

## Revision of the European Chips Act

For well over half a century, semiconductors and microchips have featured prominently on Brussels' industrial policy agenda and have always been tied to geopolitical considerations. Chips are integral to virtually all modern technologies, powering everything from consumer electronics to advanced industrial systems. Building on the 2013 Chips Agenda, the EU Chips Act ([Regulation \(EU\) 2023/1781](#)) sought to provide a counterpart to the US Chips Act, adopted almost simultaneously as part of the [US Science and Chips Act](#). Structurally, the EU Act exhibits striking similarities not to the American legal provisions themselves, but to summaries of the US Act, extending even to the adaptation of the "Chips for America" banner phrase into "Chips for Europe" for its first pillar. It must, however, be recognised that the strategic position of the US chip industry differs markedly from Europe's, though Europe's position also presents distinct strategic opportunities.

The COVID-19 pandemic exposed vulnerabilities in the semiconductor supply chain, justifying the Chips Act's focus on industrial procurement risks and its three-pillar structure, in [line with the relevant European legal bases](#). An entangled aim was the preservation and reshoring of manufacturing capacity in Europe.

The European Chips Act entered into force on 21 September 2023. Now, only two years later, we are compelled to revisit it because of the evidence at hand.

1. The Staff Working Document [SWD\(2022\) 147 final](#), "A *Chips Act for Europe*," which includes many aspects left out of the more broadly framed legislative act;
2. The critical [Special Report 12/25 from the Court of Auditors](#), sharply highlighting the misdirection of the Chips Act;
3. The call by the [Semicon Coalition](#) for a Chip Act 2.0 in September 2025

and other practical reasons and developments outlined further below.

We find a broad agreement that the Chips Act I was put in place too quickly. A good semiconductor policy needs a long-term plan and strong legal support. The European Commission has also recognised that the current Act falls short in these areas.

The Chips Act places disproportionate emphasis on "leading-edge" chips, although 90% of supply disruptions during the COVID-19 pandemic involved conventional chips (65–90 nm). The 20% production target is based on inconsistent baseline data; in 2020, the European Union produced no chips below 5 nm, yet the target references "state-of-the-art" chips. Europe accounts for only 9% of global chip production, yet it meets 20% of global demand. Consequently, the Act's objectives are unattainable. Furthermore, it establishes overly optimistic political expectations regarding the market viability of experimental quantum computer chips, for which the Chips Act provides a structural framework.

In addition, several environmental changes have emerged:

- Massive semiconductor import commitment reached as a [political settlement between the European Commission and the United States](#) to resolve a unilateral American trade escalation in 2025;
- Ongoing chips crisis in the German automotive industry due to Dutch nationalisation of Nexperia; Handelsblatt [Konjunktur: Chipkrise könnte Deutschland drittes Rezessionsjahr bescheren](#)
- The “AI rush” = the generative AI boom and the resulting surge in demand for specialised chips for AI computing and machine learning, with AI chipmakers and LLM providers attaining astronomical market valuations;
- the failure of several major investment projects, such as Intel Corporation’s planned chip plant in Magdeburg, Germany,
- A growing call for more substantial alignment with Green IT objectives, as the Semicon coalition states: *“Support the development of semiconductors and electronic components and systems that contribute to the green transition, including energy-efficient chips, chips designed for green energy applications and circularity, integrated photonics, heterogeneous integration, and the use of advanced sustainable materials.”* and finally, the
- highly successful advances in RISC-V technology, which present both opportunities for Europe and a complement to current strategic approaches by mainland Chinese competitors.

As semiconductors are set to remain a critical issue in the future, a long-term and patient policy framework is required. Alongside a strategic framework, tactical interventions will always be necessary. Political responses to hypes can be helpful as flanking measures, but should not amount to last-minute investments in trends whose bursting bubbles are already foreseeable. Thanks to healthy competition, including from Europe, LLMs are undergoing a process of commoditisation. No one knows whether the vast AI computing capacities being demanded will, in fact, be fully utilised. Let us adopt an anticyclical approach by prioritising what matters most for our position over following market trends from abroad. At its core, we make the following recommendation for a Chips Act II:

- The Chips Act should provide a **long-term, sustainable framework**, which requires, above all, the inclusion of stable and more comprehensive definitions.
- The Act should strategically harness two major opportunities for Europe’s positioning: 1) Deep Software and 2) Open Hardware (OSH). The guiding principle for the Chips II process should be a commitment to openness, with a preference for open systems in microchip development, such as Open Source EDA tools and RISC-V.

In SWD(2022) 147 final, Chapter 6.4 states the following regarding design software: “Open source tools are essential for introducing new companies and more developers into the field, especially developers with a software background who can bring in innovation in hardware-software co-design.” Furthermore, Chapter 6.3 addresses the enormous opportunities that RISC-V developments present for Europe.

- A Chips Act **Interoperability agenda** to facilitate chip substitution
- Capacity expansion** through new ventures for OSH expertise should be actively pursued. An OSH foundation, modelled on open source foundations, could drive collaboration, strong governance, sustainability, innovation, and evidence-based policymaking. Only in this way can the Chips Act offer a genuine counterbalance to the strategic approach pursued by mainland China.

## 4th pillar: Deep Software

The core argument is that **hardware without software is, in practical terms, inert**. However innovative the underlying architecture, however efficient the micro-electronic design, a chip without a software ecosystem remains functionally invisible to the developers, enterprises, and industries upon which its success depends. The experience of recent decades demonstrates, with stark clarity, that it is the integration of hardware and software, conceived and developed as parallel processes, that determines both market adoption and strategic autonomy. To invest in fabrication facilities and processor architectures without a simultaneous and systematic strategy for deep software is therefore to risk constructing a monumental yet underused edifice: a continent of factories producing devices that few can employ.

In European policy discussions surrounding the semiconductor sector, it is often assumed that the physical microchip, the tangible artefact emerging from a fabrication line, constitutes the nucleus of value creation. Yet this view fails to account for the invisible scaffolding of software that transforms inert silicon into a functional technological substrate. Between the layer of transistors and the visible world of applications lies an intricate hierarchy of deep software: kernels, device drivers, firmware, compilers, and abstraction frameworks. These components are not mere technical adjuncts but constitute the essential connective tissue between design and utility. Without them, the most advanced processor remains a laboratory curiosity, incapable of integration into operational systems.

*Deep software* refers to the suite of software artefacts that operate closest to the hardware, mediating between silicon and code.

'deep software' means the foundational software infrastructure that enables semiconductor hardware to function and be utilised, comprising operating system kernels, device drivers, firmware, bootloaders, hardware abstraction layers, compiler toolchains, standard libraries, runtime environments, and board support packages;

Consider this, somewhat provocatively: Member States invest tens of billions of euros in the pillars of the Chips Act. New fabs are built, innovative processors are developed, research institutions contribute, and pilot lines produce cutting-edge chips. Yet then... nothing happens. Why? Because no one can yet use the microchips. There are:

- No kernel drivers
- No compilers that leverage the chip's special features
- No development environments
- No documentation for software developers
- No standard libraries
- No ecosystem, no community of skills

*All this is Deep Software*, the critical infrastructure that bridges hardware and the electronic applications developers create. Without it, even the most advanced semiconductor hardware remains underused, its potential locked away and inaccessible to the innovation it is intended to enable.

What's missing in the EU Chips Act: Systematic provision of the deep software required to make the hardware functional and commercially viable. The current regulatory design assumes:

1. System software will spontaneously emerge
2. Market forces will provide the necessary software
3. Software development can be deferred until after hardware completion
4. Hardware-centric thinking suffices for semiconductor policy

All four assumptions are demonstrably false in 2025.

### **Linux Kernel Device Driver:**

- Translates kernel commands into hardware instructions
- Without it, a chip is "invisible" to Linux
- Development time: 6–12 months per chip

### **Compiler Backend:**

- Translates code (C, Rust, etc.) into machine instructions
- Utilises specialised hardware features (SIMD, crypto extensions)

- Without an optimised compiler: 50–70% performance lost

### **Hardware Abstraction Layer (HAL):**

- Abstracts hardware details for developers
- Enables portability across chips
- ARM's success is 50% based on CMSIS HAL

### **Board Support Package (BSP):**

- Basic software for a platform
- Includes bootloader, drivers, and sample code
- Without a BSP, each developer must start from scratch

The global landscape reinforces this conclusion of a Deep Software gap. The United States' CHIPS and Science Act, while popularly framed as a manufacturing subsidy, in fact devotes the majority of its funding to research and development, explicitly encompassing software and design tools. China, through its Made in China 2025 strategy and the National Integrated Circuit Industry Investment Fund, has allocated roughly forty per cent of its semiconductor budget to software and ecosystem development, sponsoring operating systems such as HarmonyOS, Kylin, and openEuler, and employing hundreds of full-time kernel and compiler maintainers. Taiwan, meanwhile, ensures that every chip produced by TSMC is accompanied by comprehensive design kits and software support packages, integrating hardware and software as inseparable components of its commercial model. Europe stands out as an anomaly: a region that invests heavily in hardware capacity yet leaves the software domain to serendipity. The result is a structural vulnerability: while others produce complete, usable systems, Europe risks producing technologically sophisticated components that remain unintegrated and commercially marginal.

Even where European industry relies on foreign-supplied chips, its ability to switch to alternative chipsets for products and industrial applications depends critically on deep software, as seen when the European electronics industry adapted to supply shortages during the COVID pandemic.

At a deeper level, the neglect of indigenous Deep Software undermines Europe's pursuit of technological sovereignty. Even when chips are fabricated on European soil, they often rely on proprietary architectures, toolchains, and cloud environments subject to foreign export controls. A processor licensed from ARM depends on British or Japanese intellectual property; EDA tools from Synopsys or Cadence remain governed by American regulatory regimes; and much of the associated development infrastructure operates within U.S.-based cloud systems. The result is a paradox: nominally European chips whose operational dependence compromises the very sovereignty they were intended to secure.

An open, European-centred Deep Software ecosystem offers an escape from this predicament. By grounding its semiconductor strategy in open architectures, such as RISC-V, and by cultivating domestic expertise in the Linux kernel, GCC, and LLVM compilers, as well as hardware abstraction layers, Europe could establish a self-reliant technological base. In such an environment, no third country could impose a “kill switch”, restrict updates, or deny access to essential tooling. Moreover, open source foundations enable verifiable security, a crucial quality in an era when digital infrastructures are targets of geopolitical competition.

When Europe combines its hardware investments under the existing pillar with a comprehensive deep software strategy and embraces open first principles, a fundamentally different picture emerges, one of genuine **technological sovereignty**.

At the foundation lies the **hardware layer**, built upon the existing Chips Act infrastructure with an open twist. This encompasses open-architecture and non-proprietary approaches to processor design, which represent a strategic departure from purely proprietary alternatives. Unlike architectures locked behind expensive licensing agreements, which expose Europe to geopolitical licensing risk, open architectures enable any European company, research institution, or start-up to design, modify, and manufacture processors without seeking permission from foreign licensors or paying royalties (or at least with reduced dependency). This open philosophy provides the bedrock for true independence.

Supporting this open architecture are onshored **European fabrication facilities**, the physical manufacturing capabilities that transform silicon wafers into functioning chips. European sites, such as GlobalFoundries’ prominent Dresden plant, STMicroelectronics’ multiple European manufacturing sites, and Infineon Technologies’ upcoming plant in Dresden, collectively represent substantial capital investment, thousands of skilled jobs, and decades of accumulated manufacturing expertise. When these facilities produce chips built on open-standard or open-architecture foundations, they complete the hardware sovereignty equation: European-designed chips, manufactured on European soil.

Complementing the fabrication capabilities are **open source electronic design automation tools**. Rather than depending entirely on American companies like Synopsys and Cadence, whose tools are subject to US export controls and licensing conditions, Europe must develop and deploy open source alternatives. EDA tools allow engineers to design, simulate, verify, and prepare chips for manufacturing. Despite being one of the most challenging technical hurdles, due to decades of entrenched proprietary development, the strategic imperative is clear: control over chip design tools is as important as control over fabrication.

Although the hardware foundation encompasses essential software for design and manufacturing, it remains insufficient without the application-level and system software

that enable chips to realise their full potential. The proposed **fourth pillar, deep software**, addresses this crucial layer.

A significant area of work involves contributing to **OS kernel development**, optimised for use with European semiconductors. This isn't merely about hoping that community developers will eventually add support; it requires European developers to serve as official maintainers of kernel subsystems. These maintainers ensure that device drivers for European chips are not afterthoughts, but are integrated into the mainline kernel from the outset. They guarantee that when a European automotive company evaluates a chip, Linux support, the operating system running everything from smartphones to servers to automotive systems, is already present, tested, and production-ready. This is open source software developed in the open, auditable by anyone, and controlled by Europe.

Parallel to kernel development sits **compiler infrastructure**, specifically GCC and LLVM, the two dominant open source compiler toolchains with their standard libraries. These compilers translate high-level programming languages (C, C++, Rust, Python) into the machine code that microprocessors actually execute. Having European developers actively contributing to and optimising compilers for European chip architectures means several things: first, European chips can utilise their full performance potential rather than suffering from generic, unoptimised code generation. Second, Europe ensures that critical development tools remain free from geopolitical interference. Third, European companies and developers gain deep expertise in the most fundamental software infrastructure, creating knowledge that cannot be sanctioned, export-controlled, or withdrawn.

Above the compiler layer sits the **hardware abstraction layer (HAL) and board support packages (BSP)**. The HAL provides standardised interfaces that allow application developers to write code once and deploy it across multiple European chip variants without having to rewrite low-level hardware access routines. Think of it as the European answer to ARM's CMSIS, but open, auditable, and under European governance. The board support packages provide the complete software foundation for specific hardware platforms: bootloaders that initialise the hardware, device drivers that control peripherals, example code that demonstrates capabilities, and documentation that explains everything. When a startup or SME wants to build a product using a European chip, these BSPs dramatically reduce time-to-market, often cutting development time from 18 months to 6 months.

The beauty of this integrated vision is its mutual reinforcement. European hardware without European software remains dependent on foreign software ecosystems. European software without European hardware has nowhere to run except on foreign chips. However, European hardware built on open standards, manufactured in European fabs, designed with open source tools, running European-maintained operating systems, compiled with European-optimised toolchains, abstracted through European-developed HALs, and

secured with formally verified European security stacks, represents **genuine technological sovereignty**.

Moreover, the open source nature of an entire deep software stack creates strategic advantages that alternative strategies cannot match. When everything is open, Europe isn't merely reducing dependencies; it's making an attractive platform for global collaboration. Developers worldwide can contribute to improving European chip software, whilst Europe maintains governance and direction. Companies globally can build products on European chips without fearing vendor lock-in. Researchers can study and improve every layer of the stack. And in geopolitical crises, Europe retains the ability to fork any component, maintain it independently, and continue innovation regardless of external pressures.

Europe must embrace a **software-aware mindset**, recognising that in contemporary technology, the hardware merely sets the stage upon which software performs the drama of innovation. This is the vision that Pillar 4 enables: not merely adding software to an existing hardware production strategy, but architecting a cohesive European-controlled microchips ecosystem from silicon to security, from bootloader to application, from hardware to software.

As a critical enabler, a deep software pillar would transform the Chips Act from a hardware production subsidy programme into a forward-looking European semiconductor strategy for achieving technological sovereignty in the 21st century.

## Open Source Hardware (OSH)

Over the past three decades, open systems have transformed the entire software-led economy. From high-performance computing to the Web, cloud, edge, mobile and embedded sectors, open and open-source ecosystems have steadily removed market frictions, accelerated innovation, and established de facto global standards that now underpin most digital infrastructures. The open model has consistently proved its capacity to enhance transparency, competitiveness, and Europe's digital sovereignty agenda.

In many policy discussions, open systems remain an elephant in the room: their pervasive influence is so extensive that they are often taken for granted rather than treated as a deliberate policy instrument. The same transformative forces are now beginning to reshape the semiconductor domain, where Open Source Hardware (OSH) is emerging as the hardware counterpart to the open-software revolution.

The People's Republic of China has moved with considerable determination to adopt and industrialise open hardware ecosystems, particularly those based on the RISC-V instruction set architecture. This strategy enables China to reduce its dependence on foreign intellectual

property, accelerate domestic design capacity, and cultivate an increasingly self-sufficient innovation base.

Europe cannot afford to concede leadership in open hardware architectures. The adoption and development of OSH would allow the European Union to mitigate concerns about dependencies on production centres in Taiwan and elsewhere in East Asia, to reinforce its technological autonomy, and to build a collaborative innovation ecosystem.

OSH represents more than a technological approach; it constitutes a strategic instrument of industrial and geopolitical policy. Through it, Europe has the opportunity to help shape the next global design paradigm rather than simply adapt to one defined elsewhere.

The OSH sector is now entering a phase of market expansion comparable to that of open source two decades ago. Across the world, research institutions and enterprises are embracing open reuse of intellectual property, collaborative chip design, and shared verification frameworks.

The number of open silicon designs published globally has skyrocketed since 2018, and thousands of verified open source cores are now available. European initiatives such as the OpenHW Group, the Barcelona Supercomputing Centre, SiPearl, and ETH Zurich's PULP platform have already demonstrated that open hardware in Europe can achieve industrial-grade reliability. Investment trends indicate rising venture interest in open-chip start-ups, which mirrors the early trajectory of the open software industry.

The forthcoming Chips Act II should recognise OSH as a principal component of Europe's semiconductor growth strategy. It lowers entry barriers, accelerates time-to-market, and enables the establishment of design competence throughout the Member States.

Licensing frameworks determine whether an open ecosystem remains genuinely accessible and innovation-friendly, or becomes fragmented. Liberal and non-discriminatory licensing regimes are essential if Europe wishes to ensure that the benefits of OSH extend beyond incumbent corporations to emerging small and medium-sized enterprises, start-ups, and academic teams. These actors are frequently those most capable of disruptive innovation but least able to absorb the cost of proprietary licensing. For that reason, OSH licensing policy should prioritise accessibility over control and encourage reuse, adaptation, and redistribution of open designs.

A coherent European approach to open-hardware licensing would help to avoid legal fragmentation, enhance trust between participants, and allow integration with open-software and open-EDA toolchains in a legally consistent manner.

To provide clarity and alignment with open principles, the following definition could be incorporated into Article 2 (Definitions) of a revised Chips Act:

(25) 'open hardware' means semiconductor designs, intellectual property blocks, electronic design automation tools, or related technologies whose specifications, schematics, source code, or design files are publicly available under licenses that permit study, modification, and redistribution and use, without discrimination;

Such availability includes sufficient transparency and documentation to allow adequate understanding and replication by users or developers.

This definition would establish a clear legal foundation for funding, procurement, and compliance across European OSH initiatives.

## Substitution - Plan B

Global semiconductor supply chains are under strain due to geopolitical tensions, trade interests, military sanctions, and market vulnerabilities. Industries are grappling not only with securing stable chip supplies but also with their limited ability to substitute one chip or chip supplier for another.

While tech sovereignty measures in the context of the Chips Act often focus on the mid-term **onshoring of semiconductor production and preservation of domestic fabs**, this approach is not without significant drawbacks. Establishing chip manufacturing facilities requires massive investments, advanced workforce skills, and years of planning. For Europe, the time and costs associated with such ambitions can be prohibitive, making onshoring an impractical and **incomplete solution**. Incomplete as it is (even with expanded European production capacity), industries would still face the regular challenge of integrating new chip types while supply chains would remain globalised.

A more immediate and cost-effective way to address this issue is to increase **the industry's ability to substitute chips** and suppliers. Transitioning to a different chip set or supplier requires significant investments in redesigning hardware, rewriting software, re-certifying products, and adapting production processes. For many firms, these daunting challenges effectively lock them into their existing supply chains, limiting their ability to pivot during crises, such as the COVID-19 pandemic.

Therefore, a **chips interoperability** agenda should be considered for a Chips Act revision:

- **Standardisation** allows chips from different suppliers to function seamlessly within existing systems, simplifying the process of substitution and reducing reliance on any single supplier. The Chips Act II should incentivise modular chip designs and standardised integration frameworks across the industry. But there are limits to that. In many cases, the interoperability needs to be guarded on a different level, such as deep software or product and procurement regulations, and economies of scale,

fostered by standardisation, could still favour concentration and production in other regions.

- **Substitution** was the primary industrial mitigation strategy in strained COVID supply chains. Hardware should be **designed with chip substitution in mind**.
- With a **Chip interoperability agenda**, member states and industry would seek to adapt to supply chain disruptions more quickly. This may involve risk management, identifying alternatives that can replace unavailable chips, or adopting a modular hardware design to enable the smooth integration of diverse chips. Encouraging these industry practices would strengthen the ability to maintain operations in the face of procurement disruptions. The EU legislator also needs to foster supply chain flexibilities for the case of a procurement crisis, such as fast-track options in procurement laws or market certifications, export controls etc., with a plan B for critical dependencies. Lessons learned from the COVID crisis need to be sustained in political instruments.

In addition to interoperability, European industries must continue to incorporate redundancy into their supply chains through strategies such as **sourcing from multiple suppliers**. A Plan B also implies reserve technologies and supporting market challengers.

Ultimately, the industry's ability to switch between chips and suppliers will determine the European Union's resilience to future supply chain shocks. While onshoring production is a long-term ambition that carries high financial and logistical costs, focusing on chip interoperability and supply chain strategies offers more practical and immediate solutions to the challenges of technological sovereignty. The Chips Act revision provides a crucial opportunity to address this issue.