European Commission

Joint Research Centre

SCIENCE FOR POLICY BRIEF

From dependency to resilience

JRC science for EU technological sovereignty

2026

HIGHLIGHTS

- The EU Technological Sovereignty Package marks a decisive shift — from digital regulation to assertive industrial strategy aimed at securing EU control over critical technologies, infrastructures and data.
- JRC research shows that nearly 80% of EU semiconductor firms' key suppliers are headquartered outside Europe. Of 127 semiconductor products monitored, 23 carry high risk with limited EU substitution potential — including gallium, germanium, DRAM memories and key processor categories.
- JRC monitoring tools, analytical reports and crisis simulation exercises have informed Chips Act 2, shaping its objectives, scope and crisis-preparedness architecture.
- Semiconductor dependency is one dimension of a broader challenge. JRC research addresses digital sovereignty holistically, spanning governance, infrastructure, software, data and people, providing a multi-disciplinary foundation for the full scope of the Package.

When the global semiconductor shortage struck in 2021, the EU automotive sector experienced a 23% decline in output compared to 2019 levels.

The cause was not a lack of demand. It was overreliance on a handful of suppliers concentrated in geopolitically sensitive regions. Strategic dependency had translated, almost overnight, into economic vulnerability.

Semiconductors were the first wake-up call. But **the underlying risk runs deeper than chips.**

European dependence on third-country technologies, platforms, infrastructures and data represents a structural exposure that no single policy intervention can fully address. This spans cloud computing, artificial intelligence, software and data ecosystems and critical materials.

This is the challenge the EU Technological Sovereignty Package is designed to meet. And it is the challenge that JRC research is built to inform.

Policy context

The just published European Commission's Technological Sovereignty Package [1] marks a decisive shift in EU digital policy: from a purely regulatory agenda toward an assertive industrial strategy. Its overarching ambition is to strengthen the EU's capacity to adopt, develop, control and scale critical technologies, infrastructures, services and data that underpin Europe's economy, security and digital society.

The package brings together a unique set of policy measures aiming to substantially improve the ways in which technology in the EU is produced and used. It brings together initiatives on

1) semiconductor supply chains, and
2) cloud infrastructures,
3) the promotion of open-source solutions and an open digital ecosystem approach to reduce dependencies on third-country proprietary technologies while incentivizing innovation.

JRC Contribution I
Semiconductor supply chain and the Chips Act

The policy challenge

In 2025, EU semiconductor consumption reached €41.1 billion: 10.5% of global shipments. Yet, the majority of production remains outside Europe. Semiconductors are not merely industrial goods: they are the enabling technology underlying the digital economy, the green transition and European defence. Every electric vehicle, every AI system, every defence application depends on chips.

The European Chips Act (2023) laid the foundations for a more resilient EU semiconductor ecosystem. Chips Act 2 builds on that foundation, seeking to reinforce EU technological sovereignty and guarantee a secure, resilient supply of chips across key sectors. Its objectives include expanding EU capacity in both mainstream and advanced chips, including AI-specific devices, fostering strong user markets across industries, and strengthening crisis preparedness and intelligence capabilities.

JRC scientific contributions

Since the launch of the first Chips Act, the JRC has provided the scientific and analytical backbone for EU semiconductor policy through **three** mutually reinforcing **contributions.**

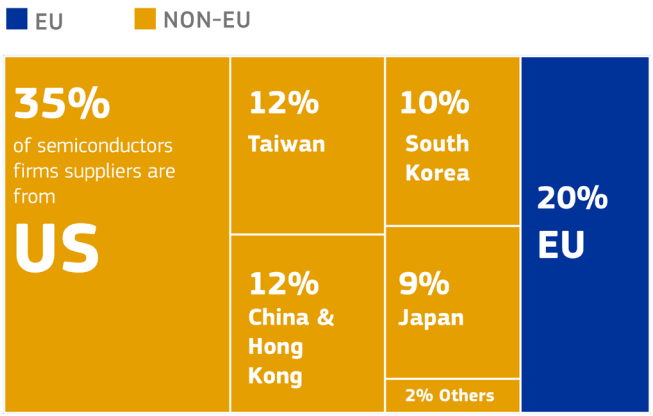
1. **Monitoring framework**

The JRC designed a supply-chain monitoring architecture that:

- **maps key players** in the global semiconductor value chain, identifying critical bottlenecks, dependency hotspots and opportunities for diversification;
- **tracks product-risk trends** and generates early-warning indicators; and
- **put forward a prototype** that could **detect early signs of potential disruption**, by combining multiple data streams from news media to natural disaster databases.

The firm-level analysis highlighted a concentration of companies in Northern Europe and showed that nearly 80% of European semiconductor firms' suppliers are headquartered outside the EU (see Figure 1) with the US (35%), Taiwan (12%), China and Hong Kong (12%), South Korea (10%), and Japan (9%) dominating the picture.

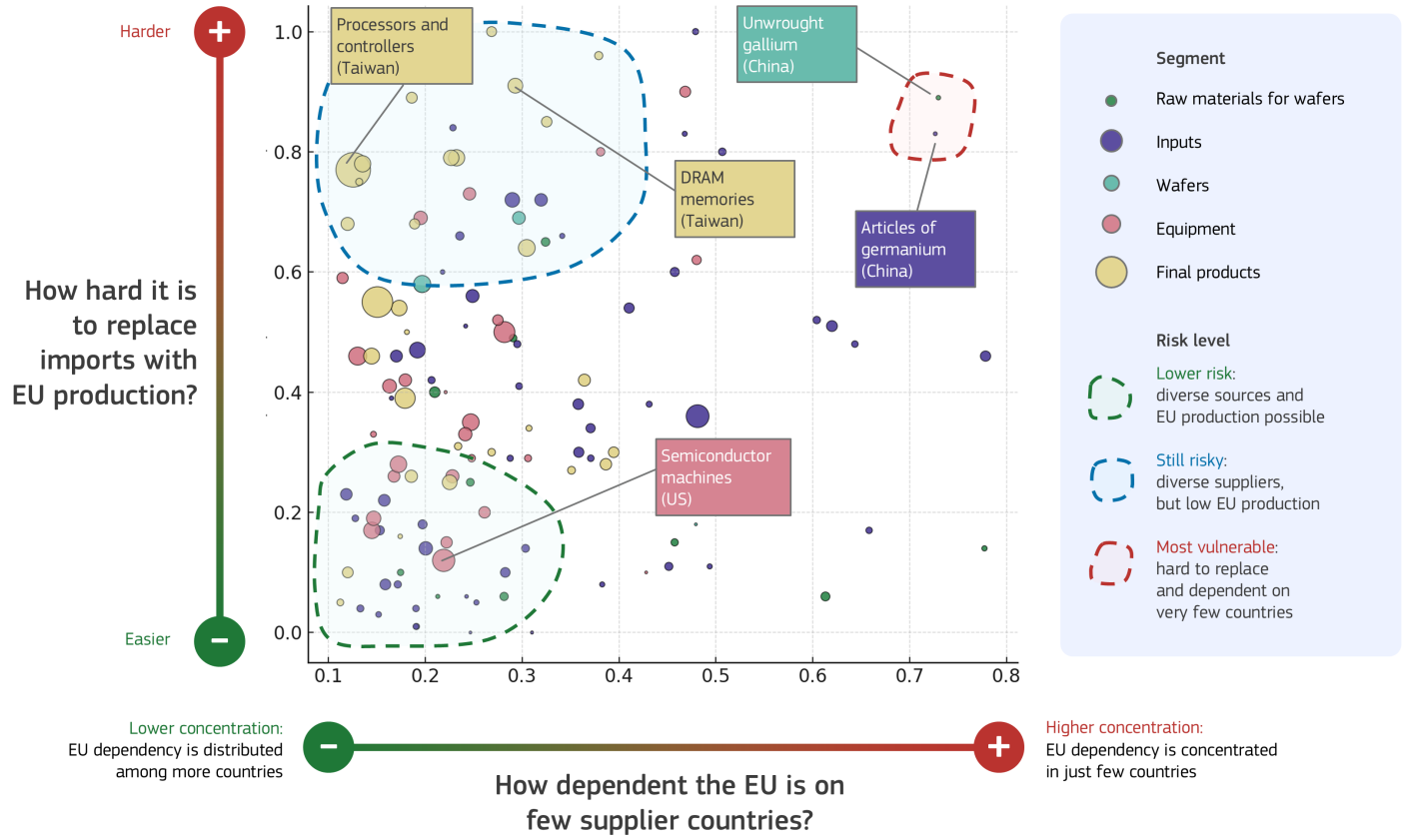
Figure 1. Geographic distribution of EU semiconductor suppliers



Over one third of EU semiconductor firms' external suppliers are headquartered in the United States, with significant additional concentration in Asia.

Source: JRC calculation

Figure 2. EU semiconductor products by import concentration and substitution risk



Source: JRC calculation

Note: Each bubble represents one of 127 monitored products, plotted by substitution difficulty (vertical axis) and import concentration across supplier countries (horizontal axis). Products in the upper-right zone are most vulnerable(hard to replace domestically and dependent on very few countries). Unwrought gallium and articles of germanium, sourced almost entirely from China, sit firmly in this zone. Processors, controllers and DRAM memories, primarily supplied from Taiwan, occupy an intermediate risk band. In total, 23 of the 127 products carry high risk with limited EU substitution potential.

2. Product-level risk assessment

At product level, the Supply-Chain Analysis Network tool operationalises the framework, identifying structural dependencies, tracking how those dependencies evolve over time, and signaling the first signs of supply-chain distress (see Figure 2 above).

Out of 127 products under regular monitoring, the JRC identified 23 high-risk items for which Europe has limited substitution potential. Critical upstream materials, like unwrought gallium and germanium compounds, are almost entirely sourced from China, with minimal domestic EU alternatives.

Several chip categories, including Dynamic random-access memory (DRAM) memories and certain processor and controller subcategories similarly combine high import volumes from Asian suppliers with low domestic substitution capacity.

3. Analytical reports and crisis simulations

A series of scientific reports (see “References” [2], [3], [4], [5], [6] and [7]) supplied solid evidence underpinning the preparation of the Chips Act 2, detailing systematic data-collection procedures and recommending further indicators for semiconductor supply-chain monitoring.

These outputs also fed into a tabletop exercise involving the European Semiconductor Board and the Council Working Party on Competitiveness and Growth.

The simulation identified the need to strengthen EU crisis preparedness, extend the crisis-response scope to cover raw materials and downstream user industries, and improve the granularity of supply-chain data collection.

Policy significance

JRC independent scientific assessments provide solid evidence that supported the development of the Chips Act 2's narrative and objectives.

The importance of this monitoring work has grown as geopolitical tensions have intensified, global value chains have been reshaped, and semiconductors have been recognised as a strategic asset.

Evidence points to the value of integrating JRC monitoring outputs with the efforts of industrial alliances, and developing the Business-to-business Semiconductor Supply chain Platform envisaged in Chips Act 2.

JRC Contribution II
A holistic framework

The policy challenge

Semiconductor dependency is one dimension of **a deeper, structural challenge.** Sovereignty is a broader and complex subject that cuts across multiple interdependent layers, including:

- governance,
- digital infrastructures,
- software and data,
- digital markets and
- people. (see [8. Di Marco et al.)

No single-sector intervention can address it fully. What is required is a **multi-disciplinary approach** capable of mapping the i**nteractions between these layers** and informing policy choices with appropriate scientific rigour.

JRC scientific contribution

The JRC investigates digital sovereignty from a **holistic perspective,** examining the geopolitical (see Fratini et al [9].) technological, social, economic, environmental and implications of digital transformation simultaneously.

This approach grounds the operationalisation of technological sovereignty in evidence rather than assumption, offering policymakers a scientifically sound framework for understanding what EU strategic autonomy in the digital sphere truly entails.

In this context, forthcoming JRC research is oriented in two directions.

- First, it will deepen understanding of the techno-socio-economic implications of sovereignty, mapping different policy pathways and the costs associated with each.
- Second, it will develop practical tools and methodologies to help stakeholders —from industry to public authorities to civil society— operationalise sovereignty in their own contexts. This includes a **sovereignty self-assessment tool** and a **digital sovereignty canvas** adapted from the established business canvas framework, both designed to strengthen sovereignty posture while preserving openness to global cooperation.

Policy significance

Dependence on third country proprietary platforms in cloud computing, AI development, software and data ecosystems could amplify the very vulnerabilities that the Chips Act is designed to address in semiconductors.

The JRC holistic framework provides the conceptual and methodological lense needed to monitor and respond to those broader dependencies as the Technological Sovereignty Package is implemented.

It also serves as the scientific foundation for future policy initiatives wherever the development and use of technology in the EU is a matter of strategic concern.

Looking ahead

Chips are the physical foundation of digital sovereignty, but strategic autonomy requires attention to the full technology stack.

The monitoring agenda must evolve accordingly, expanding beyond semiconductors to cover:

- dependence on third country proprietary platforms in cloud computing,
- artificial intelligence development, and
- software ecosystems

Each of these areas could amplify the vulnerabilities the Chips Act is designed to address in semiconductors. Open-source solutions offer one concrete pathway to reducing such dependence.

Quantum technologies represent a further strategic opportunity in the longer term. The JRC has in fact confirmed that the EU is well-positioned —with a strong research and innovation ecosystem and significant sectoral investment— to build sovereign capacity in quantum before deep structural dependencies form (see [10 and [11]).

Early commitment now could prevent the vulnerabilities that characterise today's semiconductor landscape from being replicated in the quantum sector tomorrow.

In parallel, a scientifically sound approach to monitoring indicators will be retained and where necessary refined. The main challenge ahead remains limited data availability: progress requires action not only from the European Commission but also from Member States and industry.

As Europe moves from diagnosing its dependencies to addressing them, JRC science will continue to provide the evidence base that policy decisions of this scale require.

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