



# IPCEI on Microelectronics – Key technology for Europe

**Life without microelectronics? That is hardly imaginable any more. It is in our computers, smartphones, cars, it is needed for medical devices, for power supply and in industrial manufacturing. That is why this key technology has been classified as an important research topic, the development of which is being promoted not only in a national but also in a European context. For this Important Project of Common European Interest - IPCEI for short - Italy, France, the United Kingdom and Germany have joined forces to enable transnational and interdisciplinary research, development and investment up to the first commercial use.**

## **Funding from the idea to production**

For the first time, the IPCEI Microelectronics makes it possible to grant funding that covers innovations from their development to their first commercial use. This is new, because other funding possibilities usually exclude the step to the first commercial use in order not to create unequal competitive conditions. With the merger of the four states, which want to create cross-border synergies with their funding, the European Commission approved the funding for the IPCEI Microelectronics under state aid law for the first time at the end of 2018.

The four states are investing a total of 1.75 billion euros in the IPCEI, from which 29 European companies benefit with a total of 40 closely interlinked sub-projects. Germany is funding both large and small and medium-sized enterprises with up

to 1 billion euros. The funds come from national budgets and not from the EU.

## **New systems for the European market**

The aim of the IPCEI Microelectronics is to promote the key technology of microelectronics in Germany and Europe. Innovative technologies and components are being developed for the automotive industry, Industry 4.0 and other key applications. As part of the funding measure, targeted investments are being made in companies that focus on chip production, foundry expertise, hardware design, process knowledge, production facilities and downstream applications. In this way, the first industrial applications can be established in these areas and the technological and economic potential of microelectronics can be tapped. This benefits not only the participating companies, but also downstream industries throughout Europe, which can use the results to their advantage.

## **Combining key capabilities in important technology fields**

To achieve this goal, key skills are required in five important fields of technology:

- Energy-efficient chips,
- power semiconductors,
- intelligent sensors,
- advanced optical devices and
- composite materials.

For most products, a combination of these key components is necessary to strengthen both Germany's and Europe's

technological sovereignty and competitiveness on the international market. Therefore, the individual projects are closely interwoven.

## **THE FIVE TECHNOLOGY FIELDS**

### **Energy efficient chips**

In technology area 1 „Energy efficient chips“, eight partners (three of them from Germany) are working together to improve the energy efficiency of basic microelectronic components or chips. For this purpose, so-called FD-SOI technology (Fully Depleted Silicon on Insulator) is used in chips, which reduces so-called leakage currents through intellectual insulation and design. Transistors thus consume less power and can be switched faster. The innovative wafer substrate is currently being supplied in Europe by SOITEC and will then be used by the chip manufacturer STMicroelectronics and the semiconductor foundries GlobalFoundries and X-FAB for industrial applications.

The aim is to expand European FD-SOI technologies along the value chain (substrates, technology platforms, innovative systems, designs/IP) through strong investments in research, development and innovation. The technology is particularly interesting for the automotive, IoT and space markets as it meets the necessary requirements for energy efficiency, performance and reliability.

### Power semiconductors

In technology area 2 „Power semiconductors“, ten partners (including six full partners and one associated partner from Germany) are working together to advance the development of power semiconductor components with increased energy efficiency and reliability. To strengthen Europe in the Internet of Things (IoT), Industry 4.0 or electric vehicles, innovative technologies need to be accelerated and aligned along the relevant value chain (technologies, assembly techniques, design/libraries, digital manufacturing, quality/reliability). This is a prerequisite to provide power semiconductors and integrated smart power circuits with smaller size, less energy dissipation, smaller cooling structures and longer lifetime for advanced application and market requirements. The respective contributions of the power semiconductor industry can be summarized into four main technical objectives: sustainable power generation and conversion, reduction of energy consumption, high reliability and functional safety through embedded on-chip diagnostics and efficient energy management.

### Smart sensors

In technology area 3 „Smart sensors“, twelve partners (six of them from Germany) are working on developing and supplying sensor components for the European market. This is to improve European cooperation, research and development. Sensors are used, among other things, in condition monitoring, where they detect light intensity, temperature, pressure, humidity or movements and transmit this information to a network. As the main components, they generate all the data that is transmitted in the IoT, for example. A current challenge in sensor development is data integrity. Here, work is being done on both the trustworthiness of the data and the processing of the flood of data generated by the sensors. Intelligent sensors are needed to secure the data including their transmission as well as to process and interpret the collected data locally. The industrial companies involved have the necessary know-how to develop

such intelligent sensor solutions, e.g. for the IoT or driver assistance systems. This requires considerable investment in research and development, but also in new wafer fabs, test facilities and the necessary infrastructure. Infrastruktur.

### Advanced optical equipment














































In Technology area 4 „Advanced optical equipment“, a German partner collaborates with an associated partner to strengthen research, development and innovation (R&D&I) for the European semiconductor equipment industry. A particular focus is on extreme ultraviolet (EUV) technology. EUV will be crucial for future high-end chip manufacturing in the next decade. Semiconductor chips are manufactured using photolithographic processes, whereby photoresists are exposed on wafers and the resulting structures are later transferred to the silicon of the wafers. If extreme UV radiation with a smaller wavelength is used for the exposure (EUV lithography), correspondingly smaller chips can be produced with the same output. These are required for highly complex electronic devices for data storage and processing. Optical equipment is at the beginning of the value chain in the electronics industry. With new technical approaches, the structuring of integrated circuits can be resolved by a factor of 5 higher.

### Compound materials

In technology area 5 „Compound materials“, eleven partners (two of them from Germany) are working to create an integrated, pan-European compound semiconductor ecosystem. This ecosystem is intended to make compound semiconductor (CS) technologies available that are needed in technology areas 1-4 and other technological areas throughout the supply chain. At the same time, extensive cooperation between different European supply chain participants is to be achieved in order to further advance CS technologies and make them accessible. New production facilities for optoelectronic components and products of the future generation will also be created for this

purpose. Compound semiconductors are a family of semiconductor materials that have unique optical, electronic, magnetic and HF (high frequency) properties that cannot be achieved with silicon and related materials. By combining the two technologies (silicon and compound semiconductors), highly efficient and cost-effective solutions can be implemented for advanced microelectronic components and systems. With input from universities and institutes, products are thus to be developed from material design through semiconductor production to application.

**PARTICIPATING COMPANIES**

Energy Efficient Chips	Power Semiconductors	Smart Sensors	Advanced Optical Equipment	Compound Materials
CEA-Leti** 	3D Micromac** 	CEA-Leti 	AMTC** 	AZUR Space Solar Power 
Cologne Chip 	AP&S International 	CorTec 	Carl Zeiss* 	CEA-Leti 
Globalfoundries 	CEA-Leti 	Elmos Semiconductors 		Integrated Compound Semiconductors 
RacyLCs 	Elmos Semiconductors 	Fondazione Bruno Kessler 		IQE* 
Soitec* 	Infineon* 	Infineon 		Newport Wafer Fab 
ST Microelectronics   	MURATA 	Robert Bosch* 		SPTS Technologies 
X-FAB  	Robert Bosch 	ST Microelectronics   		Osram 
	Semikron 	TDK-Mikronas 		LYNRED 
	X-FAB 	LYNRED  		Soitec 
		X-FAB  		ST Microelectronics 

\*coordinator, \*\*associated partner

**COOPERATION AND KNOWLEDGE TRANSFER**

The five technology fields are strongly interconnected and complement each other. Most microelectronics applications require not only individual components or chips, but complete systems. These systems are based on a combination of elements developed and manufactured in the different technology fields.

The IPCEI Microelectronics thus combines the development and initial industrial use of microelectronic components for the manufacture of microelectronic systems. To this end, on the one hand, disruptive technologies are supported, which often originate from long R&D projects and now benefit from the European cooperation initiative IPCEI. On the other hand, support is provided to companies that

use these technologies and are in the pilot phase of developing new products for the market or are already on the verge of their first industrial launch. To ensure that the benefits of IPCEI Microelectronics are not limited to the participating companies, all companies have committed to disseminating their results and to achieve positive spillover effects.

The results are to be disseminated beyond the participating member states as well as beyond the participating companies. In this context, utilization beyond the original sectors is also required. The funded companies therefore go well beyond routine and normal business relationships or marketing activities in disseminating their results.

Given its positive impact on the European internal market, the IPCEI Microelectronics represents a very important contribution to economic growth, employment and competitiveness for industry and business in the European Union.