Position Paper Microelectronics 2030+

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Executive Summary

The Covid-19 pandemic has revealed structural weaknesses in Europe, particularly in microelectronics. Europe is caught between the technological dominance of the USA and China and must reposition itself in this global competition. Particularly affected are crisis-prone supply chains and dependencies on external players, which are evident in the automotive industry and energy supply.

Saxony has a strong microelectronics ecosystem that can be used to advance Germany and Europe. The position paper proposes a national strategy based on European goals to strengthen the microelectronics industry in Saxony and achieve technological sovereignty in Germany and Europe.

The paper defines four fields of action, each with core requirements, which are presented below in abbreviated form as an overview:

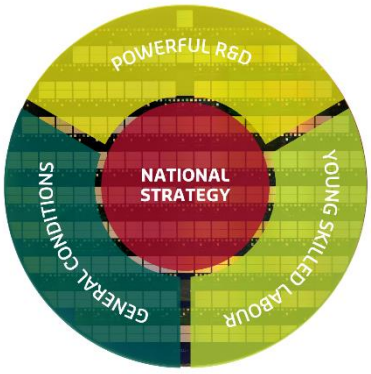

Illustration 1: Fields of action

National strategy	Improving framework conditions	Powerful R&D	Securing next generation of skilled labour
• national strategy document • Sovereignty fund • Adjustment of funding • Indudstrial utilization • Synergy with other strategy documents • Framework conditions for a high proportion of EU suppliers • Accompanying scientific study • Planning framework with phases • Special Representative for Microelectronics • Addressing the issues in the federal ministries at least at departmental level	• Sustainable, stable and affordable energy supply • Ensuring the availability of materials • Promoting resilience • Expand infrastructure in line with industry growth • Build up/expand capacity +know-how in administration • Simplification & digitalisation of administrative and investment processes	• Expand framework conditions for cooperation • State-of-the-art education/training centre • Development of innovative pilot line Advanced Heterogeneous System Integration (AHSI) • Strengthening chip design • strengthen R&D activities in testing and reliability • Incentives for regional R&D co-operation	• STEM practice-orientated schools • Securing university research & education • Increasing the visibility of microelectronics

Illustration 2: Fields of action and demands at a glance

The position paper emphasizes the need for a long-term, sustainable strategy that takes economic as well as ecological and social aspects into account. The implementation of this strategy should enable a sustainable transition to a digital, decarbonized and resilient society.

Initial situation

As a result of the Covid-19 pandemic, Europe and the world are in what the IMF calls "a crisis like no other". It has brought to light a number of structural weaknesses in Europe that go far beyond the lack of protective equipment and basic materials for medicines. Like a burning glass, the pandemic has revealed Europe's much larger dilemmas:

- When it comes to being in pole position in many forward-looking sectors, **Europe finds itself in an uncomfortable sandwich position between East and West**. China has irrevocably established itself as a technological superpower and is pursuing an extremely ambitious industrial policy, focusing primarily on topics such as microelectronics and e-mobility. The United States has a start-to-finish victory when it comes to the platform economy. The dominant US companies ("GAFAM") with their disruptive business models benefit from the dynamism of the American high-tech landscape and its start-up culture.
- Furthermore, **European (supply) chains** have proven **to be extremely crisis-prone.** This is primarily due to unbalanced and one-sided dependencies. While it was the lack of chips for the automotive and other key industries in the years of the pandemic, the lack of cheap energy exports from Russia from mid-2022 led to massive distortions in the national economies (inflation, recession, deep social uncertainty, etc.).

On the other hand, Saxony in particular has a diverse and efficient range of players in microelectronics, from excellent teaching and cutting-edge research to promising start-ups, efficient SMEs and globally competitive high-volume production - know-how is available for many areas of the value chain.

From Saxony for Germany and Europe

Based on this foundation, the following pages present positions that have been developed in cooperation and coordination with regional, national and international players in the industry and are revised and, if necessary, adapted on a regular basis, but at least once a year.

The overarching objectives are:

- ➔ Securing the positive development of the industry in Saxony (at least 100,000 employees in 2030)
- ➔ Technology sovereignty at German and European level (broadest possible coverage of the value chain in research and by corresponding industrial players)
- ➔ Strengthening the existing players and the corresponding sub-competencies in Saxony (especially front-end production)

In four fields of action, specific requirements are identified and measures proposed that can be used to achieve a sustainable transition to a digital, decarbonized and resilient society in accordance with the EU's Digital Compass 2030[1] , the BMWK's industrial strategy[2] and the BMBF's framework programme[3] as well as the innovation strategy[4] and the Free State of Saxony's White Paper for Research[5] . Economic as well as ecological and social aspects are taken into account.

Due to the complexity of the global microelectronics landscape, the strategy therefore also addresses topics which, although Saxony can contribute to solutions, must go beyond the regional and in some cases also beyond the national level.

Fields of action for efficient microelectronics in Saxony, Germany and Europe

Saxony and Germany can make a major contribution to the ambitious targets at European level in the following areas.

The fields of action are included:

1. National strategy with long-term financial planning (until 2040)
2. Improvement of important framework conditions for Germany and Saxony as a production location (energy, bureaucracy, materials and infrastructure)
3. High-performance R&D with industrialization in Europe
4. Securing the next generation of skilled workers (strengthening STEM)

[1] Europe's Digital Decade: Goals for 2030 | European Commission
[2] BMWK - Sustainably strengthening industrial competitiveness
[3] 2021-12-framework-program_microelectronics_neutral.indd (bmbf.de)
[4] Innovation strategy of the Free State of Saxony - Publications - sachsen.de
[5] Into the future with successful research (sachsen.de)

1. National strategy with long-term financial planning

The German and European microelectronics industry is facing numerous challenges, particularly in connection with the complexity of supply chains. In addition to the front-end manufacturing of wafers, the supply of critical materials and other precursors such as masks, chip design, back-end and testing are of crucial importance. While not all aspects of the supply chain are located in Saxony, there is potential for these components to be increasingly established in Europe.

The context of this analysis is therefore at European level. The approach is to reinforce existing strengths and close existing gaps. The existing instruments such as IPCEI and ECA must be used much faster and more effectively. This requires a critical examination of the processes at national and European level. The current principle of local and regional co-financing stands in the way of the effective creation of European champions.

Another key point here is the promotion of research and development (R&D), which is still too often geared towards small and medium-sized enterprises (SMEs). However, the necessary scaling in the industrialization of R&D results is not feasible on an SME scale.

However, this focus on SMEs in the German funding landscape poses a challenge, as this can lead to disadvantages for companies that no longer have SME status in terms of strengthening competitiveness compared to players from other regions (USA and even France). In order to compensate for this disadvantage, it is necessary to pursue a holistic approach that is not only aimed at promoting SMEs, but also at strengthening the strengths of the Saxon and German microelectronics sector as a whole.

Measures/demands:

a) The further development of Saxon and German microelectronics requires a **national strategy** that is geared towards the goals of the EU Chips Act at European level (20% market share by 2030, increasing resilience, environmentally friendly production)

b) A special "sovereignty fund" would be a possible solution for financing the necessary investments in production capacities even after 2024/25. The approximately € 20 billion currently provided by the federal government has already been largely exhausted. As part of the strategy, a continuation or further development of both the EU Chips Act and the IPCEI ME/KT should therefore be initiated.

c) 100% federal funding, regardless of the federal state, is proposed in order to avoid limitations due to different financial restrictions of the federal states.

d) The closer R&D projects come to commercialization, the more the "think-big" approach must be taken into account. The SME focus must therefore not be the determining factor for project sizes, especially in projects with a lighthouse character; instead, industrial exploitation by larger SMEs and large-scale industry must be taken into account.

e) It is undisputed that a microelectronics strategy can only be successful if it is pursued on a long-term and sustainable basis and is also financially backed. Synergies with the German strategy for decarbonization and digitalization (65% reduction in greenhouse gases by 2030 and 88% by 2040) are therefore essential and must be ensured

f) Creation of framework conditions for the highest possible proportion of a European supply chain for current and future microelectronics factories, also in the sense of strengthening the corresponding SME structures.

g) Accompanying scientific studies on the impact of an efficient Saxon and German microelectronics industry on employment, prosperity, resilience and security must be carried out, also to ensure social acceptance of the measures. Studies in other regions, e.g. Japan[6] or the USA[7] , can be used as a guide.

h) As a result, we propose a planning framework up to 2040 - planning in short-term phases with 3-year slices:
    1. Phase until the end of 2024,
    2. Phase 2025-2027,
    3. Phase 2028-2030,
    4. Phase 2031-2033,
    5. Phase 2034-2036,
    6. Phase 2037-2040

[6] 168486_400886_misc.pdf (pref.kumamoto.jp)
[7] https://www.semiconductors.org/wp-content/uploads/2021/05/SIA-Impact_May2021-FINAL-May-19-2021_2.pdf

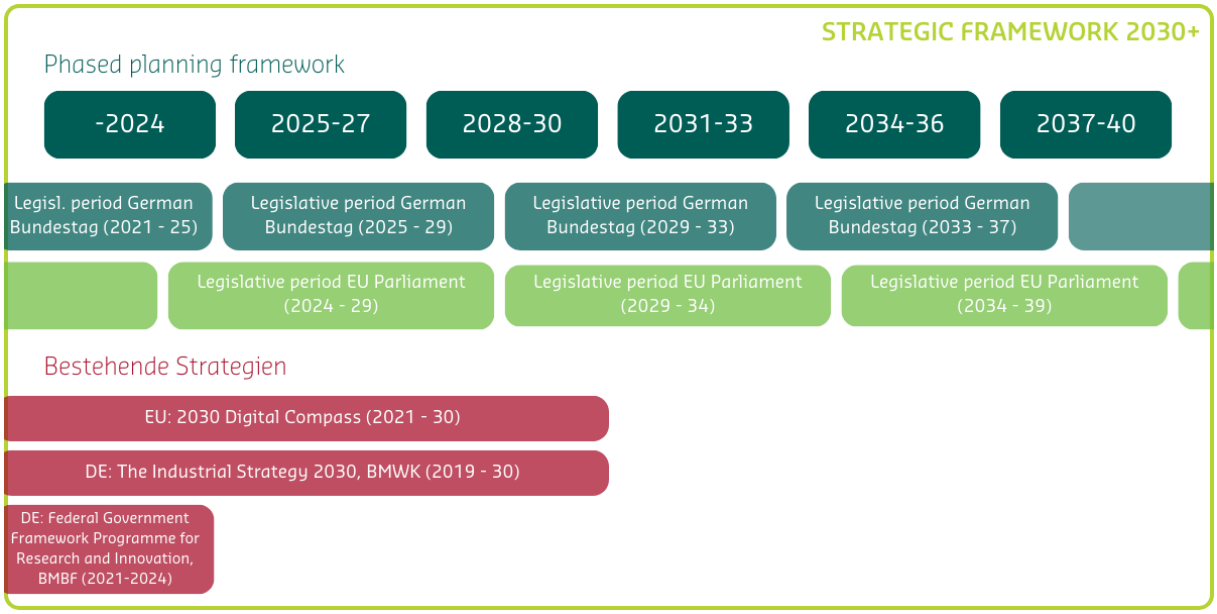

Illustration 3: Strategic framework 2030+

A funding volume of around € 25 billion is required for each phase in order to achieve the targets set. With a funding rate of 30%, this will generate leverage for investments in microelectronics capacities of at least €83 billion. Based on the VDA study[8] from May 2023, this would allow investments in the region of € 170 billion by 2030, which would at least cover the majority of the demand for semiconductor components for the automotive industry.

i) Transparency & consolidation of existing bodies at regional, national and EU level, creation of the role of special representative for microelectronics at federal level, also dealing with relevant topics such as PFAS at this level

j) Microelectronics and the Sovereignty Fund must be addressed in the relevant ministries (including BMBF, BMWK, BMF and BK) at least at departmental level (see also demand 2 e)

[8] Semiconductor crisis (vda.de)

2. improvement of important framework conditions for Germany and Saxony as a production location (energy, bureaucracy, materials and infrastructure)

The microelectronics strategy aims to maintain and even strengthen what already exists and what has proven itself, as well as to work in a focused manner on locational disadvantages and eliminate weaknesses. In general, it is important to anchor a "both and strategy" among stakeholders instead of managing the shortcomings in an "either or" approach. The availability of resources (e.g. water and energy) as a basis for microelectronics production in the Free State of Saxony is high. At the same time, the corresponding costs are not a locational advantage. Different global transformation speeds towards a CO_2 -neutral economy will cause further local distortions in terms of the competitiveness of Saxony and Germany as a microelectronics location.

Individual requirements are derived from this in the focus areas of energy, materials, resources and support from the public administration.

Measures/demands:

a) Provision of CO_2 -neutral, uninterrupted and peak-free industrial power supply; the electricity price must be less than **10 cents/kWh.** The connection to the transmission grid with the provision of low-cost offshore wind power is an important prerequisite for a low-cost energy supply in the future.

b) Ensuring the availability of materials for sustainable microelectronics, including concepts for recycling etc. (circular economy). To achieve genuine technological sovereignty, skills and capacities are required along the entire value chain, and gaps need to be closed where necessary. The German government's raw materials strategy[9] already offers important starting points here.

c) Creation of transparency for unilateral dependencies at national/EU level, particularly for the area of materials/chemicals → ♓♐ ■♏♍♏♦♦♋❒🖂🖃 reconstruction of European production; the corresponding framework conditions must be created for this. In addition to the potential creation of substitute sources already addressed, strategic action planning in terms of resilience must also take into account R&D for possible substitutions.

d) Other infrastructure (water, (air and ship) traffic, hydrogen, transportation, logistics, etc.): The infrastructural connection of the semiconductor industry in Germany and Saxony in particular is still good, but the growth of the industry must be taken into account in planning. This requires the further expansion of

[9] BMWK - The Federal Government's raw materials strategy

transport routes, in Saxony, for example, the maintenance of Dresden Airport as a feeder to the major hubs and the connection of the hydrogen core network to Dresden, Freiberg and Chemnitz.

e) Strengthening administrations for the new challenges by building capacity/know-how among political decision-makers and the corresponding administrative structure, similar to the US Chips Act Office. This applies to the regional as well as the national and EU level

f) streamlining and digitalization of administrative processes, in the implementation of investment measures, but also for operations. To this end, consistent and extensive use of the respective digital twins should be aimed for.

3. high-performance R&D with industrial utilization in Europe

In order to maintain the competitiveness of Saxon, German and European companies, both access to the results of excellent preliminary research (i.e. basic research with a wide range of variants based on small substrates, thus more cost-efficient, through to individual components as samples/prototypes) and access to production-related research and development capacities are a decisive factor.

The existing structures in research and development are a very good basis for the further expansion of Silicon Saxony. The high number of institutes at the interface between academic research and industrial implementation as well as the range of topics (KPIs) being worked on is unique worldwide.

At present, however, microelectronics technologies are primarily commercialized and scaled up in Asia or America. In the long term, **industrially implemented innovation** must become the hallmark of Saxon and German microelectronics. A competitive location that utilizes its strengths and works on its weaknesses is the necessary prerequisite for this. For this reason, investments must focus on production capacities and the successful transfer of R&D results that are developed outside the companies.

Due to the capital-intensive nature of investments in semiconductor equipment, a local concentration of semiconductor manufacturing expertise for the efficient and cost-effective operation of shared research and training facilities is practiced globally, for example in Taiwan or in the USA (NY Creates).

In Germany, the Micro/Nano Performance Center in Saxony and the Research Fab Microelectronics (FMD) already offer corresponding application-oriented approaches, but these must be consistently developed further. In the basic research sector, there is usually a high degree of fragmentation. However, the first similar approaches can be found in the ForLabs.

At European level, Europe's technological sovereignty is being promoted through the establishment of coordinated pilot lines as part of the EU Chips Act. Of the three pilot lines emerging in the first phase, the pilot line "Advanced Heterogeneous System Integration (AHSI)" via the FMD is important from a German and Saxon perspective. In order to offer the European and German microelectronics ecosystem the greatest possible impact for innovative solutions, this pilot line focuses on the three subject areas that are underexposed in the EU:

- Chiplet and Advanced Packaging,
- Testing, characterization, reliability and
- Design.

The focus is on innovations at a high level of quality. At the same time, companies, universities and research institutes are given extended and simplified access to high-tech microelectronics solutions, including the production of small series and transfer.

In the **field of basic research, there is** currently an urgent need to catch up in Saxony and Germany in the field of microelectronics. There are several reasons for this. One of these is the current practice of funding microelectronics-related topics. Another is the fragmentation of semiconductor manufacturing expertise. Current practice in appointments and the procurement of large-scale equipment assigns these to individual professorships without classifying them in an overall concept/equipment pool. The often capital-intensive equipment is thus essentially available to individual laboratories or individuals and not to a broader base. There is a lesson to be learned here from Taiwan and the USA. In addition, microelectronics is neither clearly defined at colleges and universities, nor is it often given the necessary priority due to the high costs of clean rooms and equipment (this can even lead to it being downgraded). In the case of emeritus professorships, microelectronics chairs are sometimes not reoccupied, and professorships are also adapted to "fashionable topics", as a result of which the research capacities of microelectronics in the basic area and thus the KPIs are declining. This also has an impact on training and young talent.

Measures/demands:

a) Creating the conditions to be able to think even further ahead in terms of cooperation levels and models:

   - Creation and maintenance of viable central laboratories - modeled on the BMBF's ForLab research infrastructure funding program[10]
   - Support of the ForLabs with the involvement of all universities and colleges involved in microelectronics research and training

[10] https://www.forlab.tech/

b) Support in the establishment and operation of a (German/Saxon) education/training center with state-of-the-art cleanroom + production facilities (similar to Taiwan) with integration of FMD Chipakademie[11] (80% of the equipment is used for very different technology nodes, so synergies can be used here)

c) Supporting the development of the innovative pilot line Advanced Heterogeneous System Integration (AHSI) via FMD with a focus on testing, characterization, reliability as well as advanced packaging and design.

d) Strengthening chip design by supporting a European virtual design platform with design enabling teams driven by companies and organizations that provide system houses, SMEs, start-ups, universities and colleges with complete and production-ready design systems for the development of innovative circuits and AHSI systems

e) R&D activities relating to testing and reliability must be driven forward as enablers of new technologies

f) Creation or strengthening of incentives for regional and local R&D cooperation, also beyond SMEs

4. securing the next generation of skilled workers (strengthening STEM)

In Saxony's high-tech landscape, including in the member companies of Silicon Saxony, there is also an increasing shortage of competent specialists - from classic cleanroom jobs such as operator and maintenance technician to mechatronics technician and microtechnologist to software developer, security expert, electrical technician and engineer. And there is a particular lack of people whose job title has an "-in" at the end - women who are enthusiastic about these technical professions and would increase the proportion of women in our member companies.

The existing structures in the area of education and training are a very good basis for the further expansion of Silicon Saxony. However, dual training must be significantly expanded in specific sectors and, above all, demographic change must be addressed through broader recruitment beyond the Free State of Saxony.

[11] https://www.forschungsfabrik-mikroelektronik.de/de/presse--und-medien/Presse/me-akademie.html)

The same applies to the relevant degree programs at Saxon universities and colleges. Here, too, it is important to ensure both breadth and depth. This means that even in the case of the retirement of professorships relevant to microelectronics, the common practice of not reappointing some of these microelectronics chairs or adapting them to "fashionable topics" must be ended, as the current practice is jeopardizing both excellence in teaching and research and the visibility of microelectronics for prospective students is declining.

In January 2023, Silicon Saxony presented a position paper on securing a skilled workforce[12] . The measures in field of action 1 are particularly relevant in the context of this paper.

Measures/demands:

a) in the school sector:

- Contemporary teaching with a strong practical orientation, for which the companies of the Silicon Saxony network can be involved as local partners.

- Developing attractive, practical training opportunities for teachers, for example on relevant job profiles in collaboration with companies, in order to arouse enthusiasm for STEM subjects among children and young people is best achieved if the teachers themselves are enthusiastic about these subjects. This needs to be developed.

- Sustainable all-day programs (GTA) with a technical focus offer a good opportunity to teach technical topics and should be offered on a larger scale than before in cooperation between educational institutions and companies. The successful concepts for school labs in urban areas need to be made more widely known and established in rural areas, with the support of companies and the public sector. Mobile and virtual offerings should also be further strengthened.

- By sponsoring STEM topics (e.g. equipping a technology lab in a school or leisure facility), companies can increase their visibility and establish concrete collaborations. In cooperation with schools or leisure facilities, companies can help to offer attractive vacation activities with a STEM focus.

[12] Final strategy paper (silicon-saxony.de)

b) Safeguarding university research and education:
   - Chairs at universities in the field of microelectronics must be maintained and, in the event of retirement, filled and further developed.

   - Cross-institutional training and further education (degree courses, internships, etc.) as part of creating the conditions to be able to think even further ahead in terms of cooperation levels and models

   - Support for international degree programs at universities in terms of student support, recruitment, increasing capacity, creating the conditions for the expansion of English-language Bachelor's degree programs

c) Increasing the visibility of microelectronics as widely as possible in public spaces:
   - By planning and setting up a "Semiconductor World" that is open to the public for children, young people and adults, the semiconductor companies at the Dresden site are planning a state-of-the-art offering that will reach as many young people as possible.

   - Supporting the establishment and operation of a STEM laboratory in the West Saxon region