SILICON SAXONY
THE HIGH-TECH NETWORK

# NEXT

ISSUE 02/2022

## IN THE SPOTLIGHT
## MICROELECTRONICS

**STORIES, FACTS AND FIGURES**

#WeAreSiliconSaxony

# Microelectronics ...
## (sometimes synonymously semiconductors)

describes the design and manufacture of thousands of tiny integrated circuits (ICs) within a single device, the „chip“. In most cases, the basic material of this chip is silicon, which is processed by semiconductor factories (fabs) on so called wafers, thin circular slices of the material. Here, insulating or conductive layers are applied in numerous complex process steps. This is how electronic components, for example transistors and capacitors, are realized, which can be combined depending on the desired function of the chip. The production process ends with packaging, in which in some cases several thousand chips are separated from one another and placed in a package, as well as an elaborate test procedure. Basically, it can be said that as the size of the transistors decreases, the performance of the chip increases, but the production also becomes more complex and expensive. Chips are used today in all technical devices - from alarm clocks and cell phones to industrial robots.

**THE TOP 3 CHIP MANUFACTURERS**

**WORLDWIDE**
(BY SALES IN USD BILLIONS)

**1. SAMSUNG (SÜDKOREA) – 75,9**
**2. INTEL (USA) – 73,1**
**3. TSMC (TAIWAN) – 56,8**

**EUROPE**
(BY SALES IN € BILLIONS)

**1. ST MICROELECTRONICS (SCHWEIZ) – 11,2**
**2. INFINEON (DEUTSCHLAND) – 11,0**
**3. NXP (NIEDERLANDE) – 9,7**

*Source: Statista, FAZ

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SAW COMPONENTS Dresden & X-FAB Dresden: p. 8
Federal Ministry of Economics: p. 7
Fraunhofer FEP: p. 10



# Dear readers,

Production stops, delivery difficulties, price increases - the semiconductor shortage highlighted the importance of the microelectronics industry. In Saxony, too, work is continuing to end the shortage - with excellent research, new materials, forward-looking technologies and fully automated factories. Our booklet provides an overview of all relevant topics relating to microelectronics. It also offers the opportunity to obtain in-depth information online. Look forward to exciting details on chip production, application areas, future-proof jobs and the immensely important promotion of the industry. You will be amazed at the importance of microelectronics in your life.

**Enjoy reading,**
**Yvonne Keil**

**Sr. Director Global Supply Management | GlobalFoundries Dresden**
**Board member | Silicon Saxony**

## Table of contents

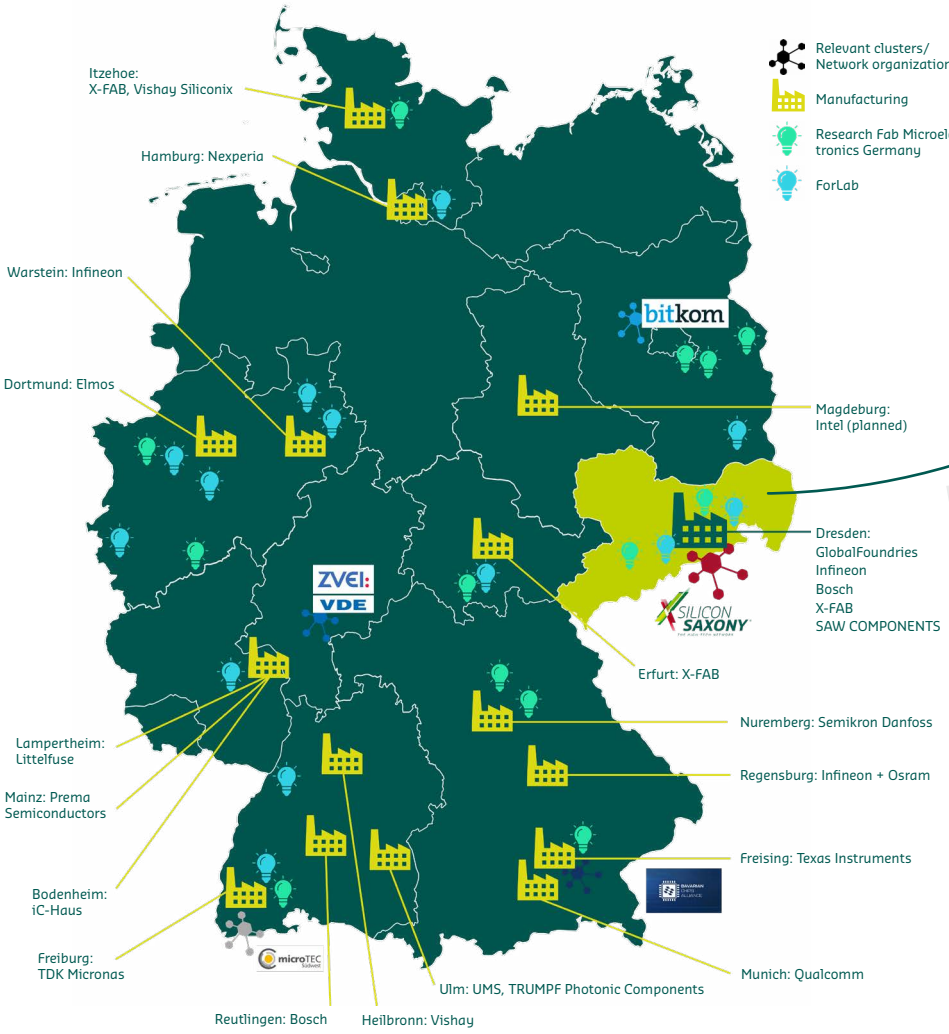


EACH QR CODE UNHIDES FURTHER INFORMATION

**JUST SCAN IT WITH YOUR PHOTO APP**

# Germany's microelectronics landscape - Europe's semiconductor heart beats here

Absolutely cutting-edge research, world-class product development, highly and fully automated production factories - the semiconductor heart of Europe beats in Germany. Locations such as the microelectronics valley Silicon Saxony have long since made a name for themselves worldwide. But where are the chips of tomorrow actually being developed? Where are the industry's major fabs located? Which companies and institutions shape the German semiconductor market? Our location map provides a quick overview.






# Silicon Saxony in numbers

**> 1 million wafers** processed per year

Approx. **113,000 square meters** of cleanroom space

**51 educational and research** institutes

**> 40,000 employees** work directly and indirectly in the microelectronics industry

**5 fabs** at one location

**Every 3rd microchip** produced in Europe is „Made in Saxony"

**GET TO KNOW THE +400 MEMBERS OF SILICON SAXONY**

SILICON EUROPE

***„It is not about competition within Europe. It's about Europe's position in global competition."***

**Frank Bösenberg, Managing Director | Silicon Saxony**

To remain internationally competitive, the microelectronics industry in Europe must cooperate more closely. Silicon Saxony has therefore been involved in the Silicon Europe Alliance - a network of eleven European cluster partners - since 2012 and is also active in the EU projects ASCENT+, Eurocluster, METIS and EXCITE.

**LEARN MORE ABOUT OUR EUROPEAN COOPERATION PROJECTS**

# Saxony's chip industry strengthens its supply chains

Wafers, spare parts, gases - Microelectronics logistics must manage material flows around the globe

In the past two years, the discussion about disrupted value chains has focused strongly on missing chips for the automotive industry. Rather little public attention has been paid to what a sophisticated high-tech product the microelectronic circuit is and what complex paths lead from sand to chip. It is therefore even more remarkable that most semiconductor manufacturers have been comparatively successful in keeping their own value streams flowing.

This task is demanding: To manufacture a microelectronic circuit, you need high-purity silicon, targets for the ion implanters, noble gases, aqua regia and many other chemicals, equipment costing millions, know-how accumulated over decades and an excellent system to coordinate thousands of people and process steps around the globe. De-globalization in the semiconductor industry? Difficult, because no single country is able to realize all links of the semiconductor value chain entirely within its own borders. Some chips travel two and a half times around the globe from sand to assembly at the end user.

Do you want to know how complex the process is in detail, what supply flows look like, why companies are expanding a multi-source approach, and what the energy supply situation is like for semiconductor fabs in times of energy crisis?

**Why are semiconductor factories so expensive?**




Bosch's fully automated fab in Dresden is one of the most modern in Europe



Digital twin of the Bosch fab

**CONTINUE READING THE ENTIRE ARTICLE ONLINE**



## Facts & Figures

***2.5 times*** around the earth.
This is the distance some chips cover from sand to the final consumer.

***1 trillion*** chips are installed worldwide every year.

***8.5 million*** tons of silicon are extracted worldwide every year. The largest producers are China, Russia, Brazil, Norway and the USA.

On average, ***25 countries*** are directly involved in each stage of the semiconductor value chain, and another 23 countries are indirectly involved.

Some circuits cross ***up to 70*** country borders from the start of production to delivery to the customer.

**Sources:** Ifo Dresden, Bosch, Federal Institute for Geosciences and Natural Resources, Statista, GlobalFoundries, Accenture.

***Read how the German government is supporting the microelectronics industry in international competition in a statement by Robert Habeck, Germany's Minister of Economics.***

Why Robert Habeck speaks from the soul of the Dresden fabs...

# Saxony's fabs in interview

How do the managers of the Saxon fabs view the location? What role does the network play? Where does cooperation end and competition begin? Our interviews reveal the answer.

READ THE COMPLETE INTERVIEWS:

*[We] need [...] support at all levels of government. [...] This includes not only funding programs, but also an environment that attracts skilled workers from other regions. Only in this way can the European microelectronics industry survive in global competition.*

Raik Brettschneider, Vice President & Managing Director | Infineon Technologies Dresden

*Our goal is to make SAW COMPONENTS a cross-industry provider of thin film technology and lithography at the Dresden site. For this purpose, we cooperate with Saxon partners from industry and research and at the same time we see a tough competition for talents.*

Steffen Zietzschmann, CEO | SAW COMPONENTS Dresden

*„Silicon Saxony" has the potential to become the center of modern, forward-looking manufacturing - the home of Industry 4.0. By 2026, Bosch Dresden [...] will invest not only in additional manufacturing capacity [...] but also in research and development.*

Dr. Christian Koitzsch, Plant Manager | Robert Bosch Semiconductor Manufacturing Dresden

*A location like Dresden [...] is unique in Europe. This has an appeal beyond Saxony and leads to skilled workers coming to the region. But of course, competition also increases the competition for talent.*

Rico Tillner, Managing Director | X-FAB Dresden

*In Germany and Europe, we need greater ambition, higher budgets, a much faster pace and, above all, a focus on implementation. Only if these four aspects are addressed with equal speed and sustainability, we can remain successful.*

Dr. Manfred Horstmann, Sr. Vice President & General Manager | GlobalFoundries Dresden



| | Infineon Technologies Dresden | SAW COMPONENTS Dresden | Robert Bosch Semiconductor Manufacturing Dresden | X-FAB Dresden | GlobalFoundries Dresden |
|---|---|---|---|---|---|
| **Opening** | 1994 | 1993 | 2021 | 1981 | 1999 |
| **Size of the fab** | 300,000 sqm | 4,000 sqm | 100,000 sqm | 81,000 sqm | 407,000 sqm |
| **Clean room size** | 40,000 sqm | 1,800 sqm | 13,000 sqm | 3,800 sqm | 52,000 sqm |
| **Employees at the site** | 3,200 | 33 | > 400 | 540 | 3,400 |
| **Share of women** | 25 % | 40 % | customary in the industry | 22 % | 16 % |

## Through the day with 1000 chips

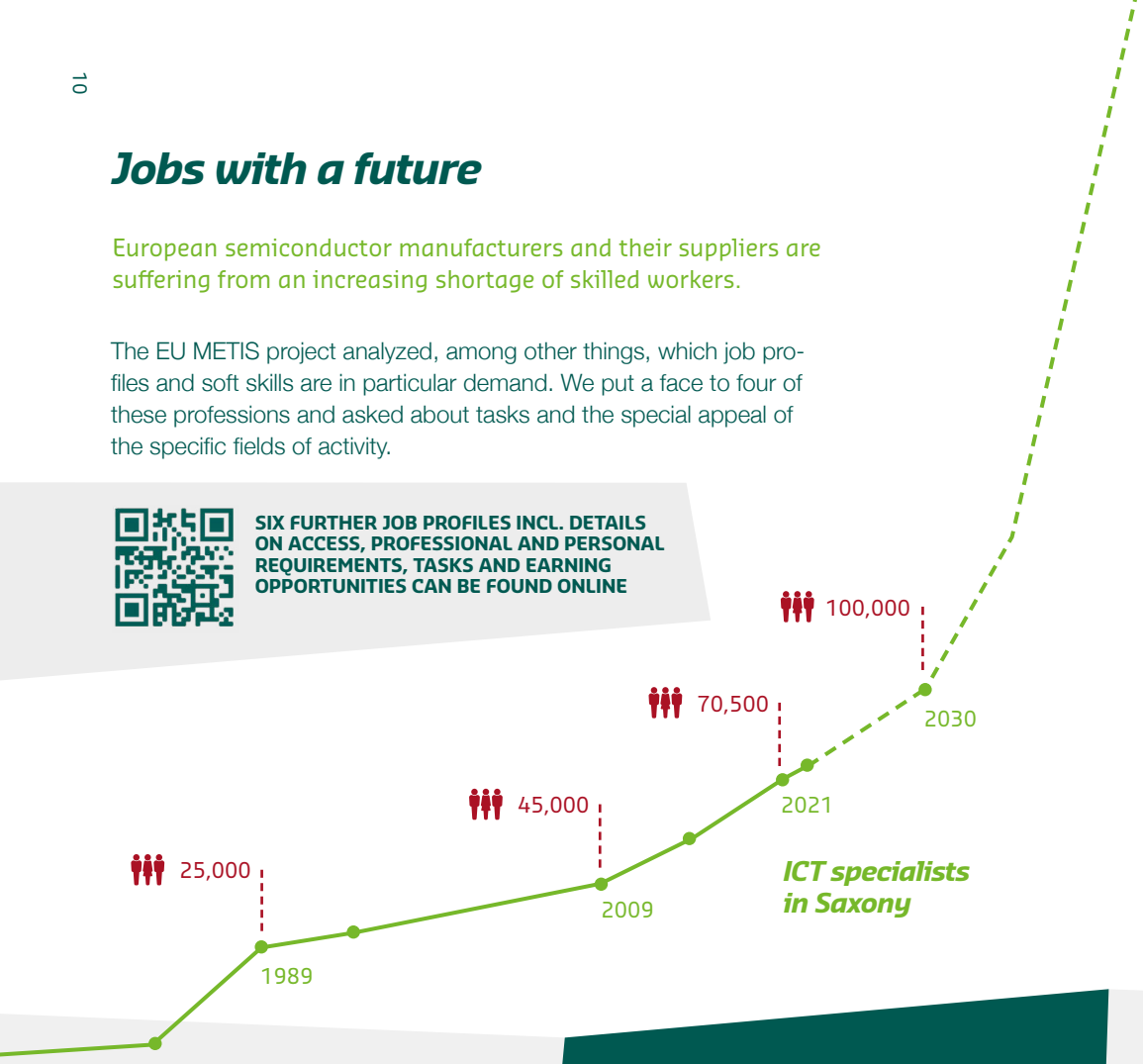
Scan QR code and learn more!

# Jobs with a future

European semiconductor manufacturers and their suppliers are suffering from an increasing shortage of skilled workers.

The EU METIS project analyzed, among other things, which job profiles and soft skills are in particular demand. We put a face to four of these professions and asked about tasks and the special appeal of the specific fields of activity.

**SIX FURTHER JOB PROFILES INCL. DETAILS ON ACCESS, PROFESSIONAL AND PERSONAL REQUIREMENTS, TASKS AND EARNING OPPORTUNITIES CAN BE FOUND ONLINE**




## IC-Designer

*The most exciting moment for me is when my layout is realized on a chip - when I see that what I have thought about before actually works. This magic of technology fascinates me.*

**Dirk Schlebusch**
System Design Engineer for Microdisplays and Sensors, Fraunhofer FEP

**CHANGE THE WORLD – AN EXCITING STORY ABOUT THE POSSIBILITIES OF IC DESIGN**

## Robotics Engineer

*I love to research. As a robotics engineer, I can pursue this passion, put new findings straight into practice and directly observe how the robots react.*

**Feryel Zoghlami**
Senior Engineer Sensor Fusion, Development Center, Infineon Technologies Dresden



## Top 5 professions in microelectronics*

1. Design Engineer
2. Software Engineer & Developer
3. Process Engineer
4. Test Engineer
5. Maintenance Technician/ Maintainer

## Top 5 soft skills*

1. Ability to work in a team
2. Creativity
3. Communication skills
4. Problem solving skills
5. Leadership quality

*Source: EU-project „METIS"

**OUR MICROELECTRONICS WORKING GROUPS: NETWORKING, EXCHANGE OF EXPERIENCES AND TECHNOLOGY INSIGHTS**

## Equipment Engineer

*Due to the large number of technical systems I support, exciting situations arise on a permanent basis. We analyze these intensively, discuss them at the desk and then actively implement them on the system and in the team.*

**Patrick Mülverstedt**
Equipment Engineer, Robert Bosch Semiconductor Manufacturing Dresden GmbH

## Process Technician

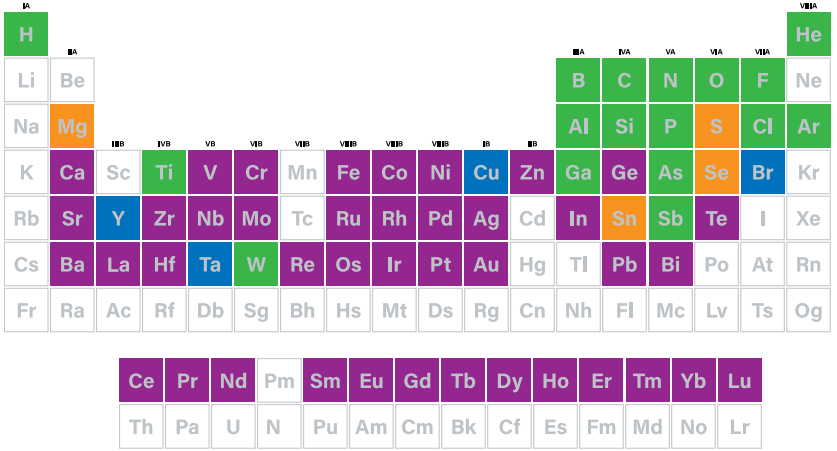
*I appreciate the responsibility that my team and I have to ensure that at the end of production our customers receive their order in the desired quality, quantity and at the right time.*

**Djamila Steinich**
Senior Technician Production Planning & Control, GlobalFoundries Dresden

# A journey across the periodic table

What the chips of the future are made of

The digital revolution is taking hold of ever broader segments of society, but without modern semiconductors in sufficient quantities, it could quickly grind to a halt. In order to develop ever faster and better chips for this purpose, which in their hunger for electricity do not immediately destroy the urgently needed energy turnaround, new materials beyond classic silicon are indispensable. They block leakage currents, i.e. unwanted power losses, provide energy-efficient computing power for mobile use, among other things, and pave the way for green energy from wind and solar power plants to enter the grids. We therefore take a look at the most promising materials and material groups and see what specific advantages and disadvantages or fields of application they have.




*„Only about 25 years ago, the number of materials that were important for microelectronics was was very manageable. Since then, this number has really exploded and the semiconductor technology has expanded to include a large part of the periodic table.“*

**Prof. Dr. Thomas Mikolajick**
TU Dresden | Director NaMLab

- **used before 1980**
- **added in 1990**
- **discovered and added in 2000**
- **discovered and added in 2010**

## Magnetic stacks with materials such as cobalt-iron-boron or iridium-platinum compounds, magnesium oxide, etc.

**Advantages:**
- fast storage capability
- low voltage

**Disadvantages:**
- separation of the materials is complex and expensive
- industry still has little experience with it

**Application:**
- memory cells embedded in logic circuits or other complex systems

## Metal oxide semiconductors such as indium tin oxide (ITO) and indium gallium zinc oxide (IGZO)

**Advantage:**
- can be processed at low temperatures
  - important for layer build-up!

**Disadvantage:**
- unlike silicon, these metal oxides are not single crystals, their charge carrier mobility is lower
  - i.e. it may be more difficult to achieve a high switching speed

**Application:**
- highly integrated electronics for autonomous cars, smartphones, data centers, control electronics in factories, etc

## Tantalum oxides and amorphous hafnium oxide

**Advantage:**
- inexpensive

**Disadvantages:**
- only withstands a relatively low number of switching cycles
- high statistical fluctuation from switching cycle to switching cycle
- industry still has little experience with it

**Applications:**
- currently in demand primarily as a low-cost alternative to flash memory cells
- perspective as hardware for certain computational tasks of artificial intelligence (AI)

## Crystalline hafnium oxide

**Advantages:**
- as a memory in performance and efficiency a quantum leap compared to flash
- easy to integrate into existing CMOS processes

**Disadvantages:**
- tolerates only a few million switching cycles
- relatively high voltage compared to MRAM (about 3 volts)

**Applications:**
- very fast memory with very low power consumption
- perspective: neuromorphic computing for artificial intelligences

**FURTHER MATERIAL GROUPS AND DETAILS AS WELL AS OUR CONCLUSION CAN BE FOUND ONLINE**

# Technology trends: Quantum computing, neuromorphic computers and tap-proof telephony

## How Saxony's engineers are working on the future

In the past decades, the semiconductor industry has pushed supposed limits of physics and technology further and further. Nevertheless, it has long been clear that classic semiconductor technology cannot continue to develop linearly forever through mere miniaturization. What was still science fiction yesterday is coming within reach in the search for alternatives: Computers that are „knitted" similarly to the human brain, computers that can crack almost any code, and the like.

READ THE ENTIRE ARTICLE ONLINE





### *Brain-inspired computing*

To this day, the „Von Neumann architecture", which strictly separates signal processing and memory, dominates the world of digital computers. To achieve higher performance, engineers are packing the components in these computers more densely and clocking them higher and higher. The disadvantages include high power consumption - which could overtax the batteries of future autonomous electric cars - and cumbersome „back and forth" movement of data between the computing unit and memory.

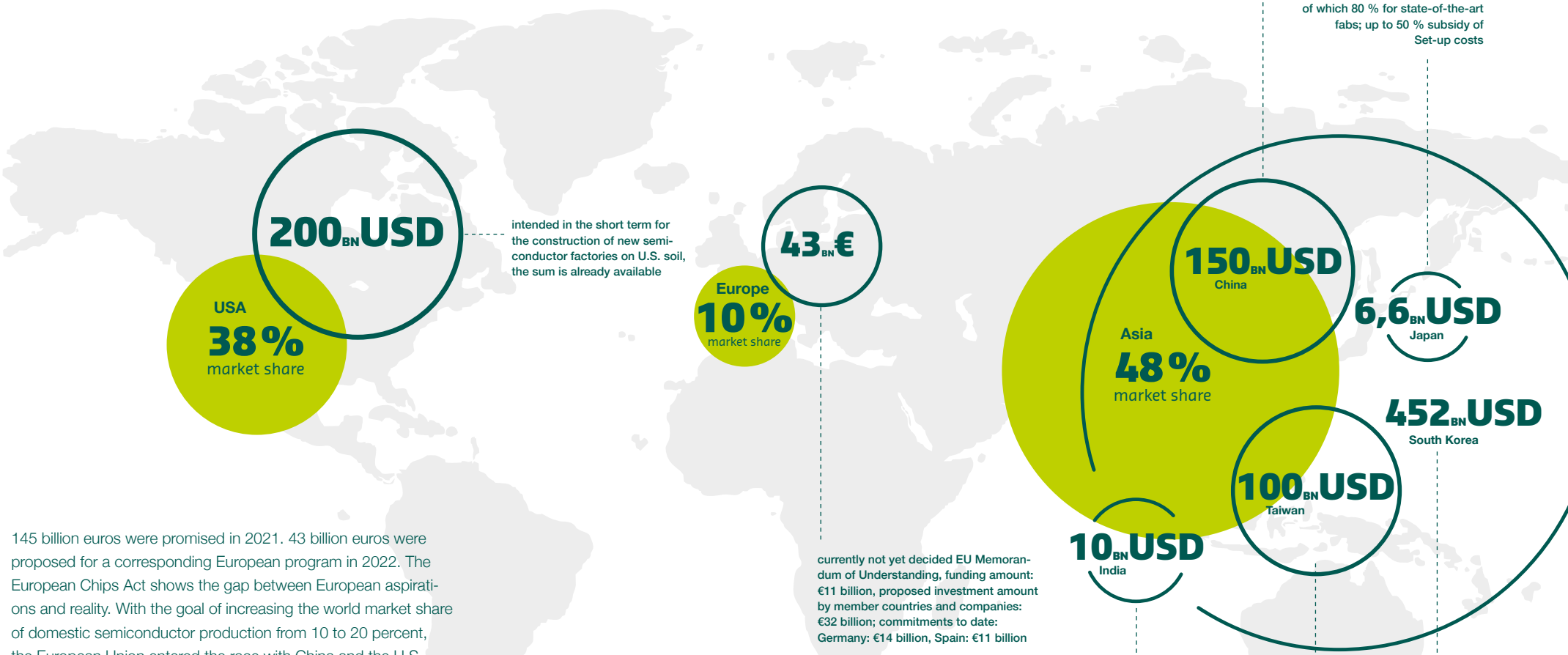
Evolution has „worked out" a more economical and efficient principle: The brain uses its neurons equally to store information and to process it. Some tasks that a human brain can solve in the blink of an eye with a power consumption of 20 watts, today's digital computers often manage only approximately as well - and often suck up 1000 watts or more in the process.

Neural networks simulate these brain principles, at least in part, via software on classic silicon digital computers. They are used primarily for the training and work of „artificial intelligences" (AI). For example, when we start an Internet search query today, a Google neural network is usually pondering in the background.

But there is more to it than that. Find out online how neuromorphic networks reproduce brain structures - at least to some extent - how far brain-like solutions have already come, what Saxon scientists are currently working on in the fields of quantum computing and quantum communication, sensor technology, chiplets and automotive, and what tomorrow's energy systems will look like.

PODCAST „HALLO ZUKUNFT" ARTIFICIAL INTELLIGENCE AND NEUROMORPHIC COMPUTING GUEST: PROF. DR. THOMAS MIKOLAJICK
*(THIS PODCAST IS IN GERMAN)*

# *European Chips Act: Good, but good enough?*




145 billion euros were promised in 2021. 43 billion euros were proposed for a corresponding European program in 2022. The European Chips Act shows the gap between European aspirations and reality. With the goal of increasing the world market share of domestic semiconductor production from 10 to 20 percent, the European Union entered the race with China and the U.S. While the competition has so far mobilized more than three times the financial volume in each case, much is still vague in Europe. In this respect, the justified question arises as to who should give up market shares to Europe in the future?

**READ MORE ABOUT CONCRETE MEASURES, THE CURRENT STATUS QUO AND WHAT EUROPE CAN EXPECT FROM THE CHIPS ACT IN THE COMING YEARS**

**LET'S BUILD A STRONG EUROPE TOGETHER! BECOME PART OF SILICON SAXONY, THE LARGEST MICROELECTRONICS CLUSTER IN EUROPE**

*Data: Semiconductor Industry Association, 2021

ADVERTISEMENT

# Exciting jobs in Silicon Saxony

FIND ALL VACANCIES ONLINE

## ELECTRICAL ENGINEERING

**Fraunhofer Institute for Electronic Nano Systems ENAS**

- AI, Computer Vision, Software Developer (m/f/div)

**Bosch Sensortec GmbH**

- Project Manager ASIC Development (m/f/div)
- Test Engineer for ASIC Development (m/f/div)
- System Engineer for Inertial Sensors (m/f/div)

**ebee Engineering GmbH**

- Electronics Technician Hard- and Software Testing eMobility (m/f/div)
- Development Engineer Software eMobility (m/f/div)
- Requirements Engineer eMobility (m/f/div)

**Infineon Technologies Dresden GmbH & Co. KG**

- Maintenance technician (m/f/div)

## IT

**Siltronic AG**

- Software Engineer MES Automation (m/f/div)
- License Manager (m/f/div)

**Infineon Technologies Dresden GmbH & Co. KG**

- IT Manufacturing Execution (m/f/div)

**PeerGroup**

- Test Engineer Automation (m/f/div)
- Software Engineer Customer Project (m/f/div)
- Software Engineer Professional Services (m/f/div)

## RESEARCH & DEVELOPMENT

**Novaled GmbH**

- Vacancies in Research and Development (m/f/div)
- Coordinator Organizational and Personnel Development (m/f/div)
- Work Students (m/f/div)

## OTHER

**CRC Clean Room Consulting GmbH**

- Engineer/Technician/Chemist as Planner Industrial Wastewater Treatment (m/f/div)
- MEP Engineers (m/f/div)
- Process Engineers / Engineers Process Technology (m/f/div)

**Siltronic AG**

- Employee Production Support Team (m/f/div)

**Entegris GmbH**

- Customer Service Representative (m/f/div)
- Logistics Specialist Trade Compliance (m/f/div)
- Sr. Account Manager | Semiconductor (m/f/div)

**Infineon Technologies Dresden GmbH & Co. KG**

- Specialist (m/f/div)

## *Let's connect, exchange and grow together!*

**STEFAN UHLIG**
DEPARTMENT MICROELECTRONICS

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## *Silicon Saxony Alumni*

We are looking for people who have shaped and/or experienced the history of Saxon microelectronics!

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