Germany is a major microelectronics force, securing its place at the top of the international table as Europe's leading semiconductor production location. The country's second-biggest manufacturing industry in terms of workforce, microelectronics is also the leading sector in terms of value added. The country is investing significantly in next-generation microelectronics innovation, as it seeks to extend the CMOS and More-than-Moore technologies required to develop the next generation components for application in the Internet of Things and the booming automotive, industry and health markets.

Microelectronics – Key Enabling Technology
Microelectronics counts as one of the most important key technology sectors driving global innovation. The sector provides innovative solutions, for example, to the intelligent mobility, industrial production, smart energy grid, and health care challenges of the digital age. Germany has established itself as an international microelectronics force; accounting for more than half of European microelectronics production. The country is also home to one of the world's most thriving and innovative electronics sectors. The industry recorded turnover of EUR 178.9 billion in 2015, equivalent to a 4.1 percent increase. With a workforce of 85 thousand people, it is also Germany’s second biggest manufacturing industry by number of employees. It is also the country’s strongest manufacturing sector in terms of value added. Germany is expected to dominate the European market in terms of per capita microelectronics consumption, with a USD 180 forecast for 2021 putting it behind just Japan (USD 293) and the USA (USD 202) internationally. The ZVEI electrical industry association also forecasts that Chinese per capita spending will be just USD 91 over the same period, compared to USD 59 and USD 78 in 2011 and 2016 respectively. Internationally, China remained the biggest market in 2016, with semiconductor sales worth USD 1076 billion (9.2 percent increase), followed by the USA on USD 59.8 billion (5.7 percent decrease) and Korea with USD 45.6 billion (10.4 percent decrease).

Europe’s Semiconductor Leader
Germany is the beating heart of the European semiconductor industry, ranking among the world's top semiconductor production locations. The country boasts an unparalleled density of world-leading device manufacturers and suppliers for materials, components, and equipment across the value chain. German semiconductor producers are the revenue leaders in a competitive European market, generating turnover of EUR 9 billion in 2015. One in three chips produced in Europe is German-made, with the country being an international leader in sensors systems, energy-efficient electronics and chip-based security. According to industry reports, the global semiconductor market will grow by more than five percent annually up to 2019, with the mobility and Internet of Things (IoT) market segments recording particularly strong increases. Domestically, Germany’s automotive, industry and data technology sectors are the biggest semiconductor client industries with future application areas including Industrie 4.0, IoT, and smart energy grids expected to create further significant demand.
Application Industries

Increased levels of automation in passenger vehicles, the ongoing digitalization of industry, and a burgeoning mobile health sector are creating increased demand for advanced electronics and sensor technologies.

Automotive Sector
The automotive industry is the largest industry sector in Germany, generating turnover of EUR 404 billion in 2016 alone. Semiconductors account for around 80 percent of innovations in modern vehicles. Mobile internet access, digital operating controls and electronic assistance systems – once the sole preserve of the premium vehicle segment – are slowly finding their way into all vehicle segments. The sector is driving increased chip demand, with digitalization and electrification fueling semiconductor growth of 103 percent for the period 2000 to 2016. It is also the semiconductor sector’s main industry sector client, accounting for around 44 percent of domestic industry demand.

According to the ZVEI electrical industry trade association, the automotive semiconductor segment recorded an increase in growth from 7.7 percent to 11.6 percent during the period 2011 to 2016. Internationally, demand for semiconductors and vehicle electronics rose to almost USD 35 billion by 2014, and is forecast to grow by around 4.5 percent annually through to 2021.

According to McKinsey, automotive semiconductor demand is expected to continue growing in the mid- to long term as electric vehicles - with around three times the value of on-board semiconductors – supercede conventional drive trains. Forecast annual growth of around six percent through to 2020 is also slightly higher than the three to four percent growth expected for the semiconductor sector as a whole.

Medical Technology Sector
Germany is Europe’s biggest healthcare market. The country is also the world’s third largest medical technology producer – with around 10 percent of worldwide production – and counts as a major exporter of innovative medtech solutions. Company turnover in the sector has been growing at two to three times the level of gross domestic product since 1995, taking it to more than EUR 20 billion annually. In 2016, almost 70 percent of all medical technology products made in Germany were produced for international markets.

Mobile health solutions are the main driver of the significant growth recorded in the growing digital health market which is currently worth around EUR 3 billion (recording a CAGR of around 22 percent since 2012). The hardware segment, including mobile sensors and mobile monitoring devices, accounts for around 60 percent – over EUR 1.7 billion – of total mobile health market turnover. Current forecasts indicate that hardware will continue to be the main source of future revenue. Technological advances in electronic component miniaturization, autonomy and communication are allowing intelligent and networked medical devices to be developed. These will run the gamut from electronics-based diagnosis systems for hospital in-patient use to wearable electronics and sensor systems for mobile diagnosis and therapy purposes.

Industry Sector
Microelectronics has a decisive role to play in the ongoing digitalization of industrial production. Microelectronics and microsystems are central to Germany’s Industrie 4.0 project to establish the country as an integrated industry lead market and provider. As key enablers in industrial automation, electronics and sensors help transform production systems and products into cyber-physical systems (CPS). Embedded system production technologies and intelligent production processes show the way forward for peerless ICT-based integration making vertically integrated and networked manufacturing a reality.

The industry sector is the second largest semiconductor segment, with a 24 percent semiconductor share. Industry also recorded growth in semiconductor demand, recording an increase of 9.6 percent to 12.9 percent during the period 2000 to 2016. This growth is reflected in domestic business acceptance levels of the importance of the Industrie 4.0 project. Almost 40 percent of small and medium-sized enterprises in Germany’s thriving Mittelstand sector consider Industrie 4.0 an important issue, with 50 percent of large companies also convinced of its importance for the future.

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German Semiconductors Market Segmentation 2015 in percent

Source: ZVEI 2016
Germany’s microelectronics sector is organized into strong regional clusters that form a complete industry value chain network responsible for developing the smart, integrated systems required to meet industry’s changing needs.

Germany’s rich and diverse industry network and cluster landscape has given rise to a number of microelectronics regions with strong European and international profiles. In the east, the Free State of Saxony – home to the Silicon Saxony network - enjoys a reputation as Europe’s biggest micro- and nanoelectronics location. Silicon Saxony counts as the biggest high-tech network for the microelectronics, smart systems, photovoltaic, software, and applications sectors in Europe. Knowledge transfer and intra-company synergies are created as a result of close cooperation within the network; further consolidating the region’s reputation as a center of ICT excellence. The Cool Silicon leading-edge cluster, also in Saxony, was set up to develop energy-efficient – and even zero energy – solutions in the three ICT focus areas of computing, broadband wireless and sensor networks. The microTEC Südwest cluster in Baden-Württemberg counts as a major European competence and cooperation network for intelligent microsystem technology solutions in the fields of production, mobility, health, and energy. The it’s OWL cluster in OstWestfalen-Lippe is playing a leading role in developing automation and mechatronics technologies for industry. Intelligent technical systems are being developed in 47 research projects to make Industrie 4.0 a reality. A number of institutes within the Fraunhofer Group for Microelectronics and the Leibniz Association are also playing a decisive role in consolidating Germany’s role as a major international semiconductor and electronics research location. The Fraunhofer Group for Microelectronics, is a research and development service provider in the areas of microelectronics and smart systems integration. Part of the Fraunhofer-Gesellschaft, Europe’s largest application-oriented research organization, the group combines the expertise and know-how of 11 separate Fraunhofer Institutes (and seven guest institutes).

The Leibniz Association is a non-profit association made up of 91 basic and applied science and research institutions. Non-profit organized in nature, the Leibniz Association promotes science and research objectives among its member institutions with specific significance accorded their scientific, legal and economic independence. Member activities include knowledge-based and applied basic research, scientific infrastructure maintenance, research-based service provision, and eight research museums.
Supporting Innovation

Generous public research funding and industry development initiatives play a vital role in consolidating the domestic microelectronics sector’s leading European and international position.

Research and Development
Framework Programme for Research and Innovation
The Federal Ministry of Education and Research (BMBF) “Microelectronics from Germany – Driver of innovation for the digital economy” initiative (part of the German Federal Government’s Framework Programme for Research and Innovation 2016-2020) will see public funding in the region of EUR 1 billion invested in the country’s chip industry through to 2020. Additional industry investment of around EUR 2.3 billion should also be generated over the same period as part of efforts to strengthen Germany’s already thriving semiconductor sector. The subsidy activity is already reaping dividends with Bosch having announced planned investment of EUR 1 billion in a new 15,000 m² wafer fab in Dresden. The new wafer fab, necessary to meet growing Internet of Things (IoT) and mobility applications demand, represents the single biggest investment in Bosch’s 130-year plus history. Construction is set to be completed by the end of 2019, with production likely to start at the end of 2021. Globalfoundries has also announced planned investment of more than EUR 1.5 billion in Saxony, where it plans to produce next-generation FDX chips used in automotive and IoT applications.

Research Fab Microelectronics Germany
Eleven institutes within the Fraunhofer Group for Microelectronics and two institutes from the Leibniz Association have developed a concept for a cross-location micro- and nanoelectronics research factory. The “Research Fab Microelectronics Germany” initiative will consolidate the country’s global position in semiconductors and electronics in four future-relevant technology areas (“silicon-based technologies,” “compound semiconductors and special substrates”, “heterointegration,” and “design, testing and reliability”). Industry clients, SMEs and research institutes alike will enjoy access to the complete micro- and nanoelectronics value chain from a single source. As the world’s largest pool for smart system technologies and intellectual property rights, the initiative will strengthen German and European competitiveness in the field. The BMBF has made total funding of EUR 350 million through to 2020 available for the project.

Internationalization of Excellence Clusters, Future Projects and Comparable Networks
This BMBF “Leading-Edge Cluster Competition” successor initiative promotes innovation through cooperation between German clusters, networks and innovation regions for the period 2015 to 2021. Individual R&D partnership projects will be developed with partners from the prioritized international innovation regions. Joint activities with international partners receive funding of up to EUR 4 million over the duration of the program.

Productive 4.0
Productive 4.0 is a European co-funded digital industry innovation and lighthouse project with major relevance for the semiconductor industry. More than 100 partners from 19 European countries have signed up to the Infineon-led research project to strengthen Industrie 4.0 microelectronics competences for the international market. As well as partners from industry, research institutes including the Karlsruhe Institute of Technology, Fraunhofer-Gesellschaft and TU Dresden are involved in the EUR 106 million project.

Electronic Components and Systems for European Leadership
The Electronic Components and Systems for European Leadership (ECSEL) Joint Undertaking is a public-private partnership committed to maintaining Europe’s position at the forefront of electronics development. Committed to strengthening existing and creating new clusters, ECSEL strives to maintain and grow semiconductor and smart system manufacturing capability while providing access to world-class design and manufacturing infrastructure for all stakeholders.

go-cluster Initiative
The Federal Ministry for Economic Affairs and Energy “go-cluster” excellence program brings together around 100 innovation clusters from across Germany. Cluster members are at the cutting-edge of innovation and represent the technological diversity within the country’s industry and technology sectors. The initiative provides financial stimulus – in the form of support for innovative services and funding for novel solutions – to optimize cluster management allowing member clusters to position themselves as highly effective and visible international clusters. Membership provides numerous advantages to innovation clusters, actors and partners.

www.clusterplattform.de
MARKET OPPORTUNITIES

Future Markets

Digitalization is creating new opportunities for microelectronics in a number of emerging markets beyond the major application industry sectors. Microelectronics is the main driver of the digital transformation in which Big Data and the Internet of Things create an Internet of Everything that connects people, objects, data and processes in a brave new automated world.

Industrie 4.0

Germany’s technological leadership in the fields of manufacturing, automation and software-based embedded systems forms the cornerstone for the long-term success of the Industrie 4.0 project. Modern electronic and microelectronic components and systems are an important prerequisite in making Industrie 4.0 objectives a reality. New microelectromechanical systems (including sensors and actuators) building blocks (particularly for 3D motion tracking and technical monitoring systems) need to be developed for deployment in future cyber-physical production systems (CPPS). Additive manufacturing processes like 3D visualization and 3D printing also have an important role to play in the change to Industrie 4.0.

German industry plans to invest in the region of EUR 40 billion annually in Industrie 4.0 applications through to 2020, with Industrie 4.0-related growth of EUR 153 billion expected over the same period. Eighty-three percent of companies foresee an increased degree of digitalization in their value chains by 2020. The central findings of a recent PwC study show that value chain digitalization levels will reach 80 percent, with an overall efficiency increase of 18 percent. Twenty percent of companies in the automotive sector already use self-controlling production facilities.

Internet of Things

Internet of Things applications are of significant strategic importance for semiconductor manufacturers. According to McKinsey, the Internet of Things (IoT) will create up to USD 11 trillion in value added in 2025. This is equivalent to around 11 percent of global economic output; with the most lucrative application markets being the production (up to USD 3.7 trillion), cities (USD 1.7 trillion) and health economy sectors (USD 1.6 trillion). Within Germany, IoT-generated turnover is expected to double in just two years from a forecast level of EUR 24.5 billion in 2018 to more than EUR 50 billion by 2020 according to Deloitte.

The Internet of Things also gives rise to the age of the “connected car” and, ultimately, autonomous vehicles. Car connectivity will enable forays into previously unheard of levels of vehicle automation and management. According to PwC Strategy&, the digital mobility services sector is set to dwarf the smartphone sector by 2030, with USD 2.2 trillion industry value putting it on a par with the e-commerce sector. Technological advances made in fifth generation (5G) mobile communication networks and applications will lead to the creation of the “tactile internet.” This promises to unleash the full potential of the Internet of Things in a number of markets including Industrie 4.0, transportation systems and smart grids as well as the health and construction sectors. The success of Germany’s Industrie 4.0 project is largely tied up with the country also establishing itself as a major 5G market.

Big Data

Turnover for Big Data solutions in 2017 alone is forecast at more than EUR 50 billion worldwide. Big Data and IoT connect to form an industrial internet of everything that uses sensor systems, applications and data analytics to reinvent value chain models. Nowhere is this more relevant than in Germany’s changing energy market. New energy management networks that require real-time data management become essential with the change to volatile fuel sources.

Big data energy sector applications can improve grid efficiency and stability and significantly reduce operating costs. Abandoning nuclear energy in favor of renewable energy sources also requires a major research effort and investment in high-performance power semiconductors. In Germany alone, smart grid market revenue is forecast to grow from a 2010 level of EUR 1 billion to EUR 10 billion by 2020.

Internet of Things Turnover Forecast Germany in EUR billion

<table>
<thead>
<tr>
<th>Year</th>
<th>Turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>5.9</td>
</tr>
<tr>
<td>2014</td>
<td>9.2</td>
</tr>
<tr>
<td>2016</td>
<td>13.7</td>
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<tr>
<td>2018</td>
<td>24.5</td>
</tr>
<tr>
<td>2020</td>
<td>50.1</td>
</tr>
</tbody>
</table>

Source: Statista (Technavio, Deloitte) 2017
About Us

Germany Trade & Invest (GTAI) is the foreign trade and inward investment agency of the Federal Republic of Germany. The organization advises and supports foreign companies planning to expand into the German market and assists German companies seeking to enter foreign markets.

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GTAI provides close-to-market information to international companies looking to enter German markets. Our specialist industry teams prepare all of the relevant information essential to business success in Germany. GTAI’s comprehensive range of information services includes:

- Market and industry reports
- Market entry analyses
- Business and tax law information
- Business and labor law information
- Funding and financing information

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GTAI supports international companies from market entry to business start-up in Germany. Expert project teams advise and assist in the business establishment phase. GTAI’s range of free services includes:

- Legal and tax-related project support
- Funding and financing advisory services
- Site visit organization
- Local partner and network matchmaking
- Public and private partner coordination

All investment-related services are provided entirely free of charge. Our specialist industry teams have hands-on experience in their respective industries and treat all investor enquiries with the utmost confidentiality.

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