shortens iteration cycles, and builds the deep product understanding that turns a standard component into a differentiated one. In an environment where competing on cost alone becomes increasingly difficult for European producers, the ability to differentiate through technology leadership and close customer collaboration is a strategic asset that only proximity can deliver. The investment decision must therefore be grounded not only in today's order books, but in a forward-looking assessment of where demand is heading, how it is composed, and whether it aligns with what Europe strategically requires and can credibly produce. Despite this, reliable figures on the trajectory of microelectronics demand originating in Europe have been largely absent, leaving the discussion about whether the continent offers sufficient market pull to sustain large-scale manufacturing investment unresolved.

This chapter quantifies European semiconductor demand to 2040, structured by end-market vertical, semiconductor type, and process node. The analysis applies two distinct demand perspectives throughout. Consumption demand covers semiconductors embedded in end-products sold within the EU. Industry demand covers semiconductors required for products manufactured or assembled in Europe and sold globally (see Section 1.1 for the methodological framework). Comparing the two reveals where the trajectories align and where they diverge, which market segments are growing faster on the consumption side than the European semiconductor industry can currently serve, and where European semiconductor producers are well-positioned to meet rising demand. Not every gap requires a domestic supply response, but identifying those gaps and assessing their strategic weight is a precondition for informed investment decisions.

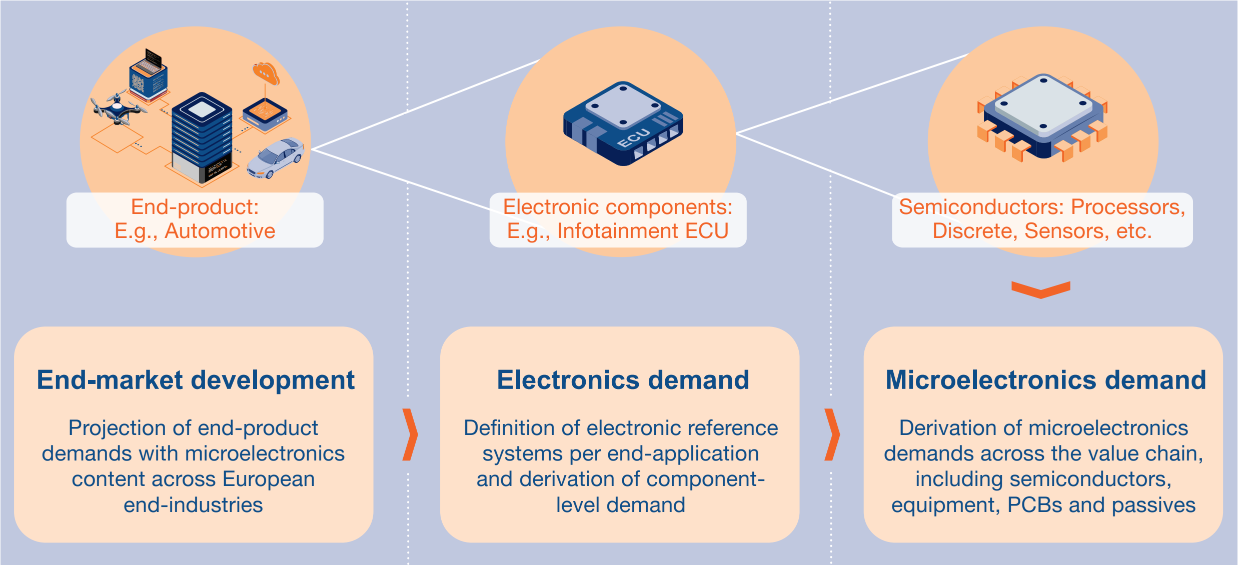
The analysis necessarily extends beyond semiconductors to assess the resulting demand for semiconductor equipment, printed circuit boards (PCBs), and electronics manufacturing services (EMS), because the resilience and competitiveness of Europe's microelectronics ecosystem depend on the health of the entire value chain, not just the core semiconductor value chain from chip design, materials and equipment to production in fabs. Resources for industrial policy and corporate investment are scarce, and not every segment can be given equal treatment. The chapter therefore concludes by identifying key technologies and capabilities within each value chain step where action is most consequential, whether that means defending established European strengths in the global competition, closing gaps that pose risks to growth or sovereignty, safeguarding control points where Europe holds a leading global position, or securing early footholds in emerging technologies that could reshape market dynamics in the decade ahead. The resulting framework provides European policymakers and industry with a shared basis for directing resources where they are most valuable.

1.1 Demand assessment methodology

The demand model is built bottom-up from end-market applications to semiconductor content (see Figure 1.2). The starting point is the end-product: a car, a wind turbine, a mobile phone, a medical device. Each product contains electronic systems, and each electronic system requires a specific set of semiconductor components. The model traces this chain in reverse. It starts with forecasts for end-product volumes in the European market, identifies the electronic subsystems each product contains, and then breaks down those subsystems into their semiconductor content using electronic reference designs. These reference designs specify which types of chips are needed, in what quantities, and, eventually, are translated into semiconductor wafer area per unit. They are calibrated to reflect current technology levels and account for expected shifts over the forecast period , such as the increasing semiconductor intensity of electric vehicles compared to combustion-engine cars, the growing processing requirements of automated factory systems, or the rising chip content per data centre rack as AI workloads scale. The model does not attempt to anticipate disruptive innovations that cannot yet be foreseen. It captures what is known and what can be reasonably projected from current technology roadmaps and announced product trajectories. Its modular structure is designed for periodic updates, so that new developments can be incorporated as they materialise rather than requiring a full reconstruction. The result is a detailed picture of European semiconductor demand, expressed in wafer starts per month, that can be broken down by end-market vertical, by semiconductor type, and by semiconductor process node. The model does not cover every niche segment. It follows a concentration logic, prioritising the segments that together account for more than 85–90% of European semiconductor consumption while accepting that a residual share falls outside its scope. Within that scope, the bottom-up approach makes it possible to connect a macro-level demand trajectory to the specific types of production capacity needed to serve it.

The analysis covers the period from 2025 to 2040. This timescale reflects the investment horizons that characterise the semiconductor industry. Given that a new fab requires three to five years from planning to commissioning and then operates for two decades or more, a shorter forecast window would not capture the demand developments that matter for investment decisions being taken today. For capacity that is yet to be planned and built, the relevant question is not what the market looks like in five years but what it looks like when a fab build in 5-8 years reaches full-scale production and throughout its operational life.

Fig. 1.2: Methodology of the European microelectronics demand assessment



End-market development

Projection of end-product demands with microelectronics content across European end-industries

Electronics demand

Definition of electronic reference systems per end-application and derivation of component-level demand

Microelectronics demand

Derivation of microelectronics demands across the value chain, including semiconductors, equipment, PCBs and passives

Source: Strategy& analysis

Each vertical is disaggregated into its constituent application segments, which together cover the majority of their semiconductor-consuming end-products in the European market.

- **Automotive and Transportation** spans passenger vehicles, commercial vehicles, and mobility infrastructure. The ongoing transition to electric drivetrains combined with increasing levels of vehicle automation is driving sustained growth in chip content per vehicle, making this the vertical where European industrial strength and semiconductor demand are most tightly linked.

- **Energy** captures the semiconductor demand generated by the European green transition, from renewable generation and grid modernisation to heat pumps and charging infrastructure. This vertical links climate policy directly to chip demand.

- **Compute and Consumer** spans the full range from hyperscale data centres to personal devices. It is the vertical undergoing the most structural change, driven by the global build-out of AI training and inference capacity.

- **Communication** covers the infrastructure that connects devices, machines, and systems, from mobile networks and fixed-line equipment to satellite terminals. Demand here is shaped by successive generations of connectivity rollout and the growing data volumes generated by IoT and edge applications.

- **Industrial Products** cover factory automation, robotics including industrial Physical AI systems, process control, and industrial drives, reflecting Europe's deep manufacturing base. This represents a vertical where proximity between chip producers and system integrators creates particularly strong co-development dynamics.

- **Aerospace and Defence** includes military platforms, space systems and avionics. Volumes are modest relative to commercial verticals, but sovereignty requirements, high supply chain standards, and long qualification cycles give this segment disproportionate strategic weight.

- **Healthcare** is driven by an ageing European population and the increasing integration of AI into clinical workflows, spanning applications from diagnostic imaging and implantables to digital health infrastructure. At the same time, consumerisation is driving demand for wearable monitors, at-home diagnostics, and portable therapy devices.

Fig. 1.3: Overview of the end-markets and underlying applications

Vertical	1 Automotive and transportation	2 Energy	3 Compute and consumer	4 Communication	5 Industrial products	6 Aerospace and defence	7 Healthcare
Segment	Light vehicles	PV systems	Data centers	Mobile access network	Communication systems	Tanks and ground vehicles	Surgical robots
	Trucks and busses	Wind systems	Personal and enterprise compute	Fixed access networks	Stationary production robots	Maritime	Diagnostics
	Chargers	Battery storage	Mobile compute and phones		Mobile robots	Commercial aircrafts	Treatment systems
	Trains	Heat pumps and ACs	Wearables		Building control systems	Private and commercial drones	Monitoring devices and wearables
	Off-road	Smart home energy systems	Adapters and chargers		Factory infrastructure	Satellites	Rehab and assistive devices
		Auxiliary power supplies	TVs and displays		CNC machines	Military aircraft	
		Energy management systems	Gaming		Conveying equipment	Military drones	
		Grid control	White goods		Lifting and hoisting equipment	Missiles	
			IoT and Smart home		Forklifts		
			Humanoids and service robots		Storage and retrieval systems		

Source: Strategy& analysis

In addition, any demand forecast over a 15-year horizon carries inherent uncertainty due to market and technological developments. To account for this, the analysis does not rely on a single set of growth assumptions but works with scenarios that vary the key input parameters across each vertical. The scenario dimensions reflect the forces that are shaping semiconductor demand most significantly over the forecast period.

Automotive and Transportation	Pace of economic development, speed of the shift from combustion engines to battery-electric and plug-in hybrid vehicles, and rate of proliferation of autonomous mobility and advanced driver-assistance systems.
Energy	Economic growth, pace of electrification across sectors, and additional electricity demand generated by AI computing infrastructure.
Compute and Consumer	Consumer spending trajectories, expansion of cloud and data centre capacity, and growth of connected IoT devices.
Communication	Roll-out of next-generation 6G networks, integration of AI into communication functions, and build-out of smart city infrastructure.
Industrial Products	Economic growth, adoption rate of automation and connectivity in factory environments, and speed at which manufacturing footprints shift between regions.
Aerospace and Defence	Level of defence spending growth, scale of EU programmes for unmanned and autonomous systems, and degree to which technological sovereignty requirements drive local production of defence electronics.
Healthcare	Consumerization of medical devices, pace of digitalisation and AI adoption in clinical care, and uptake of medical robotics.

The two demand perspectives introduced in the chapter opening, consumption demand and industry demand, are applied across all verticals and semiconductor categories (see Figure 1.4).

Consumption demand measures the total semiconductor content embedded in end-products that are purchased, deployed, or installed within the EU, regardless of where and by whom those products were manufactured, whereas industry demand measures the semiconductor content required for products and components that are manufactured or assembled by European industry, regardless of where those products are ultimately sold. To illustrate: when a European consumer purchases an electric vehicle manufactured in Asia, the semiconductors inside that car count towards European consumption demand but not towards industry demand. Conversely, when a European automotive OEM produces a vehicle in Germany for export to China, the semiconductors in that vehicle count towards European industry demand but not towards consumption demand. The same logic applies across all verticals with one exception.

For data centres, the **consumption demand** approach was not feasible in the same way, as there is no reliable basis to determine the total computation demand required to serve EU citizens and businesses, much of which is fulfilled by servers located outside Europe. Instead, consumption demand for data centres was calculated based on the data centre capacity physically built and operated within the EU. This means the figure captures the semiconductor content of servers deployed on European soil rather than the full compute demand generated by European users. The resulting number is presumably lower than a true end-user demand figure, since European companies and citizens also rely on data centre capacity located in other regions, particularly the United States.

Industry demand is derived from the consumption demand baseline. For each application segment, the model adjusts the consumption figures based on European production volumes, where direct production data is available, or on trade flow data capturing export and import shares by segment. The underlying calculation follows a straightforward accounting logic: industry demand equals consumption demand plus exports minus imports. In verticals where European manufacturers hold strong global positions, such as automotive or industrial production, this adjustment pushes industry demand above consumption demand, reflecting the fact that European factories produce for world markets. In verticals where Europe is primarily a buyer rather than a producer, such as consumer electronics or computing hardware, the adjustment works in the opposite direction, and industry demand falls well below consumption levels.

Fig. 1.4: Definition of European microelectronics demand (consumption versus industry)

Consumption demand

Microelectronics required for **end-products sold in the EU** to end-consumers, businesses, or governments

e.g., consumer in Germany buying a smartphone or a business in the Netherlands purchasing a vehicle fleet

Industry demand

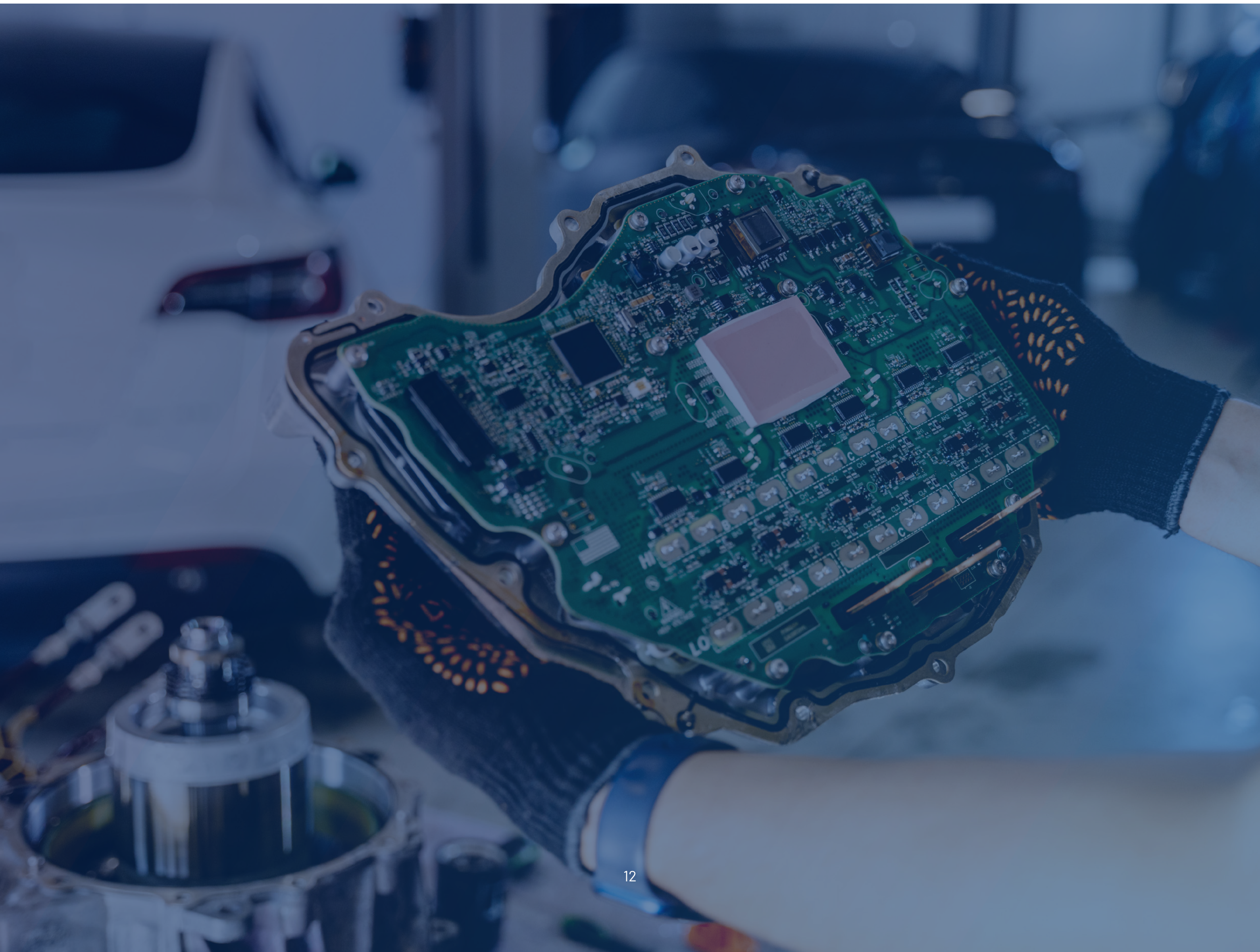
Microelectronics required for components or products **assembled or produced in the EU** and sold globally

e.g., an electric vehicle assembled in France and sold domestically, within the EU, or exported globally

Source: Strategy& analysis

The model is designed to provide a directional view of how European semiconductor demand develops over the forecast period. Its purpose is to establish orders of magnitude and structural trends rather than to deliver point-precise forecasts for individual product categories. The granularity and accuracy of the underlying data vary across segments. Verticals such as automotive or industrial production machinery can be modelled in considerable detail, drawing on robust production statistics and established market intelligence. Other segments, such as communication devices for factories or building and control systems, require a greater degree of assumption-based estimation, as publicly available data and dedicated market reports for these end-segments are either limited or non-existent.

The model was developed and owned by PwC Strategy& and refined in close collaboration with roughly 20 companies and 50 industry experts from across the semiconductor and end-industry landscape, predominantly member companies of ZVEI and FME. They contributed to construction of the model itself, calibration of reference designs, and validation of assumptions on technology evolution and market development. The outputs were also cross-referenced against established market intelligence from the participating companies and publicly available production and capacity data, to test consistency with independently-published forecasts and observed market trends. This process has strengthened confidence in the overall demand trajectory and its structural composition, though the accuracy of individual segments naturally varies with the underlying data availability.



1.2 EU semiconductor demand development

European semiconductor demand is on a clear growth trajectory across both demand perspectives (see Figure 1.5). The drivers are structural rather than cyclical. End-market industries that form the backbone of the European economy, from automotive and industrial production to energy infrastructure and healthcare, are all increasing their semiconductor content per unit of output as electrification, digitalisation, and automation advance. At the same time, entirely new demand pools are forming around AI infrastructure, edge computing, and connected systems. The combination of growing end-market volumes and rising chip intensity per product creates a compounding effect that sustains demand growth across the full forecast period.

On the consumption side, European semiconductor demand stands at approximately 1.8 million wafer starts per month (WSPM) in 2025, equivalent to the output of roughly 32 reference fabs. This represents around 12 to 16% of global semiconductor production capacity, broadly in line with the EU's share of global GDP.[3] In the base case, consumption demand roughly doubles by 2040, corresponding to around 65 fabs. This scenario projects forward the trends currently observable in the market, including AI data centre capacity expanding along the trajectory set by the ongoing wave of gigafactory investments, electrification of transport and industry advancing in line with existing regulatory frameworks and European climate targets, defence budgets rising as European governments follow through on spending commitments, and automation adoption proceeding at a steady pace across industrial environments. The approach to the green transition builds on the semiconductor demand modelling developed in the previous ZVEI Microelectronics Study, which used a comparable bottom-up methodology.[1] For segments with high current growth rates, the base case assumes a gradual deceleration over time to reflect increasing market maturity. The segment-specific drivers are discussed in detail in Section 1.3.

The pessimistic scenario reflects a world of slower transitions. Electrification proceeds at a more gradual pace, Physical AI systems such as mobile robots and humanoids take longer to reach large-scale adoption and cost competitiveness, and infrastructure constraints including electricity availability and grid capacity limit the pace of data centre build-out in Europe. Weaker economic development dampens consumer spending and industrial output, reducing the pull of semiconductor content across most verticals. Even under these conditions, consumption demand still grows by a factor of x1.6, confirming that the structural direction of travel holds even if the speed varies.

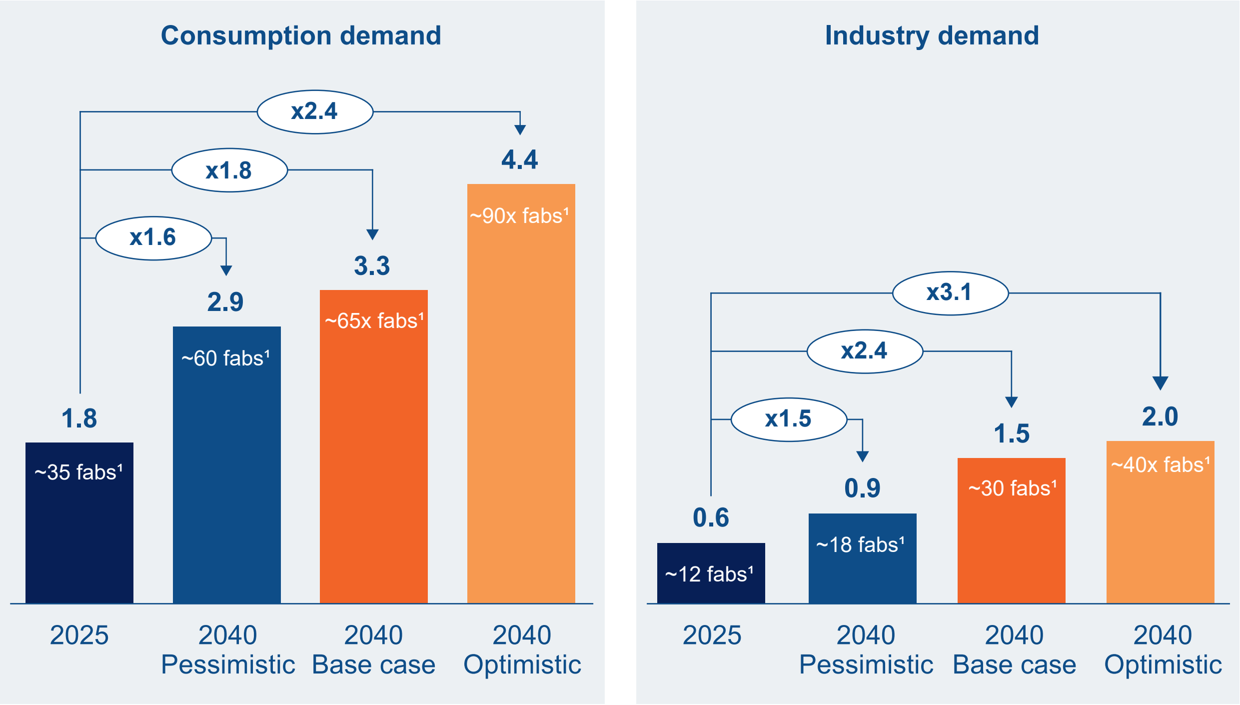
The optimistic scenario captures a faster-moving environment. AI compute demand scales rapidly and drives an accelerated build-out of data centre and edge infrastructure, electrification gains momentum through supportive regulation and falling technology costs, and connected systems from smart factories to autonomous vehicles move from pilot to mainstream deployment. Under these conditions, consumption demand grows by a factor of x2.4, meaning roughly 30% more semiconductors would be needed in 2040 compared to the base case.

Industry demand starts from a lower base of approximately 0.6 million WSPM in 2025, reflecting the fact that a significant share of the products consumed in Europe is manufactured elsewhere. However, in the base case, industry demand grows by a factor of roughly x2.4 by 2040, outpacing consumption demand growth. This is partly a compositional effect. Segments with lower growth rates, such as Consumer electronics, where Europe has limited manufacturing presence, carry less weight in the industry demand picture, while faster-growing segments where European producers hold strong global positions are more pronounced. The base case assumes the same underlying market trends as in the consumption demand perspective, combined with export shares for European industries that remain broadly stable at current levels. Under these conditions, Europe's established manufacturing strengths in automotive, industrial production, and energy technology continue to generate substantial semiconductor pull from global markets. The fact that industry demand grows faster than consumption demand strengthens the case for onshoring production capacity to Europe. It signals that European manufacturers are expanding their global footprint and, with it, their need for reliable, proximate access to semiconductor supply.

Furthermore, the scenario corridor is even wider here than for consumption demand, ranging from a growth factor of 1.5 under pessimistic assumptions to 3.1 under optimistic ones. The pessimistic scenario not only inherits the slower adoption dynamics described above but also assumes further declining export shares for European core industries such as automotive and industrial production, driven by intensifying competition from Asian manufacturers and the effects of ongoing geopolitical fragmentation on trade flows.

Taken together, the demand outlook for both perspectives confirms that semiconductors and microelectronics are becoming more deeply embedded in Europe's economy and daily life, not less. Consumption demand reflects the growing chip intensity of products used by European citizens, businesses, and public institutions. Industry demand captures the additional pull generated by Europe's manufacturing base, which translates domestic and global end-market growth into semiconductor volumes that go well beyond what local consumption alone would imply. Both dimensions show sustained growth across all three scenarios. That is the central conclusion of this first demand view: the market foundation for continued investment in European microelectronics is solid and structurally grounded. Where that growth concentrates, which segments drive it, and what it means for the positioning of the European ecosystem are the questions addressed in the following sections.

Fig. 1.5: European semiconductor demand development by scenario, in million WSPM and 300mm equivalent



1) A fab is defined here as a fab module with approximately 50.000 wafer starts per month. The fab numbers indicate the total equivalent capacity associated with the semiconductor demand shown at each point in time.
Source: Strategy& semiconductor demand model in collaboration with ZVEI and FME (see Section 1.1 for details)

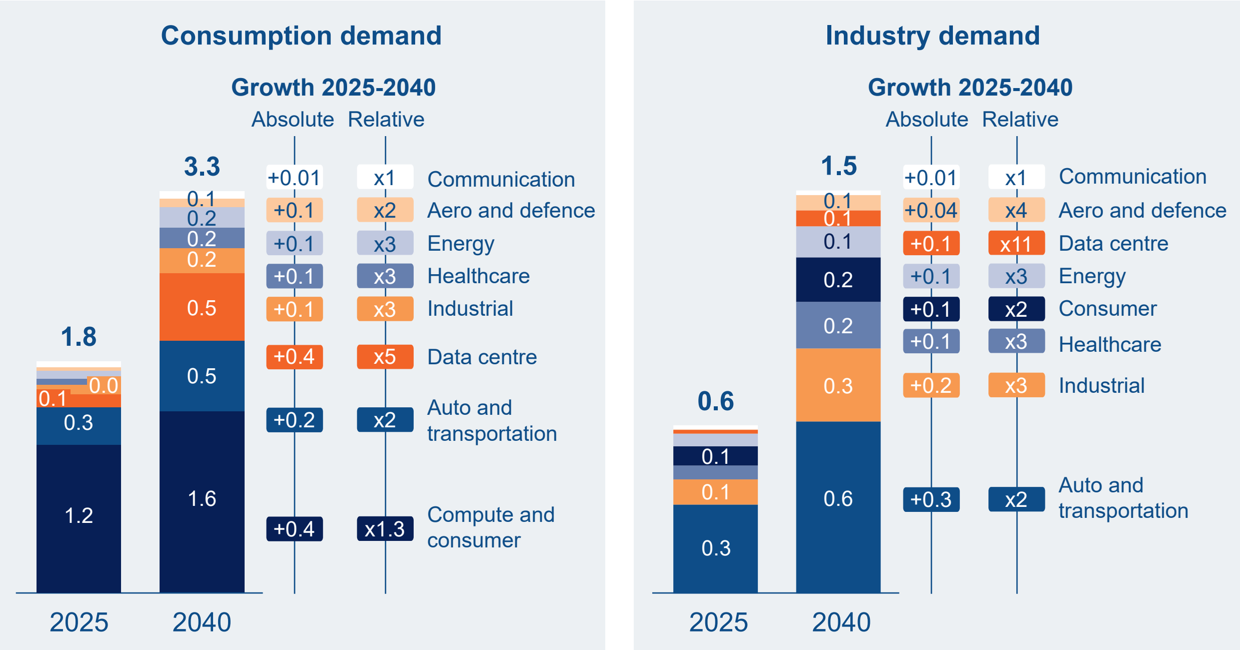
1.3 Demand development by industry

Disaggregating demand by industry (see Figure 1.6) shows that the sectors at the heart of European economic strength will remain major drivers of semiconductor demand over the forecast period. Automotive, industrial production, energy, and healthcare all show sustained growth on both the consumption and industry demand side. For automotive and industrial production, the industry demand trajectory is contingent on European end-players maintaining or further expanding their globally leading market positions in these sectors. Aerospace and Defence adds a further dimension, with strong growth potential driven by rising European defence spending and a deliberate policy shift towards European sourcing.

The end-market where the outlook raises the most fundamental question for Europe is data centres. Consumption demand for data centre semiconductors is growing at a factor of roughly x5, reflecting the structural build-out of AI and cloud infrastructure across the continent. Yet industry demand does not follow, because Europe currently lacks hyperscale data centre operators and cloud platform providers of global scale. Ongoing European initiatives in cloud infrastructure and digital sovereignty may begin to shift this trajectory, but on the current path, data centres represent the single largest gap between what Europe consumes and what its industry can generate in semiconductor pull.

A closer look at the composition of demand reveals how distinctly European industry demand differs from the consumption distribution. On the consumption side, as in any other region of the world, Compute & Consumer is by far the largest end-market, accounting for roughly 45% of total demand in both 2025 and 2040, driven by the sheer volume of purchased consumer electronics such as smartphones, laptops, and tablets. Since Europe has only a few domestic manufacturers in these product categories, with partial exceptions in white goods and smart-home segments, their weight in the industry demand picture is less pronounced. Instead, automotive & transportation dominates industry demand and delivers the largest absolute growth (+0.3 million WSPM), followed by Industrial (+0.2 million WSPM). This structural divergence is a defining feature of the European semiconductor landscape. It means that the sectors driving the largest volumes of consumption demand are not the same sectors where European industry generates its strongest chip pull, and investment priorities must reflect both realities.

Fig. 1.6: European semiconductor demand development by end-market, consumption and industry demand in million WSPM and 300mm equivalent



Source: Strategy& semiconductor demand model in collaboration with ZVEI and FME (see Section 1.1 for details)

Automotive & Transportation remains one of the largest demand pools across both perspectives. On the consumption side it roughly doubles to 2040, while on the industry side it grows from about half of total demand to roughly 40%, adding the single largest absolute volume of any segment. Key drivers are the ongoing electrification of powertrains, the proliferation of advanced driver-assistance systems (ADAS), and the growing semiconductor content per vehicle as software-defined architectures take hold. Europe's automotive OEMs and Tier-1 suppliers are among the world's largest consumers of power semiconductors, microcontrollers, and sensors, and their global production footprint means that industry demand for these chip types remains firmly anchored on the continent. That said, the scenario analysis reveals that automotive industry demand is particularly sensitive to whether European OEMs maintain their current global production share. If that share erodes through intensifying competition or geopolitical fragmentation of trade flows, industry demand could fall roughly 30% below the base case. The upside is more contained, driven primarily by faster electrification and ADAS adoption, which raise semiconductor content per vehicle but do not fundamentally alter production volumes. This makes Automotive the segment where the semiconductor investment case and the broader competitiveness of European industry are most directly intertwined.

Industrial covers a broad range of applications from factory automation and process control to robotics, logistics systems, and building technology. It grows solidly in both perspectives, with industry demand adding +0.2 million WSPM to 2040, making it the second-largest contributor to industrial growth after automotive. The underlying drivers are the continued digitalisation of European manufacturing, the deployment of industrial IoT at scale, and the increasing use of AI at the edge for predictive maintenance, quality inspection, and autonomous material handling. European industrial companies are significant global exporters, which sustains a strong industry demand pull for the microcontrollers, sensors, and power devices that these systems require. The longer-term trajectory of this segment depends to a considerable degree on whether European companies can establish competitive positions in the emerging Physical AI market, including production robotics, humanoid systems, and next-generation IoT platforms. If they succeed, the industrial vertical offers significant upside potential as these systems are highly semiconductor-intensive. A strong European Physical AI and industrial automation base would also help keep manufacturing across other European industries competitive, which in turn strengthens the economic case for producing semiconductors in Europe by deepening the domestic demand base and reinforcing cluster dynamics. If they do not, and the market is captured by non-European players, the resulting loss of manufacturing relevance would weigh on industry demand in much the same way as declining automotive export shares would affect that segment.

Compute & Consumer is the largest consumption demand segment, driven by personal computing devices, smartphones, gaming hardware, and the broader consumer electronics ecosystem. Growth here is steady rather than explosive, expanding by a factor of roughly x1.3 to 2040. The segment's sheer size reflects the volume of electronic devices purchased by European households and businesses. On the industry side, compute & consumer is smaller in absolute terms but grows faster at x2. This is largely a compositional effect. The slower-growing mass-market categories that dominate consumption demand, such as smartphones, notebooks, and TVs and displays, carry far less weight in the industry perspective because most of that hardware is assembled outside Europe. The categories that do have a European manufacturing dimension, such as smart home systems, service robotics, and embedded computing platforms, are growing at higher rates and account for a larger share of industry demand. As a result, the industry demand profile for this segment is tilted towards the faster-growing applications where European companies are more active.

Data centre is the fastest-growing segment by far, expanding at roughly x5-6 on the consumption side and x11 on the industry side, albeit from a small base. The growth is driven by the global build-out of AI training and inference infrastructure, hyperscale cloud capacity, and the increasing compute intensity of enterprise workloads. European consumption demand reflects the data centre capacity being deployed on European soil by both US hyperscalers and emerging European cloud providers. The resulting data centre wafer starts demand corresponds to roughly 8 to 10% of global data centre semiconductor demand, as indicated by expert interviews with companies within ZVEI and FME. If the EU's share of global data centre demand were proportional to its GDP share, as it broadly is in other industry verticals, this would imply that the EU currently covers approximately 60 to 80% of its data centre compute needs through facilities located within Europe. The gap to full coverage is consistent with the fact that Europe remains behind the United States in data centre build-out, particularly for AI training infrastructure. Industry demand remains modest in absolute terms, reflecting the limited presence of European data centre hardware manufacturers today. Whether this segment develops a meaningful European industry dimension will depend on the build-up of local design, packaging, and system integration capabilities over the coming years.

Energy demand grows in step with the green transition. The electrification of heating, the expansion of renewable generation capacity, the build-out of grid infrastructure, and the rollout of EV charging networks all translate directly into semiconductor demand, primarily for power devices and control electronics. Growth is around x3 across both perspectives. While the absolute volumes are smaller than those of automotive or industrial, the energy vertical carries strategic weight because it sits at the intersection of climate policy and infrastructure resilience, two areas where European governments are committing long-term public investment. The scenario corridor for this segment is shaped by two main forces. The first is the pace of the green transition itself: if regulatory momentum slows or policy shifts delay electrification targets, demand growth will fall below the base case. The second is the build-out of AI and data centre infrastructure, which is emerging as a major driver of electricity demand and, by extension, of the renewable generation, grid capacity, and charging infrastructure needed to support it. Together, these two factors create a scenario range of roughly -15% to +25% relative to the base case by 2040, making energy one of the segments where policy decisions and technology adoption dynamics on adjacent markets have the most direct impact on semiconductor demand.

Healthcare grows at a comparable pace and to a comparable size as the energy segment, reaching roughly x3 on both consumption and industry demand by 2040. The drivers are structural. An ageing European population, the increasing integration of AI into clinical workflows, and the steady rise of connected medical devices across diagnostics, imaging, and patient monitoring are all pushing demand upward. As healthcare systems digitalise, semiconductor content per device is climbing across the board, from high-end imaging equipment to wearable monitors and implantables. This makes healthcare a segment with sustained, policy-supported growth that is less exposed to cyclical swings than consumer-facing verticals and, correspondingly, less affected by the different scenario assumptions than most other segments in the demand outlook.

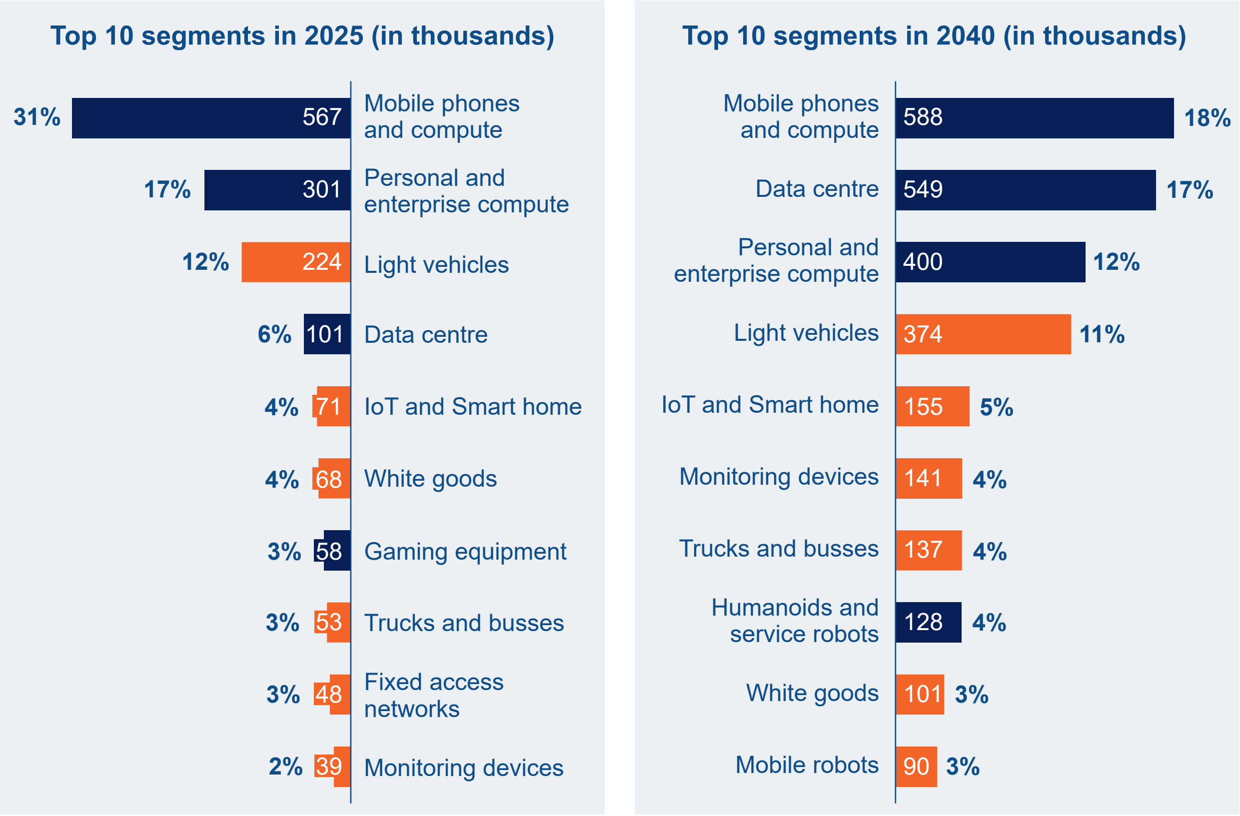
Aerospace and Defence is smaller in absolute volume but carries outsized strategic relevance. Consumption demand roughly doubles, while industry demand grows by a factor of x4, driven by increased European defence spending and the growing semiconductor intensity of modern military and space systems. A significant share of the growth comes from unmanned aerial systems, both military and private drones, although the trajectory for this sub-segment is inherently more uncertain than in other verticals as the technology is evolving rapidly and operational concepts are still being defined. The strong increase in industry demand relative to consumption demand is partly explained by a deliberate policy shift towards European sourcing. EU member states have committed to procuring at least 50% of defence equipment from the European defence industrial base by 2030 and 60% by 2035, up from levels where the vast majority of acquisitions were made outside the EU in recent years.[4] If implemented, this shift would substantially increase the semiconductor content sourced from European supply chains. These applications demand chips that meet stringent reliability, security, and certification standards, and they create a sovereignty-driven demand case that exists independently of commercial market dynamics.

Communication is the smallest segment and grows only modestly, reflecting the fact that the large-scale infrastructure rollout for 4G and 5G networks has already absorbed much of its demand peak in earlier years. Residual growth comes from network densification, private 5G deployments in industrial settings, and the gradual preparation for future 6G standards. The semiconductor content embedded in communication technology is nonetheless substantial and growing, but much of that growth is captured in adjacent segments. The chips powering edge computing nodes, data centre networking equipment, and connected IoT subsystems are classified under the verticals where those end-applications sit, rather than under communication infrastructure itself. Communication electronics remain a relevant enabler across virtually all other segments, but the demand attributed directly to this vertical reflects only the infrastructure layer.

Biggest segments driving semiconductor demand

Taking the analysis one level deeper, to the individual application segments that sit within those markets, the structural shift becomes even more visible. The ranking of the top ten application segments by semiconductor demand in 2040 looks significantly different from today's order (see Figure 1.7). Data centres rise from outside the top ten to the largest single segment, overtaking mobile phones and personal computing. Robots enter the ranking for the first time, reflecting the expected scale-up of Physical AI systems in manufacturing and logistics. Light vehicles climb further as ADAS and electrification push semiconductor content per car to new levels. Connectivity-driven applications such as smart home systems and industrial IoT communication move up as the installed base of connected devices expands across households and factory environments. Medical monitoring devices also enter the top ten, driven by the digitalisation of patient care and the proliferation of wearable health technology. The common thread across these shifts is clear. AI-enabled applications, connectivity platforms, and digitally enhanced physical systems are the segments gaining the most ground, while established mass-market categories such as smartphones and personal computing retain large absolute volumes but grow more slowly. This reconfiguration matters for capacity planning because it signals where future investment must be directed to match supply to demand, and it highlights that several of the fastest-rising segments sit in areas where European industry holds strong positions.

Fig. 1.7: Top 10 segments by European semiconductor consumption demand 2025 vs. 2040, in WSPM and 300mm equivalent; percentage number shows share of total European semiconductor demand across all segments



Note: Orange bars are core industry segments in the EU by being a top 10-15 segment within the EU industry demand
Source: Strategy& semiconductor demand model in collaboration with ZVEI and FME (see Section 1.1 for details)

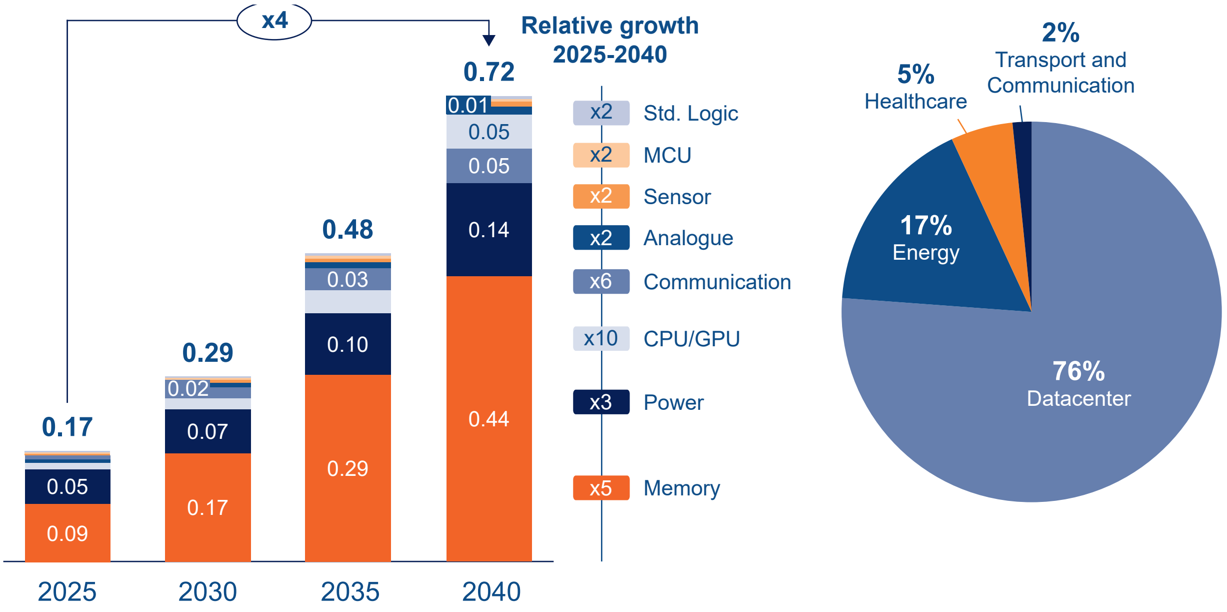
Critical infrastructure demand

Not all semiconductor demand carries the same strategic weight. Some applications underpin the continuous operation of systems that European society and economy cannot afford to see disrupted, from electricity grids and communication networks to hospitals and data centres. These applications cut across several of the verticals examined above. To make this cross-cutting dimension measurable, the scope applied in this analysis follows the definition set out in Annex I of the NIS2 Directive, which identifies the sectors of high criticality whose continuous operation is considered systemically relevant[5]. Sectors listed under Annex II, covering other important but less systemically critical areas, are not included. Within this perimeter, the scope captures semiconductor demand from commercial data centre operators, communication networks, grid-level energy generation and management, EV recharging infrastructure, ground-based infrastructure for space-based services, and critical-care and public health emergency medical devices, including patient monitoring equipment, treatment systems, diagnostics, and surgical devices. Consumer applications, road and transportation vehicles, defence applications, and industrial manufacturing and machinery fall outside the Annex I perimeter and are not included.

Figure 1.8 shows the resulting semiconductor consumption demand for critical infrastructure applications. The total rises from 0.17 million WSPM in 2025 to 0.72 million WSPM in 2040, a fourfold increase that underlines the growing role of semiconductors in critical infrastructure applications. The sector composition in 2040 is dominated by data centres, which account for 76% of total critical infrastructure demand and absorb the bulk of the growth. Energy applications contribute 17%, healthcare 5%, and transport and communication together 2%. The prominence of data centres reflects the scale of compute infrastructure required to support both cloud services and the expanding AI workloads that European businesses and public institutions increasingly rely on.

At the component level, the growth pattern mirrors the shifts already observed in the broader semiconductor mix, with greater intensity in categories tied to AI and connectivity. On the strength side, power devices grow by a factor of 3, while sensors, microcontrollers, analogue ICs, and standard logic each roughly double over the forecast period. These are the components embedded in energy generation and grid assets, charging infrastructure, and medical devices, and they map closely onto European manufacturing strengths. A meaningful share of the demand generated by systemically critical applications in Europe can therefore be served from European production, provided that the corresponding capacity is secured and scaled in line with the demand trajectory.

Fig. 1.8: Semiconductor consumption demand development for critical infrastructure applications, in million WSPM and 300mm equivalent, and share by end-market in 2040 in %



Source: Strategy& semiconductor demand model in collaboration with ZVEI and FME (see Section 1.1 for details)

On the gap side, the picture is more challenging. Data centre expansion is by far the dominant driver of demand growth in this perimeter and translates into a steep rise across three component categories. CPU and GPU demand grows by a factor of 10 from 2025 to 2040, the steepest trajectory across all component types in the segment, driven by the compute requirements of cloud and AI workloads. Memory grows by a factor of 5 and communication chips by a factor of 6, reflecting the networking and interconnect silicon needed to move data at scale within and between data centres, alongside the continued build-out of public communication networks. Taken together, these categories account for the largest share of absolute demand growth within the critical infrastructure perimeter, and they are precisely the segments where Europe has limited or no production capacity today.

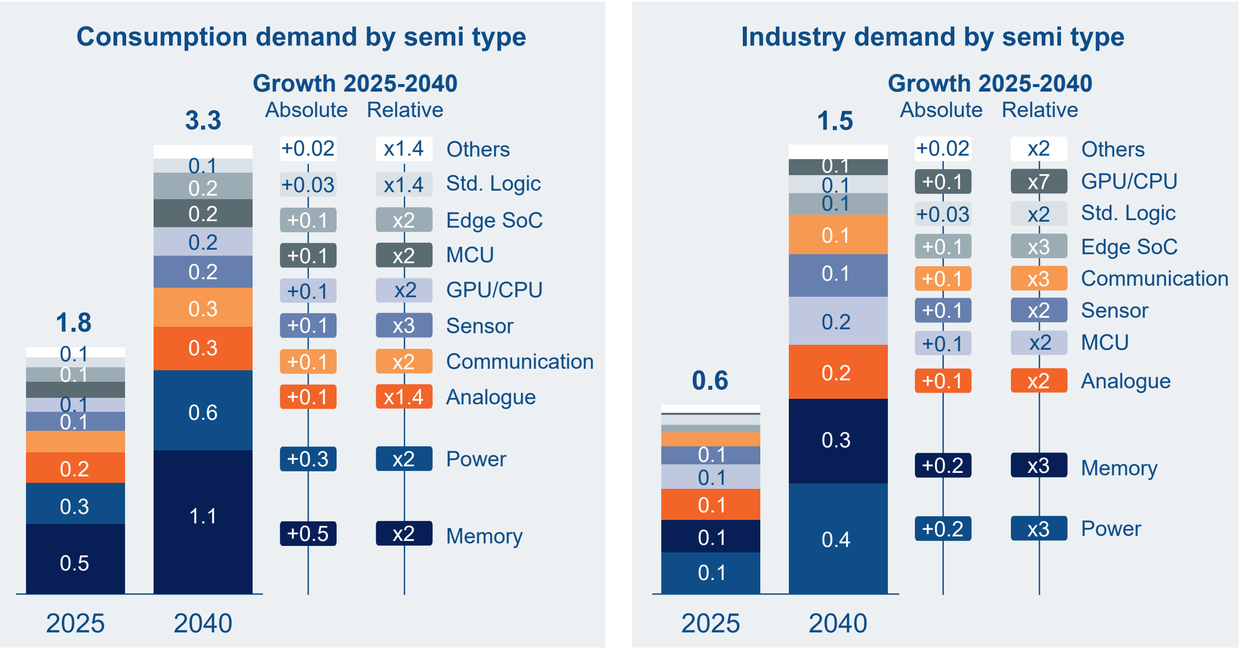
That alignment is a strategic asset, but it requires active maintenance. If European capacity keeps pace, the critical infrastructure segment offers a demand base that is less exposed to cyclical swings than consumer-facing markets and that reinforces the commercial case for sustained investment at mature nodes. If it does not, the resulting dependence on non-European suppliers for the semiconductor content of energy grids, hospital equipment, and telecommunications networks creates a vulnerability that commercial procurement alone cannot manage. The supply chain disruptions of 2020 to 2023 underlined that the risk is not hypothetical. Customers experienced first-hand that access to semiconductors can be interrupted for reasons entirely outside their control, from pandemic-related factory shutdowns to geopolitical tensions affecting trade flows. For these customers, the ability to source from a region that can guarantee continuous and reliable supply has become a procurement criterion in its own right.

1.4 Demand development by semiconductor type and technology

The preceding section showed where European semiconductor demand is growing by end-market. It answers the question as to which industries drive demand. It does not, however, answer the question of what types of chips and what production technologies are needed to serve that demand. Both questions matter for prioritising investments. The end-market perspective determines which customer industries justify investment. The semiconductor type and process node perspective determines what design capabilities and manufacturing capacity Europe needs to have in place. It is this second lens that connects the demand outlook directly to the focus area assessment in Section 1.7, where the analysis identifies which positions along the value chain Europe should strengthen, build, or maintain.

The demand outlook by semiconductor type confirms that the product categories at the core of Europe’s semiconductor industry remain on a robust growth trajectory. Power semiconductors, microcontrollers, sensors, and analogue ICs all show sustained demand expansion driven by the electrification, automation, and digitalisation of European end-markets. These are the categories where European Integrated Device Manufacturers (IDMs), fabless companies, and foundries hold established global positions, and the data shows that those positions are aligned with where substantial demand growth is heading. Maintaining and extending these positions requires continued investment in both production capacity and next-generation product development. A dominant market position is not self-sustaining. It must be actively reinforced through technology leadership, manufacturing scale, and the ability to serve customers from a competitive domestic production base. At the same time, the outlook reveals that semiconductor categories where Europe has limited or no industrial presence are among the fastest-growing segments in absolute terms. Memory, GPUs, and advanced logic processors are absorbing a rising share of total demand, pulled by the AI compute build-out and the exponential growth in data-intensive workloads. The resulting picture is one of continued relevance in Europe’s traditional strongholds, provided the necessary investments are made to defend them, combined with widening exposure in product categories that are becoming systemically important.

Fig. 1.9: Semiconductor demand by semiconductor type, consumption and industry demand in million WSPM and 300mm equivalent



Source: Strategy& semiconductor demand model in collaboration with ZVEI and FME (see Section 1.1 for details)

Power semiconductors and analogue ICs

Power semiconductors and analogue integrated circuits form the backbone of Europe's established semiconductor industry. Power devices grow by roughly x2 on the consumption side and x3 on the industry side, driven by the electrification of transport, the build-out of renewable energy infrastructure, and the increasing power management requirements of industrial systems. The expansion of AI applications is compounding this growth from two directions. AI data centres require sophisticated power delivery and conversion infrastructure, while edge systems such as robots, drones, and autonomous machines depend heavily on efficient power management at the device level. Analogue ICs follow a comparable trajectory at roughly x1.4 on consumption demand, serving a wide range of signal processing, power conversion, and interface functions across virtually every end-market. Both categories are manufactured predominantly at mature nodes above 80 nm, where European fabs are concentrated, and both are produced by European IDMs with strong global market positions. The growth in these categories is substantial in absolute volumes, adding +0.4 million WSPM in both consumption and industry demand, and confirms that Europe's core manufacturing base is aligned with a demand pool that is expanding steadily.

Sensors and microcontrollers

Sensors and MCUs are the second pillar of European semiconductor strength. Sensors grow at roughly x2 across both perspectives, pulled by automotive (ADAS, powertrain monitoring), industrial automation (machine vision, predictive maintenance), and healthcare (wearable diagnostics, patient monitoring). MCUs follow a similar pattern, with demand driven by the proliferation of embedded intelligence across all verticals. Every connected device, every automated production cell, every smart grid node requires at least one MCU. As the number of these endpoints grows and their functionality increases, MCU demand compounds accordingly. On the industry side, growth is even stronger, reflecting the fact that European companies design and manufacture many of the MCUs and sensors used in their own automotive and industrial end-products.

GPUs, CPUs, and memory

The fastest-growing semiconductor categories are GPUs and memory, areas where European producers have minimal or no presence. GPU/CPU demand grows at roughly x3 on consumption and x7 on industry demand, albeit from a very small industry base, driven by the build-out of AI training and inference infrastructure in European data centres. Memory follows a comparable trajectory at roughly x3 on both perspectives, as every additional GPU deployed requires corresponding volumes of high-bandwidth memory. Together, these two categories represent the product space most directly tied to the AI compute cycle. The gap between what Europe consumes in GPUs and memory and what it can supply domestically is widening with each year. This is also where the node requirements diverge most sharply from Europe's current manufacturing profile, as GPUs and advanced memory are produced at sub-10 nm nodes where Europe has almost no production capacity today.

Communication and Edge SoCs

Communication chips and Edge SoCs serve the connectivity and distributed computing layers that link sensors, controllers, and cloud infrastructure. Communication chips grow at roughly x2 on consumption and x3 on industry demand, driven by the expansion of IoT networks, private 5G deployments, and vehicle-to-everything connectivity. Edge SoCs, which integrate processing, connectivity, and increasingly AI inference capabilities into a single device, grow at roughly x2 on consumption and x3 on industry demand. These categories are particularly relevant for the European ecosystem because they sit at the intersection of hardware and application-specific software, an area where proximity between chip designers and system integrators creates strong co-development dynamics.

Standard logic and other devices

Standard logic, optoelectronic components, and other semiconductor categories grow more moderately, at roughly x1.4 to x2 across both perspectives. Standard logic provides general-purpose building blocks used across a wide range of electronic systems. Optoelectronics, including LEDs, laser diodes, photodetectors, and image sensors, serve applications from automotive lighting and industrial machine vision to medical imaging and fibre optic communication. While these categories do not individually stand out as growth drivers, they remain essential components in virtually every electronic system and their combined volume is substantial.

Value development

Beyond the volume dimension captured by the wafer view, the value dimension of demand offers additional insight into the strategic picture. A full revenue-based assessment was not part of the analytical scope of this study, but a high-level perspective on how the quantity picture shifts when translated into value is worth setting out here, as it sharpens several of the implications discussed above.

On the strength side, a number of categories where European players lead become even more important when demand is measured in economic value rather than wafers. Edge AI is migrating into microcontrollers, sensors, automotive and industrial SoCs, and connectivity ICs, and this transition lifts the value of each device well beyond the underlying volume growth. Software-defined vehicles, Physical AI applications, and connected industrial systems add further silicon content per end product, reinforcing the revenue trajectory across Europe's specialty portfolio.

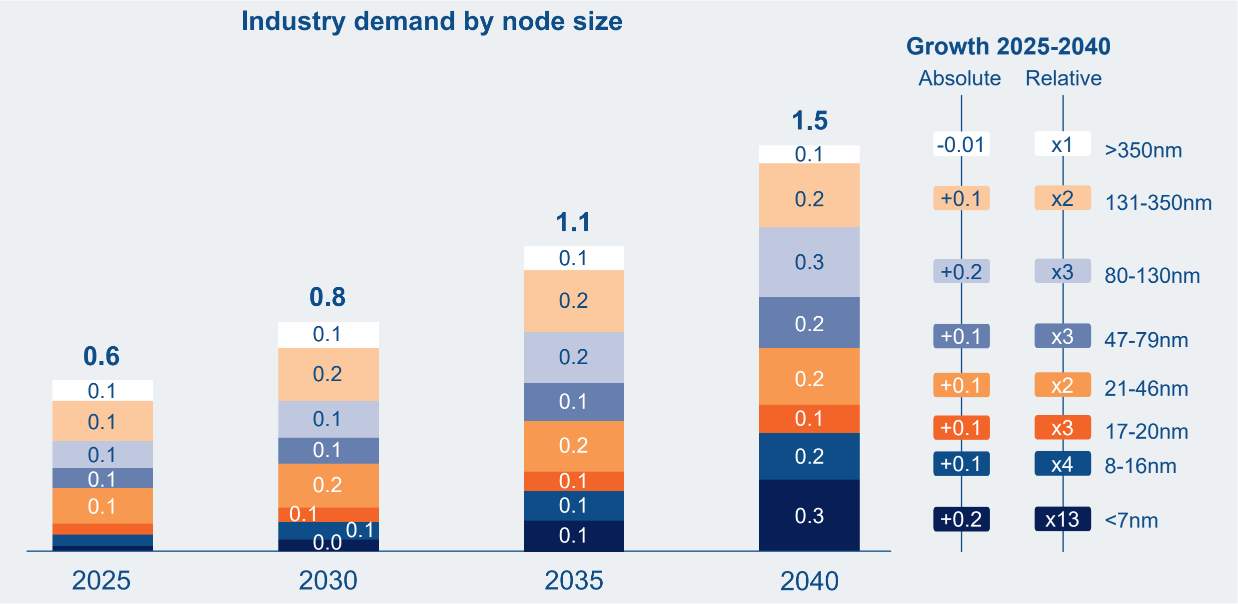
On the other hand, some of Europe's gaps become even more pronounced in the value picture. Advanced logic and high-bandwidth memory are the most expensive components in the current semiconductor landscape, and although present shortages contribute to a disproportionately high price level that will ease over the coming years, these segments will remain at the top of the value pyramid. Europe's absence from them therefore represents a larger share of the global semiconductor revenue pool than the capacity numbers alone indicate. Taken together, the value perspective reinforces rather than displaces the quantity view. It widens the advanced-node gap that Europe needs to address and, at the same time, strengthens the economic case for the specialty positions where European companies have leading positions.

Process node perspective
Translating demand into process nodes requires grouping technologies into defined ranges. In practice, adjacent generations such as 12/16 nm or 22/28 nm are often produced in the same facilities and on shared toolsets, so the ranges used here should be understood as an analytical segmentation to identify key growth areas going forward rather than strict physical separations. On this basis, they provide a reliable approximation of the broader demand and capacity trends relevant to the European investment discussion.

On this basis, the node view reveals where European manufacturing capacity matches the growth trajectory and where it does not. In the mainstream node ranges of roughly 21 to 130 nm, where Europe has meaningful industrial positions across IDMs and foundry-supported supply, demand continues to grow at robust rates. This range includes the core of Europe's MCU, sensor, analogue, and power semiconductor production, but also strategically important nodes such as 45 nm, 28 nm, and 22 nm, where foundries such as GlobalFoundries and ESMC in Dresden play an important role. Nodes above 130 nm, anchored in the electrification cycle, remain substantial in volume and are far from declining. This sustained growth confirms that expanding and modernising production capacity at these nodes is not only justified but necessary, and it underscores that the European investment conversation should not be narrowed to leading-edge geometries alone. The mainstream nodes are where European producers compete globally today, and the demand trajectory shows that these positions will only grow in strategic and commercial relevance over the coming decade.

At the same time, the structural challenge at the other end of the spectrum cannot be ignored. Demand at nodes below 16 nm is growing faster than any other segment, driven by AI processors, advanced logic, and high-bandwidth memory, yet Europe currently has virtually no production capacity at these geometries. Between these two poles, the memory-dominated 17 to 20 nm range presents distinct strategic questions that require differentiated responses. The node view sharpens the investment question. It shows both how much additional capacity Europe needs and at which technology levels that capacity must be built. European strengths and gaps across the node landscape are discussed in detail in Section 1.7.

Fig. 1.10: Semiconductor industry demand by process node, in million WSPM and 300 equivalent



Source: Strategy& semiconductor demand model in collaboration with ZVEI and FME (see Section 1.1 for details)

Below 16 nm: advanced logic, AI processors, and high-bandwidth memory

The nodes below 16 nm display the steepest growth trajectories in the entire demand outlook (see Figure 1.10). At sub-7 nm, industry demand grows by roughly x13, driven by GPUs and high-performance CPUs for AI training and inference, alongside high-bandwidth memory. With an absolute increase of +0.2 million WSPM, sub-7 nm is the largest contributor to industry demand growth across all node ranges. The 8 to 16 nm range follows a structurally similar pattern at somewhat lower intensity. Beyond AI applications, semiconductor types previously manufactured at larger geometries are also migrating into sub-16 nm territory as their performance requirements increase. A portion of MCUs will move below 7 nm as software-defined vehicle architectures demand more on-chip compute. Communication chips for high-speed data centre interconnects and edge SoCs integrating processing, connectivity, and AI inference on a single die are following the same trajectory. Europe currently has no significant production capacity at these nodes, with the partial exception of Intel's operations in Ireland. The gap between European demand and domestic supply at leading-edge nodes is therefore widening as the AI infrastructure build-out accelerates. Closing or narrowing this gap would require both manufacturing investment and the development of European design capabilities in advanced logic and memory.

17 to 20 nm: the memory node

The 17 to 20 nm range is defined almost entirely by memory. Demand roughly triples on both consumption and industry demand, driven by the expansion of data-intensive applications across virtually every end-market. Every additional GPU deployed in an AI accelerator requires corresponding volumes of high-bandwidth DRAM, every data centre expansion increases NAND Flash storage demand, and every connected device adds incremental memory content. Europe has no meaningful memory manufacturing presence at these nodes, and the global market is highly concentrated among a small number of Asian producers.

21 to 130 nm: the broadest product mix and European manufacturing core

The node range between 21 and 130 nm is where the broadest mix of semiconductor types comes together, and where European manufacturing is most firmly established. Demand grows at roughly x2 to x3 across the 47 to 130 nm ranges on both consumption and industry demand, with the 21 to 46 nm segment growing more moderately at around x1 as some product categories migrate further downward into sub-16 nm territory. MCUs, the workhorses of automotive and industrial control systems, are produced predominantly in this range. Sensors of all types, both optical and non-optical, are concentrated here alongside analogue ICs, Edge SoCs, and communication chips. Standard logic and a share of specialty memory also fall within this band. This is the node range that serves the verticals where European industry is strongest, from automotive and factory automation to energy infrastructure and healthcare devices. The growth is driven by both the expansion of served end-markets and the ongoing migration of chip designs into more advanced process generations within this range. The data confirms that Europe's existing fab base remains well-aligned with a large and expanding demand pool and warrants sustained investment in both capacity expansion and technology migration.

Above 130 nm: power devices, non-optical sensors and analogue

At nodes above 130 nm, demand at 131 to 350 nm remains roughly stable while nodes above 350 nm show a slight contraction. The absolute volumes, however, remain substantial. This is the domain of power semiconductor discretes, produced overwhelmingly at these geometries due to the physics of high-voltage and high-current switching. The demand is anchored in the electrification of transport, renewable energy build-out, grid modernisation, and EV charging infrastructure. Analogue ICs, non-optical sensors, and optoelectronic components are also concentrated here, serving long-lifecycle applications where reliability and qualification standards outweigh the performance advantages of node shrinks. The slight contraction above 350 nm reflects a gradual migration of some designs into smaller geometries rather than a decline in underlying applications. European manufacturers hold strong positions across these nodes, and the continued demand reinforces the rationale for maintaining and modernising existing production capacity.

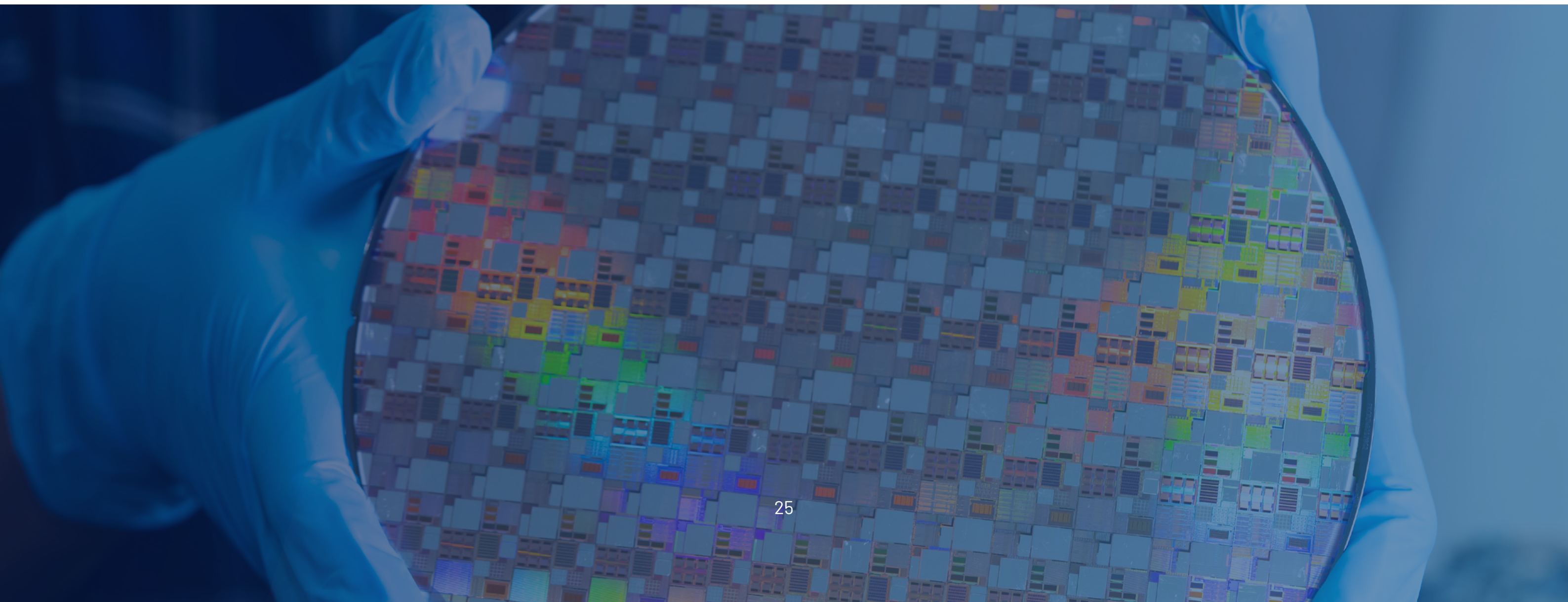
1.5 Demand across other parts of the value chain

Every chip that is designed, manufactured, and shipped requires equipment to produce it, a printed circuit board to mount it on and connect it, passive components to enable its function, and electronics manufacturing services to assemble the final system. The health of Europe's microelectronics ecosystem, which defines its strategic strengths in the global competition, therefore depends on the entire value chain, not only on the fabs at its centre. A demand outlook that doubles European semiconductor consumption by 2040 has direct consequences for the adjacent segments that enable chip production and integration. Understanding these downstream effects matters for two reasons: it identifies where additional investment is needed to avoid bottlenecks, and it reveals where Europe's position is strong enough to capture the value that a growing chip market generates.

The demand estimates for equipment and PCBs were derived directly from the semiconductor demand models developed in the preceding sections. For equipment, a dedicated model estimates the type and quantity of production tools required for semiconductor manufacturing by production technology and node size, translating wafer capacity growth into equipment demand by category. For PCBs, the model translates semiconductor die area by chip type into corresponding PCB area requirements. Industry-validated assumptions for support component factors, which account for the board footprint of surrounding passive components, and routing and spacing factors, which account for the area between components, complete the translation from chip-level demand to board-level demand. EMS was not modelled separately but is discussed alongside the PCB segment, as similar growth patterns would be expected based on industry trends.

The analysis shows that increasing semiconductor demand drives significant growth across all adjacent value chain segments, but the picture is more complex than a simple read-across from chip volumes would suggest. In semiconductor equipment, theoretical demand derived from European consumption and industry demand grows substantially, by factors of x3 to x4. A large portion of that growth, however, is attributable to AI-driven and high-performance computing applications whose chips are overwhelmingly manufactured outside Europe — in Taiwan, South Korea, China and the United States. European equipment makers operating in those segments therefore serve the majority of their customers outside the EU, including the build-up of critical process IP jointly with local manufacturers on-site. European equipment companies focused on mainstream process technologies, by contrast, stand to benefit directly from the capacity expansions taking shape within Europe.

In PCBs and EMS, the demand trajectory is driven by the same end-market verticals that underpin European semiconductor strength: automotive, industrial, energy, and an increasingly important defence segment. Growth in these verticals is robust and structurally anchored. The challenge is that Europe holds less than 2% of global PCB and EMS production, with the overwhelming majority concentrated in Asia, including a heavy dependence on China. As semiconductor content per European end-product rises and the defence and critical infrastructure segments grow in strategic importance, this dependence is not shrinking but deepening. The result is a widening gap between the demand that European industries generate and the manufacturing capacity that Europe controls in the segments that turn chips and boards into functional systems.



Semiconductor equipment market value

The equipment market derived from European semiconductor demand follows the same structural growth trajectory as the underlying chip volumes, amplified by the technology mix (see Figure 1.11). Total equipment value driven by European end-market consumption roughly triples between 2025 and 2040, growing to USD 50 billion. On the industry demand side, the market value expands from around USD 6 billion to approximately USD 19 billion. Much of this growth, however, is a theoretical market from Europe's perspective. It quantifies the equipment that would be needed if all the chips consumed in Europe were also produced here. At advanced nodes at 7 nm and below, where EUV lithography is the fastest-growing equipment category by a wide margin, virtually all production and a significant portion of the IP and product development takes place in Taiwan, South Korea, and the United States. The equipment demand those chips generate materialises in those regions, not in Europe, even though many of the lithography systems, deposition tools, and metrology platforms serving that demand are designed and built by European companies. At the mainstream nodes where Europe's manufacturing base is concentrated, equipment demand translates into actual business for European fabs and the companies that supply them.

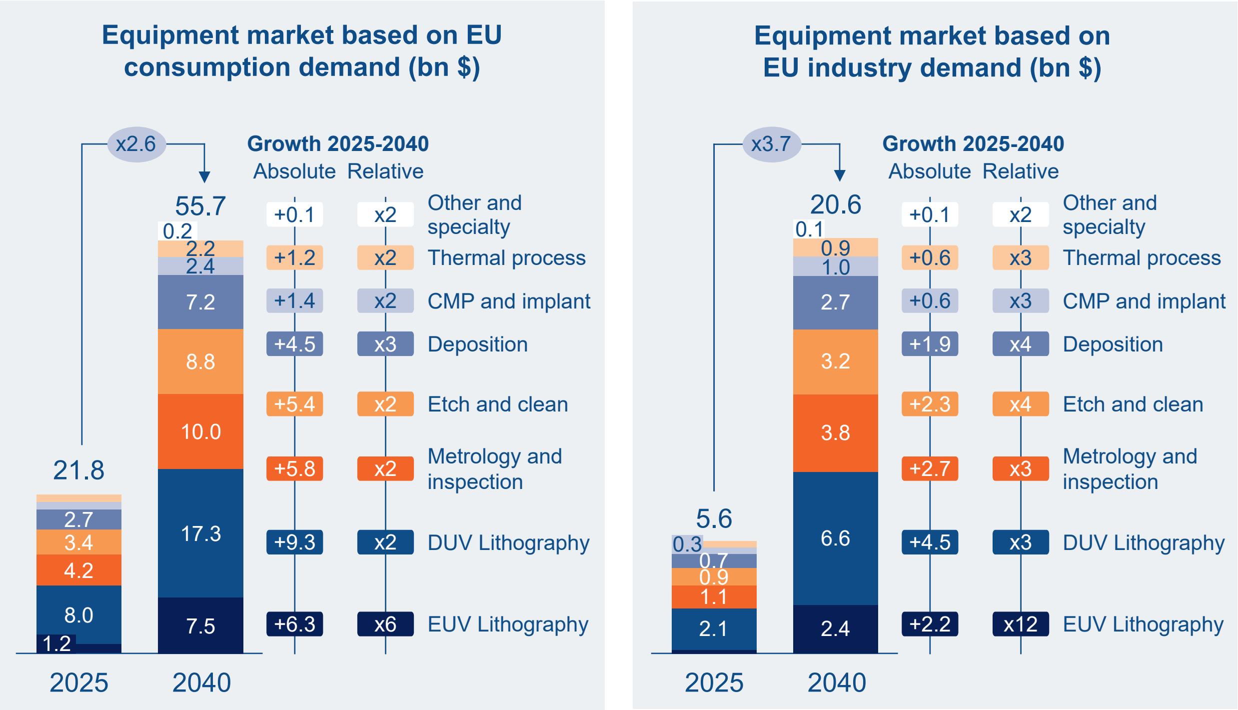
How much of that business could be captured within Europe through additional capacity build-up also depends on the competitive landscape across equipment categories. ASML occupies a singular role in lithography. Its EUV technology has no equivalent anywhere in the world, and in DUV lithography the company commands a dominant market share. In deposition, metrology, and specialty process equipment, companies such as ASM, AIXTRON, and SUSS MicroTec hold strong positions in specific segments. In etch and clean, CMP, and mainstream deposition, by contrast, European presence is limited or absent, with the market dominated by US, Japanese, and increasingly other Asian competitors. As European fab capacity expands, demand will grow across all these categories. Where European suppliers lead, that growth reinforces their position. Where they do not, it deepens Europe's dependence on non-European equipment makers for the tools its own fabs require.

Revenue from equipment sales, moreover, captures only a fraction of the value the industry creates. For every euro spent on assembling and installing equipment in a fab, an estimated factor of up to ten is spent upstream on the research, development, and engineering required to create that equipment in the first place.[6] Product development cycles for next-generation tools span years and consume billions of euros. The equipment industry's economic footprint in high-value employment, supplier ecosystems, and innovation output is therefore a multiple of what the sales figures alone suggest. Since next-generation equipment must be developed in close collaboration with the lead customers who run the most advanced processes, the product development centres of European equipment companies increasingly gravitate towards the regions where those customers operate. The extensive presence of European equipment companies in East Asia is the most visible example, but the pattern extends across the equipment value chain. When the customers that define the technology frontier are located outside Europe, the R&D that serves them follows, together with the high-value engineering jobs, supplier networks, and knowledge accumulation that product development generates.

The technology leadership of European equipment companies is deep, but it is not self-sustaining. Continued investment in R&D and next-generation product development is essential to maintain it, particularly as competing regions, most notably China, accelerate efforts to build domestic equipment capabilities as part of broader self-sufficiency strategies. Export restrictions add further pressure by narrowing the addressable market for European suppliers in certain segments. In this context, expanding semiconductor manufacturing capacity in Europe at advanced nodes would serve a dual purpose. It would address the supply gap in chips, and it would create local demand that strengthens the investment base of European equipment companies, anchoring product development activity, high-value engineering jobs, and supplier ecosystems on the continent rather than ceding them progressively to the regions where the customers with the most demand currently operate.

Reshoring selected equipment product development activities to Europe is an important step toward an ecosystem capable of supporting advanced-node chip development and manufacturing. Strengthening Europe's base for semiconductor equipment technology development, rather than relying on activities that increasingly take place outside the EU, would reinforce technological sovereignty and deepen the ecosystem by stimulating innovation across research organisations, materials and component suppliers, and chip design firms.

Fig. 1.11: Semiconductor equipment market volume derived from European semiconductor demand by equipment type, in billion USD



Source: Strategy& semiconductor equipment model in collaboration with ZVEI and FME (see Section 1.1 for details)

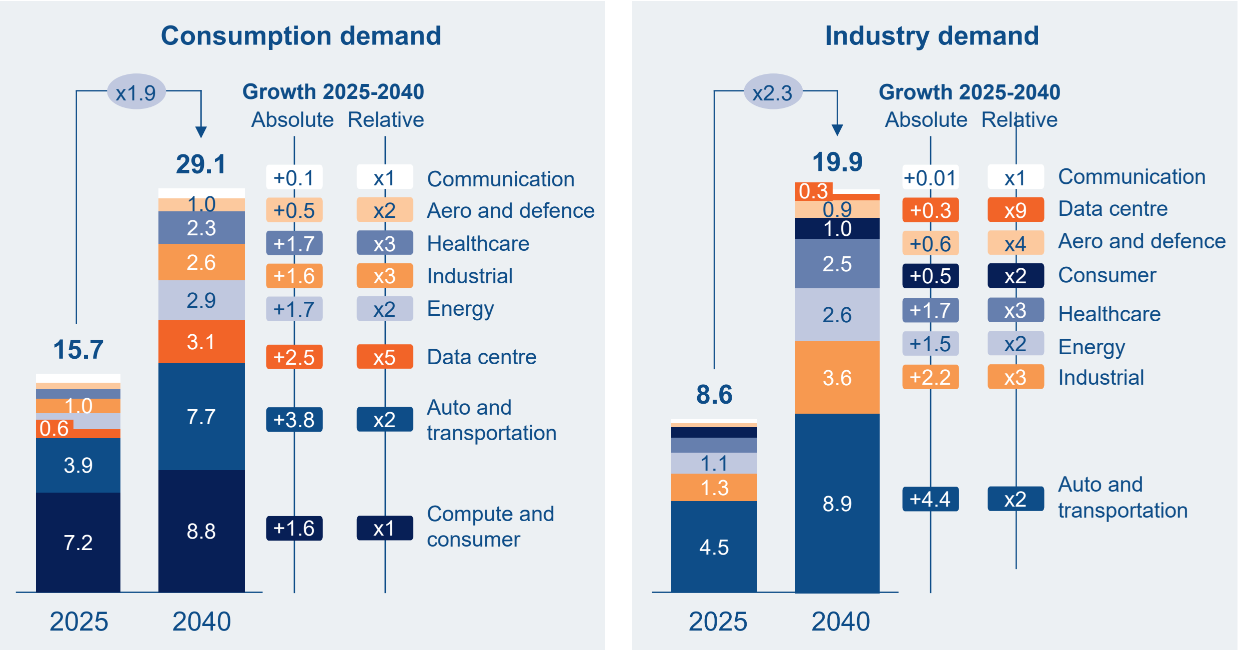
Printed circuit boards

PCB demand follows a trajectory that is structurally linked to, though distinct from, semiconductor demand (see Figure 1.12). Every end-product that contains semiconductors also requires circuit boards to mount them on, connect and route signals between them, and provide the physical and electrical interface to the broader system. On the consumption side, total PCB demand grows from roughly 13 million square metres per year in 2025 to approximately 25 million square metres by 2040. Industry demand grows faster, from around 7 million to 17 million square metres, again mirroring the pattern observed in the semiconductor analysis where European manufacturers' global export activity generates proportionally stronger pull. The same end-market verticals that drive semiconductor growth also drive PCB demand. Automotive delivers the largest absolute growth on both perspectives, reflecting the rising electronic content per vehicle. On the industry demand side, automotive alone accounts for nearly half of total PCB demand in 2040. Data centres stand out with the steepest relative growth on the consumption side, expanding roughly twentyfold from a small base, driven by the board-level complexity of AI server architectures. A single high-performance AI server rack requires multiple layers of advanced PCBs using high-density interconnect technology, high-frequency substrate materials, and embedded component techniques that push well beyond conventional board manufacturing. The broader trend towards heterogeneous integration, where semiconductor dies are embedded directly into circuit board substrates to improve performance and reduce system size, further elevates the PCB from a passive carrier to an active part of the semiconductor package itself. Defence and critical infrastructure applications add a further dimension where the requirements are not volume-driven but defined by stringent reliability, traceability, and supply chain security standards, with industry demand in this segment growing by roughly a factor of four. This segment becomes notably more critical in the future, and local sourcing requirements will have direct implications for the European ecosystems.

The structural challenge for Europe in PCBs is not demand, but supply. European PCB manufacturing capacity has declined substantially over the past two decades as production migrated to Asia, where labour costs are lower and economies of scale favour large-volume operations. China alone accounts for over half of global PCB production, with Taiwan, South Korea, and Japan covering much of the remainder. The European PCB base that remains is concentrated in lower-volume, higher-complexity segments such as aerospace, defence, automotive, and medical applications, where proximity to the customer, qualification requirements, and security considerations justify the cost premium. For high-volume consumer and datacom PCBs, Europe is almost entirely import-dependent.

This dependency creates a resilience vulnerability that the demand numbers make visible. For commercial applications, global sourcing is a workable model so long as trade flows remain open. For defence electronics, critical infrastructure, and applications subject to export control regimes, however, reliance on non-European PCB supply introduces a risk that cannot be managed through commercial procurement alone. The demand outlook therefore reinforces the case for maintaining and selectively expanding European PCB capacity in strategically relevant segments, and for investing in the technology upgrades needed to keep that capacity competitive in HDI (high-density interconnect technology), advanced substrates, and embedded component technologies that align with the growing complexity of European semiconductor products.

Fig. 1.12: PCB demand by end-market, consumption versus industry demand in million square metres per year



Source: Strategy& PCB demand model in collaboration with ZVEI and FME (see Section 1.1 for details)

Electronics manufacturing services

The EMS segment sits at the downstream end of the electronics value chain, where semiconductors, PCBs, passives, and other components are assembled into functional electronic systems. EMS demand is a derived function of the same end-market trajectories that drive semiconductor and PCB growth. As automotive electronics content increases, as industrial systems become more sensor-rich and connected, as energy infrastructure deploys more power electronics and smart controls, and as defence systems grow in electronic complexity, the assembly and integration workload grows in proportion. The demand for EMS in Europe is therefore expanding along the same structural lines as PCB.

The supply-side mirrors the challenges described for PCBs, with additional characteristics that make the EMS segment distinctly difficult for European operations. Electronics assembly is labour-intensive, particularly at high volumes, and the cost advantage of Asian EMS providers, especially in China, Vietnam, and Malaysia, is substantial. Global EMS leaders such as Foxconn, Pegatron, and Flex operate at scales that European contract manufacturers cannot match, and their cost structures reflect decades of optimisation around high-throughput, low-margin operations. European EMS capacity has consequently consolidated into niches where the requirements go beyond pure assembly cost: automotive electronics with functional safety certification, medical devices with regulatory traceability, aerospace and defence systems with security-cleared production environments, and industrial equipment with small-to-medium batch sizes and high product variability.

What the semiconductor and PCB demand analysis makes clear is that these niche positions are becoming more, not less, important. As semiconductor content per European end-product rises, the assembly and integration step that turns discrete components into functional systems grows in both technical complexity and strategic relevance. A power electronics module for an EV drivetrain, a radar sensor assembly for an autonomous vehicle, or a server board for a defence-grade data centre cannot be assembled on a generic consumer electronics line. They require specialised process knowledge, quality management systems certified to automotive or aerospace standards, and in some cases security-cleared facilities and personnel. European EMS providers occupy these segments because the requirements serve as natural barriers to offshoring. The question is whether the capacity in these segments is sufficient for the projected demand trajectory, and whether the investment needed to modernise and expand these operations is forthcoming.

For defence and critical infrastructure applications specifically, the case for European EMS capacity is not primarily economic but strategic. The growing policy emphasis on European defence procurement, with EU member states committing to source an increasing share of equipment from the European defence industrial base, creates a demand signal that runs directly through the EMS segment. A semiconductor designed in Europe and manufactured in a European fab still depends on a trusted assembly step to reach the final system. If that assembly step takes place outside controlled European supply chains, the sovereignty objective is incomplete.

1.6 Emerging technologies on the rise

The demand model underlying this study captures what can be quantified from current technology roadmaps and announced product trajectories. It does not, and cannot, account for technology shifts that are still in the laboratory or at early-stage commercialisation. Several of these shifts have the potential to reshape semiconductor demand patterns, create new market segments, and alter the competitive equation in ways that could favour Europe if the right investments are made early enough. The window to establish meaningful positions in these fields is open now, but it will not remain so indefinitely. Once global leaders lock in scale advantages and ecosystem control, latecomers face far steeper barriers to entry. Europe's research institutions and industrial players are active across all of the technologies discussed below. The question is whether that research base translates into industrial positions before competitors capture the ground, and how European policymakers and industry can actively support the industrialisation and commercialisation of these technologies through targeted funding, regulatory frameworks, and strategic procurement.

- **Silicon photonics** uses light instead of electrical signals to transmit data, offering step-change improvements in bandwidth and energy efficiency for data centre interconnects, telecommunications infrastructure, and sensing applications. As AI workloads drive exponential growth in data movement within and between data centres, the performance limits of copper-based electrical interconnects are becoming a binding constraint. Silicon photonics addresses this by integrating optical components onto standard silicon wafers, leveraging existing CMOS manufacturing infrastructure while delivering throughput and power efficiency that electrical connections cannot match at scale. Europe has a strong starting position. The STARLight consortium, selected under the EU Chips Joint Undertaking and led by STMicroelectronics, brings together 24 technology companies and universities from 11 EU member states to establish a high-volume 300 mm silicon photonics manufacturing line, with initial demonstrators targeting datacom links at 200 Gbps per lane and a research trajectory towards 400 Gbps.[7] X-FAB and SMART Photonics have formed a strategic collaboration to integrate silicon photonics with indium phosphide (InP) chiplets through micro-transfer printing, targeting modulator bandwidths exceeding 120 GHz for next-generation telecom and datacom standards.[8] The PIXEurope pilot line, backed by EUR 400 million under the European Chips Act, is building the first open-access photonic integrated circuit ecosystem in Europe, covering PIC design, manufacturing, hybrid integration, packaging, and testing across multiple material platforms.[9] Organisations such as imec, CEA-Leti, Fraunhofer, and VTT are contributing foundational process capabilities. These projects represent a coordinated European effort to translate decades of photonics research into manufacturing-ready technology. The semiconductor demand implications are direct: silicon photonics will generate demand for new types of wafer processing, for photonic integration and packaging capabilities, and for co-designed electronic-photonic chiplets that blend the photonic and semiconductor value chains. If Europe captures a meaningful share of this emerging market, it adds a new pillar to its semiconductor portfolio that is distinct from the power-and-sensors stronghold and directly connected to the fastest-growing infrastructure segment in the global economy.

- **RISC-V and open instruction set architectures:** The global processor landscape has long been shaped by proprietary instruction set architectures, principally x86 for data centre and PC computing and Arm for mobile and embedded applications. RISC-V, an open-source instruction set architecture, is changing this picture by providing a royalty-free, customisable foundation for processor design. For Europe, RISC-V represents an opportunity to build sovereign design capabilities in a processor domain where the continent has historically been dependent on US- and UK-controlled IP. The DARE (Digital Autonomy for RISC-V in Europe) programme, funded under the EuroHPC Joint Undertaking with a budget of approximately EUR 240 million, is developing three RISC-V-based chiplets: a vector accelerator for HPC workloads, an AI processing unit for inference, and a general-purpose processor for European supercomputers. The project brings together more than 40 partners, including companies such as Codasip and Axelera AI alongside research institutions including imec, CEA, and the Barcelona Supercomputing Center. RISC-V does not require Europe to compete head-to-head with established x86 or Arm ecosystems across all segments. It offers a path to design autonomy in specific high-value domains: edge AI accelerators, automotive compute platforms, secure processors for defence and critical infrastructure, and HPC systems where European institutions need control over the full hardware and software stack.

- **Memory** is the semiconductor category where Europe's absence is most complete in terms of manufacturing, and it is simultaneously one of the fastest-growing segments in the demand outlook. High-bandwidth memory (HBM), stacked through advanced packaging onto AI accelerators, is the enabling component for large-scale AI training. Beyond HBM, emerging memory technologies such as MRAM (magnetoresistive RAM), RRAM (resistive RAM), and ferroelectric memory offer the prospect of embedded non-volatile storage directly integrated into logic and edge processors. CEA-Leti has demonstrated embedded FeRAM platforms compatible with the 22 nm FD-SOI node, while the Dresden-based Ferroelectric Memory Company has developed ferroelectric hafnium oxide memory technology (FeFET and FeCAP) that can be integrated into standard CMOS production lines without additional capital equipment, targeting embedded memory for microcontrollers, AI, and edge computing applications. These technologies do not require Europe to replicate the massive DRAM and NAND fabs that characterise Asian memory production. They offer instead a route to memory capabilities that are tightly integrated with European-designed and European-manufactured processors, sensors, and microcontrollers, adding functionality and performance without dependence on non-European memory supply chains.

- **Quantum computing** remains at an earlier stage of development than silicon photonics, but its potential to transform computational capabilities in fields ranging from materials science and drug discovery to cryptography and logistics optimisation makes it a technology that no serious semiconductor strategy can ignore. Quantum processors require entirely new types of semiconductor devices, from superconducting qubits fabricated in modified CMOS processes to photonic quantum circuits and trapped-ion control electronics. The manufacturing requirements overlap with, but differ from, classical semiconductor production, creating demand for specialised process technologies, cryogenic packaging, and control chip architectures that will need to be produced at scale as quantum systems move from laboratory prototypes towards commercially deployed machines. Europe has credible foundations in quantum hardware, anchored by research institutes such as QuTech in Delft, the Walther-Meißner-Institute in Garching or DESY in Hamburg, and by a growing cohort of hardware scale-ups such as IQM, Pasqal, Alice & Bob, QuantWare, SpiNNcloud and planqc. The semiconductor demand that quantum computing generates is small today, but it carries strategic weight precisely because the technology is pre-competitive. Investing now, when the cost of entry is still manageable, secures optionality that becomes far more expensive to acquire once the technology matures, and allows Europe to seize industrialisation opportunities early in collaboration with key European end markets such as pharmaceuticals, automotive, and secure communications.

- **Neuromorphic chips** emulate the architecture of biological neural networks, processing information through event-driven, massively parallel circuits rather than the sequential instruction execution of conventional processors. They promise orders-of-magnitude improvements in energy efficiency for specific workloads, particularly pattern recognition, sensor fusion, and real-time decision-making at the edge. These are tasks central to European strength industries such as automotive, industrial automation, and robotics. Intel's Loihi research programme has demonstrated the concept, but the field remains open. European research groups at institutions including TU Dresden, TU Graz, imec, and CEA-Leti are active in neuromorphic device and circuit design. The EU-funded PROMETHEUS project is exploring the integration of neuromorphic and quantum photonic computing on a common platform.[10] If neuromorphic computing reaches industrial maturity, it would create demand for novel semiconductor devices produced using modified CMOS processes, and it would do so in application domains where European system integrators are already the lead customers. This alignment between the technology's strength profile and Europe's industrial base makes it a natural candidate for early-stage investment.

Implications for the demand outlook
None of these technologies are reflected in the quantitative demand model, which captures proven, production-stage semiconductor categories. The timing of their transition to mass production and the extent to which they will substitute existing technologies are too uncertain to quantify reliably at this stage. They should nonetheless be part of future focus areas, as Europe has genuine research strength in all five fields and early industrial investment as well as close collaboration with end markets would establish positions that become valuable as these markets develop. The common pattern across all five is that each sits at an inflection point between research and commercialisation, each aligns with European industrial strengths or fills a strategic gap, and each will require semiconductor manufacturing capabilities that Europe either already possesses or is building. Failing to invest in these fields does not show up as a missing figure in today's demand forecast. It shows up a decade from now as another segment where Europe consumes technology that others design and produce.

1.7 Identification of key areas for future initiatives and investments

The assessments so far have quantified where European semiconductor demand is growing and discussed emerging technologies that could reshape the competitive landscape in the decade ahead. The logical follow-on question is where along the value chain Europe should focus its resources. Not every segment can receive equal attention, and not every gap requires the same response. The analysis below applies a structured framework to classify each technology and value chain step, resulting in a prioritised map that distinguishes between positions to strengthen, gaps to close, and segments to monitor. The resulting assessment does not claim to provide definitive answers for every segment. Its purpose is to demonstrate what a demand-driven perspective can contribute to the investment and policy discussion, and to serve as a starting-point for more granular dialogue between industrial and political stakeholders on where action is most consequential.

The framework is designed to identify where Europe holds positions of strength that are reinforced by future demand growth, and where critical gaps exist that could constrain economic growth or compromise sovereignty. The framework assesses each relevant technology within a given value chain step across four dimensions (see Figure 1.13):

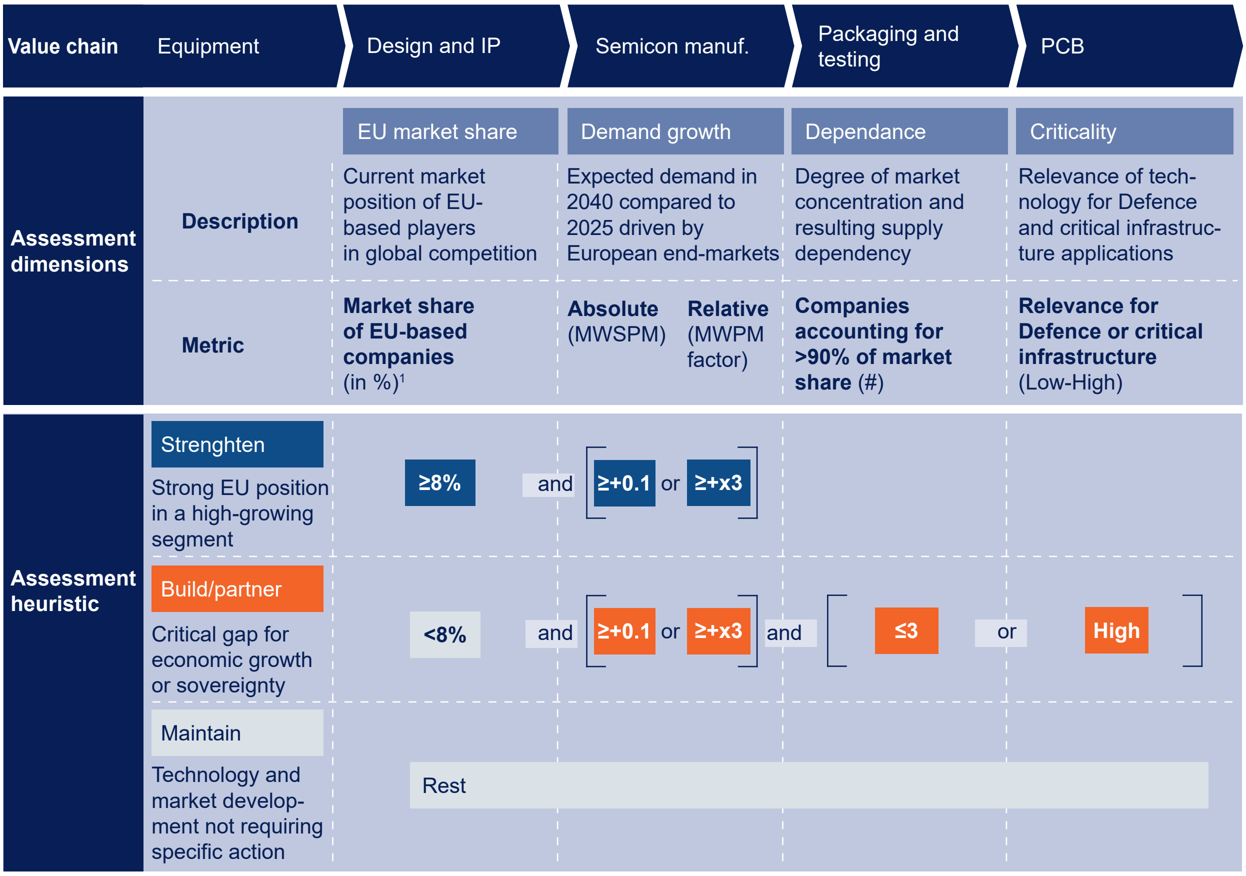
- **EU market share** captures the current market position of EU-based companies in global competition, measured as their combined market share. It reveals where European players hold leading positions today, and where they are absent or marginal. A strong existing position in a growing segment is a strategic asset worth defending. A weak or missing position in a segment of rising importance is a vulnerability that needs to be understood.

- **Demand growth** captures the expected demand in 2040 compared to 2025 driven by European end-markets, measured both in absolute terms (million WSPM) and as a relative growth multiple. It translates the end-market outlook into a forward-looking signal for each technology across the value chain, identifying where future value creation is concentrated and where investment will yield the largest returns.

- **Dependence** captures the degree of market concentration and resulting supply dependency, measured by an estimate of companies accounting for more than 90% of market share. A technology segment dominated by two or three suppliers, particularly if those suppliers are located outside Europe, creates a structural vulnerability that commercial procurement alone cannot mitigate.

- **Criticality** captures the relevance of the technology for defence and critical infrastructure applications. Technologies that underpin military systems, energy grids, or secure communications carry a sovereignty dimension that goes beyond commercial market logic and may justify investment even where the purely economic case is less decisive.

Fig. 1.13: Framework for identifying EU focus areas along the value chain



Value chain	Equipment	Design and IP	Semicon manuf.	Packaging and testing	PCB
Assessment dimensions		EU market share	Demand growth	Dependance	Criticality
	Description	Current market position of EU-based players in global competition	Expected demand in 2040 compared to 2025 driven by European end-markets	Degree of market concentration and resulting supply dependency	Relevance of technology for Defence and critical infrastructure applications
	Metric	**Market share of EU-based companies** (in %)[1]	**Absolute** (MWSPM) **Relative** (MWPM factor)	**Companies accounting for >90% of market share** (#)	**Relevance for Defence or critical infrastructure** (Low-High)
Assessment heuristic	Strenghten Strong EU position in a high-growing segment	≥8%	and [≥+0.1 or ≥+x3]		
	Build/partner Critical gap for economic growth or sovereignty	<8%	and [≥+0.1 or ≥+x3]	and [≤3	or High]
	Maintain Technology and market development not requiring specific action	Rest			

Source: Strategy& analysis

The interplay of these four dimensions determines whether a given technology falls into one of three categories, each carrying a distinct strategic implication:

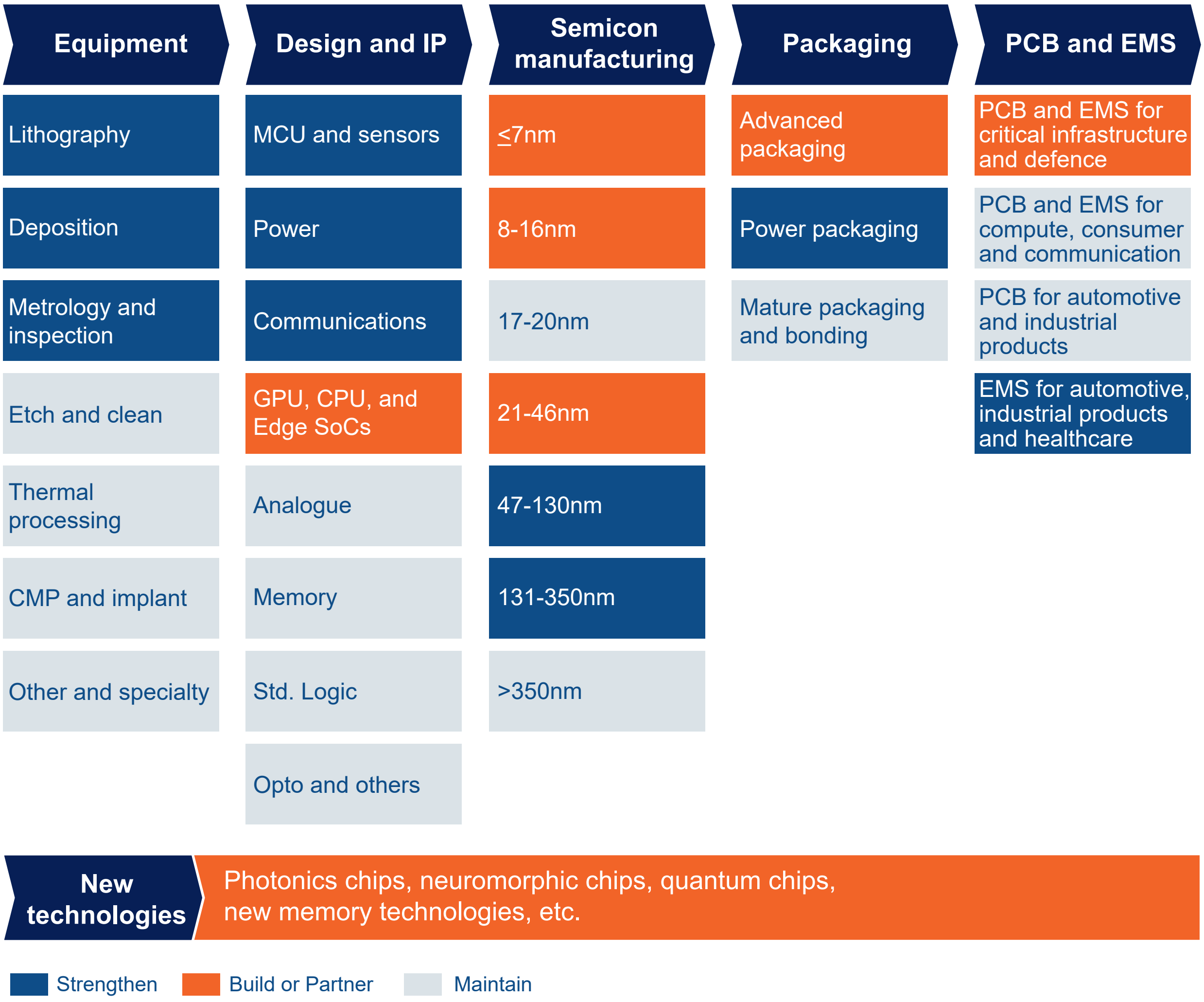
- **Strengthen** describes areas where Europe holds a strong position in a segment with high and growing demand. The threshold is an EU market share of 8% or above, combined with absolute demand growth of at least +0.1 million WSPM or relative growth of x3 or more. The priority here is to defend and expand strengths through continued capacity investment, technology leadership, and ecosystem development.

- **Build or Partner** describes areas where a critical gap exists for European economic growth or sovereignty. The threshold is met when EU market share is below 8%, demand growth is substantial (at least +0.1 million WSPM in absolute terms or x3 as a relative multiple), and either market concentration is high (fewer than three companies control more than 90% of the market) or the technology carries high criticality for defence and critical infrastructure. Closing these gaps requires a combination of domestic investment and strategic partnerships with trusted regions.

- **Maintain** covers the remaining segments, where the current European position and market dynamics do not trigger either of the above thresholds. These technologies still warrant attention to avoid erosion through underinvestment, but they do not require the same level of targeted action as the strengthen or build categories.

Applied across the full value chain, the framework produces the integrated map shown in Figure 1.14. The target picture shows which areas should be targeted with future initiatives and investments to strengthen and strategically grow the European microelectronics ecosystems. The detailed implications per value chain are discussed below. However, the prioritisation presented in this chapter is, by its nature, a snapshot built on current trajectories and announced product roadmaps. Investment decisions require continuously updated demand signals that reflect shifting end-market dynamics, technology transitions, and evolving policy priorities. Translating the macro-level demand outlook into ongoing, actionable guidance for both investment planning and policy design would benefit from a structured mechanism through which European end-industries and companies along the microelectronics value chain jointly consolidate and update their forward-looking demand perspectives.

Fig. 1.14: Prioritisation of technologies for future initiatives across the microelectronics value chain



Equipment	Design and IP	Semicon manufacturing	Packaging	PCB and EMS
🟦 Lithography	🟦 MCU and sensors	🟧 ≤7nm	🟧 Advanced packaging	🟧 PCB and EMS for critical infrastructure and defence
🟦 Deposition	🟦 Power	🟧 8-16nm	🟦 Power packaging	⬜ PCB and EMS for compute, consumer and communication
🟦 Metrology and inspection	🟦 Communications	⬜ 17-20nm	⬜ Mature packaging and bonding	⬜ PCB for automotive and industrial products
⬜ Etch and clean	🟧 GPU, CPU, and Edge SoCs	🟧 21-46nm		🟦 EMS for automotive, industrial products and healthcare
⬜ Thermal processing	⬜ Analogue	🟦 47-130nm		
⬜ CMP and implant	⬜ Memory	🟦 131-350nm		
⬜ Other and specialty	⬜ Std. Logic	⬜ >350nm		
	⬜ Opto and others			

New technologies: 🟧 Photonics chips, neuromorphic chips, quantum chips, new memory technologies, etc.

🟦 Strengthen 🟧 Build or Partner ⬜ Maintain

Source: Strategy& analysis

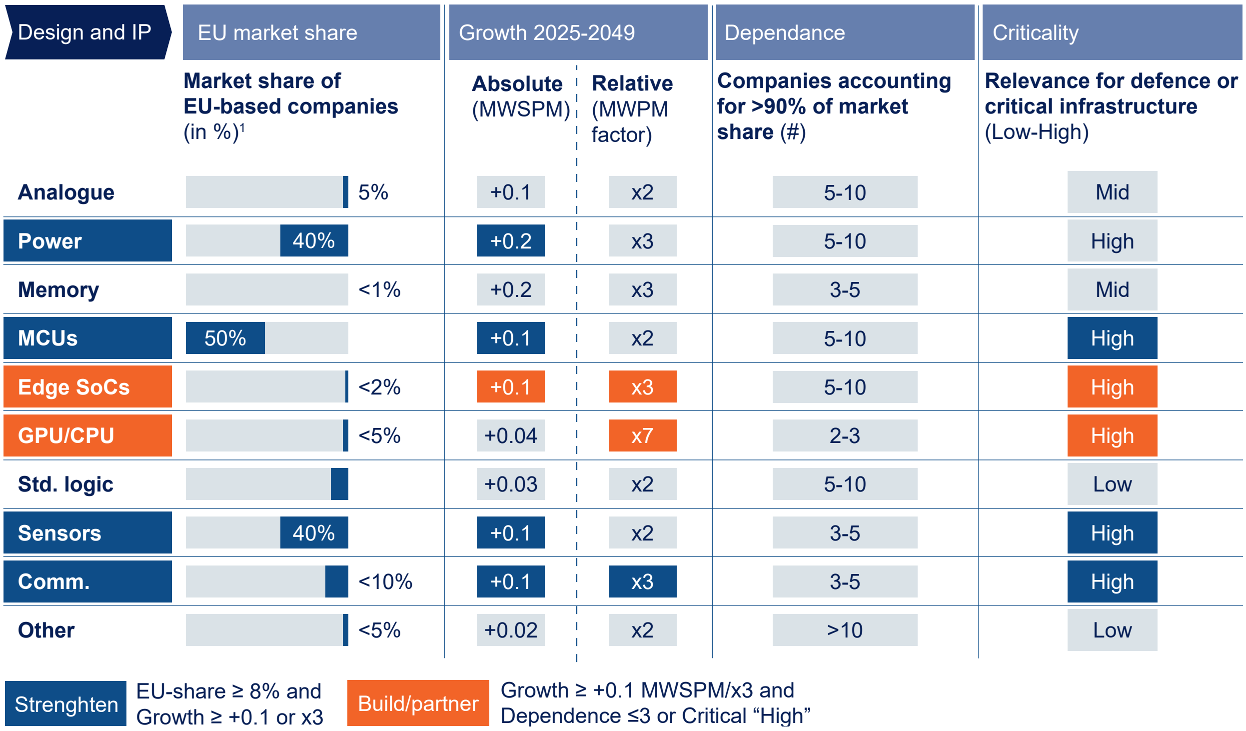
Design and IP

To illustrate how the framework translates into concrete assessments, Figure 1.15 provides a detailed view of the Design & IP value chain step, showing how the four dimensions produce classification outcomes for individual semiconductor categories.

In chip design and intellectual property, the framework identifies a clear set of European strengths that warrant active reinforcement. Power semiconductor design (EU share around 40%), microcontrollers (roughly 50%), sensors (approximately 40%), and communication chips (around 10%) all meet the strengthen threshold, combining meaningful EU market positions with robust demand growth and high relevance for critical infrastructure and defence applications. These are the categories where European companies have built leading global positions through decades of co-development with automotive, industrial, and energy customers. Those positions are not self-sustaining. A dominant market share in power design today does not automatically translate into leadership in next-generation wide-bandgap devices or AI-optimised power management. As application requirements evolve towards higher performance, greater on-chip integration, and AI-enabled edge functionality, the investment in next-generation product development must be deliberate and sustained.

Edge SoCs and CPU/GPU design are the most prominent build or partner categories. Both show strong demand growth and high market concentration, with European shares below 5%. For CPU/GPU, the practical dependency is even more acute than a simple count of competitors would suggest. In AI training and inference, NVIDIA's ecosystem dominance (encompassing hardware, the CUDA software stack, and developer tools) means that for a large share of deployment scenarios the choice is effectively a single supplier. The pathway for Europe is not frontal competition across all processor segments, but targeted investment where European requirements create natural differentiation: RISC-V-based alternatives for edge and HPC applications, accelerator architectures co-designed with European AI and system companies, and secure processor platforms for defence and critical infrastructure.

Fig. 1.15: Identification of focus areas for future initiatives within semiconductors Design and IP



Design and IP	EU market share	Growth 2025-2049		Dependance	Criticality
	Market share of EU-based companies (in %)[1]	**Absolute** (MWSPM)	**Relative** (MWPM factor)	**Companies accounting for >90% of market share** (#)	**Relevance for defence or critical infrastructure** (Low-High)
Analogue	5%	+0.1	x2	5-10	Mid
Power	40%	+0.2	x3	5-10	High
Memory	<1%	+0.2	x3	3-5	Mid
MCUs	50%	+0.1	x2	5-10	High
Edge SoCs	<2%	+0.1	x3	5-10	High
GPU/CPU	<5%	+0.04	x7	2-3	High
Std. logic		+0.03	x2	5-10	Low
Sensors	40%	+0.1	x2	3-5	High
Comm.	<10%	+0.1	x3	3-5	High
Other	<5%	+0.02	x2	>10	Low

Strenghten: EU-share ≥ 8% and Growth ≥ +0.1 or x3

Build/partner: Growth ≥ +0.1 MWSPM/x3 and Dependence ≤3 or Critical "High"

Note: EU market share for Design and IP is measured by sales share from European semiconductor IDMs and fabless companies;
Sources: Industry expert input and previous ZVEI study for EU market shares, Strategy& analysis

Analogue ICs, standard logic, and opto/other categories fall into the maintain category. Analogue ICs carry a moderate EU share of around 5% and solid but less dynamic growth, while memory design remains almost entirely outside Europe. In both cases, the market structure and criticality profile do not trigger the build or partner threshold, but these positions should not be left to erode through neglect. Memory design and manufacturing is a special case. The growth trajectory is strong enough to justify a build classification, but the realistic path for Europe runs through the next-generation embedded memory technologies discussed in ection 1.6 rather than through competition with established memory companies.

Semiconductor manufacturing (front-end)

Nodes from 47 nm upward fall squarely into the strengthen category, with EU shares of 8 to 16% and robust demand growth across the 47-79 nm, 80-130 nm, and 131-350 nm ranges. These are the nodes that produce the power devices, sensors, MCUs, and analogue ICs that anchor European semiconductor strength. European fabs at these geometries are not legacy infrastructure operating on borrowed time. They serve end-markets with growing demand, are operated by companies with strong global positions, and are embedded in dense ecosystems of equipment suppliers, materials providers, and process knowledge. The risk to these positions is not technological obsolescence, but underinvestment relative to competing regions that are expanding their own mature-node capacity with aggressive state support.

The build or partner categories span the 8-16 nm, sub-7 nm, and 21-46 nm ranges. Sub-7 nm represents the largest and most consequential gap: European production capacity is minimal (EU share around 3%), yet this range shows the steepest growth trajectory of any node segment (x13 on industry demand), driven by the AI compute and advanced logic cycle. The 8-16 nm range (EU share 5%) is transitional, with demand growing as edge SoCs, communication chips, and next-generation automotive processors migrate into these geometries. The 21-46 nm range (EU share 2%) warrants attention because of its high criticality for defence and industrial applications, despite more moderate growth. For all three, the near-term pathway runs through strategic partnerships with established manufacturers, combined with the stepwise development of European design and packaging capabilities that can progressively build the foundation for future manufacturing ambitions.

The 17-20 nm range and nodes above 350 nm fall into the maintain category. The 17-20 nm range is dominated by memory manufacturing concentrated in East Asia, while nodes above 350 nm serve long-lifecycle applications with stable but non-growing demand. Both require preservation of existing capacity rather than expansion.

Packaging

Advanced packaging has emerged as one of the most consequential enabling technologies in the current phase of semiconductor development. As the economics of monolithic scaling encounter rising costs and diminishing returns, the industry is shifting towards heterogeneous integration: combining multiple chiplets, potentially manufactured at different nodes and in different materials, into a single package that delivers system-level performance. Advanced packaging falls firmly into the build or partner category. The EU share stands at roughly 1%[6], while the global market is concentrated in fewer than three players (TSMC, ASE, Amkor). Without access to advanced packaging, European chip designers cannot bring heterogeneous products to market without routing their designs through non-European supply chains. The path forward combines targeted domestic investment in pilot lines and first production facilities with strategic partnerships involving packaging leaders who may establish European operations for proximity to the automotive and industrial customer base.

Power packaging (EU share around 10%[11]) is a strengthen category, closely tied to the European power semiconductor manufacturing base and serving the same automotive, industrial, and energy customers. As the electrification of transport, energy systems, and industrial processes accelerates, power applications become more demanding. Continued investment in next-generation packaging technologies for wide-bandgap devices (SiC, GaN) is essential to keep pace with these requirements.

Semiconductor equipment

European equipment companies occupy globally leading, and in several cases singular, control points in the semiconductor value chain. Lithography (EU share 80%[4]), deposition (8%[4]), and metrology and inspection (10%[4]) all carry strengthen classifications. The demand growth described in Section 1.5 translates directly into expanding market opportunity for these companies, and protecting their technology leadership is among the highest-priority items on the European semiconductor agenda. The strategic logic is twofold. Equipment is a profitable industry in which Europe enjoys unique advantages that are difficult for other regions to match quickly. And leadership in equipment provides leverage: it ensures European fabs have access to the tools that define process capability, generates technology spillovers and strong local value chains that accelerate innovation on both sides, and gives Europe a voice in the technological trajectory of the global industry.

Etch and clean, thermal processing, chemical mechanical planarisation (CMP) and implant, and other specialty equipment fall into the maintain category, with EU shares ranging from 1 to 5%[4]. European companies hold positions in these segments but face strong competition from US and Japanese incumbents. They do not carry the same concentration of European market leadership as lithography or deposition, but they contribute to the breadth of the European equipment ecosystem. Erosion in any of these categories would narrow the European equipment base and reduce the ecosystem density that benefits the stronger segments.

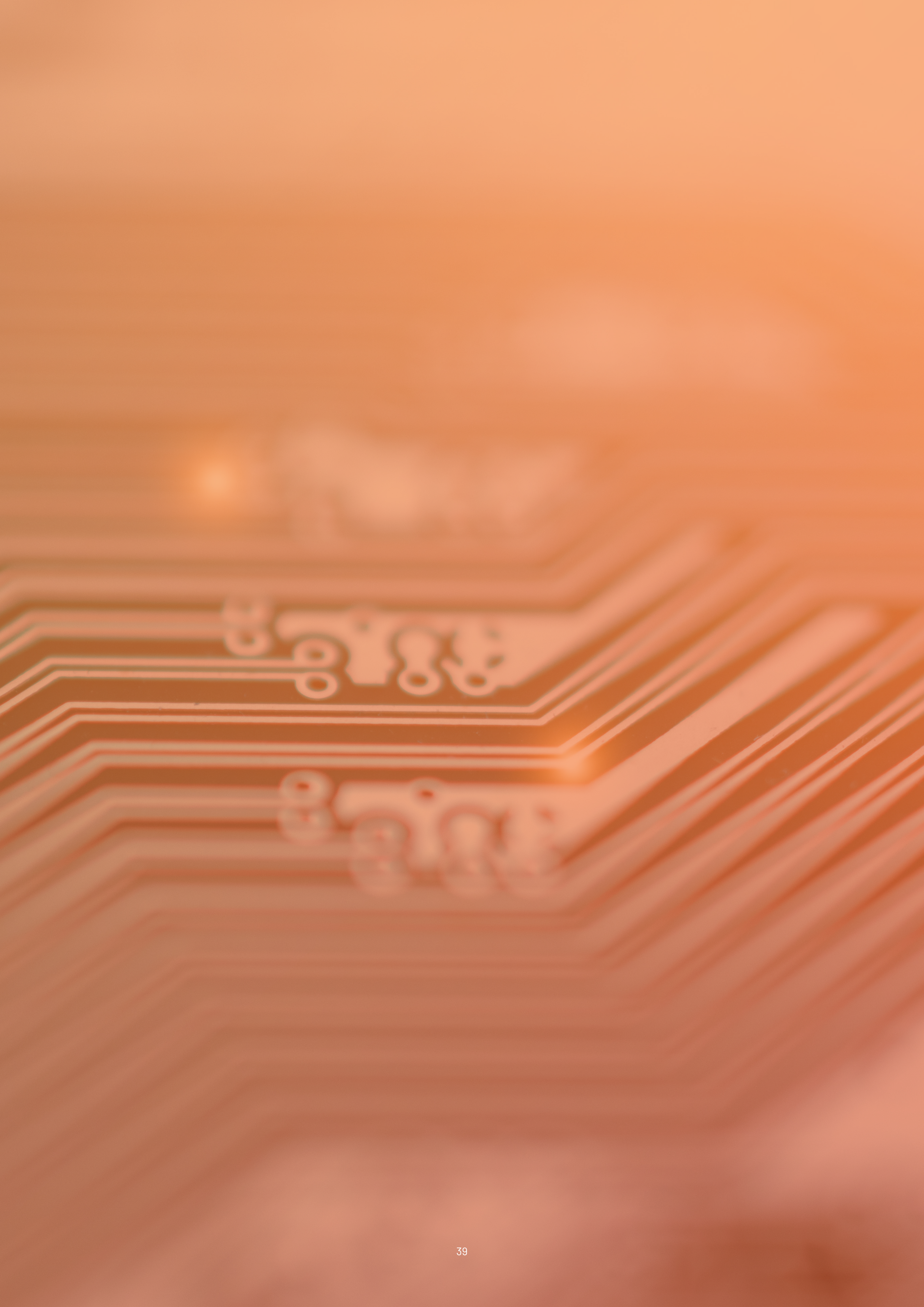
PCBs and EMS

European PCB and EMS capacity has contracted to an EU share below 2%[1] across most end-market segments, with the overwhelming majority of global production concentrated in Asia. The framework identifies PCBs and EMS for critical infrastructure and defence as a build or partner category driven by high criticality for European sovereignty and, in the case of aerospace and defence, steep relative growth (x4). These are the segments where reliance on non-European supply introduces risks that commercial procurement alone cannot mitigate. EMS for automotive, industrial products and healthcare falls into the strengthen category, reflecting a stronger EU position in those areas. Building sufficient European capacity in these segments does not require matching the throughput of Asian volume operations. It requires ensuring that specialised European providers can invest in the automation, workforce development, and facility upgrades needed to serve the demand that the semiconductor and PCB growth trajectories are generating.

The remaining segments, including PCB for automotive, industrial products and healthcare (the largest by absolute PCB volume), and PCB and EMS for compute, consumer and communication, fall into the maintain category. For these segments, global sourcing remains workable as long as trade flows are open and not interrupted, though the near-complete absence of European production capacity warrants continued monitoring as semiconductor content per end-product rises and supply chain resilience becomes a broader policy concern.

Testing across the value chain

Testing sits across every step of the microelectronics value chain and deserves specific attention in a demand-driven perspective. Design-for-test methodologies, built-in self-test structures, and the verification environments used in design determine how effectively defects can be detected later in the flow. In the front-end, in-line metrology, process control, and wafer-level test drive yield, identify excursions early, and reduce the cost of scrapped material at the most capital-intensive stage of production. In the back-end, final test and burn-in determine which packaged devices meet the reliability requirements of automotive, industrial, and defence customers, and increasingly shape the economics of advanced packaging where known-good-die screening is a prerequisite for heterogeneous integration. At the EMS level, system-level and in-circuit testing validate that chips, boards, and assemblies function together under real operating conditions, with functional safety and traceability requirements that are particularly demanding in the European end-markets identified as strengthen and build categories. Rising semiconductor content per product, the multiplication of interfaces introduced by chiplet-based architectures, and stricter qualification regimes for defence and critical infrastructure applications will drive demand for test capacity and test IP in step with the underlying chip volumes. Strengthening European capabilities in test across all value chain steps is therefore a cross-cutting enabler of yield, quality, and supply chain trust.



2 Semiconductor cost comparison

Europe is home to a substantial microelectronics manufacturing base. European companies operate fabs globally and across the continent, supplying chips to the automotive, industrial, energy, and defence sectors. Yet, as the previous ZVEI Microelectronics Study established[1], Europe's share of global semiconductor production stands at around 8% today and is likely to decline further without strengthened investment, as other regions expand their capacity at pace. Sustaining and growing this manufacturing base is important for the whole European microelectronics ecosystem that depends on it, including chip design, semiconductor equipment, chip packaging, PCB manufacturing, electronics assembly, and passives production.

A strong local demand outlook, as evidenced in the previous chapter, is a necessary condition for continued investment. It is not, however, sufficient in itself. Investment decisions in the semiconductor industry are heavily driven by economics. If the cost of producing a wafer or packaging a chip in Europe is materially higher than in competing regions and cannot be offset by other advantages and location conditions, capital and production capacity will flow elsewhere, regardless of how large the European market is. That matters not only commercially but also for Europe's sovereignty and resilience, which depend on having trusted, domestically controlled production capacity in place. The question this chapter addresses is twofold: whether Europe's existing manufacturing base can remain competitive, and whether the cost conditions are right to attract new investments to the continent.

The total cost of producing semiconductors at any given location depends on a unique combination of technology, scale, product mix, and customer requirements, and it spans both the upfront capital investment to build and equip a fab (CAPEX) and the ongoing operating costs of running it (OPEX). To make the cost landscape comparable across regions and derive meaningful conclusions at the industry level, this chapter works with representative fab archetypes and a standardised set of assumptions. This approach allows for a structured comparison with three objectives. First, to quantify the cost difference between European semiconductor production and the major global alternatives. Second, to break that difference down into its underlying drivers and assess which of them are structurally addressable. Third, to outline the pathways through which the gap can be narrowed, whether through direct cost reduction or through targeted compensation mechanisms.

It is well established that semiconductor production in Europe is more expensive than in Asia. But it makes a considerable difference whether one is looking at front-end or back-end operations, which technology nodes are involved, and in which country. The global semiconductor landscape is not uniform. The semiconductor value chain consists of distinct steps, from design and wafer fabrication through packaging and testing to final assembly, each with its own cost structure and competitive dynamics. Different countries have built up different positions along this chain over decades.[1] Front-end manufacturing clusters look different from back-end clusters, and the countries that lead in one do not necessarily lead in the other. This chapter maps out these differences by comparing front-end and back-end production costs across major global regions and within Europe, breaking down the gap by its underlying drivers, and outlining the pathways through which it can be narrowed.

For the European side of the comparison, the analysis uses Germany as the primary reference point, given its position as the largest semiconductor manufacturing cluster in Europe, with a deep supplier ecosystem, broad talent pool, and well-established research infrastructure. On the other side, the comparison covers countries with established semiconductor ecosystems, including the United States, Japan, South Korea, Taiwan, China, and Singapore, together with Malaysia and India, two countries that are investing heavily to build up their manufacturing base. To capture the cost differences within Europe, the analysis also includes Portugal, Poland, and the Netherlands as representative countries that reflect the range of cost and capability profiles across EU member states.

The other steps in the value chain are equally important for Europe's microelectronics ecosystem, but operate under fundamentally different cost dynamics. Chip design and IP competitiveness are driven primarily by talent cost, intellectual property protection, and ecosystem maturity. Equipment manufacturing is a global business where Europe holds a leading position and where the cost discussion mostly centres on R&D investment and supply chain access. PCB and EMS operations face their own distinct cost pressures, shaped by labour intensity and material sourcing as well as by tariff structures and the concentration of AI-driven demand growth in other regions. These segments are not covered in the cost comparison, but are addressed from the demand and strategic perspectives in the other chapters.

2.1 Methodology of the cost comparison

To analyse Europe's current cost competitiveness for semiconductor production, this chapter compares the cost of manufacturing across major global regions and within Europe. The analysis covers front-end and back-end operations, using a set of representative fab archetypes. For each archetype, CAPEX and OPEX are broken down by individual cost driver, making it possible to identify not only the overall gap but also its composition.

To ensure that the cost comparison reflects the diversity of semiconductor manufacturing, the analysis is built around five fab archetypes (see Figure 2.1): three for front-end and two for back-end. Each archetype represents a distinct and important segment of the industry, with its own technology profile, cost structure, and relevance to European end-markets. For each front-end archetype, a representative fab with an assumed capacity of 50,000 wafer starts per month (in 300 mm wafer size equivalent) serves as reference. The remaining parameters, workforce, capital expenditure, and cleanroom size, vary by archetype and reflect the different levels of process complexity and equipment intensity.

To maintain comparability across regions, all cost calculations assume a standalone greenfield fab, meaning a newly-built facility where ecosystem synergy effects such as shared infrastructure, established supplier networks, and a concentrated talent pool are not factored into the comparison. Equally, the analysis does not capture economies of scale that emerge when a region hosts multiple fabs, enabling shared utilities, services, and talent pools that reduce per-unit costs over time. In practice, fabs located within established semiconductor clusters benefit from both of these dynamics, which reduce effective operating costs. The greenfield assumption therefore represents a conservative baseline that tends to overstate the cost gap for locations with established clusters.

Furthermore, the comparison does not account for differences in product mix, yield, and application-specific requirements between regions. These differences are outside the scope of a standardised archetype comparison. Tax-related cost reductions are also not reflected in the global comparison. Several countries offer mechanisms such as reduced electricity tax rates, energy-intensive industry exemptions, or R&D tax credits that lower the effective operating cost for semiconductor manufacturers. These are not included in the baseline figures, to maintain comparability across regions. Their directional impact is, however, discussed in Section 2.4 when examining cost variation within Europe.

Fig. 2.1: Front-end and back-end fab archetypes for cost comparison

	Fab archetype	Description	Semi types
Front-end	**90-350nm** Power and discretes	Discrete semiconductors used in energy conversion including EV drivetrains, renewable energy inverters, industrial motor drives, and other power systems	Power and discrete
	12-80nm Smart control and connectivity	Embedded processing and wireless connectivity for automotive control units, industrial automation, IoT endpoints, aerospace systems, and secure identification	MCUs, Communication, Analogue, Standard Logic
	Sub-10nm High-performance compute	Advanced logic and high-bandwidth memory for data centres, AI training and inference, cloud computing, and edge computing applications	CPU/GPU, Memory, Edge SoCs
Back-end	**Traditional packaging**	Commodity package formats assembled using wire bonding and flip-chip techniques used for mainstream node devices across all application industries and account for the large majority of global packaging volumes	Power, Analogue, Sensors, MCUs, Communication, Edge SoCs, Std. Logic
	Advanced packaging	Multi-die integration through 2.5D/3D stacking, enabling tight coupling of compute and memory dies for AI accelerators, high-performance processors, and emerging automotive edge AI applications	CPU/GPU, Memory Edge SoCs

Source: Strategy& analysis

Front-end and back-end archetypes

The three front-end archetypes cover the full range of technology nodes that are significant for the European semiconductor landscape. The first archetype operates at 90 to 350 nm, the Power and Discretes segment. This category covers power semiconductors, along with other discrete components. These devices are central to the energy transition and to the competitiveness of Europe's industrial base. For instance, they are used in electric vehicle drivetrains, energy inverters for renewables, industrial motor drives, grid infrastructure, and defence power systems. This is an area of established European leadership, with globally relevant companies designing and manufacturing on the continent. A representative fab in this category requires investment of approximately USD 1 to 2 billion, cleanroom space of around 10,000 square metres, and a workforce of approximately 500 full-time employees.

The second archetype covers the 12 to 80 nm range, the Smart Control and Connectivity segment. This is required for microcontrollers, communication chips, analogue integrated circuits, sensors, and mixed-signal devices. These products sit at the heart of European strength industries, particularly automotive, industrial automation, aerospace and defence, and increasingly in IoT and edge computing applications. They are often designed and manufactured by European IDMs or foundries with strong European footprint. A representative fab requires investment of USD 5 to 10 billion, cleanroom space of around 30,000 square metres, and a workforce of roughly 2,000 employees. The 12 to 28 nm range is of particular strategic importance for Europe, with notable expansion projects in the EU including TSMC's ESMC facility and GlobalFoundries in Dresden. A facility at these nodes would be expected to sit between the two adjacent archetypes in cost terms, and the analysis therefore provides directional guidance for this range as well.

The third archetype operates at nodes below 10 nm, the High-Performance Computing segment. Fabs in this category produce the most advanced logic chips, used in artificial intelligence, high-performance computing, and data centre applications. Manufacturing at these nodes requires extreme ultraviolet (EUV) lithography, a technology in which the European equipment ecosystem is globally leading. The capital intensity is correspondingly extreme, with investment volumes typically ranging from USD 25 to 35 billion per fab. A representative facility requires cleanroom space of around 60,000 square metres and a workforce of approximately 4,000 full-time employees. At present, with the exception of Intel's operations in Ireland, there are no sub-10 nm manufacturing capabilities within the EU. The archetype is included because the demand assessment in Chapter 1 identifies sub-10 nm as a fast-growing node segment, and understanding the cost position is relevant for any discussion of future European capabilities in this space.

On the back-end, two archetypes are distinguished. Traditional packaging refers to commodity package formats assembled using wire bonding and flip-chip techniques. This type of packaging is used across all semiconductor categories but is especially common for power and discrete semiconductors at larger node sizes.

Advanced packaging encompasses a range of techniques, from wafer level packaging to multi-die integration using 2.5D and 3D architectures, that achieve higher performance, greater integration density, and smaller form factors than conventional formats. A more detailed overview of these techniques and their strategic relevance is provided in the previous ZVEI Microelectronics Study. For the purpose of this cost comparison, the reference configuration is an 8+1 die package: one high-performance logic or GPU die combined with eight high-bandwidth memory (HBM) stacks, integrated on a common substrate. This architecture is representative of packages used in AI accelerators and similar compute-intensive processors, where a single die requires direct access to large volumes of fast memory. Advanced packaging is increasing in relevance across a range of applications, from data centre processors and HBM to power semiconductors and, increasingly, automotive use cases such as edge AI and advanced driver-assistance systems.

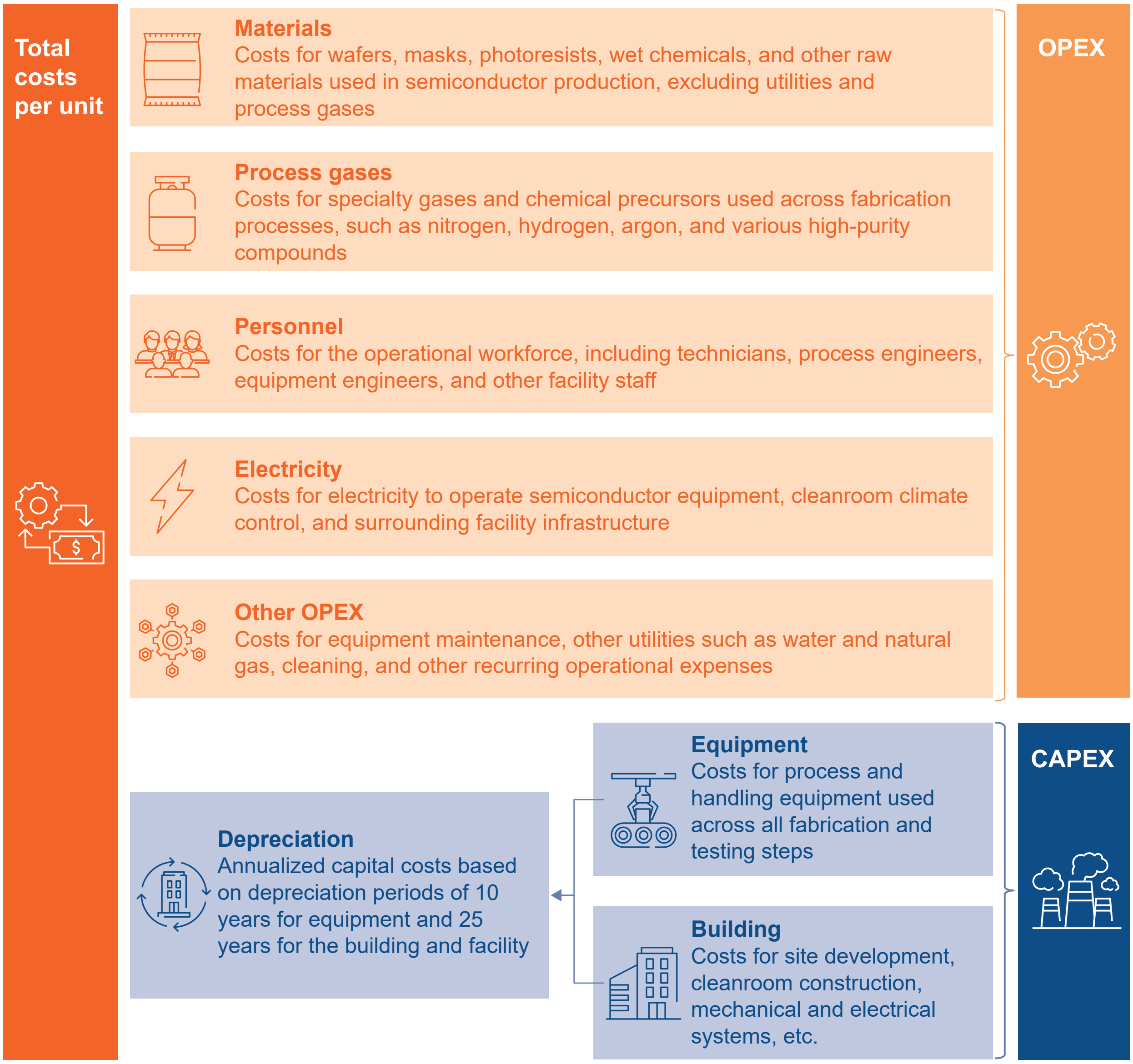
Cost structure

For each of the five archetypes, costs are broken down into two main categories (see Figure 2.2). CAPEX capture the upfront investment required to build and equip a fab. They consist of two components. The first is the building, which covers site development, cleanroom construction, mechanical and electrical systems, process systems, and other facility structures like utilities. The second is the equipment, which includes the semiconductor process and handling tools used across all steps in fabrication and testing. Equipment costs account for the dominant share of CAPEX at the smallest process nodes. Because the global supplier base for semiconductor equipment is highly concentrated, with only a small number of companies producing the required tools, equipment prices are effectively uniform regardless of where a fab is built. Building costs, by contrast, are driven by local construction labour rates, material prices, and regulatory requirements, and therefore differ significantly across regions. CAPEX are converted into an annualised cost per wafer through depreciation, using industry-typical periods of 10 years for equipment and 25 years for buildings and facilities.

OPEX represent the recurring costs of running a fab once it is built and equipped. They are divided into five blocks. Materials covers the cost of wafers, masks, photoresists, wet chemicals, and other raw materials consumed in production, excluding utilities and process gases. Process gases covers the specialty gases and chemical precursors used across fabrication processes, such as helium, nitrogen, hydrogen, argon, and various high-purity compounds. Personnel covers the workforce costs for the operational staff running the fab, including technicians, process engineers, equipment engineers, and other facility personnel. Electricity covers the energy costs for operating semiconductor equipment, cleanroom climate control, and the surrounding facility infrastructure. Other OPEX covers maintenance, other utilities such as water and natural gas, cleaning, and other recurring operational costs. The relative weight of these blocks in total OPEX variessignificantly by fab archetype, which is one of the main reasons the cost gap between Europe and Asia differs across node ranges.

The cost data is based on November 2025 figures for labour and electricity, and on 2024/2025 investment cost data for fab construction and equipment. The analysis draws on publicly available information, industry knowledge, and expert discussions with semiconductor manufacturers.

Fig. 2.2: Cost blocks for cost comparison assessment



Total costs per unit

OPEX

Materials
Costs for wafers, masks, photoresists, wet chemicals, and other raw materials used in semiconductor production, excluding utilities and process gases

Process gases
Costs for specialty gases and chemical precursors used across fabrication processes, such as nitrogen, hydrogen, argon, and various high-purity compounds

Personnel
Costs for the operational workforce, including technicians, process engineers, equipment engineers, and other facility staff

Electricity
Costs for electricity to operate semiconductor equipment, cleanroom climate control, and surrounding facility infrastructure

Other OPEX
Costs for equipment maintenance, other utilities such as water and natural gas, cleaning, and other recurring operational expenses

CAPEX

Equipment
Costs for process and handling equipment used across all fabrication and testing steps

Building
Costs for site development, cleanroom construction, mechanical and electrical systems, etc.

Depreciation
Annualized capital costs based on depreciation periods of 10 years for equipment and 25 years for the building and facility

Source: Strategy& analysis

2.2 Front-end costs: Europe as the most expensive region

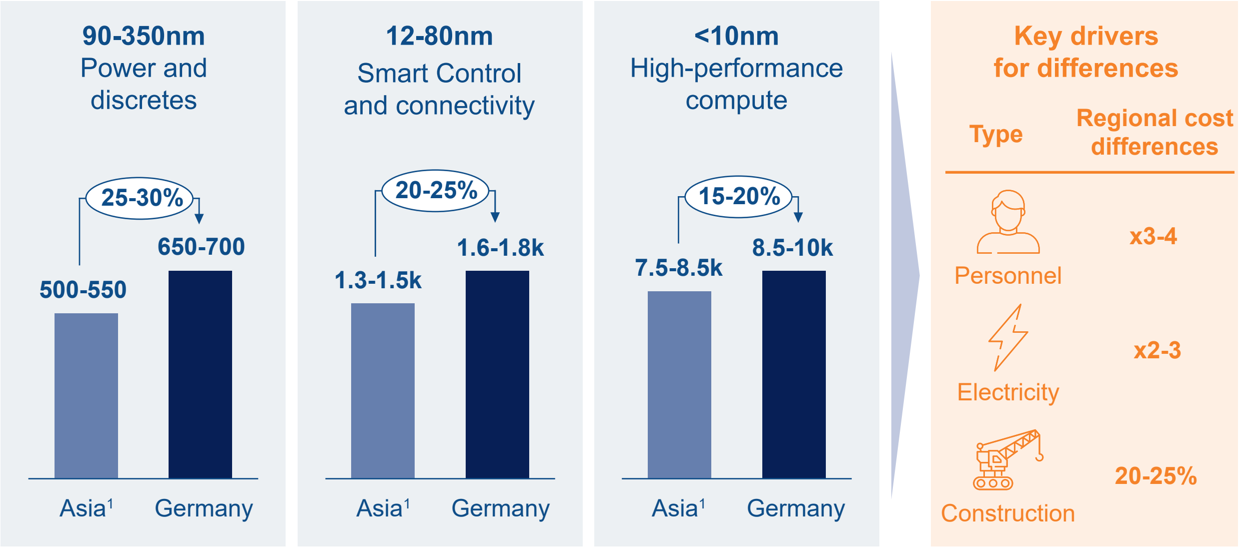
The front-end cost comparison reveals a consistent pattern: producing wafers in Europe is more expensive than in the most cost-efficient Asian production regions. The analysis uses Germany as the primary European reference point. Germany hosts the largest semiconductor manufacturing cluster in Europe, with a deep supplier ecosystem, a broad talent pool, and a well-established research infrastructure. It provides a strong reference point for a European greenfield cost assessment, while recognising that other EU member states offer different and, in some cases more, competitive cost profiles, as we will discuss in Section 2.4.

Across all three front-end archetypes, total production costs per wafer in a German greenfield fab are 15 to 30% higher than in the most cost-efficient regions, which are located in Asia (primarily the People's Republic of China, Malaysia, and India), followed by Taiwan and South Korea (see Figure 2.3). The cost difference is driven by three factors. Labour costs in Germany can be three to four times as high as in the most cost-efficient Asian regions. Electricity costs can be two to three times as high. Construction costs for building the fab facility are elevated by higher wages for construction workers and more complex permitting requirements. Together, these three drivers account for the bulk of the cost gap between European and Asian production.

The extent of that gap, however, depends on the production technology, because different process nodes have fundamentally different cost centres of gravity. At the smallest process nodes, such as the sub-10 nm archetype, CAPEX account for a larger share of total cost, driven above all by equipment. Because equipment is for the most part priced uniformly worldwide, this dominant cost block does not vary meaningfully between regions, and the region-specific factors carry comparatively less weight. This compresses the gap to 15 to 20%. At larger process nodes such as the 12 to 80 nm or 90 to 350 nm archetypes, CAPEX are less dominant and the region-specific OPEX categories account for a larger share of total production cost. These are precisely the cost blocks where Europe is most expensive, which is why the gap widens to 20 to 30% for these archetypes. A more detailed breakdown of OPEX and CAPEX drivers by archetype follows below.

This pattern is directly relevant for European manufacturers. Europe's production profile is concentrated at 40 nm and above, in the Power and Discretes and Smart Control and Connectivity segments where European companies hold strong global positions. These are the node ranges where the relative cost gap is most pronounced, and where sustainable measures to improve cost competitiveness would have the greatest effect on Europe's actual manufacturing base. At the same time, the emerging 12 to 28 nm segment, where new European capacity is being established, sits in a cost position between the two larger archetypes, benefiting from higher equipment intensity that compresses the regional gap while still being exposed to the labour and energy cost differentials that affect all European production.

Fig. 2.3: Front-end cost comparison most expensive versus cost-efficient region, total costs per produced wafer in USD and 300mm equivalent



1) Asia including India, China and Malaysia as cheapest region followed by Taiwan and South Korea;
Sources: Strategy& analysis based on industry expert input and publicly available information including GlobalPetrolPrices (average 2023–2025), Eurostat, and publicly available compensation databases

Country-level comparison

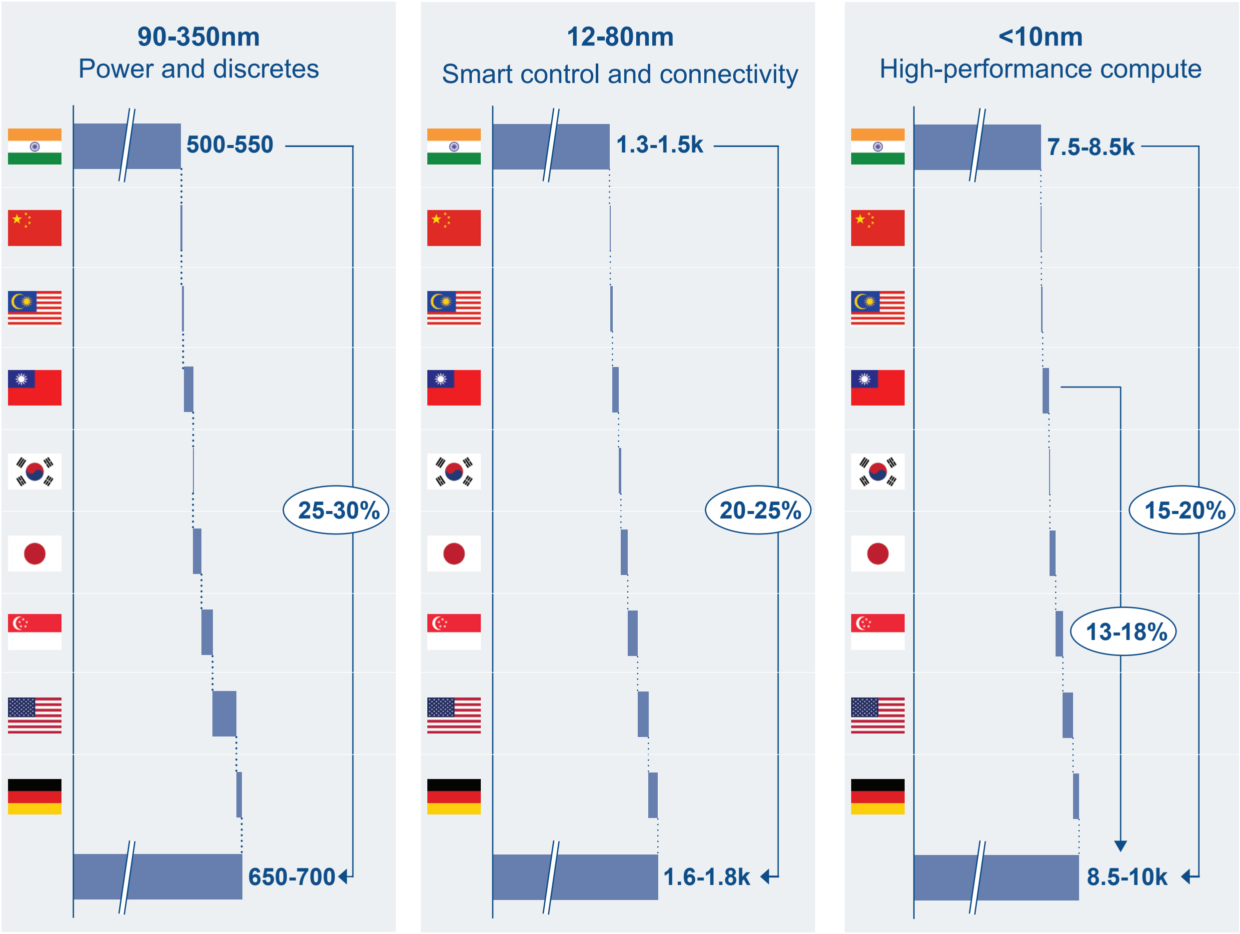
When the analysis is extended to individual countries, a more differentiated picture emerges (see Figure 2.4). The comparison covers countries with established semiconductor ecosystems, including Japan, the United States, Germany, South Korea, Singapore, Taiwan, and China. It also includes India and Malaysia, two countries that are actively pushing into front-end manufacturing. Malaysia already operates a world-leading back-end ecosystem and is now broadening into wafer fabrication. India is at an earlier stage, building its first large-scale front-end facilities. It remains an emerging semiconductor location where the infrastructure required for fab operations, including reliable energy supply, ultrapure water treatment, and specialty materials logistics, still needs to be developed and where production clusters have yet to form.

The country-level view reveals a cost gradient rather than a binary divide between Asia and Europe. India, China, and Malaysia form the lowest cost tier, with production costs at a comparable level across all three countries. Taiwan and South Korea sit in the middle range, followed by Japan. The United States positions between Asia and Europe, while Germany has the highest cost position among the major semiconductor-producing countries in this comparison.

For the sub-10 nm High-Performance Computing archetype, this gradient requires qualification. India and Malaysia do not currently have the capability to manufacture at these nodes and are unlikely to develop it in the near term. China has demonstrated production capability down to approximately 5 nm, though without access to EUV lithography. The cost figures calculated for these countries are therefore partly theoretical at this technological level. A more realistic benchmark for the smallest nodes is Taiwan, which accounts for roughly 90% of global production at these process nodes, alongside South Korea. The cost difference between Taiwan and Germany at sub-10 nm is 13% to 18%.

It is worth noting that the rankings in this comparison are not static. They are heavily influenced by electricity prices, which can shift significantly over time and have the potential to reshape relative cost positions in future years. Labour costs also play a role. While they tend to evolve more gradually in most regions, several Asian semiconductor locations are experiencing notable upward pressure on salaries, particularly for experienced semiconductor talent. In Taiwan, South Korea or China, growing competition for skilled engineers and technicians is driving compensation levels higher, a trend that will narrow part of the labour cost gap to European locations over time.

Fig. 2.4: Front-end cost comparison by country, total costs per produced wafer in USD and 300mm equivalent



Sources: Strategy& analysis based on industry expert input and publicly available information including GlobalPetrolPrices (average 2023-2025), Eurostat, and publicly available compensation databases

OPEX and CAPEX driver analysis

To understand what drives the cost gap, the analysis breaks both operating and capital expenditures down into their constituent parts for each archetype, comparing the cost structure in the most cost-efficient Asian region with Germany.

The OPEX breakdown (see Figure 2.5) shows that the share of region-specific cost elements varies considerably across process node ranges. This is the main reason the overall cost gap differs by archetype. The two cost elements that vary by location are personnel and electricity. Personnel costs are higher in Europe because of structurally higher wage levels for engineers, technicians, and facility staff. Electricity costs are higher because European industrial electricity prices reflect a combination of higher generation costs, network charges, taxes, and levies that do not apply at the same level in most Asian production countries. Materials, process gases, and other OPEX such as maintenance and utilities are held constant across all regions in this analysis. These inputs are sourced from a small number of global suppliers at standardised specifications, which means their prices do not differ meaningfully by location. While the percentage share of these constant cost blocks appears lower in Germany than in Asia, this is entirely because personnel and electricity are substantially higher in absolute terms, which expands the total cost base and compresses the relative share of everything else. The key patterns for each archetype are as follows:

90 to 350 nm (Power and Discretes)	This archetype is most sensitive to regional cost factors. Personnel and electricity together account for roughly 37% of total OPEX in Germany, compared to just 14% in Asia. This is the main reason the overall OPEX gap for this archetype reaches 35 to 40%.
12 to 80 nm (Smart Control and Connectivity)	The pattern is similar but less pronounced. Personnel and electricity together reach 32% of OPEX in Germany versus 12% in Asia, resulting in an overall OPEX difference of 30 to 35%.
Sub-10 nm (High-Performance Computing)	At the smallest nodes, materials and process gases together account for over 80% of OPEX in both regions, leaving less room for regional factors to drive a wedge. Personnel and electricity reach 22% of OPEX in Germany versus 7% in Asia. The overall OPEX difference narrows to 20 to 25%.

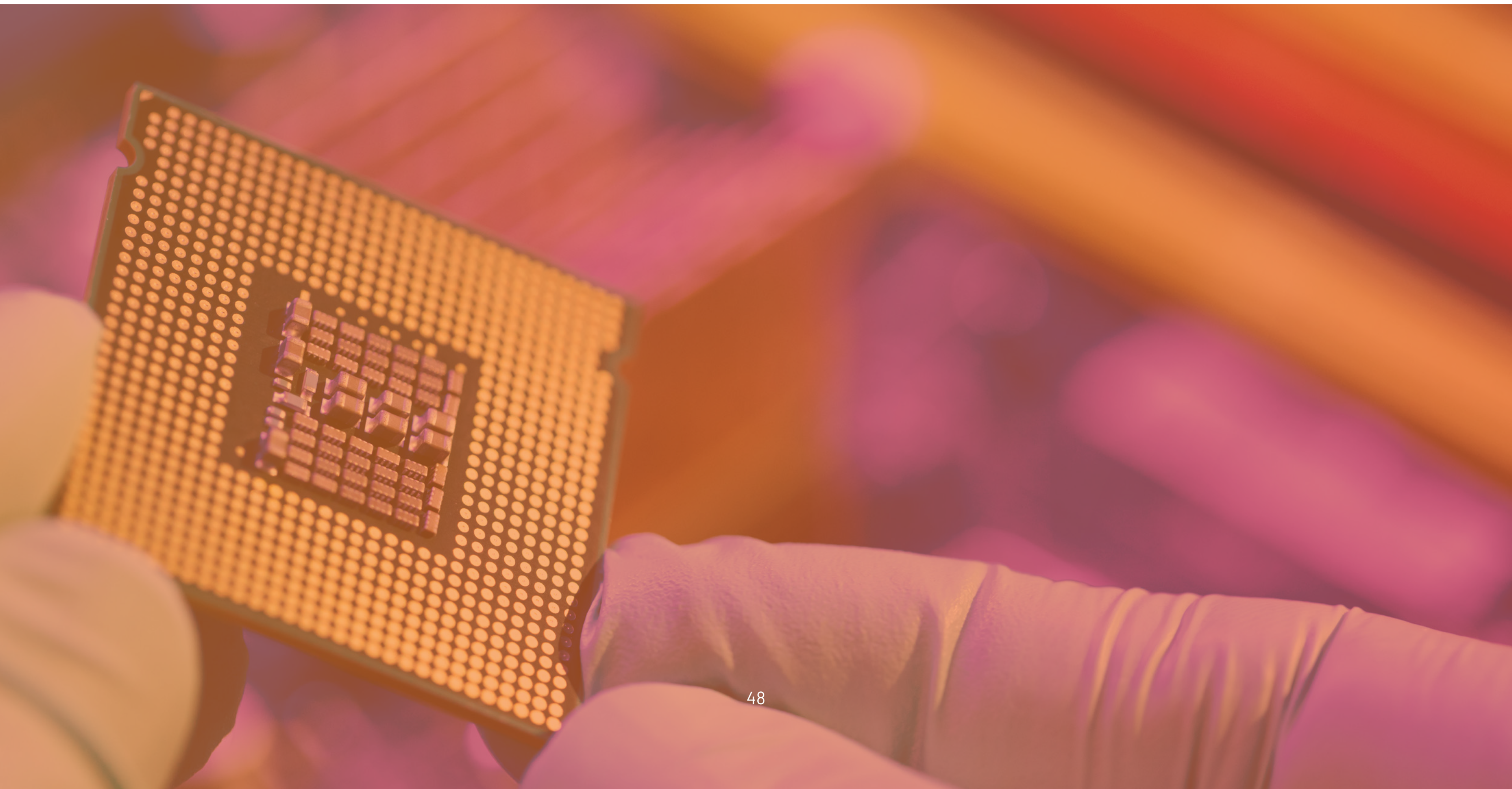
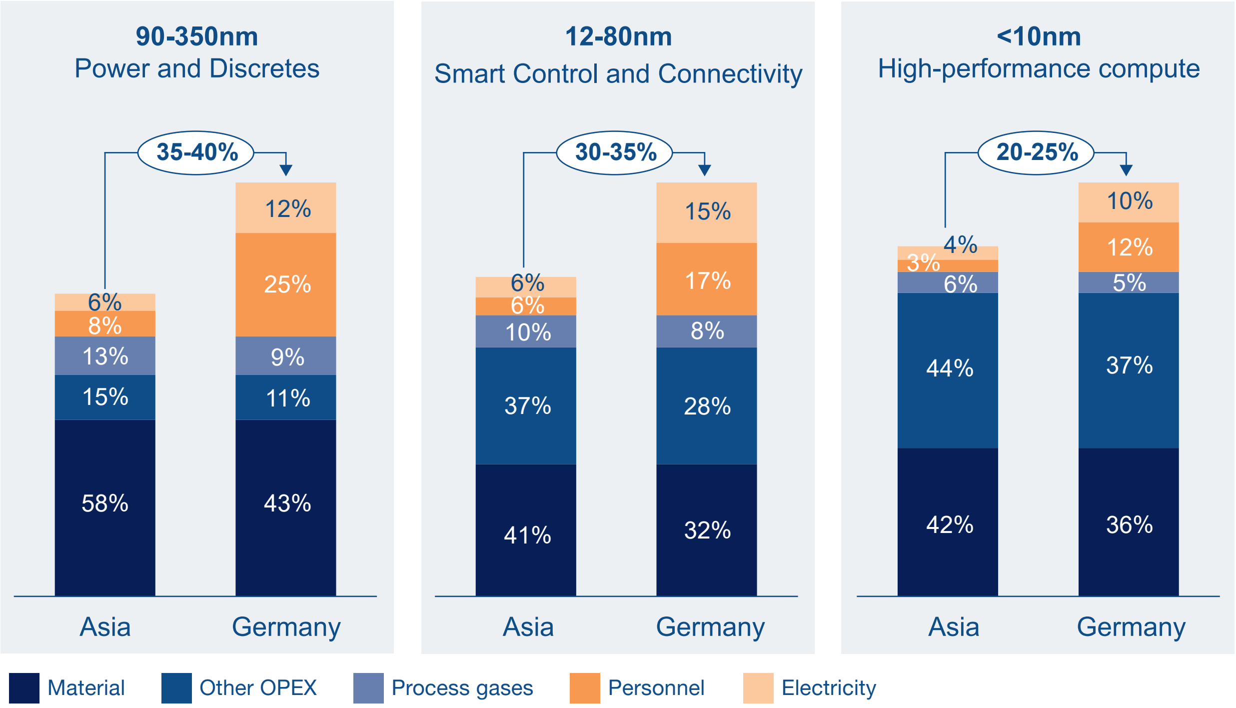


Fig. 2.5: Front-end OPEX breakdown most expensive versus cost-efficient region, relative share by cost block in percent



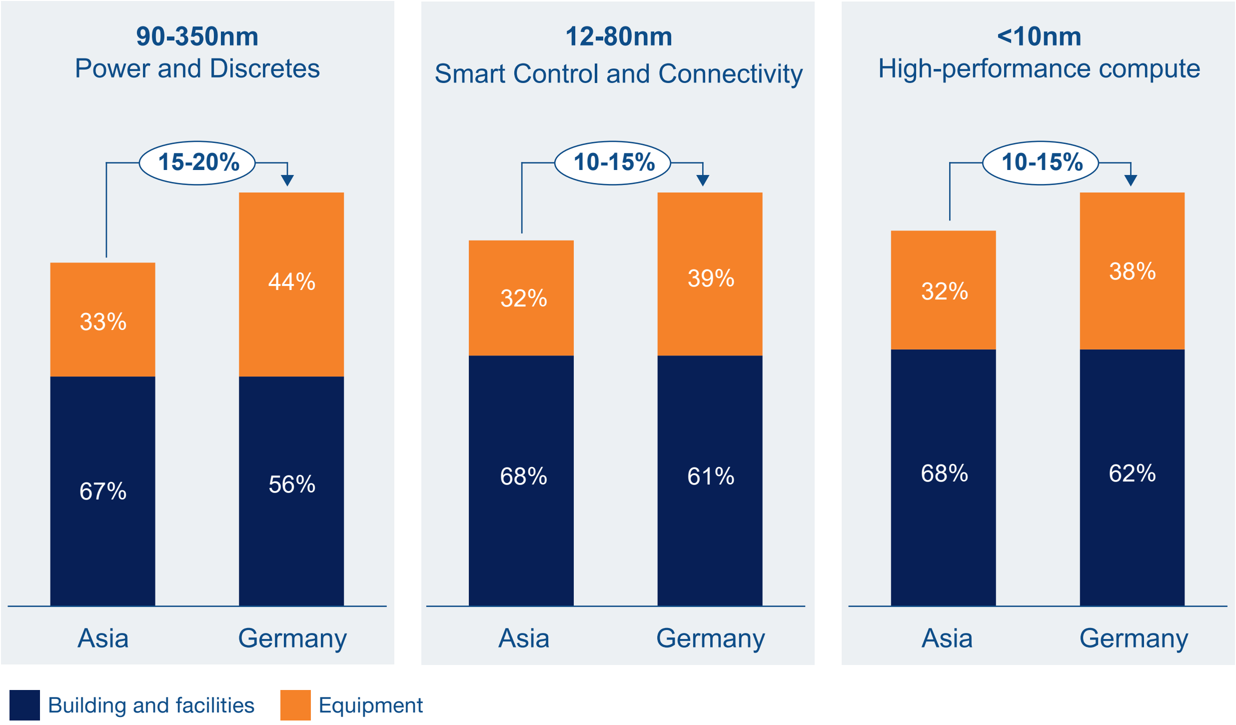
Sources: Strategy& analysis based on industry expert input and publicly available information including GlobalPetrolPrices (average 2023-2025), Eurostat, and publicly available compensation databases (November 2025)

On the CAPEX side, the picture is different (see Figure 2.6). Equipment costs, which represent the dominant share of capital expenditure particularly at the smallest nodes, are priced uniformly across regions. The global supplier base for semiconductor production equipment is highly concentrated, with only a small number of companies producing the required tools. As a result, equipment prices do not differ materially between locations. The regional variation in CAPEX is therefore driven almost entirely by building and construction costs, which include site development, cleanroom construction, mechanical and electrical systems, and other facility structures.

The CAPEX premium in Germany relative to the most cost-efficient Asian regions is estimated at 15 to 20% for the 90 to 350 nm archetype and 10 to 15% for 12 to 80 nm and sub-10 nm. This premium is driven by higher wages for construction workers, along with assumed higher material prices for construction materials.

The impact of this premium on total CAPEX depends on the ratio of construction cost to equipment cost. At larger nodes, where equipment is less expensive relative to the building, construction costs represent a larger share of total CAPEX. The construction cost premium therefore has a proportionally larger impact on the 90 to 350 nm archetype than on the sub-10 nm archetype, where equipment investment dwarfs the building costs and dilutes the regional difference.

Fig. 2.6: Front-end CAPEX breakdown most expensive versus cost-efficient region, relative share by cost block in percent



Sources: Strategy& analysis based on industry expert input and publicly available information including GlobalPetrolPrices (average 2023-2025), Eurostat, and publicly available compensation databases (November 2025)

2.3 Back-end costs: Advanced packaging as an opportunity

The cost picture for back-end operations differs substantially from the front-end, but the two packaging archetypes within it also differ considerably from each other. Traditional packaging is highly labour-intensive, which makes its cost comparison extremely sensitive to regional wage differences. Advanced packaging, by contrast, is dominated by the cost of the dies themselves, which in a multi-die configuration such as the 8+1 package used in this analysis represent the largest single cost component by far. This shifts the cost structure away from labour and towards globally-priced inputs. The labour share in advanced packaging is comparable to or even lower than in front-end manufacturing. As with the front-end analysis, the same set of countries is compared, with Germany as the European reference point.

Traditional packaging

Traditional packaging in Germany is approximately 55 to 60% more expensive than in the most cost-efficient Asian locations, primarily China and Malaysia (see Figure 2.7). The United States is even more expensive, sitting 2% to 3% above Germany, driven by its higher labour costs.

The OPEX breakdown (see Figure 2.8) reveals why this gap is so large. In Asia, personnel costs account for 15% of total back-end OPEX, while materials account for 75%. In Germany, the cost structure essentially inverts: personnel costs rise to 47% of OPEX, while materials drop to 46%. What is a materials-dominated business in Asia becomes a labour-dominated business in Germany. Electricity accounts for a small percentage share in both regions, at 3% in Asia and 2% in Germany, though in absolute terms the electricity cost in Germany remains significantly higher.

Traditional packaging operated as a standalone business runs on lower margins than front-end fabrication. For integrated device manufacturers with blended value chains the economics look different, but for pure-play packaging operations, competitiveness depends on highly efficient, scaled-up manufacturing where even small cost differences have a direct impact on profitability. The Asian back-end industry has built exactly this kind of efficiency over decades, supported by established production clusters with optimised processes, massive throughput volumes, and deep operational expertise. Replicating that level of cost efficiency in Western Europe, where labour costs are multiples higher, would require a fundamental shift in how these operations are run.

This is where automation becomes a potential lever. Increasing the degree of automation in traditional packaging operations could structurally reduce the labour share and narrow the gap over time. However, the current generation of traditional packaging processes was not designed for full automation, which limits how far this lever can reach without rethinking the operations from the ground up.

Fig. 2.7: Back-end cost comparison by country, advanced packaging in USD per unit and traditional packaging in USD per k units

Sources: Strategy& analysis based on industry expert input and publicly available information including GlobalPetrolPrices (average 2023–2025), Eurostat, and publicly available compensation databases (November 2025)

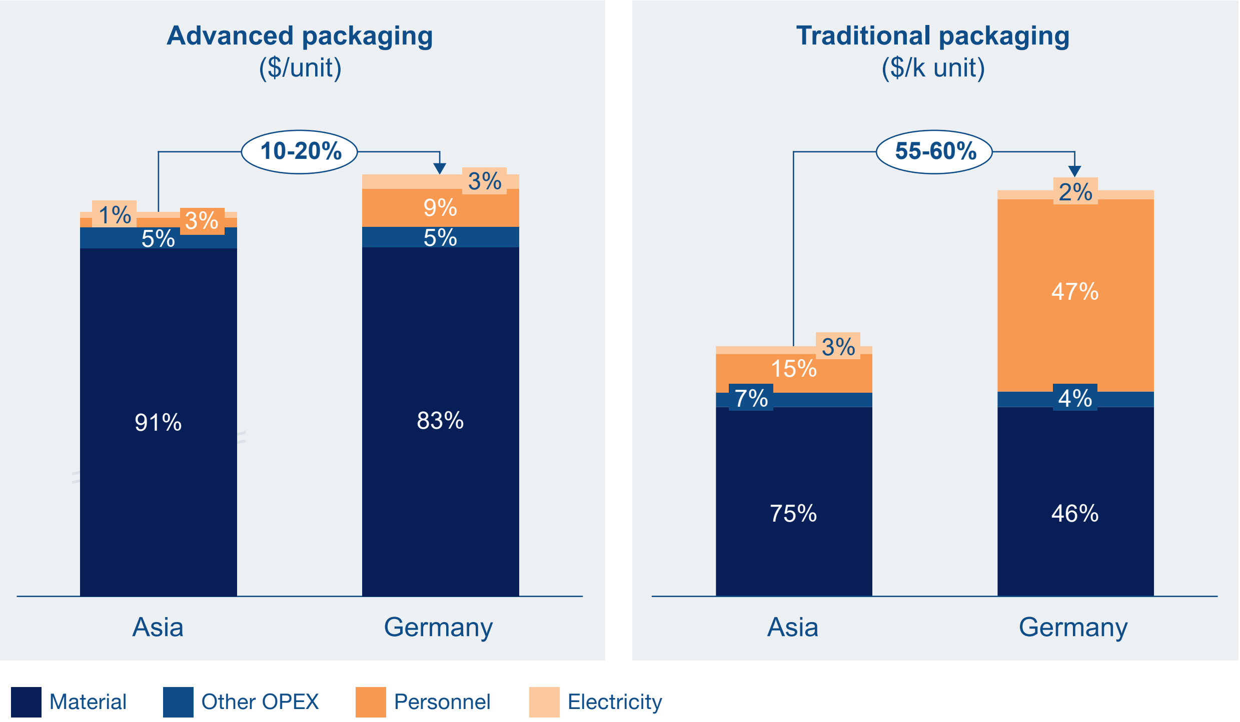
Advanced packaging

Advanced packaging presents a fundamentally different picture. The cost premium in Germany relative to the most cost-efficient Asian locations is 10 to 20%, a gap comparable to what is observed in front-end manufacturing (see Figure 2.7). The OPEX breakdown explains why. Materials dominate the cost structure, at 91% of total OPEX in Asia and 83% in Germany. This is because the largest cost component in advanced packaging is the chips themselves. In an 8+1 die package, the cost of the nine integrated dies far outweighs all other operating cost elements. Personnel accounts for just 3% in Asia and 9% in Germany. Electricity is marginal at 1% and 3% respectively. Because the cost structure is driven overwhelmingly by globally-priced chip and material inputs rather than by regional labour costs, the percentage gap between regions compresses to front-end levels.

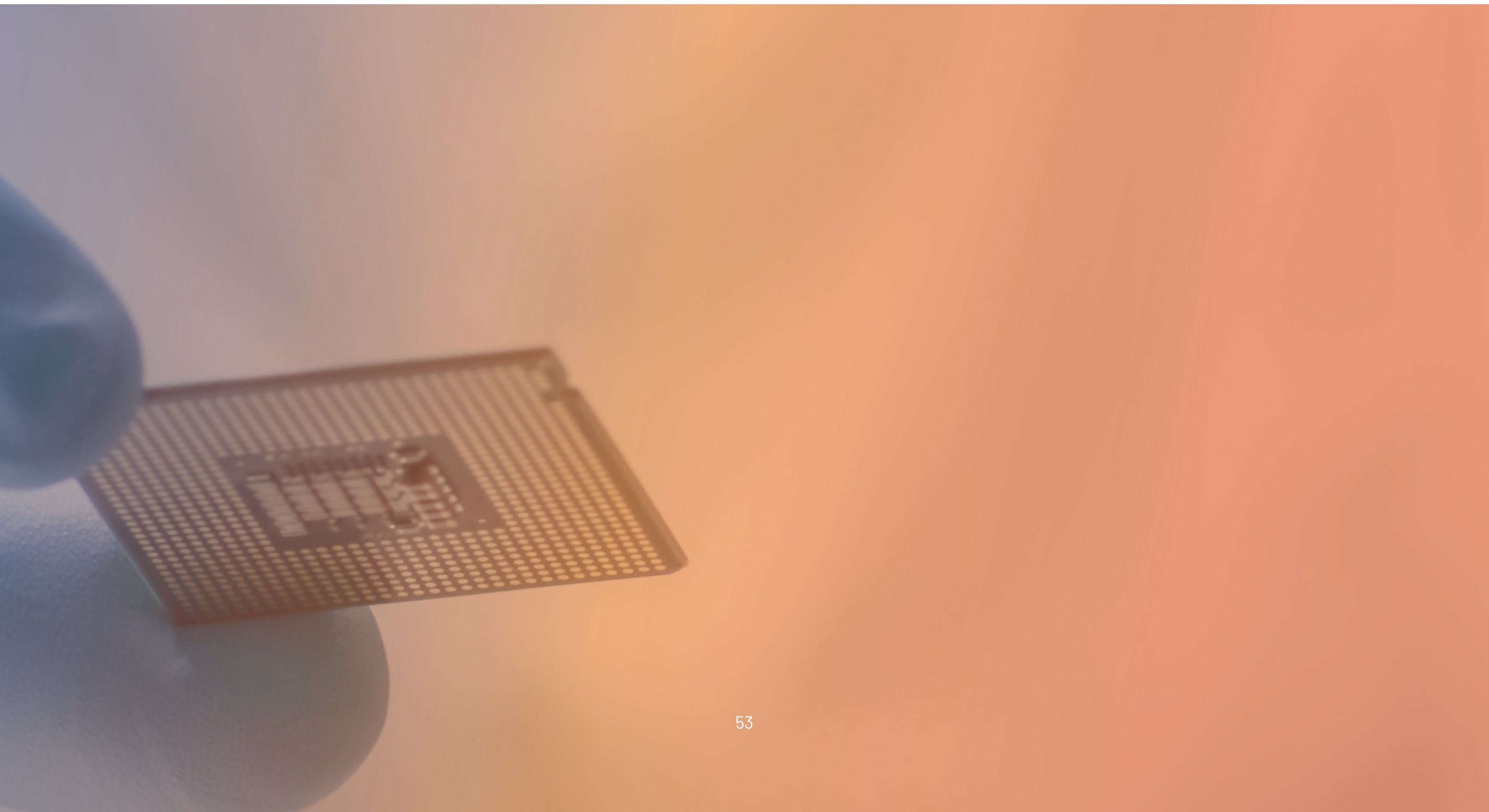
Advanced packaging also lends itself more naturally to further automation than traditional packaging. The processes are already more equipment-driven and less reliant on manual labour, which means that continued investment in automation and process optimization can reduce the remaining cost gap further over time while also creating economic opportunities for Europe's strong equipment sector. An additional consideration is that advanced packaging can benefit significantly from physical proximity to front-end fabrication. Tighter integration between wafer processing and packaging steps reduces cycle times, improves yield, and enables the co-optimization between chip design and package architecture that high-performance applications demand.

This finding has a direct strategic implication. If Europe aims to build or expand packaging capacity, advanced packaging offers a business case that is comparable in competitiveness to front-end fabrication. It is also the packaging segment with the strongest demand growth, driven by high-performance computing, AI, automotive systems, and edge applications. Building advanced packaging capacity near existing European front-end clusters would create mutual reinforcement between the two value chain steps open connections with emerging technologies such as integrated photonics.

Fig. 2.8: Back-end OPEX breakdown most expensive versus cost-efficient region, relative share by cost block in percent



Sources: Strategy& analysis based on industry expert input and publicly available information including GlobalPetrolPrices (average 2023-2025), Eurostat, and publicly available compensation databases (November 2025)



2.4 Cost differences within Europe

The analysis so far has used Germany as the primary European reference point. But Europe is not a single cost zone, and treating it as one would miss an important dimension of the diverse European value proposition. This section extends the comparison to other EU member states, specifically Portugal, Poland, and the Netherlands, to assess the range of cost profiles available within Europe.

Front-end variation within Europe

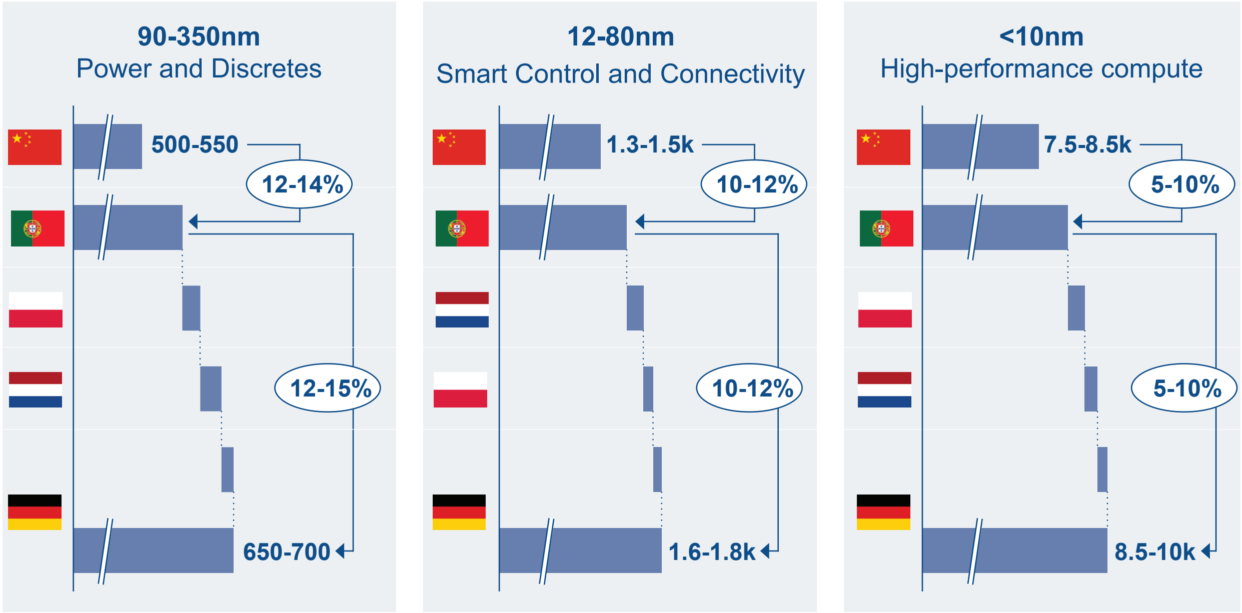
When the front-end cost analysis is extended across EU countries, a meaningful spread emerges (see Figure 2.9). Portugal and Poland offer front-end production costs that are consistently below Germany across all three archetypes. For the sub-10 nm archetype, the difference is 5 to 8%. For 12 to 80 nm, it reaches 8 to 12%. For 90 to 350 nm, where region-specific cost factors weigh most heavily, it is 10 to 15%. The Netherlands positions between Portugal/Poland and Germany.

The drivers behind this variation are the same ones that explain the gap between Germany and Asia, just in a milder form. Electricity prices in Portugal and Poland are lower than in Germany, though not as low as in Asia. Labour costs follow a similar pattern.

It is worth noting that the electricity costs used in this comparison are based on nominal prices and do not reflect tax and levy exemptions or network fee reductions, as comparable data is not available for all regions considered. In Germany, such mechanisms are already in place. According to a study by E-Bridge on electricity cost assessment for large industry in the Netherlands, Belgium, Germany, and France, these exemptions and reductions lower the effective electricity cost in Germany by approximately 30%.[12] When accounted for, this brings German electricity prices to 10 to 15% below the Netherlands, making the Netherlands effectively the most expensive European location in this comparison by a margin of 1 to 2%. The resulting shift in relative positions within Europe would be noticeable, though the overall gap to Asia would remain substantial. This comparison highlights that national governments can already have a significant impact on effective electricity costs for industrial users, and several member states are actively using these levers. Coordination at European level could build on this to establish a level playing field across member states, so that energy cost relief for semiconductor production is not confined to a few national jurisdictions while others remain uncompetitive.

This internal variation within Europe also means that the EU can offer a differentiated set of location profiles to prospective investors. Across its member states, Europe combines established semiconductor clusters with deep supplier ecosystems, world-class research institutions, globally leading equipment and design capabilities, competitive labour and electricity costs in several regions, growing technical talent pools, and proximity to key end-markets such as automotive and industrial production. The key condition is that this diversity is approached as a coordinated, pan-European value proposition, where countries build on their respective strengths rather than competing against each other for the same investments.

Fig. 2.9: EU front-end cost comparison by country, total costs per produced wafer in USD and 300 mm equivalent



Sources: Strategy& analysis based on industry expert input and publicly available information including GlobalPetrolPrices (average 2023-2025), not corrected for tax examptions, Eurostat, and publicly available compensation databases (November 2025)

Back-end variation within Europe

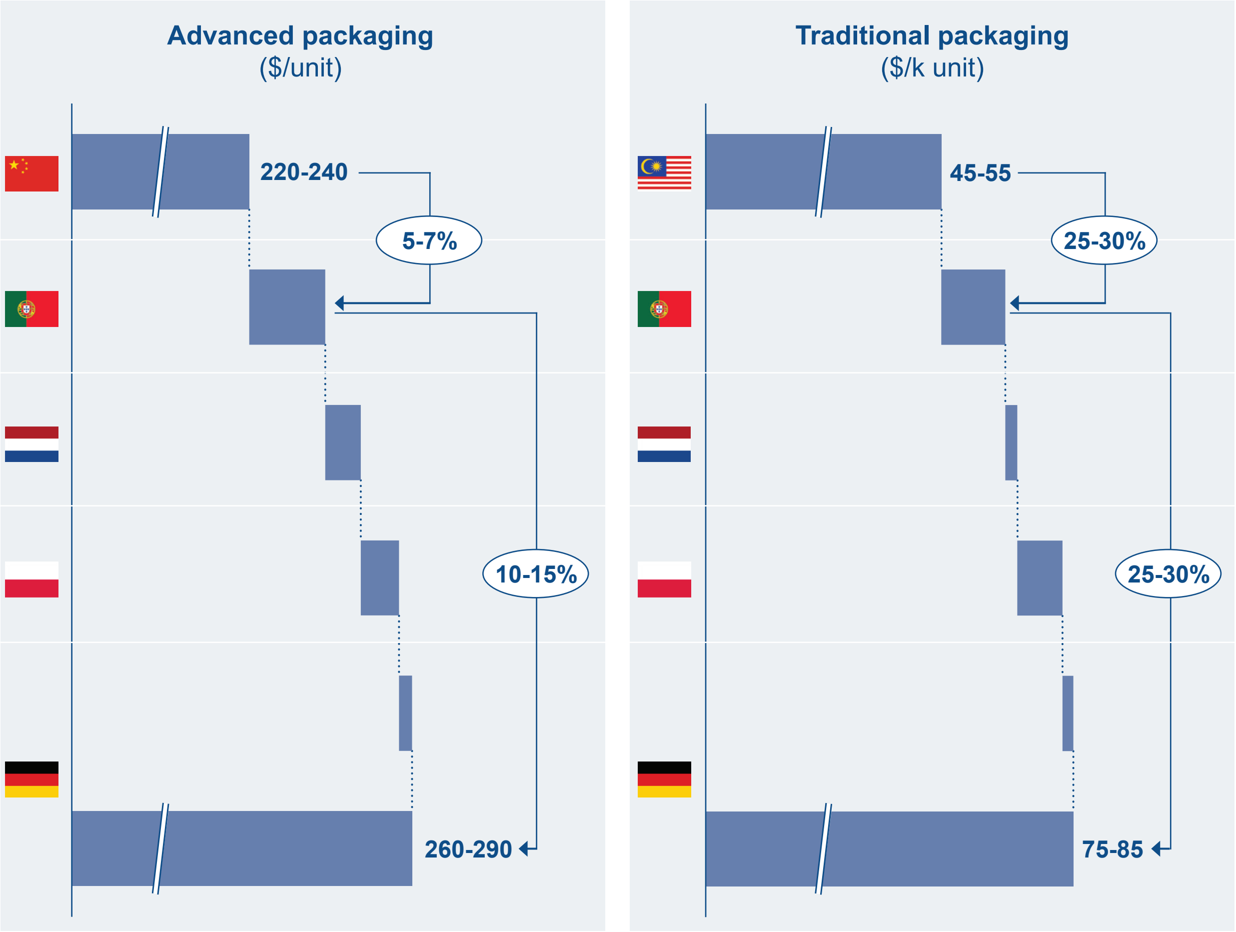
The same logic applies to back-end operations, though the spread within Europe differs between the two packaging types (see Figure 2.10).

For advanced packaging, Portugal offers costs that are 5 to 7% above the most cost-efficient Asian region, making it the most competitive EU location. Poland and the Netherlands sit in the middle, while Germany is the most expensive at 5-12% above Portugal. The overall spread within Europe for advanced packaging is moderate, reflecting the cost structure dominated by dies and materials discussed in Section 2.3.

For traditional packaging, the intra-EU differences are more pronounced. Portugal and Poland offer costs that are 25 to 30% above the most cost-efficient Asian locations, roughly half the gap that Germany and the Netherlands face at 55 to 60%. This is a direct consequence of lower labour costs in Portugal and Poland, which matter far more in the labour-intensive traditional packaging segment.

The implication is that an EU-wide packaging strategy could benefit from leveraging this cost variation. Lower-cost EU countries offer a more competitive position for traditional packaging operations that would be uneconomic in Western Europe. For advanced packaging, where the cost spread within Europe is smaller and ecosystem factors carry more weight, established hubs with stronger supplier networks and talent pools remain the natural location.

Fig. 2.10: EU back-end cost comparison by country, advanced packaging in USD per unit and traditional packaging in USD per k units



Sources: Strategy& analysis based on industry expert input and publicly available information including GlobalPetrolPrices (average 2023-2025), not corrected for tax examptions, Eurostat, and publicly available compensation databases (November 2025)

2.5 Pathways to closing the gap

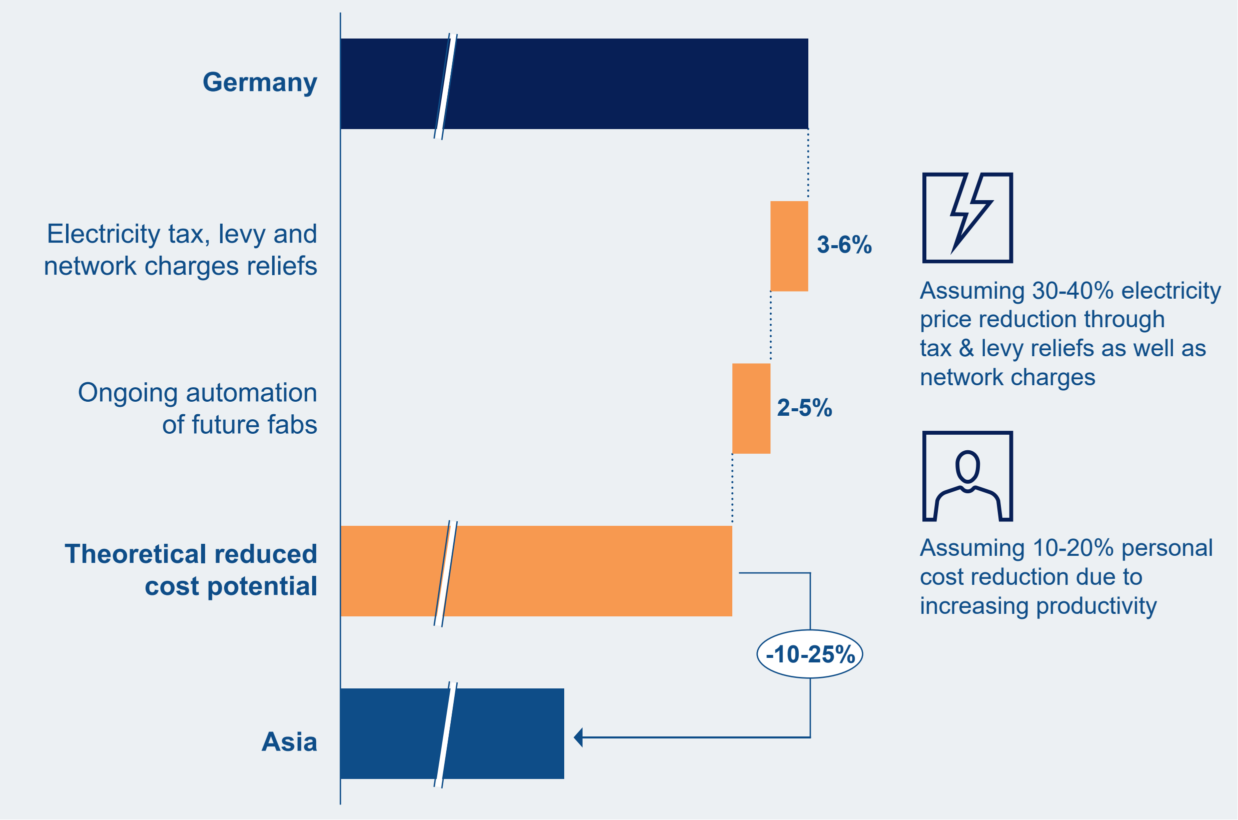
The cost comparison for front-end and back-end reveals a gap that is real but not insurmountable. Depending on the fab archetype and the type of packaging operation, the premium for producing in Europe ranges from 15% at the lower end for sub-10 nm front-end and advanced packaging to up to 55% for traditional packaging. The question is how much of that gap can be closed, and through what means. Three categories of levers are available: structural measures that reduce the underlying cost drivers, compensatory measures that offset what cannot be eliminated structurally, and scale and cluster effects that reduce cost over time as the ecosystem matures.

Structural measures

The two largest contributors to Europe's operating cost disadvantage, electricity and labour, both offer room for structural improvement. To illustrate the potential impact, Figure 2.11 presents a theoretical scenario that models the combined effect of two levers on the cost gap between Germany and the most cost-efficient Asian regions. The first lever is a reduction in effective electricity costs through tax and levy reliefs, together with network charge reductions. Assuming a 30 to 40% reduction in electricity prices through such mechanisms (based on Eurostat data and the E-Bridge report), the analysis estimates a 3 to 6% reduction in the overall cost gap, depending on the archetype. Coordination at European level is necessary to ensure that European locations collectively close the gap to Asia and other global competitors rather than competing against each other for the same investments. The second lever is ongoing automation of future front-end fabs, which would reduce personnel costs through increasing productivity. Assuming a 10 to 20% reduction in personnel costs, the estimated impact is a further 2 to 5% reduction in the cost gap. Realising this is a longer-term public-private effort, requiring sustained investment in automation technologies, workforce reskilling, and supporting infrastructure. Combined, these two structural levers could narrow the cost gap by 5 to 11%, bringing the remaining difference between Germany and the most cost-efficient Asian regions down to approximately 10 to 25%, depending on the archetype.

Applying comparable levers to back-end operations yields a similar direction, though the magnitudes differ. For advanced packaging, where the cost structure is dominated by globally-priced die and material inputs, electricity and personnel reductions each contribute an estimated 1 to 2 percentage points, bringing the remaining gap for Germany or the Netherlands to approximately 10 to 15% compared to the most cost-efficient Asian regions. For other European locations such as Portugal and Poland, the lever would be smaller since cost levels are already lower, but the remaining gap is also more moderate to begin with.

Fig. 2.11: Theoretical cost reduction potential through structural measures, front-end Germany versus cheapest Asian region



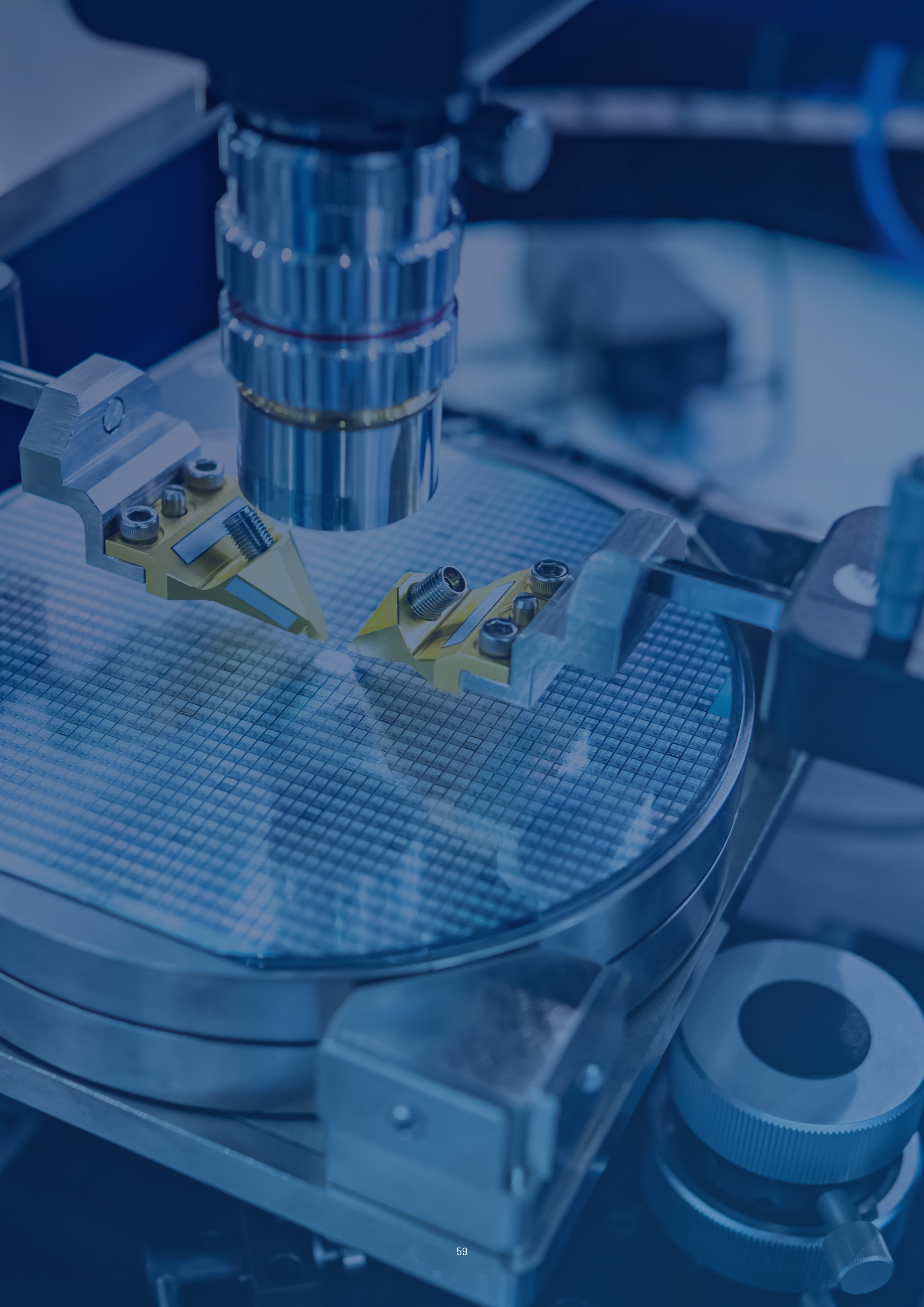
Sources: Strategy& analysis based on industry expert input and publicly available information including GlobalPetrolPrices (average 2023-2025), Eurostat, and publicly available compensation databases (November 2025)

Compensatory measures and distribution of efforts

For the portion of the cost gap that cannot be eliminated structurally, targeted financial instruments are needed. These could include accelerated depreciation schedules for semiconductor equipment, CAPEX tax relief for new fab investments, and R&D tax credits that recognise the innovation-intensive nature of the industry. Such instruments are already in place in several jurisdictions, have proven effective for microelectronics investments, and can serve as reference for future mechanisms. A detailed analysis of these effects was not conducted in this study, as the impact depends on various factors including the specific fab scope and region.

Moreover, the cost comparison presented in this chapter is based on greenfield economics and captures the cost of building and operating a fab from scratch in a given location. What it does not fully capture is how costs evolve over time as a semiconductor ecosystem grows in density and scale. When multiple fabs, supplier facilities, research institutions, and training programmes concentrate in a single region, cost-reducing dynamics emerge: suppliers locate closer to customers, a shared talent pool develops, specialised service providers become available, and knowledge spillovers between companies and research institutions accelerate yield learning and process improvements. At the same time, economies of scale allow a region with multiple fabs to support shared infrastructure, such as semiconductor-grade water treatment, specialty gas supply, and waste processing, at a lower cost per facility than isolated locations.

These effects do not appear in a static cost comparison, but they are real factors in long-term investment decisions. Europe's existing semiconductor production clusters, including Dresden, Grenoble, Catania, Eindhoven and others, already generate some of these benefits. Scaling them further through continued investment can progressively close part of the cost gap that appears in a pure greenfield analysis. Conversely, spreading investment too thinly across too many locations would dilute these effects and keep per-unit costs higher than they need to be. The intra-European cost variation documented in Section 2.4 reinforces this logic. Different member states offer distinct strengths in terms of cost, talent, and ecosystem maturity. A coordinated pan-European approach that leverages this variation, directing activities to where conditions are most favourable rather than duplicating efforts across locations, allows Europe as a whole to present a more competitive position than any single country could achieve alone. R&D and product development concentrate where ecosystem density and proximity to customers and research institutions matter most, while manufacturing and assembly operations can be located where labour availability and cost conditions are more favourable. This differentiated approach applies across the value chain, from front-end fabrication and equipment development to packaging and electronics manufacturing services.



3 Location conditions assessment

The global semiconductor landscape today is shaped by a small number of regions that have each built distinct positions along the value chain over decades of sustained investment. Taiwan and South Korea have developed world-leading positions in advanced logic and memory manufacturing, supported by deep talent pools, established ecosystems, and governments that make semiconductor production a national strategic priority. The United States combines a dominant position in chip design and IP with a renewed push into manufacturing through the US CHIPS Act. Japan has rebuilt its relevance through strategic alliances and targeted subsidies focused on domestic resilience. Singapore has carved out a role as a highly efficient hub for advanced packaging, design, and regional headquarters. China is investing aggressively across the entire value chain, using large-scale state funding and a vast domestic market to build capacity at speed.

Europe belongs to this group of established semiconductor regions, with globally leading positions in power semiconductors, sensors, microcontrollers, and semiconductor equipment. Its manufacturing clusters are the product of decades of industrial development and public investment, creating dense ecosystems of fabs, equipment suppliers, research institutions, and specialised service providers that reinforce each other. At the same time, newer regions are actively working to establish themselves. India, which has long been a centre for semiconductor design and R&D engineering, has launched the India Semiconductor Mission to attract packaging and manufacturing investment, with the first large-scale front-end facilities now under construction. Malaysia has built a world-leading back-end cluster and is now broadening into front-end manufacturing to move up the value chain.

Each of these regions is competing for the same pool of global semiconductor investment. When companies evaluate where to build or expand capacity, they assess potential locations through a structured framework that combines a quantitative cost analysis with a qualitative assessment of the broader business and operating environment. The cost analysis, as presented in Chapter 2, is one part of that decision. The other is determined by a set of qualitative factors that shape the long-term viability, risk profile, and strategic fit of a location. This chapter covers that second part, benchmarking the EU against eight other semiconductor regions to identify what Europe should promote, where it can build on existing foundations, and where it needs to act.

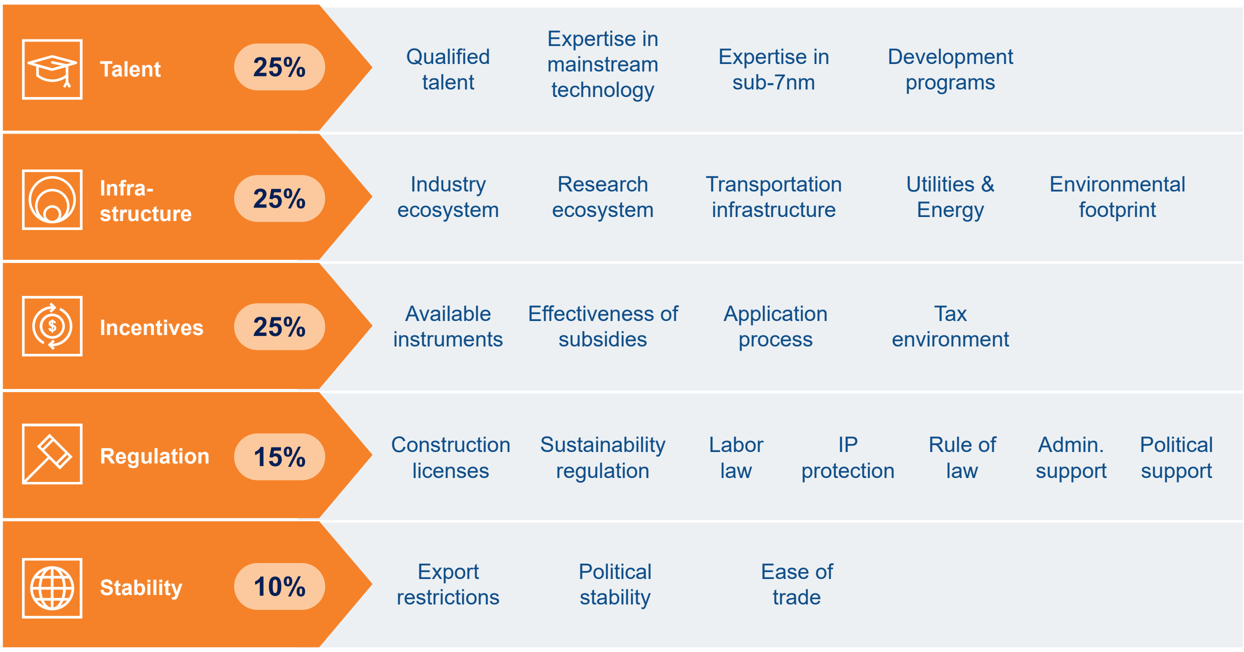
3.1 Methodology

The framework used in this assessment mirrors the decision-making process that semiconductor companies apply when evaluating locations for new capacity investments. It supplements the cost analysis with a structured evaluation of the operating and business environment, covering talent availability, ecosystem strength, government support, regulatory conditions, and political stability.

The relative weight given to each factor varies by strategic context, technology focus, and existing footprint. Expanding an existing site in an established cluster is a fundamentally different decision from building a greenfield fab in a new region. Furthermore, priorities that received limited attention in the past, such as geopolitical risk and supply chain resilience, now carry significantly more weight. The weightings used in this study represent a reasonable baseline, but they should be read as indicative rather than prescriptive, as should the scores themselves, which aggregate individual perspectives that naturally differ depending on regional heritage, product portfolio, and strategic priorities.

The regional scores are based on a structured survey conducted with experts from 15 semiconductor companies, equipment suppliers, and industry stakeholders across the European value chain, predominantly from member companies of ZVEI and FME. The respondents are professionals who conduct these types of location assessments internally for their companies when investment and site decisions are made, typically based in corporate strategy or operations functions. They were asked to rate each of nine regions across 23 individual criteria, grouped into five dimensions (see Figure 3.1). The weightings were defined by Strategy& and validated separately with the same group of experts. Each criterion was scored on a scale from 1 (very poor) to 5 (excellent). The nine regions benchmarked are the EU, the United States, Japan, South Korea, Taiwan, China, Singapore, Malaysia, and India. The 15 responses were aggregated and anonymised.

Fig. 3.1: Assessment framework for location conditions



Talent	25%	Qualified talent	Expertise in mainstream technology	Expertise in sub-7nm	Development programs			
Infra-structure	25%	Industry ecosystem	Research ecosystem	Transportation infrastructure	Utilities & Energy	Environmental footprint		
Incentives	25%	Available instruments	Effectiveness of subsidies	Application process	Tax environment			
Regulation	15%	Construction licenses	Sustainability regulation	Labor law	IP protection	Rule of law	Admin. support	Political support
Stability	10%	Export restrictions	Political stability	Ease of trade				

Source: Strategy& analysis

Talent
(weight: 25%)

The availability and quality of talent is consistently cited as one of the most important factors in semiconductor investment decisions. Building and operating a fab requires a deep pool of highly specialised professionals, from process engineers and equipment technicians to process specialists and cleanroom operators. The expertise needed differs between mainstream technologies above 16 nm, where Europe has an established manufacturing base, and advanced logic and memory below 16 nm, where the required skill sets are concentrated in a small number of regions globally. Talent is also the factor with the longest lead time to address. Unlike incentives or regulatory adjustments, which can be changed through policy decisions within months or years, building a semiconductor workforce takes a sustained investment in education, training, and immigration pathways. This dimension assesses the availability of qualified personnel, the depth of experience for both mainstream and advanced logic, and the quality of talent development opportunities including university programmes, industry training, and partnerships with research institutions.

Infrastructure
(weight: 25%)

A semiconductor fab does not operate in isolation. It depends on the surrounding ecosystem of material suppliers, equipment service providers, specialty gas and chemical logistics, wafer and mask supply, and testing and packaging operations. The density and maturity of this ecosystem directly affect operational efficiency, supply chain resilience, and the speed at which new processes can be ramped up. Beyond that, fabs require reliable and high-quality physical infrastructure including stable energy supply at industrial scale, semiconductor-grade water treatment, efficient transportation networks for logistics and employee commuting, and a research environment that enables continuous process innovation. This dimension also captures the environmental footprint of production in each region, an increasingly relevant factor as end-customers and regulators worldwide impose stricter sustainability requirements on supply chains. Europe's high share of renewables in the energy mix is a potential differentiator in this context.

Incentives (weight: 25%)	Government subsidies and financial incentives have become a standard feature of the global competition for semiconductor investment. Every major region now offers significant funding packages to attract fabs. The relevant question is no longer whether incentives exist, but how attractive they are relative to competing offers, how effective the programmes are in supporting long-term operations beyond the initial investment phase, how burdensome the application and compliance process is, and how appealing the broader tax environment is for semiconductor R&D and production. Incentives carry equal weight to talent and infrastructure in this framework, reflecting the increasing importance of government support in a global environment where every major region is actively competing for semiconductor investment with substantial funding packages. A subsidy package will not compensate for a shortage of talent or insufficient infrastructure. But in a competition between locations that are broadly comparable, the speed and reliability of incentive programmes can tip the decision.
Regulatory environment (weight: 15%)	The regulatory framework shapes how quickly an investment can move from decision to operational production, how efficiently a fab can operate on a daily basis, and how well the innovations it generates are protected. It covers the ease and speed of obtaining construction and operational permits, the impact of sustainability and supply chain regulations on manufacturing operations, the flexibility of labour law for 24/7 fab operations including shift models, hiring, and workforce management, the strength of intellectual property protection as a foundation for continued R&D investment, the objectivity and reliability of the rule of law, the quality of government administrative support, and the overall political backing for semiconductor projects. A strong regulatory environment does not mean the absence of regulation. It means regulation that is predictable, proportionate, and administered efficiently. What the industry finds challenging is regulatory layering, where multiple overlapping requirements at EU, national, and regional level create cumulative compliance burdens and unpredictable timelines. The absence of a single coordinating authority for fab construction approvals amplifies this problem. Companies must navigate multiple agencies in parallel, each with its own timelines and documentation requirements, adding time and cost that a single point of contact could significantly reduce.
Political stability (weight: 10%)	Semiconductor investments are long-term commitments that span decades. The political environment in which a fab operates over that period matters as much as the conditions at the time of the investment decision. This dimension assesses the risk of export restrictions, tariffs, and trade barriers that could affect the movement of materials, equipment, or finished products. It evaluates the political and economic stability of the region for long-term investment, including the predictability of government policy, the risk of political upheaval, and the resilience of the economic environment. It also captures the availability of free trade agreements and the size of the accessible internal market, both of which affect a fab's ability to serve customers efficiently across borders.

3.2 Results overview and global comparison

The weighted results show that the established semiconductor regions score within a relatively narrow range, from 3.4 to 3.8. This clustering is not surprising since these regions have built ecosystems over decades, and it would be unusual to see large differences in overall scores between them. The exceptions are Malaysia (3.2) and India (2.8), both of which are still developing their ecosystems and score notably lower as a result. The more revealing picture lies in the details: how each region's profile is composed, where the specific strengths and gaps sit, and what drives the differences beneath the headline numbers.

Europe in the middle

Europe scores 3.5 in the weighted comparison, placing it squarely among the established semiconductor hubs. This confirms that the region is perceived as a credible and competitive location with real strengths that matter to investors. At the same time, the score does not place it at the top of the ranking, and in a global competition where multiple regions are offering compelling propositions, there is room and need for improvement. What stands out is the contrast between the strongest and weakest dimensions of the European profile. The region ranks at the top on infrastructure and second on political stability, two dimensions rooted in decades of institutional development that competitors cannot replicate quickly. Its weaker scores, by contrast, are concentrated in talent, incentive execution, and regulatory complexity, areas that are challenging but ultimately within its own control to address. This combination illustrates that a path to a stronger competitive position does not require building something from scratch. It requires fixing specific, identifiable bottlenecks while leveraging the durable advantages already in place. Strengthening the conditions in those areas would also have implications beyond the location assessment itself. As companies weigh total investment attractiveness across both cost and qualitative factors when making location decisions, and a more competitive operating environment can help offset part of the cost premium. Section 3.3 examines these strengths, and Section 3.4 the improvement areas.

Comparison of the other regions

Taiwan and South Korea have built their semiconductor industries around a model of deep vertical integration, concentrated talent development, and sustained government partnership. Taiwan's strength rests on a concentration of manufacturing talent, cultivated over decades through a tight feedback loop between its universities, research institutes, and a domestic industry dominated by TSMC and its surrounding ecosystem. The Taiwanese government treats semiconductor permitting as a national priority, with dedicated fast-track mechanisms that allow new capacity to come online faster than in almost any other region. At the same time, Taiwan's geopolitical exposure remains a factor that weighs on long-term investment planning across the industry. South Korea follows a similar model, with Samsung and SK hynix at its centre, supported by strong tax incentives, low-interest loans, and a strategy of long-term cluster development. The concentration of its ecosystem around a number of large conglomerates is both a source of efficiency and a structural vulnerability. South Korea also faces a growing talent challenge, compounded by one of the steepest demographic declines of any major economy. The Korea Semiconductor Industry Association projects a shortage of 54,000 workers in the chip sector by 2031, while international competitors begun actively recruiting Korean semiconductor engineers, intensifying a war for talent.[13]

The United States combines a strong research ecosystem and design industry with a renewed push into manufacturing through the CHIPS Act. Its dominance in end-application markets, particularly in cloud computing, AI, and high-performance computing, creates a powerful pull effect. The companies driving demand for advanced logic and AI accelerators are headquartered in the US, and their proximity to the design ecosystem attracts fab investments from TSMC, Samsung, and Intel that are heavily oriented towards leading-edge nodes. The US approach reinforces this focus through a combination of instruments that goes beyond direct subsidies. Large-scale public funding through the CHIPS Act is complemented by tariff measures, Buy American procurement requirements, and export controls that together create a policy environment designed to pull manufacturing investment onshore. A dedicated CHIPS Program Office provides hands-on support to applicants. Its talent base is broad and deep, though concentrated in specific hubs, and the rapid expansion of manufacturing capacity is creating workforce pressures that vary significantly by region. A 2023 study by the Semiconductor Industry Association (SIA) and Oxford Economics projects a shortfall of roughly 67,000 technicians, engineers, and computer scientists in the US chip sector by 2030[14], with new fab locations such as Arizona and Ohio facing particularly acute challenges in building local workforce pipelines fast enough to match investment timelines. Construction permitting remains an additional challenge, and the regulatory environment, while more flexible than Europe's in labour law, is not uniformly efficient.

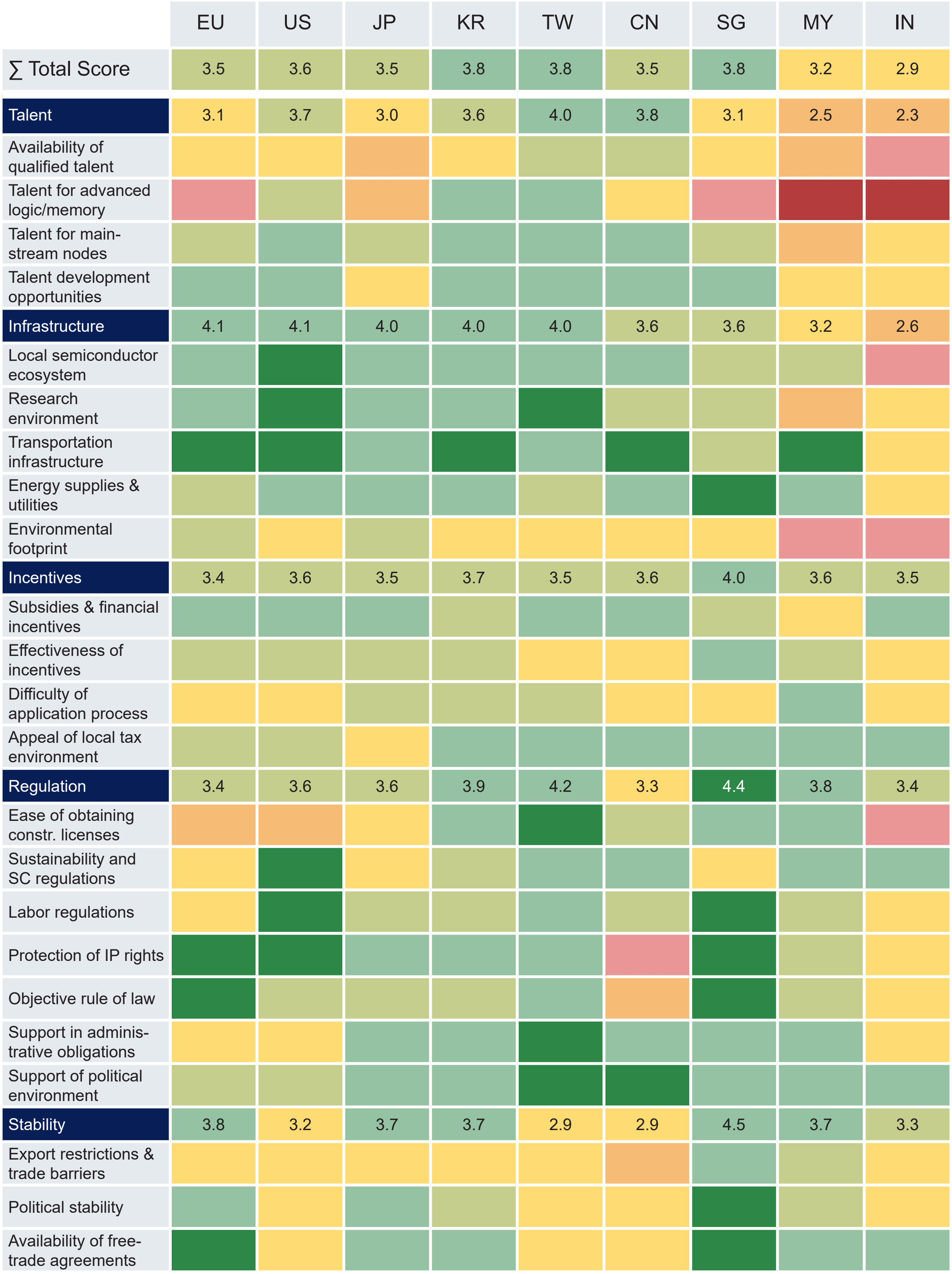
Japan is rebuilding its semiconductor relevance through a combination of strategic alliances and homegrown ambition. On the one hand, it has attracted manufacturing investment from TSMC, whose Kumamoto fab is backed by substantial government subsidies and streamlined approval processes. On the other, Japan has launched Rapidus, a bold domestic initiative aimed at establishing indigenous production capability for advanced logic at 2 nm and below, backed by government funding, a consortium of Japanese companies, and a technology partnership with IBM. Alongside these efforts, Japan is leveraging its existing strengths in materials, equipment, and specialty devices. Its approach to incentive programmes is focused on long-term domestic resilience rather than short-term attraction, with structured government-industry partnerships that provide predictable support over multi-year horizons. The country's main constraint is demographic. A shrinking and ageing workforce limits the available talent pool, and scaling production capacity will require Japan to attract international workers at a pace it has historically not pursued.

China presents a different model built on massive state-funded investment, combined with a vast domestic market and aggressive talent development. The region scores well on talent availability and the scale of incentives, but its low scores on IP protection, rule of law, and geopolitical risk create significant barriers for companies that need trusted supply chains or handle sensitive technologies. The lower score on political stability does not reflect domestic instability. The concern expressed by survey participants relates to the operational risks that arise from third-country export control regimes, particularly US restrictions on semiconductor equipment and technology, which create uncertainty about whether companies producing in China can access the tools and inputs they need over the lifetime of an investment.

Singapore has taken a different approach, building a position not through manufacturing scale but through regulatory efficiency, tax attractiveness, and a deliberate focus on becoming the most business-friendly location in the region. Its regulatory environment and political stability score highest in the entire comparison, which explains why many companies choose Singapore for regional headquarters, design centres, and advanced packaging operations even though its talent pool and physical ecosystem are smaller than those of Taiwan or South Korea. Singapore demonstrates that a region does not need to be the largest producer to be a critical node in the global semiconductor value chain.

Malaysia has built a world-leading position in back-end packaging and assembly, anchored by decades of investment. It has a deep ecosystem in this segment, with established supplier networks, experienced workforces, and competitive operating costs. Malaysia is now working to move up the value chain into front-end manufacturing, but the transition requires building the infrastructure, research capabilities, and talent base that its back-end cluster did not need. India is at an even earlier stage, with a strong base in semiconductor design and R&D engineering but virtually no manufacturing history. Its aggressive incentive programme through the India Semiconductor Mission is a first step, but the infrastructure, talent, and cluster development needed for fab operations will take years to build.

Fig. 3.2: Country location conditions comparison results



	EU	US	JP	KR	TW	CN	SG	MY	IN
∑ Total Score	3.5	3.6	3.5	3.8	3.8	3.5	3.8	3.2	2.9
Talent	3.1	3.7	3.0	3.6	4.0	3.8	3.1	2.5	2.3
Availability of qualified talent	🟨	🟨	🟧	🟨	🟡	🟡	🟨	🟧	🔴
Talent for advanced logic/memory	🔴	🟡	🟧	🟢	🟢	🟨	🔴	🟥	🟥
Talent for mainstream nodes	🟡	🟢	🟡	🟢	🟢	🟢	🟡	🟧	🟨
Talent development opportunities	🟢	🟢	🟨	🟢	🟢	🟢	🟢	🟨	🟨
Infrastructure	4.1	4.1	4.0	4.0	4.0	3.6	3.6	3.2	2.6
Local semiconductor ecosystem	🟢	🟩	🟢	🟢	🟢	🟢	🟡	🟡	🔴
Research environment	🟢	🟩	🟢	🟢	🟩	🟡	🟡	🟧	🟨
Transportation infrastructure	🟩	🟩	🟢	🟩	🟢	🟩	🟡	🟩	🟨
Energy supplies & utilities	🟡	🟢	🟢	🟢	🟡	🟢	🟩	🟢	🟨
Environmental footprint	🟡	🟨	🟡	🟨	🟨	🟨	🟨	🔴	🔴
Incentives	3.4	3.6	3.5	3.7	3.5	3.6	4.0	3.6	3.5
Subsidies & financial incentives	🟢	🟢	🟢	🟡	🟢	🟢	🟡	🟨	🟢
Effectiveness of incentives	🟡	🟡	🟡	🟡	🟨	🟨	🟢	🟡	🟨
Difficulty of application process	🟨	🟨	🟡	🟡	🟡	🟨	🟨	🟢	🟨
Appeal of local tax environment	🟡	🟡	🟨	🟢	🟢	🟢	🟢	🟢	🟢
Regulation	3.4	3.6	3.6	3.9	4.2	3.3	4.4	3.8	3.4
Ease of obtaining constr. licenses	🟧	🟧	🟨	🟢	🟩	🟡	🟢	🟢	🔴
Sustainability and SC regulations	🟨	🟩	🟨	🟡	🟢	🟢	🟨	🟢	🟢
Labor regulations	🟨	🟩	🟡	🟡	🟢	🟡	🟩	🟡	🟨
Protection of IP rights	🟩	🟩	🟢	🟢	🟢	🔴	🟩	🟡	🟨
Objective rule of law	🟩	🟡	🟡	🟡	🟢	🟧	🟩	🟡	🟨
Support in administrative obligations	🟨	🟨	🟢	🟢	🟩	🟢	🟢	🟢	🟨
Support of political environment	🟡	🟡	🟢	🟢	🟩	🟩	🟢	🟢	🟢
Stability	3.8	3.2	3.7	3.7	2.9	2.9	4.5	3.7	3.3
Export restrictions & trade barriers	🟨	🟨	🟨	🟨	🟨	🟧	🟢	🟡	🟨
Political stability	🟢	🟨	🟢	🟡	🟨	🟨	🟩	🟡	🟨
Availability of free-trade agreements	🟩	🟨	🟢	🟢	🟨	🟨	🟩	🟢	🟢

Sources: Strategy& analysis based on responses from 15 companies within the semiconductor and microelectronics industry, including member companies of ZVEI and FME

3.3 European key strengths

The assessment confirms that Europe has tangible strengths that resonate with semiconductor executives evaluating location decisions. These are not hypothetical advantages or policy ambitions. They are rooted in what companies observe and experience when operating in Europe, and they provide a solid platform from which to engage in the global competition for investment.

Infrastructure and ecosystem quality

Infrastructure is Europe's highest-scoring dimension at 4.1, on a par with the United States and above all Asian locations in the comparison, driven in particular by the strength of the local semiconductor ecosystem. Europe's manufacturing clusters have developed over decades into dense networks where fab operators, equipment manufacturers, material suppliers, and research institutions are co-located and work in close collaboration. This proximity creates a dynamic that interviewees highlighted as a distinct advantage. Equipment suppliers described the quality of engineering discussions between customers and suppliers in Europe, and the way European companies co-develop processes and solve problems together, as something that is difficult to replicate through arm's-length relationships in more dispersed regions. In contrast to regions where the ecosystem is organised around one or two dominant companies, Europe's ecosystem is more diversified across multiple players and product categories, particularly in power semiconductors, sensors, microcontrollers, and analogue devices. A further advantage that is often treated as implicit but carries real weight in location decisions is Europe's physical proximity to its end-industries. The automotive, industrial, energy, and healthcare manufacturers that drive semiconductor demand are headquartered and produce across the continent. This proximity shortens feedback loops between chip producers and their customers, enables closer collaboration on application-specific design and qualification, and reduces supply chain risk for components where just-in-time delivery and local technical support are essential.

The research environment is another area where Europe stands out. IMEC, Fraunhofer, CEA-Leti, and numerous universities with dedicated microelectronics programmes form a network of semiconductor research capabilities that is second only to the United States, providing a continuous pipeline of advances in process innovation, equipment characterisation, and materials science. The integration between research and industry is well-developed in Europe, with structured partnerships and joint development programmes that keep both sides closely aligned. This setup offers a platform for collaborative work on challenges that no single company could address alone, from wide-bandgap semiconductor development to advanced lithography process optimisation. For an industry where competitive position depends on continuous innovation, this research infrastructure is a strategic asset that few other regions can match in both depth and accessibility. This close integration between research, development, and production extends to Europe's equipment industry and highlights its relevance for the broader ecosystem. European equipment suppliers are increasingly expanding production into Southeast Asian locations such as Malaysia and Singapore, which for high-volume serial manufacturing is standard practice. But as these operations mature towards more specialised production, the proximity between manufacturing and R&D that currently drives Europe's innovation advantage could gradually weaken (see also Section 1.5).

Europe also leads on transportation infrastructure and environmental footprint. The quality of road networks, seaports, and airports across the continent is rated among the highest globally. On environmental footprint, Europe scores highest of all benchmarked regions, reflecting its growing share of renewables in the energy mix. As sustainability requirements from end-customers and regulators tighten worldwide, the ability to offer lower-carbon production profiles becomes a real competitive differentiator rather than merely a compliance exercise. Participants from the equipment supply chain specifically mentioned environmentally-friendly and circular manufacturing, together with civil society support as a European location advantage that is under-appreciated in investment discussions.

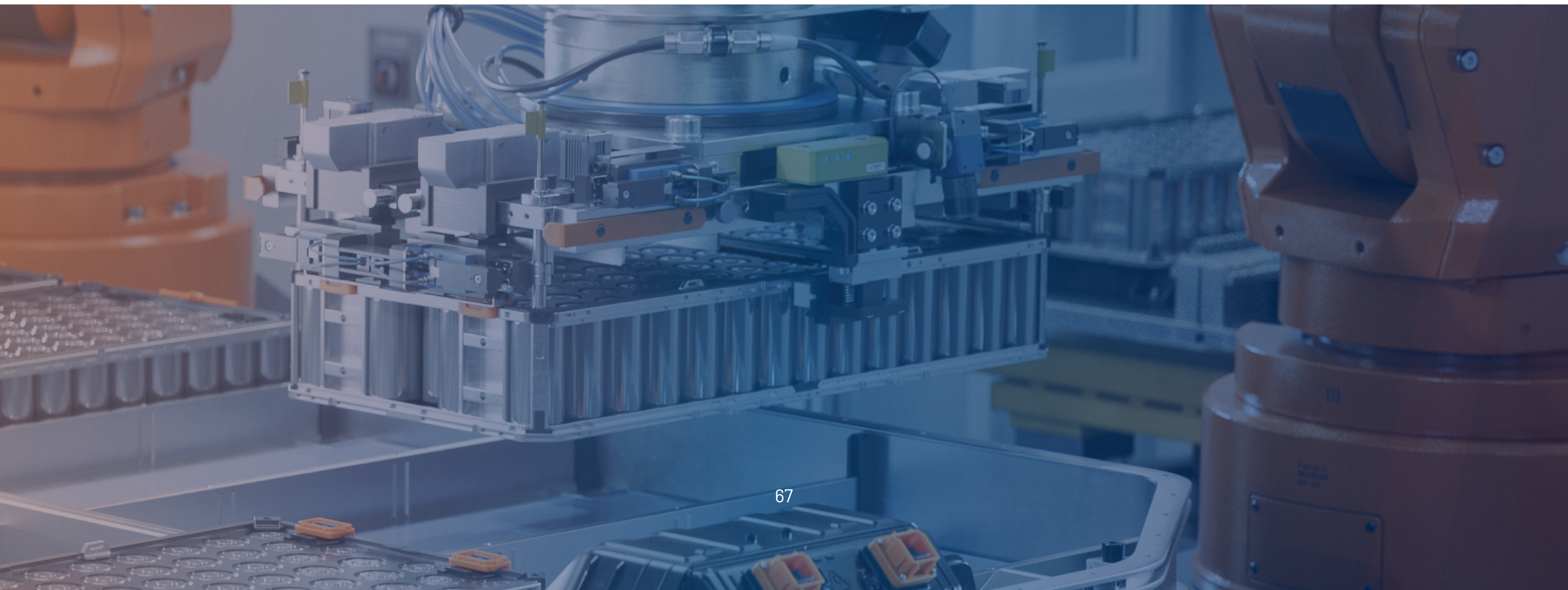
Energy supply reliability is adequate but not leading, and the challenge varies considerably across European locations. Grid congestion is a serious concern in parts of Europe, with the Netherlands as a prominent example. Grid operators have warned that companies in some Dutch provinces may face waiting times of up to ten years for a new or expanded electricity grid connection, a constraint that directly affects the feasibility of new industrial projects.[15] More broadly, the build-out of semiconductor-grade utilities, including water treatment, specialty gas supply, and waste processing, needs to keep pace with planned capacity expansions across the continent.

Political stability, rule of law, and IP protection

Europe scores second only to Singapore on political stability, and leads the entire comparison on IP protection (4.6) and rule of law (4.5). These scores reflect independent judiciaries, enforceable contracts, equal treatment of foreign and domestic companies, and the absence of expropriation risk. For investments with payback periods spanning 15 to 20 years, these factors carry real economic value. The difference between operating in a jurisdiction where legal outcomes are predictable and one where they are not translates directly into risk premiums that affect the cost of capital and the willingness of boards to commit multi-billion investments.

The EU single market and its network of free trade agreements further strengthen this position. The availability of free trade agreements and the size of the accessible internal market scores 4.3, reflecting a structural advantage that smaller jurisdictions like Singapore or Taiwan cannot match despite their regulatory efficiency. The ability to manufacture in one member state and sell across 27 countries without trade barriers, combined with preferential access to numerous international markets, gives European manufacturers a reach that few other regions can offer.

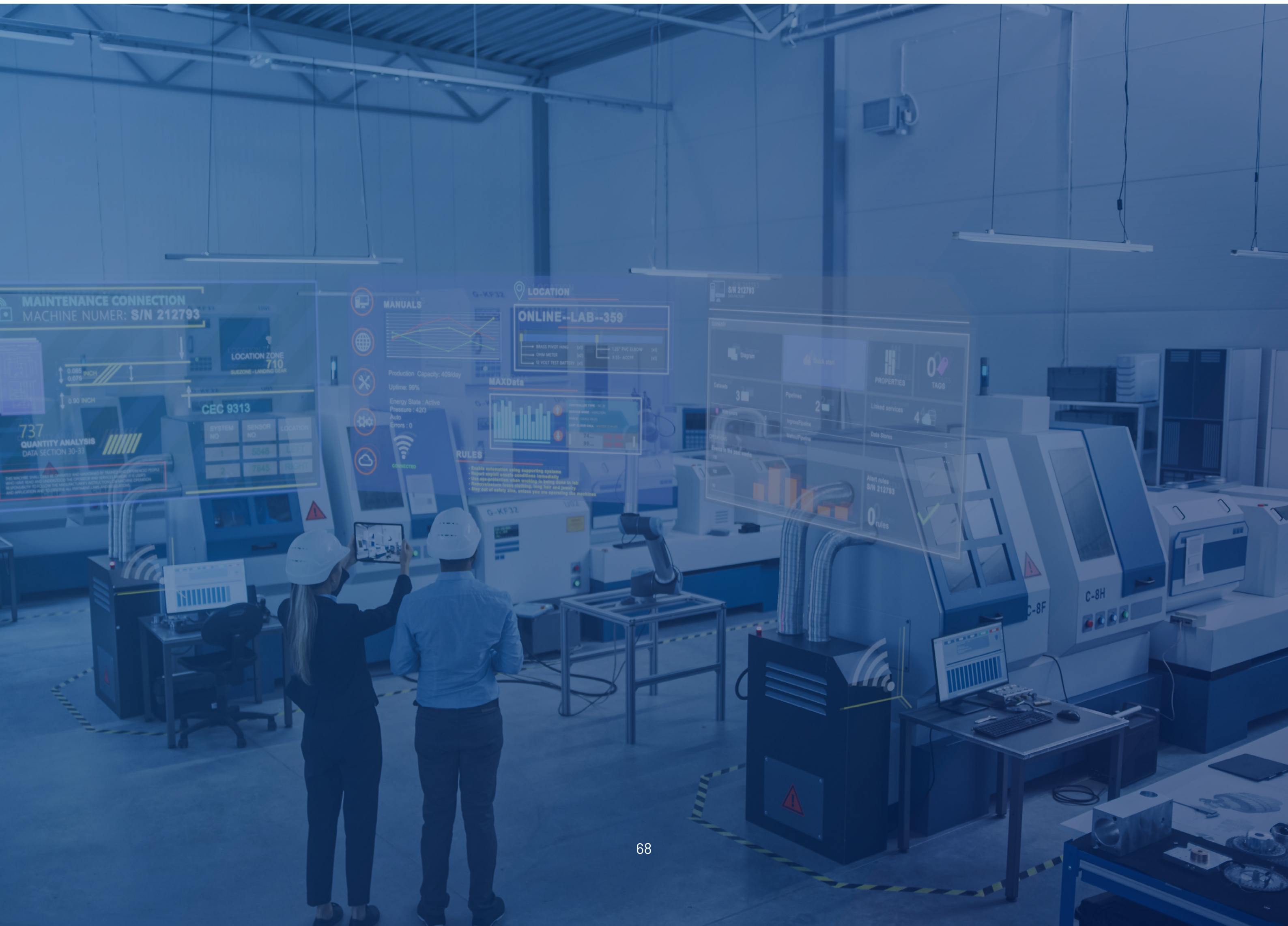
In an era where export controls, technology decoupling, and supply chain fragmentation are reshaping global trade, Europe's combination of legal predictability, political stability, and market access gains additional strategic weight. Companies that need to guarantee trusted supply chains for defence, critical infrastructure, or sensitive applications place a premium on jurisdictions where the operating environment is stable and enforceable. Europe offers this, but multiple interviewees noted that Europe does not market these advantages aggressively enough to prospective semiconductor investors. For civil applications, companies operating in the EU can procure and operate semiconductor equipment from all major global suppliers without being subject to the bilateral export control restrictions that increasingly constrain operations in other regions.



While the core IP and rule of law framework is seen as a clear European asset, some noted a growing tension on the regulatory side. The accumulation of EU-level regulation around data sharing, data protection, and technology governance, including instruments such as the Data Act and GDPR, is perceived by parts of the industry as adding complexity to innovation and commercialisation processes. The concern is not that IP is poorly protected in Europe, but that the regulatory environment surrounding how companies can use, share, and monetise data and technology is becoming more burdensome than in competing regions. This did not affect the overall score, but it was flagged as a trend worth monitoring as Europe continues to add regulatory layers that interact with technology-intensive industries.

Growing political commitment to semiconductor investment

National semiconductor strategies across several EU member states, combined with the visibility of semiconductor policy at the highest levels of government, signal a growing long-term commitment. The survey suggests that this momentum is recognised across the industry as an important factor, because it creates confidence that infrastructure investments, permitting decisions, and funding programmes will be sustained over the investment horizon. The European Chips Act at EU level and the Semicon Board NL, a standing advisory body bringing together ministers, senior industry executives, and knowledge institutions, were cited as examples of this direction. Overall, Europe is perceived as moving in the right direction, even if the pace and consistency of implementation still need to improve.



3.4 European improvement areas

The assessment identifies talent development, regulatory complexity, and incentive processes as the three dimensions where Europe has the most room for improvement. None of these are a surprise, but the survey confirms their relevance in the context of actual investment decisions and highlights the key areas where targeted action by government and industry can make a meaningful difference. The latter two are closely related, and both are rooted in bureaucratic complexity. The time from permit application to start of construction, the layering of EU, national, and regional requirements, and the administrative effort required to access funding.

Talent:
A growing gap

Semiconductor companies participating in the survey consistently confirmed that European engineers and technicians are well-regarded, and that the expertise built over decades of continuous manufacturing operations in Europe remains a genuine asset. At the same time, they reported that the number of qualified professionals available to the industry is not keeping pace with growing demand, and that this gap will widen as demographic change, competition from other sectors for engineering graduates, and the expansion of European fab capacity all compound. Survey participants also noted that the semiconductor industry faces growing competition for talent from other technology-intensive sectors, particularly software, AI, and the broader digital economy, which in many cases offer more visible career pathways and more competitive compensation packages. Attracting and retaining talent therefore requires the industry to improve how it positions itself as an employer, including through structured career development and compensation that reflects the specialisation and commitment the sector demands. A 2023 Strategy& study estimated that the European microelectronics sector could face a shortfall of around 350,000 skilled employees by 2030, giving a sense of the scale involved.

Beyond the volume challenge, demographic pressure is building. An ageing workforce in established European fabs means that a wave of retirements is approaching. Equipment and component suppliers specifically flagged that the shortage is particularly acute for experienced craftsmen and technicians with deep practical understanding of semiconductor processes, not for low-skilled roles. Without dedicated intervention through semiconductor-specific degree programmes, industry-led reskilling from adjacent sectors such as automotive, chemicals, and mechanical engineering, and faster immigration pathways for international talent, the shortage will intensify in the coming years. A separate but related constraint exists at advanced nodes. For logic below 16 nm, the near-absence of companies designing or manufacturing products in that area means there is no training ground for the engineers and technicians needed to run them. This creates a circular challenge. Attracting investment at smaller nodes is harder without the talent, but building the talent is harder without the fabs.

Talent development is an area where Europe has genuine strengths to build on. Europe's university system and research partnerships provide a strong educational foundation. Faster and simpler immigration pathways for qualified non-EU professionals would further help to close the gap and position Europe as a global destination for technology talent, as visa processes and administrative requirements currently create friction that competing locations handle more efficiently.

Regulatory environment: bureaucracy slowing execution and innovation

The permitting challenge is the most frequently cited operational barrier in the survey. According to data from Exyte, a leading semiconductor facility construction firm, building a fab from permitting and design through to production start takes around 19 months in Taiwan, 23 months in Singapore, 34 months in Europe, and 38 months in the United States.[16] Europe and the US face similar structural challenges in this regard, with both regions lagging significantly behind Asia. In Taiwan and Singapore, semiconductor facility permitting is treated as a national priority, with dedicated fast-track mechanisms, pre-approved zones, and single points of contact that compress timelines. In Europe, a fab goes through the same permitting process as any other industrial facility, with no differentiation for strategic significance. Beyond the formal process, survey participants pointed to the execution capacity of local and regional authorities as a further bottleneck as the speed at which permits are processed depends on the resources, expertise, and prioritisation within the government bodies responsible for handling them. Established European semiconductor clusters such as Dresden, Grenoble, or Catania already concentrate the necessary infrastructure, supplier networks, and institutional familiarity with fab operations. Preparing these sites with pre-completed environmental and zoning approvals would allow new investment projects to move directly into the construction phase.

Sustainability and supply chain regulations are another area of concern. Interviewees acknowledged the importance of environmental standards and sustainability objectives, but pointed to the cumulative impact on manufacturing operations. Per- and polyfluoroalkyl substances (PFAS) restrictions, the Corporate Sustainability Reporting Directive, and supply chain due diligence requirements were specifically cited as creating overlapping compliance burdens with unclear timelines and insufficient consideration of the semiconductor industry's specific technical requirements. PFAS are a particular case in point. As the previous ZVEI study highlighted, these substances are currently irreplaceable for specific processes, with initial substitutes unlikely to be available at industrial scale for another 10 to 20 years. A unilateral European restriction before viable alternatives exist would put production capacity directly at risk and simply shift manufacturing to regions with no such restrictions.

Labour regulation was also mentioned as a friction point, with concerns centred on working time flexibility, hiring and termination processes, and the regulatory framework for shift operations. Semiconductor manufacturing requires continuous operations, and the rules governing how companies can organise these vary considerably across regions. Several survey participants noted that other regions offer more flexible labour frameworks in these areas, which for some investors is a factor in location decisions.

Incentives: effective but inefficient

The European incentive programmes for semiconductor investment are broadly perceived as effective and well-designed. The overall funding commitment through the European Chips Act and national programmes is recognised as substantial and competitive with what the United States, Japan, and South Korea provide. The European Chips Act was specifically cited for supporting long-term R&D, first-of-a-kind manufacturing, and ecosystem development.

The application process for European subsidies, however, remains a significant friction point. Interviewees reported that it can take 12 to 24 months from application to approval, a timeframe during which companies are not permitted to begin the investments covered by the grant. In an industry where market conditions can shift within a single cycle, this delay has real consequences. There were several cases where projects were suspended or reconsidered because the market situation had changed over the course of the application process. For companies without dedicated public affairs and regulatory teams, particularly equipment suppliers and smaller firms, the complexity of the application is a barrier in itself, often requiring external advisory support to file successfully. South Korea was cited as a contrasting example, combining strong tax incentives and low-interest loans with streamlined administrative access. China was noted for large-scale funding with rapid execution. The US process, while backed by a dedicated CHIPS Program Office that provides hands-on support to applicants, was also described as complex, with extensive negotiations and requirements to demonstrate benefits for the local region.

The tax environment is a further area with room for improvement. The European tax landscape is fragmented across member states and lacks the targeted instruments that competing regions offer as standard, such as semiconductor-specific R&D tax credits, accelerated depreciation for fab equipment, and special economic zone benefits. The Netherlands was cited as a positive example with its long-term tax incentive programme, but this is not representative of the EU as a whole. A more harmonised and targeted European tax framework for semiconductor investment would strengthen the overall proposition.

4 Recommendations for policymakers and industry

This study sends a clear message. Despite the persistent debate about whether Europe generates sufficient semiconductor demand to warrant large-scale investment, the demand is there. It exists across all major technology categories, provides the foundation for future innovation and commercialisation, and will remain strong in both the medium and long term. The question is therefore no longer whether Europe has the necessary demand base, but whether it will act decisively enough to translate this demand into industrial strength, innovation leadership, and economic resilience. Moreover, Europe already has a well-established microelectronics base built over decades, including globally leading equipment suppliers, strong semiconductor manufacturers, world-class research institutions, and a highly interconnected industrial ecosystem of suppliers and customers. This foundation is a major strategic asset. It gives Europe the credibility, capabilities, and industrial relevance to compete globally, provided it now builds on these strengths with focus and ambition. What is needed next is clear. Europe must now focus on strengthening existing positions, closing targeted gaps, improving investment conditions, and creating the right framework for the next wave of innovation and industrial scale-up. With the right choices, Europe can reinforce its leadership in key segments of microelectronics while also shaping the next generation of technologies and value chains. Getting this right is not only an industrial priority. It is a precondition for Europe's long-term economic growth and welfare, technological sovereignty, and the resilience of the industries and infrastructure on which its citizens depend.

Realising this potential requires action from both industry and politics, and it requires that action to be coordinated. The demand growth is driven in large part by the verticals where European manufacturers hold globally leading positions, but Europe's presence remains limited in rapidly expanding areas like AI computing, advanced logic, and high-bandwidth memory. Sustained public and private investment is needed to secure current strengths and to build capabilities in these high-growth areas. The cost gap to the most competitive Asian locations is real, but a meaningful portion is structurally addressable through energy cost relief, efficiency gains from economies of scale and automation, and targeted fiscal instruments, while compensatory measures such as accelerated depreciation and continued public co-investment can narrow the rest. Europe's location environment offers durable advantages in infrastructure, political stability, and IP protection that competitors cannot replicate quickly. At the same time, bottlenecks in talent supply, permitting speed, and regulatory complexity remain within European control to fix. The following sections synthesise the evidence from the three preceding assessments and translate the findings into concrete recommendations across six action fields.

4.1 Summary of the business case assessment

The preceding chapters have examined Europe's semiconductor business case from three angles: the demand pull from European end-industries, the cost competitiveness of European production, and the broader location conditions that shape investment decisions. Taken together, the evidence confirms that Europe has a credible and structurally-grounded business case for continued and expanded investment in its microelectronics ecosystem. It also confirms that the business case does not materialise automatically. It requires deliberate action on several fronts where the current trajectory falls short of what the competitive environment demands.

On the demand side, the picture is unambiguous. European semiconductor consumption demand roughly doubles by 2040 in the base case scenario, driven by the electrification of transport and energy systems, the digitalisation of industrial production, the build-out of AI and data centre infrastructure, and the growing semiconductor content of healthcare and defence applications. Industry demand, which captures the chip pull generated by European manufacturers producing for global markets, grows at a comparable pace and in some verticals exceeds consumption demand by a significant margin. The growth is structural rather than cyclical. It is anchored in the sectors where European industry holds globally leading positions, particularly automotive, industrial production, energy, and healthcare, and it extends into new domains such as Physical AI (mobile production robots, autonomous vehicles, drones, etc.), edge computing, and critical infrastructure.

The demand foundation for investment is solid. The composition of that demand, however, reveals a dual challenge. Europe's established semiconductor strengths along the value chain are aligned with growing and durable demand pools in many areas. These positions are worth defending and expanding, not only to serve European demand but also to capture a share of global semiconductor growth. European producers with established strengths in power, analogue, sensors, microcontrollers, and specialty processes are well-positioned to participate in that worldwide demand through exports. At the same time, the fast-growing semiconductor categories in absolute terms (GPUs, memory, and advanced logic processors) are areas where European producers have limited to no presence and where the required manufacturing technologies sit at advanced nodes that Europe largely lacks. The demand assessment does not call for blanket expansion across all segments. It calls for strategic differentiation: strengthening where Europe leads, building or partnering where critical gaps threaten economic growth or sovereignty, and maintaining positions in segments where the priority is preservation rather than expansion.

On the cost side, the analysis confirms that Europe is the most expensive major region for semiconductor manufacturing across all fab archetypes examined. The cost gap to the most competitive Asian locations ranges from approximately 15% to over 30% depending on the technology segment, driven primarily by higher energy costs, higher labour costs, and in some cases higher construction costs. These are real disadvantages that affect investment decisions. They are not, however, insurmountable. Structural measures, notably energy cost reductions through tax and levy relief and productivity improvements through automation, can narrow the gap by 5 to 11%. The remaining difference requires compensatory instruments such as accelerated depreciation, CAPEX tax relief, and targeted subsidies. The cost chapter also demonstrates that advanced packaging represents an opportunity where the cost is comparable to front-ends and Europe can build competitive positions with more moderate investment. Critically, the cost comparison captures greenfield economics and does not fully account for the cluster effects that reduce effective costs over time as ecosystem density grows. Europe's existing manufacturing clusters already generate some of these benefits and scaling them further through continued investment can progressively close part of the gap that appears in a static analysis.

On the location conditions, Europe scores competitively among established semiconductor regions, with particular strengths in infrastructure and ecosystem quality, political stability, IP protection, and the rule of law. These are structural advantages rooted in decades of institutional development that cannot be replicated quickly. They provide the foundation for long-term investment confidence that the semiconductor industry, with its 15- to 20-year payback horizons, values highly. The assessment also identifies three dimensions where Europe needs to improve: talent availability, where a growing gap between supply and demand threatens to constrain expansion; incentive processes, where application timelines of 12 to 24 months create friction that competing regions handle more efficiently; and regulatory complexity, where the layering of EU, national, and regional requirements adds cost and delays that affect the speed at which investment can be deployed.

The market case for European semiconductor investment is robust. The cost position is challenging, but addressable through a combination of structural reform and targeted compensation. The location environment offers genuine advantages that Europe does not market aggressively enough, alongside specific bottlenecks that are within European control to fix. The task is not to build a semiconductor industry from scratch. Europe already has a substantial manufacturing base, globally leading equipment companies, strong research institutions, and a dense ecosystem of suppliers and customers. The task is to create the conditions under which this ecosystem can expand in line with the demand trajectory, close the gaps that the assessment has identified, and compete on terms that reflect its actual strengths rather than being dragged down by addressable weaknesses. The recommendations that follow translate this conclusion into concrete action fields for government and industry.

4.2 Recommendations for policymakers and industry

The analysis has established where European semiconductor demand is growing, what it costs to produce in Europe relative to competing regions, and which location conditions strengthen or weaken the investment proposition. The recommendations translate these findings into six action fields. Each recommendation is linked to the specific analytical evidence that motivates it (see Table 4.1). They are not ranked in order of priority, but form an integrated package where progress on one dimension reinforces the others. Faster permitting without adequate funding yields no result. Funding without talent yields empty fabs. Talent without competitive energy costs yields relocation.

Capital and funding: Build on Europe's industrial strengths through focused public and private funding that supports the scaling and enhancement of key strengths and a phased build-up of future value pools.

The demand assessment in Chapter 1 showed a doubling of European semiconductor consumption demand by 2040, with industry demand growing even faster at a factor of x2.4. The prioritisation framework in Section 1.7 translates that outlook into a strategic map of the value chain, distinguishing between areas to strengthen, gaps to close, and positions to maintain. Meeting the investment requirements across these categories demands sustained capital deployment from both public and private sources. European funding mechanisms and initiatives have been effective in supporting innovation and growth across the microelectronics ecosystem, mobilising more than EUR >86 billion in combined public and private investment. The European Chips Act and the two IPCEIs on Microelectronics have supported the development of new microelectronics technologies and the build-up of significant new production capacities across Europe. Together, these programmes have contributed materially to investment decisions in Europe's favour, anchoring major projects in existing microelectronics clusters such as Dresden, Crolles, Eindhoven and Catania. This momentum now needs to be sustained and broadened, with further investments required to keep pace with competing regions[1].

Continued and broadened funding for mainstream technologies and existing capabilities across the value chain is essential to preserve Europe's industrial strengths. Power semiconductors, sensors, MCUs, and communication semiconductors are all classified as strengthen categories, sitting on robust growth trajectories at nodes from 47 nm upward (Section 1.7), where the cost gap to Asia is most pronounced at 20 to 30% (Section 2.2). Public funding should continue to support capacity expansion and modernisation at these nodes, with an expanded first-of-a-kind scope that also covers capacity extensions and technology upgrades at existing sites across the value chain. Dedicated funding is additionally needed to transfer these strength technologies into new growth markets, particularly Physical AI systems, and to bring disruptive technologies such as silicon photonics, edge AI, quantum chips, and neuromorphic computing from laboratory to industrial scale (Section 1.6). Targeted industrial R&D funding at mid-to-high technology readiness levels is required to bridge this gap and facilitate bringing these technologies to the market.

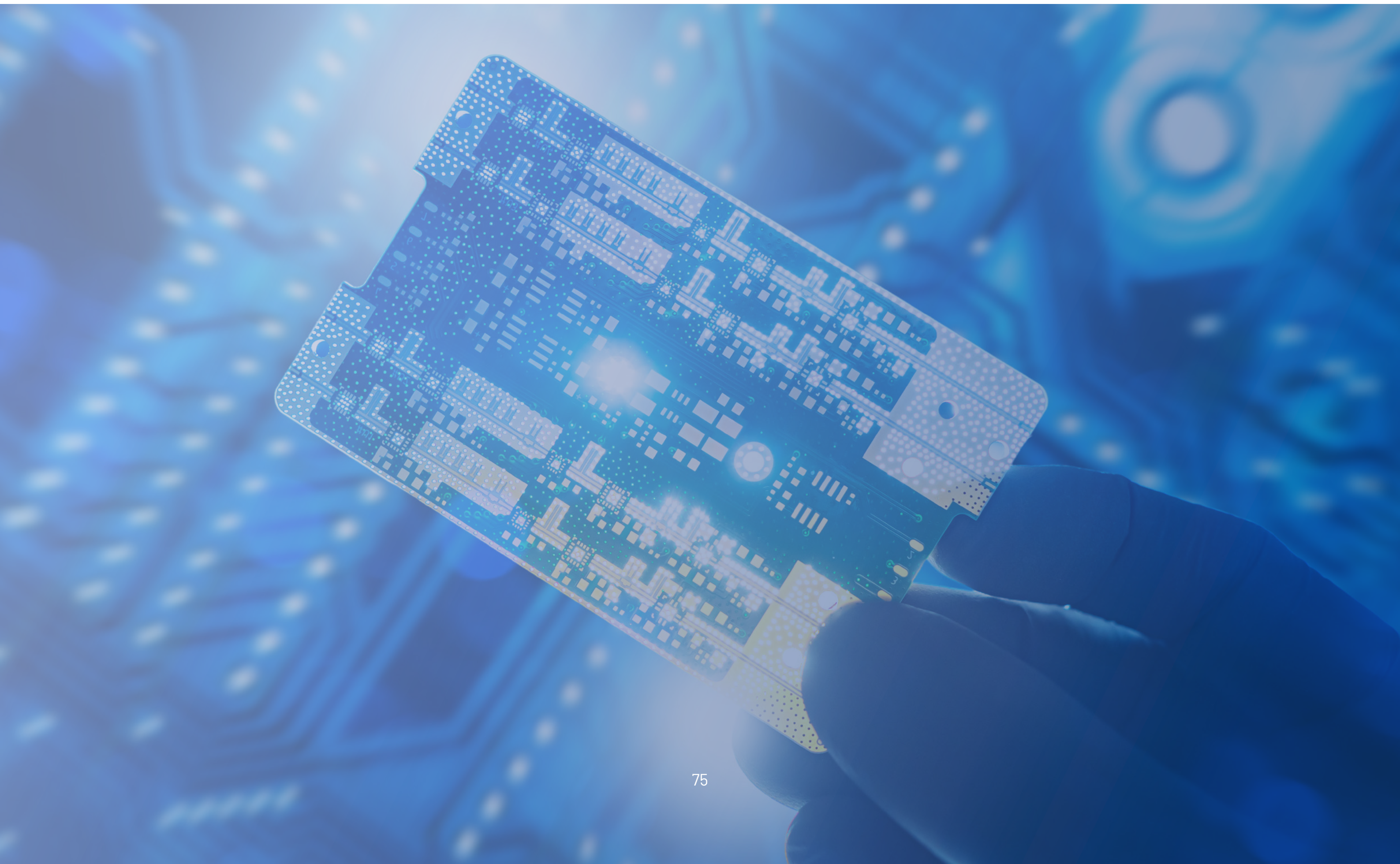
A realistic path forward starts with the capabilities that create demand for advanced manufacturing rather than with the fabs themselves. GPUs, advanced logic, and high-bandwidth memory are among the fastest-growing semiconductor categories, yet European production capacity is minimal (Section 1.4). A phased approach to building HPC and AI-relevant microelectronics capabilities is therefore required to address Europe's most consequential gap. Beginning with chip design and advanced packaging, which require far lower capital intensity than front-end manufacturing, capture a high share of value added, and rely on close collaboration with end-industries, and subsequently building towards manufacturing at advanced nodes, offers the most realistic route. Manufacturing at advanced nodes, by contrast, demands capital outlays of an entirely different order and does not allow leapfrogging, with no European player currently pursuing such ambitions. Each stage needs dedicated funding and partnerships connecting European design houses and research institutions with the global foundry ecosystem.

Packaging deserves particular attention as it represents one of the opportunities for Europe to build a competitive new position in the microelectronics value chain. As the importance of chiplet-based architectures and heterogeneous integration grows, advanced packaging is becoming a critical differentiator rather than a commodity back-end step. The cost analysis in Chapter 2 shows that the regional cost gap for advanced packaging is manageable, and can be further narrowed where packaging and testing processes are optimised for specific end-applications, improving yields and accelerating time-to-market in ways that offset remaining cost differences. Building these capabilities in close collaboration with European chip designers, equipment suppliers, and end-industry customers would allow Europe to capture a share of one of the fastest-growing segments of the semiconductor value chain. Power packaging, where Europe already holds a 10% global share tied to its leading position in power semiconductors, should be strengthened in parallel to support the growing demand from electrification (Section 1.7).

Semiconductor equipment is another key component of Europe's strong ecosystem. Each generation of tools is developed in close collaboration between equipment manufacturers, IDMs, and foundries throughout the product life cycle, with the earliest innovation phases being the most critical due to the enabling role of equipment technology in chip development and manufacturing. European equipment companies hold globally leading positions in lithography, deposition, and metrology that form the technological backbone of the entire semiconductor value chain (Section 1.7). Dedicated funding for equipment product development, leveraging Europe's existing R&D infrastructure and research organisations, would reinforce technological sovereignty and stimulate innovation across materials and component suppliers, chip design firms, and the broader ecosystem. A pan-European approach is essential here, as different European regions have built distinct equipment ecosystems with different strengths. Product development investment should be directed towards locations where R&D infrastructure and capability are strongest, while equipment manufacturing footprints can be established where competitive production conditions exist, including through the application of Physical AI and robotisation of manufacturing processes.

Targeted investment in PCB and EMS capabilities for strategic applications addresses a further vulnerability. For commercial applications, global sourcing remains viable. For defence, critical infrastructure, and export-controlled applications, dependence on non-European supply chains creates risks that need to be addressed through capacity investment in strategically sensitive segments (Section 1.5).

Public funding complements but cannot substitute for private capital. Companies across the value chain need to continue committing capital to capacity expansion and innovation in order to build European capabilities that sustain the ecosystem. The credibility of the European business case depends on industry demonstrating through its own investment behaviour that the demand outlook justifies sustained commitment. Mobilising that capital also requires improving Europe's financing ecosystem for capital-intensive technology companies through dedicated growth funds, de-risking instruments, and the removal of regulatory barriers that currently limit institutional investors from participating in deep-tech funding rounds.



Indirect incentives: Reduce the structural cost gap to competing regions through coordinated energy cost relief and a harmonised European framework of targeted tax incentives for semiconductor investment.

The cost comparison in Chapter 2 quantifies the structural disadvantages that these instruments need to address. The cost analysis identifies a greenfield cost premium of 15 to 30% for front-end manufacturing in Germany relative to the most competitive Asian locations (Section 2.2). Structural measures alone can narrow this gap by 5 to 11 percentage points, leaving a residual difference that requires compensatory instruments (Section 2.5). Targeted tax incentives for semiconductor investment are needed to bring Europe's framework closer to what competing regions offer. Accelerated depreciation for fab equipment, CAPEX-based tax relief for new manufacturing investments, and tax credits on R&D spend throughout the microelectronics value chain would address this residual gap. The location conditions assessment in Chapter 3 confirms that the European tax landscape is fragmented and lacks the targeted instruments that competing regions offer as standard. The Netherlands' long-term tax incentive programme for semiconductor-related activities provides a model within Europe, but it is not representative of the EU as a whole. A more harmonised European framework is overdue, particularly as the recent expansion of the US semiconductor investment tax credit to 35% intensifies the competition for investment.[17]

Reducing energy costs for semiconductor production is the single most impactful structural lever available. Electricity is one of the largest operating cost drivers for front-end manufacturing and the most variable cost factor across regions. The OPEX breakdown in Chapter 2 shows that personnel and electricity together account for 37% of total OPEX in Germany for the Power and Discretes archetype, compared to 14% in Asia (Section 2.2). Grid fee exemptions, electricity tax reductions, and state-facilitated long-term power purchase agreements can bring effective electricity prices for semiconductor production closer to internationally competitive levels. The cost analysis estimates that a 30 to 40% reduction in effective electricity costs through such mechanisms would narrow the overall cost gap by 3 to 6 percentage points (Section 2.5). Achieving this requires coordinated action across EU member states to ensure a level playing field, so that energy cost advantages are not confined to a few national jurisdictions while others remain uncompetitive.

Infrastructure and talent: Reinforce Europe's infrastructure advantage at established clusters and close the growing talent gap through a coordinated semiconductor skills agenda.

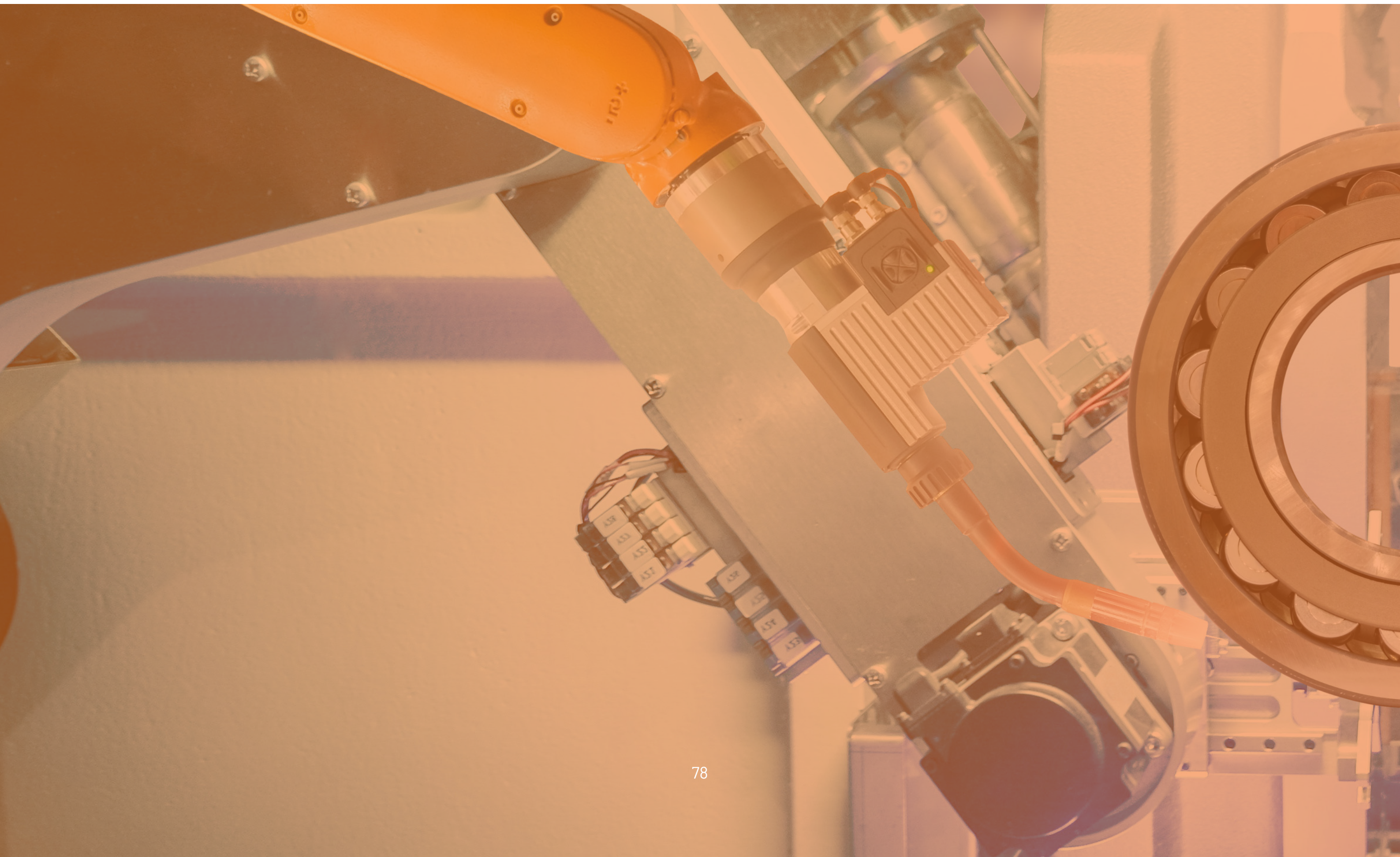
The location conditions assessment in Chapter 3 identified infrastructure and talent as two dimensions that directly shape the day-to-day operating reality of semiconductor companies. Europe scores at the top of the global comparison on infrastructure quality (Section 3.3). On talent supply, the gap is growing and needs to be closed through parallel action on education, immigration, and industry-led reskilling (Section 3.4). Semiconductor-grade infrastructure at existing and planned hubs requires state-funded build-up. Semiconductor manufacturing depends on industrial-scale energy supply, semiconductor-grade water treatment, specialty gas and chemicals logistics, and waste processing capacity. The cost analysis demonstrates that cluster effects reduce effective costs over time as ecosystem density grows, and that spreading investment across too many locations dilutes these benefits (Section 2.5). State-funded build-up of infrastructure at established clusters, such as Dresden, Grenoble, Eindhoven and Catania, reinforces the underlying ecosystem dynamics and creates strategic anchors for talent, knowledge, and investment.

Expanding the talent pipeline through education, immigration, and reskilling is an important location condition improvement that requires government and industry support alike. The talent dimension carries the heaviest weight (25%) in the location conditions framework, and Europe's score reflects a growing gap between supply and demand (Section 3.4). A 2023 Strategy& study estimated that the European microelectronics sector could face a shortfall of around 350,000 skilled employees by 2030. Addressing this requires action on multiple fronts simultaneously: dedicated semiconductor master's programmes at European universities, the integration of microelectronics into STEM school curricula, and a fast-track EU Semiconductor Talent Visa enabling qualified international professionals to relocate and work across European semiconductor sites within weeks. On the industry side, structured reskilling programmes that convert experienced professionals from adjacent sectors such as automotive, chemicals, and mechanical engineering into semiconductor manufacturing and design roles offer a near-term pathway. These programmes need to be combined with competitive compensation frameworks and structured career pathways that make the semiconductor industry attractive to talent competing with offers from other technology-intensive sectors.

European Demand Generation: Complement supply-side instruments with targeted demand-side measures that stimulate demand for European microelectronics components.

Strengthening the supply side alone will not be sufficient to secure value creation in Europe. It must be complemented by targeted measures that stimulate demand for European microelectronics components. Such demand-side instruments are essential to ensure the utilisation of new capacities, reduce investment risks, and create a reliable, predictable demand environment that encourages companies to make long-term investments in production capacity in Europe. This requires a mix of instruments. A key lever is the strategic use of public procurement. For example, publicly funded data centres should prioritise chips and other electrical components with a high share of European value creation in order to direct demand into European value chains and create investment incentives.

Furthermore, for narrowly defined strategic sectors, particularly defence, selected critical infrastructure, and applications subject to sovereignty requirements, it should be considered to give preference in relevant purchasing and sourcing decisions to electronic components that meet clearly defined requirements in terms of supply chain security, provenance, export-control compliance, long-term availability, quality standards, and cybersecurity. This could not only strengthen resilience in critical sectors, but also indirectly increase demand for microelectronics components with a high share of value creation in Europe. The semiconductor types required for these applications, predominantly power devices, sensors, MCUs, and analogue ICs, map closely onto European manufacturing strengths (Section 1.3). Translating this into more specific requirements for European-sourced semiconductor components, PCBs, and EMS could help create demand certainty for a segment with strong growth potential and high criticality. This applies with particular urgency to PCB and EMS capabilities, where European capacity is already thin and, once lost, extremely difficult to rebuild. Such an approach would need to be carefully scoped to avoid market distortions or unwanted supply chain shortages in globally integrated commercial value chains, but within a clearly defined perimeter it has the potential to create a predictable and policy-supported demand signal.



Simplification: Match the pace of the industry by accelerating fab permitting, streamlining Chips Act and IPCEI approval timelines, and reducing overlapping reporting obligations on semiconductor companies.

In a sector defined by short innovation timelines, bringing new products to market as quickly as possible is essential to capture the full value of R&D investment. The location conditions assessment consistently flagged regulatory and administrative complexity as a friction point that slows investment and raises costs (Section 3.4). Fast-track permitting for fab construction is needed to close the timeline gap with competing regions. According to data from Exyte cited in the location assessment[16], building a fab from permitting through to production start takes around 19 months in Taiwan, 23 months in Singapore, 34 months in Europe, and 38 months in the United States (Section 3.4). Granting semiconductor manufacturing facilities critical infrastructure status, creating pre-permitted "microelectronics-ready" zones at established cluster sites, simplifying environmental assessments for facilities that meet pre-defined standards, and establishing a single point of contact that coordinates approval across local and national levels would collectively bring European timelines closer to Asian benchmarks. The EU Semiconductor Coalition has called for emergency permitting legislation to fast-track strategic investments, and the proposal for a new fast-track IPCEI mechanism points in the same direction.

Streamlined and accelerated Chips Act and IPCEI funding procedures are essential to match the pace of the industry. The location assessment reports that the current application-to-approval timeline of 12 to 24 months is incompatible with corporate investment cycles where boards take decisions within months and cannot hold them open indefinitely while waiting for funding confirmation (Section 3.4). A target of 7 to 9 months from application to grant notification, as proposed by both industry associations and several member states, should be the benchmark.

Reducing the reporting burden on semiconductor companies requires a shift from compliance mandates to service-based market intelligence. The location assessment identifies PFAS restrictions, the Corporate Sustainability Reporting Directive, and supply chain due diligence requirements as creating overlapping compliance burdens with unclear timelines (Section 3.4). Mandatory supply chain reporting obligations should be replaced with a pragmatic, service provider-led approach to mapping and monitoring that builds targeted Commission market literacy without imposing additional bureaucratic obligations on individual companies.

Key to cutting red tape is the reduction of overlap between different pieces of legislation. A case in point is the current reform of the regulatory framework of Industrial AI – by integrating high-risk AI requirements from the AI Act into the Machinery Regulation, inconsistent definitions and overlapping obligations can be streamlined, significantly easing compliance without compromising health and safety.

Orchestration: Convert Europe's internal diversity into strategic asset through clearer roles across EU, national, and regional levels, an industry-led demand coordination platform, and partnerships.

The European microelectronics landscape involves multiple levels of government, dozens of national programmes, and a fragmented industrial base. The cost analysis demonstrates that the internal variation within Europe is itself an asset, offering a differentiated set of location profiles to investors. But without coordination, diversity becomes fragmentation, with efforts overlapping and funding spread too thinly. Defining clearer roles between EU, national, and regional levels, coordinating funding instruments to ensure critical mass, and managing a larger share of semiconductor funding at the European level are necessary steps. European governance bodies tasked with steering semiconductor policy should reflect this logic in their composition. Meaningful representation of industry alongside member state authorities in these bodies would ensure that strategic decisions are informed directly by those making the investment and production choices the policy framework is meant to enable. On the industry side, an industry-led demand coordination platform that consolidates future semiconductor demand across European end-industry value chains would help translate the macro-level demand outlook into actionable signals for policymakers, strengthening the link between demand trajectory and investment decisions.

Strategic partnerships with trusted APAC countries complement the domestic agenda. The prioritisation framework in Section 1.7 classifies several technology segments, including sub-7 nm manufacturing, advanced packaging, and edge SoC design, in the build or partner category, recognising that Europe cannot close these gaps alone. Partnerships with Japan, South Korea, India, Singapore, and other trusted economies through joint R&D projects, talent mobility, and coordinated approaches to standards are particularly relevant for advanced node manufacturing, where Europe's near-term pathway runs through collaboration with established players rather than standalone capacity build-up. When it comes to advanced packaging technologies, Europe should combine the development of its own capabilities with collaboration with international partners.

Fig. 4.1: Overview of recommendations derived from the analysis across six action fields

			Assessment root[1]		
Action field	**Recommendation**	**Initiative lead**	**Demand**	**Cost position**	**Location conditions**
Capital and funding	Continue and broaden funding for mainstream node technologies and existing capabilities across the value chain	Government	X	X	
	Expand targeted industrial R&D funding at mid-to-high technology readiness levels	Government	X		
	Continue and deepen private capital commitments for capacity expansions, industrial scale-up, and next-generation innovation	Industry	X		
	Pursue a phased approach to building HPC and AI capabilities, starting with chip design and advanced packaging	Industry	X		
	Targeted funding for the build-up of advanced packaging capabilities and strengthen power packaging capabilities	Government	X	X	
	Fund equipment product development and manufacturing capacity	Government	X		
	Invest in PCB and EMS capabilities for defence and critical infrastructure	Government	X		
Indirect incentives	Reduce energy costs for semiconductor manufacturing through dedicated measures	Government		X	
	Introduce a harmonised European tax framework for semiconductor investment	Government		X	
Infra-structure and talent	Build semiconductor-grade energy, water, waste treatment, and related industrial infrastructure at existing clusters	Government		X	X
	Strengthen the talent pipeline through education, STEM integration, and fast-track international recruitment	Government			X
	Develop industry-led reskilling programmes for professionals from adjacent sectors	Industry			X
	Improve competitive compensation frameworks and structured career pathways	Industry			X
Demand generation	Apply preferential procurement criteria for EU-sourced chips and components in defence and critical infrastructure	Government	X		
	Provide targeted measures that stimulate demand for European microelectronics components	Government	X		X
Simplifi-cation	Accelerate permitting through single point of contact and designate pre-permitted zones within clusters	Government			X
	Streamline and simplify Chips Act and IPCEI procedures to speed up grant notification	Government			X
	Replace mandatory supply chain reporting obligations with a pragmatic approach	Government			X
Orches-tration	Strengthen European coordination and align funding by defining clearer roles across EU and national levels	Government			X
	Create an industry-led demand coordination platform that consolidates future demands	Industry	X		
	Build strategic partnerships with trusted APAC countries for leading-edge technologies and innovation projects	Industry	X		

---

1) Assessment root indicates the part of the business case analysis that underpins each recommendation. For further details, see Chapter 4.2.
Source: Strategy& analysis

Appendix

Table A.1 part 1: Assessment along the framework for identifying EU focus areas

Value chain	Technology	EU share[1]	Growth		Dependence[4]	Criticality[5]	
		Market position of EU-based players	EU industry demand in 2040 compared to 2025		Degree of market concentration	Relevance for critical infrastructure or defence	
		2025 market share[1] (in %)	Absolute (MWSPM)	Relative (factor)	Players making up 80% of market (#)	Relevance (Low–High)	
Semicon equipment	Lithography	**80%[2]**	**6.7**	**4**	**≤3**	**Mid**	Indirect role via chip production
	Deposition	**8%[2]**	**1.9**	**4**	**3–5**	**Mid**	Indirect role via chip production
	Metrology & Inspection	**10%[2]**	**2.7**	**3**	**3–5**	**Mid**	Indirect role via chip production
	Etch & Clean	**<5%[2]**	**2.3**	**4**	**3–5**	**Mid**	Indirect role via chip production
	Thermal processing	**<5%[2]**	**0.6**	**3**	**3–5**	**Mid**	Indirect role via chip production
	CMP & Implant	**<5%[2]**	**0.6**	**3**	**3–5**	**Mid**	Indirect role via chip production
	Other & Specialty	**<5%[2]**	**N.A.**	**2**	**5+**	**Low**	Commodity tooling
Semicon design & IP	Analogue	**5%[2]**	**0.1**	**2**	**5+**	**Mid**	Supporting component
	Power	**40%[3]**	**0.2**	**3**	**3–5**	**Mid**	Supporting component
	Memory	**0%[3]**	**0.2**	**3**	**3–5**	**Mid**	Supporting component
	MCUs	**50%[3]**	**0.1**	**2**	**3–5**	**High**	Critical for secure control and safety applications
	Edge SoCs	**N.A.**	**N.A.**	**3**	**5+**	**High**	Critical for control of Physical AI system
	CPU/ GPU	**<1%**	**N.A.**	**7**	**≤3**	**Mid**	Supporting component
	Std. logic	**10%[3]**	**N.A.**	**2**	**5+**	**Low**	Commodity component
	Sensors	**40%[3]**	**0.1**	**2**	**5+**	**High**	Critical for control of Physical AI system
	Comm.	**10%[3]**	**0.1**	**3**	**5+**	**High**	Critical for control of Physical AI system
	Other	**N.A.**	**N.A**	**2**	**5+**	**Low**	Commodity component

Table A.1 part 2: Assessment along the framework for identifying EU focus areas

Value chain	**Technology**	**EU share[1]**	**Growth**		**Dependence[4]**	**Criticality[5]**	
		Market position of EU-based players	EU industry demand in 2040 compare to 2025		Degree of market concentration	Relevance of critical infrastructure or defence	
		current market share (in %)	Absolute (MWSPM)	Relative (factor)	Players making up 80% of market (#)	Relevance (Low-High)	
Semicon manu-facturing	007 down	**3%**[3]	**0.2**	**13**	**≤3**	**High**	Critical for control of Physical AI system
	008–016	**5%**[3]	**0.1**	**4**	**≤3**	**High**	Critical for control of Physical AI system
	017–020	**0%**[3]	**0.1**	**3**	**3–5**	**Mid**	Technology required across verticals
	021–046	**2%**[3]	**0.1**	**2**	**3–5**	**High**	Critical for control of Physical AI system and safety applications
	047–079	**8%**[3]	**0.1**	**3**	**5+**	**Mid**	Technology required across verticals
	080–130	**16%**[3]	**0.2**	**3**	**5+**	**Mid**	Technology required across verticals
	131–350	**11%**[3]	**0.1**	**2**	**5+**	**Mid**	Technology required across verticals
	351 up	**14%**[3]	**N.A.**	**1**	**5+**	**Mid**	Technology required across verticals
Packag-ing	Advanced packaging	**1%**[3]	**N.A.**	**3**	**5+**	**High**	Critical for autonomous edge-applications
	Power packaging	**N.A.**, EU with relevant share	**N.A.**	**3**	**5+**	**Mid**	Technology required across verticals
	Mature packaging	**1%**[3]	**N.A.**	**2**	**5+**	**Low**	Highly commoditized technology
PCB & EMS	PCB and EMS for critical infrastructure & defence	**≤2%**[3]	**N.A.**	**4**	**5+**	**High**	Part of critical infrastructure and defence
	PCB and EMS for communica-tion	**≤2%**[3]	**N.A.**	**2**	**5+**	**Mid**	Components required across verticals
	PCB for automotive, industrial, energy and healthcare	**≤2%**[3]	**N.A.**	**2**	**5+**	**Mid**	Components required across verticals
	EMS for automotive, industrial, energy and healthcare	**N.A.**, EU with relevant share	**N.A.**	**3**	**5+**	**Mid**	Components required across verticals

---

1) EU share defined as global market share by revenue of companies headquartered in Europe for equipment, packaging, PCB and EMS. For front-end manufacturing, defined as share of production capacity located in the EU. Based on ZVEI study „From chips to chances – The importance of and the economic case for supporting microelectronics" (2024) and input from ZVEI and FME. 2) High-level estimate based on publicly available data such as annual reports, comparing number of players and segment revenue. 3) Based on ZVEI study „From chips to chances – The importance of and the economic case for supporting microelectronics" (2024) and input from ZVEI and FME. 4) Strategy& estimate based on publicly available data on the number of companies active in each segment. 5) Strategy& assessment in alignment with ZVEI and FME.
Source: Strategy& analysis

Literature

1 ZVEI and Strategy& 2024: “From Chips to chances” – The importance of and the economic case for supporting microelectronics.

2 Physical AI systems include autonomous vehicles, mobile production robots, humanoids, drones.

3 World Economics: https://www.worldeconomics.com/Regions/EU/.

4 European Defence Industrial Strategy (EDIS) presented in March 2024.

5 Directive (EU) 2022/2555 of the European Parliament and of the Council of 14 December 2022.

6 Indicative number provided by expert input.

7 EC 2025: https://cordis.europa.eu/project/id/101194170.

8 X-Fab press release [11/12/2025]: https://www.xfab.com/news/details/article/x-fab-and-smart-photonics-collaborate-to-enable-multi-terabit-transceivers-with-silicon-photonics-and-inp-integration.

9 imec (11/24/2024): https://www.imec-int.com/en/press/european-commission-and-chips-ju-select-pixeurope-consortium-lead-european-pilot-line.

10 EC (07/2022): https://cordis.europa.eu/project/id/101070195.

11 See Table A.1 in Appendix.

12 E-Bridge: (8/1/2025): Electricity cost assessment for industrial consumers.

13 The Chosun Daily (11/28/2025): https://www.chosun.com/english/industry-en/2025/11/28/FVVNPEAGEZAFPFV4HXG4ZZSGWM/.

14 Oxford Economics and SIA (7/25/2023): https://www.oxfordeconomics.com/resource/chipping-away-assessing-and-addressing-the-labor-market-gap-facing-the-us-semiconductor-industry/.

15 NOS (12/19/2024): https://nos.nl/artikel/2548886-wachtlijst-voor-elektriciteit-van-tien-jaar-voor-bedrijven-noord-holland.

16 https://www.semiconductor-digest.com/building-fabs-in-the-u-s-vs-taiwan-twice-as-long-twice-as-much/.

17 SIA (7/3/2025): https://www.semiconductors.org/sia-applauds-passage-of-strengthened-semiconductor-investment-credit/.

electrifying
ideas

Contact
Clemens Otte • Director Microelectronics & Cables
E-mail: Clemens.Otte@zvei.org

Imprint
ZVEI e. V. • German Electro and Digital Industry Association
Amelia-Mary-Earhart-Str. 12 • 60549 Frankfurt am Main
Lobbyregisternr.: R002101 • EU Transparency Register ID: 94770746469-09 • www.zvei.org

In co-operation with Strategy&
Tanjeff Schadt • Partner / Managing Director • Strategy&, Part of the PwC network
Phone: +49 89 54525521 • Mobile: +49 1516 7330436 • E-mail: t.schadt@pwc.com

May 2026