QuIC Position Paper on the EU Chips Act (Chips Act 2) Review

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Executive Summary

Europe is strategically prioritizing semiconductor and quantum technologies to bolster its industrial competitiveness and technological sovereignty, in line with the Chips Act. Success will depend on **leveraging existing strengths** in areas like cryogenics, photonics, control electronics and specialized manufacturing, alongside increased investment in **quantum-specific fabrication capabilities and dedicated pilot lines**. Key challenges include transitioning from flexible R&D facilities to high-volume manufacturing, integrating quantum process design kits (PDKs) to standardize production workflows, and addressing the unique fabrication requirements of quantum processors – potentially requiring dedicated or repurposed foundries and shared infrastructure models. To accelerate iteration cycles, retain strategic IP and create local industrial value, the Chips Act 2.0 should incorporate mechanisms that provide quantum companies with **small-scale, in-house prototyping and fabrication pathways** in addition to **open foundry** access.

To maintain a leading position, Europe must also balance open global collaboration with the need for technological autonomy. This requires a nuanced, **risk-based approach to partnerships**, avoiding overly restrictive policies that could stifle innovation or discourage investment, while safeguarding critical capabilities and securing access to essential raw materials. Crucially, scaling quantum technologies demands a fully supported value chain – from design and fabrication to testing and packaging – alongside stronger cross-sector coordination between semiconductor, quantum and HPC industries. A collaborative, risk-based approach will be vital for fostering a competitive and resilient European quantum ecosystem.

Methodology and Scope

The contents of this document result from a request to the QuIC consortium membership to participate in preparing a response for feedback on the Chips JU activities related to Quantum technologies. Contributions were gathered through a four-week sprint series in November 2025, with open calls for inputs and alignment meetings for each section. The contents reflect the participants' views and are as diverse as the companies we represent in Quantum computing, Quantum sensing, Quantum Communications and Enabling technologies. We recognise that many quantum-related activities are not represented in this document, and we expect that alternative recommendations and opinions are likely from the wider QuIC membership. In addition, we recognise that many of the recommendations are already being implemented as part of some (if not all) the stability quantum pilot lines. We decided to continue to include these recommendations to ensure that all stability quantum pilot lines strive to follow the best practices and the most successful strategies being implemented across the pilot lines.

1. Importance of quantum sector and enabling tech for CfE key objectives

Europe enters the quantum field as one of the strongest regions in the world. It hosts a large share of global quantum-technology companies, with many fast-growing scale-ups and a broad industrial base across hardware, software and enabling technologies. European companies are not only advancing research but are already delivering quantum systems to customers, giving Europe a visible and credible presence in the early commercial market. This combination of industrial capacity, technological know-how and early commercial activity places Europe among the leading global actors in quantum technologies.

Support through the Chips Act can reinforce and extend this position. By backing a sector where Europe already has real industrial strength, the Chips Act can help secure Europe's long term technological sovereignty and its role in the global quantum landscape and ensure that future high-value quantum manufacturing and integration capacity remains anchored in Europe.￼.

The EuroHPC and Quantum Grand Challenge initiatives, with their ambitious but achievable performance and scale-up targets, illustrate how quantum and semiconductor policy are mutually reinforcing. The Chips Act provides the structural foundation upon which these initiatives can grow, enabling Europe to strengthen its competitive positioning in next-generation computing.

While the Chips JU aims to close the gap between Europe's existing manufacturing capabilities and global leading-edge semiconductor production, achieving this for conventional CMOS below 10 nm would require absorbing a substantial portion of the total Chips Act budget. In our view, a more pragmatic approach is to **preserve and grow Europe's position in the existing global supply chain**, while simultaneously **investing in disruptive technologies**—including quantum processors, photonics, neuromorphic systems, and advanced heterogeneous integration—**while reinforcing public investments dedicated to the deployment of the Quantum Stability Pilot Lines at SGA2 stage** - where Europe can achieve world-leading positions.

Maintaining Europe's position in both the current semiconductor and quantum supply chains is strategically essential for securing access to advanced components used in AI, HPC, and emerging quantum platforms. Encouragingly, this approach is already bearing fruit through long-standing programmes such as **Europractice, Qu-Pilot, and JePPIX**, which have enabled more than 500 innovative start-ups since 2022 and helped Europe capture nearly 20% of the global photonics market[1].

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[1] *https://optics.org/press/6207*

This model should now be **replicated and extended** to other deep-tech domains—including **quantum computing**—where Europe already occupies several "critical control points" of global supply chains. Europe is one of the world leader in cryogenic systems, photonics, control electronics, and specialised laser sources for quantum technologies. Preserving and expanding this leadership is key to establishing new control nodes in future quantum supply chains.

Europe has been highly successful in supporting early-stage (TRL 1–5) quantum technologies through Horizon funding. Several quantum processor projects have now been integrated as part of the upcoming industrial quantum stability pilot lines under the Chips JU (e.g., CHAMP-ION, SUPREME, Q-PLANET), while others regularly access pilot lines such as EPHOS and FAMES. However, **access conditions, IP policies, and exploitation frameworks may remain inconsistent** across the existing pilot lines. A structured review would help harmonise rules, improve transparency, and strengthen usability for industrial actors[2].

In addition, outreach and coordination across pilot lines should be expanded. Stability lines include numerous universities, RTOs, and companies, yet it is often unclear who will assume responsibility for commercialisation and scale-up once a technology reaches industrial maturity. Ensuring that EU companies can transition from prototype to meaningful production capacity is essential to the success of both quantum and semiconductor strategies.

Policy Recommendations:

1. **Strengthen Europe's quantum and semiconductor supply chains while enabling disruptive innovation**
2. **Establish "Quantum Chips" as a strategic pillar of the future Chips Act back-up by funding**
3. **Harmonise access, IP management, and exploitation policies across pilot lines based on lessons learned**
4. **Expand support for enabling technologies critical to quantum industrial scale-up**

[2] *https://www.tno.nl/en/newsroom/insights/2025/10/strategic-plan-26-29-interview/*

2. Integration, interfacing, dissemination

Strengthening Europe's semiconductor and quantum ecosystems requires **deeper integration across technology sectors**, improved **interfacing between supply chains**, and more effective **dissemination and exploitation** of results. These elements are essential for accelerating market uptake, ensuring industrial competitiveness, and reducing Europe's dependency on non-EU actors in critical digital technologies.

Europe currently lacks full sovereignty in several strategic technology domains, including advanced semiconductors. For example, while Europe hosts world-leading equipment suppliers, only a **very limited number of ASML EUV scanners** are currently used for semiconductor manufacturing within the EU, whereas a significantly higher number operate in the US and Asia.[3] At the same time, initiatives such as **ESMC's advanced semiconductor fab in Dresden** demonstrate that Europe *can* attract and develop leading-edge capacity when adequate policy and investment frameworks are in place.[4] *However, Quantum technologies offer a unique opportunity to help reset this imbalance*, enabling Europe to secure leadership positions in emerging high-value segments. Quantum systems rely on critical enabling technologies where Europe already holds strong industrial positions: **optics and integrated photonics, cryogenics, vacuum systems, control electronics, advanced materials, specialised lasers, and precision manufacturing.** To achieve **industrial leadership** at international level, sustained **investment** in **competitive, future-proof high-tech infrastructure** and **industrial capabilities** is required to enable **innovation and cost-effective scaling**.

To fully unlock this potential, Europe must improve support mechanisms that enable quantum companies to notably access semiconductor design (including optical semiconductors) and manufacturing capabilities. Existing services such as **EUROPRACTICE** provide an important baseline, but *they were not built for the specialised needs and low-volume, high-complexity requirements of quantum chip development*. Dedicated and cost-effective access instruments—covering chip design, manufacturing, co-packaging, heterogeneous integration, and cryogenic electronics—remain a major structural gap.[5]

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[3] *https://ourbrand.asml.com/m/79d325b168e0fd7e/original/2024-Annual-Report-based-on-US-GAAP.pdf (estimated based on reported revenue)*

[4] *ESMC Dresden: The European Semiconductor Manufacturing Company (ESMC)—a joint venture including TSMC, Infineon, Bosch and NXP—is establishing an advanced semiconductor fab in Dresden, marking a significant increase in EU leading-edge capacity.*

[5] *EUROPRACTICE: EUROPRACTICE provides shared access to microelectronics design tools and MPW shuttles; however, quantum technologies require dedicated cryo-electronics, photonic-integrated circuit (PIC) and heterogeneous-integration pathways that remain insufficiently supported.*

Dissemination and exploitation efforts must also be strengthened. The Chips Act 2.0 should ensure that research and early industrial outputs are rapidly shared across sectors, aligned with industrial roadmaps, and translated into scalable technologies. Improved cross-sector communication—particularly between semiconductor, quantum, HPC, and critical-raw-materials actors—will significantly accelerate the European uptake of strategic technologies.

Europe also has the responsibility to ensure that emerging quantum technologies remain aligned with **human-centric, sustainable and responsible innovation principles**. Quantum systems will soon stand at the threshold of transforming how we solve some of the world's most complex problems. Therefore, their development should explicitly integrate **sustainability, circularity, energy efficiency, and social responsibility**, avoiding the unsustainable patterns of past industrial revolutions. This requires alignment not only with the Chips Act 2.0 but also with the **EU Green Deal**, **the Digital Decade Targets** the **Critical Raw Materials Act**, and the **UN Sustainable Development Goals (SDGs)**[6]. Such alignment will ensure that Europe's quantum ecosystem grows in a direction consistent with global sustainability objectives and Europe's values-driven technological vision.

Policy Recommendations:

1. **Deepen dedicated financial and technical incentives for quantum chip design and fabrication, including quantum-specific extensions to EUROPRACTICE and affordable access to packaging, integration and services including but not limited to cryogenic-electronics services.**

2. **Strengthen cross-sector integration between semiconductor, quantum, photonics, on-chips lasers and HPC industries, including shared roadmaps, coordinated dissemination, use case developments and structured supply-chain interfacing.**

3. **Embed sustainability and human-centric principles (energy efficiency, circularity, responsible materials use) into all quantum-related Chips Act actions, ensuring alignment with the EU Green Deal, the Digital Decade Targets, CRMA and UN SDGs.**

[6] *UN SDGs – 17 Goals to Transform the World: https://www.un.org/en/exhibits/page/sdgs-17-goals-transform-world*

3. How: First-of-a-kind production facilities (Pillar 1)

3.1 Continuation, Viability and Exploitation of Quantum Stability Pilot Lines

The six **quantum stability pilot lines** currently being deployed under the **European Chips Act**—co-funded by the Chips Joint Undertaking and Horizon Europe for superconducting, photonic, neutral atoms, semiconducting, diamond-based, and trapped ions —represent a major milestone in supporting Europe's ability to develop **stable, manufacturable quantum chip technologies**. These pilot lines aim to strengthen process reproducibility, ensure technological stability, advance manufacturing maturity, integrate PDKs, and prepare quantum chip technologies for eventual industrialisation. Their purpose is both high-volume production while creating the *stable technological foundations* required just before commercial scaling becomes viable (TRL 9) to guarantee resilience in quantum supply chains for the European Union.

Several of these pilot lines involve **balanced consortia** composed of both companies and research and technology organisations (RTOs). While some RTOs and companies have strong industrial experience, **IP management practices and technology-transfer mechanisms can vary significantly** across entities. In the past based on the research quantum pilot lines (QuPilot/QUTest), the absence of structured licensing frameworks or differences in expectations between public RTOs and private companies could led to delays or barriers to the exploitation of these pilot lines. Therefore, ensuring clearer, fair and reasonable licensing conditions for publicly funded technologies such as the quantum stability pilot lines will be critical to maximising European industrial benefit.[7]

Experience across the (optical) semiconductor and photonics sectors shows that the transition **from prototype to commercial-grade chips** requires predictable access to industrial-grade infrastructure, clear IP rules, and robust exploitation strategies. Positive examples such as **Smart Photonics in Eindhoven**, a commercial foundry that emerged from EU-supported research ecosystems, demonstrate the value of well-structured public–private pathways. We thus welcome the emphasis placed by the European Commission and the Chips JU on **exploitation activities for the stability quantum pilot lines** under SGA1. However, SGA2 is the stage where these pilot lines will approach market readiness (up to TRL 8). Therefore, we recommend that **each pilot line would be required to deliver an exploitation and sustainability roadmap**

[7] *Licensing variability: Licensing practices among European RTOs vary significantly, with royalty rates in the chip industry often around 4% (Licensing Executives Society), though some institutions have pursued far higher equity-based claims.*

during SGA2, ensuring a concrete pathway to industrial deployment, market relevance, and economic viability.

Furthermore, a **quantum pre-standardisation roadmap** should be financed and integrated at the latest at SGA2 stage for each of the six stability quantum pilot line, ensuring that outputs are not only technically mature but also interoperable, verifiable, and ready for integration into global markets.

Finally, **dedicated use case-development** under these pilot lines in key industrial sectors—HPC, cloud, automotive, health, aerospace, energy, chemistry, public services, telecommunications - can ensure that the Stability Industrial Pilot Lines meet market needs by design. Use case developments will directly contribute to user quantum adoption at large. We therefore recommend allocating Chips Act 2.0 funding at the SGA2 stage, including a minimum number of use cases in key sectors of the European economy to ensure market alignment of the quantum stability pilot lines.

3.2 Continuation of Integrated Production Facilities

To complement the stability provided by the Stability Quantum Pilot Lines, we recommend that Chips Act 2.0 preserve and strengthen the instrument of **Integrated Production Facilities (IPFs)**. IPFs fulfil a distinct strategic role beyond that of Open EU Foundries by enabling SMEs to **design and manufacture chips in-house** within a vertically integrated environment. This supports **faster design-manufacturing iterations**, secures know-how locally, and directly contributes to technological capacity building and ecosystem resilience, fully aligned with the objectives highlighted in the CfE.

Moreover, maintaining IPFs is also crucial for SMEs that may not qualify as first-of-a-kind projects. The IPF model offers tighter control over **design-manufacturing cycles** and enables companies to protect their intellectual property more effectively. By doing so, IPFs help **anchor innovation locally** and foster **resilient regional clusters,** key priorities highlighted in the Chips Act CfE.

3.3 Complementary Note on Research Pilot Lines (QuPilot/QuTest)

Although **research pilot lines** do not fall under the scope of the Chips Act 2.0, maintaining continuity across the entire R&I to industrialisation cycle is essential. Research pilot lines play a critical role in advancing early-stage concepts and training specialised talent. Their continuation should therefore be addressed through Horizon Europe successors in term of funding. This will enable synergies and lessons learned (such as on IP management) to be transferred between the research pilot lines and the industrial stability quantum pilot lines to the benefit of European competitiveness while adding value to both the research and industrial quantum ecosystems.

Policy Recommendations:

1. **Require each stability pilot line (SGA2) to deliver a full exploitation, sustainability and standardisation roadmap backed up by industrial use cases ensuring market readiness, TRL progression and industrial viability, and to be accompanied by additional funding that also covers the implementation of the exploitation plan.**

2. **Strengthen technology-transfer frameworks and IP licensing conditions to guarantee fair, reasonable, and predictable exploitation of publicly funded results across industry.**

3. **Maintain the Integrated Production Facilities (IPF) instrument as a mechanism to enable small-scale in-house prototyping capabilities for quantum companies to accelerate iteration, retain strategic IP, and ensure Chips Act investments translate into real products while strengthening local innovation.**

4. How: Enabling technologies (integrated photonics, lasers and detectors) (Pillar 2)

Europe, due to its very diverse public national research infrastructure, a culturally open collaboration attitude with respect to deep-tech startups, often started by former members of the academic environment, -holds a **leading global position** as a supplier of enabling technologies across a wide range of strategic markets, including high-end laser and cryo technology, **quantum computing, quantum metrology, telecommunications, sensing, and advanced manufacturing**. Strengthening this enabling-technology base and preparing it for growth, is essential not only to maintain European competitiveness but to secure **strategic autonomy** and establish control over *critical nodes* in international supply chains.

Within the scope of the Chips Act, **integrated photonics** plays a pivotal role as a foundational enabler for the scaling of quantum technologies. The **PIXEurope pilot line**, launched under the Chips Act, represents an important milestone in reinforcing European photonic chip production capacity and improving autonomy for sectors such as telecommunications, datacom, and **quantum key distribution (QKD)**. Its wavelength focus, however—primarily in the **near-infrared**—reflects the needs of telecom-driven applications rather than emerging quantum modalities.

By contrast, **ion-trap** and **neutral-atom quantum computing** platforms rely on photonic components operating in the **visible (400–800 nm)** and **near-UV (295–325 nm)** spectral ranges. These wavelengths fall largely *outside the processes and PDKs* currently available in commercial foundries. Some functionalities crucial for these systems (e.g., low-loss waveguides, integrated filtering, high-power on-chip beam delivery, electro-optic modulation, or nonlinear materials) require **material platforms incompatible with standard CMOS processes**, creating substantial fabrication and integration challenges. As a result, the development and use of these chips is costly, often limited to bespoke academic cleanrooms, and not scalable to the industrial reliability levels required for commercial quantum products.

To address these gaps and support quantum systems capable of scaling to **thousands of qubits**, Europe should pursue **tailored measures** targeting the development, maturation, and industrial availability of these specialised chips. This includes:

- Making existing public fabrication infrastructure available to commercialisation requests for small-volume needs at-cost model and generating incentive models for such public foundries to support the nascent supply chain with small volume production upon agreement of the consortia members of existing or upcoming initiatives such as the Stability Quantum Pilot Lines.
- **Extending fabrication capacities** for visible and UV photonic integrated circuits (PICs), and open these for private public partnership arrangements
- Developing **PDKs** covering these non-telecom wavelengths,
- Expanding **testing, validation, packaging and cryogenic-compatibility infrastructures**,
- Supporting **heterogeneous and hybrid integration** models that combine multiple materials and platforms on a single chip (e.g., SiN + AlN + $LiNbO_3$; optical + RF integration),
- Ensuring efficient pathways for manufacturing workflows up to **TRL 8**.

Deepening support to the entire value chain—from design to fabrication, assembly, and testing—will be essential from design to fabrication, assembly, and testing. This will enable Europe to capture a meaningful share of the emerging multi-billion-euro market for quantum photonics and maintain sovereignty over a foundational enabling technology.

Policy Recommendations:

1. **Develop dedicated visible/UV photonic pilot-line capacities, including specialised PDKs, testing, and packaging compatible with quantum computing needs (ion-trap, neutral-atom, visible-range detectors).**
2. **Support heterogeneous and hybrid integration approaches that combine multiple photonic, electronic, and material platforms to enable scalable quantum PICs beyond standard CMOS constraints.**
3. **Ensure alignment and strategic coordination between Chips Act pilot lines, quantum infrastructures, and industrial roadmaps, maximising European digital leadership across the full quantum value chain.**

5. How: Semiconductor / Superconducting / Control electronics (Pillar 3)

5.1 Semiconductors and control electronics

Semiconductor quantum processors and the electronics used for qubit control are fundamentally realised using standard semiconductor technologies, making them well suited to benefit from the maturity, scale, and reliability of existing semiconductor manufacturing ecosystems[8]. The ideal goal would be to use the existing high-volume semiconductor foundries to produce all the devices necessary to build a scaled quantum computer. However, as with many semiconductor products, optimisation and enhancements are required to realise the highest-performance qubits. Presently, most semiconductor-based qubit development teams rely on low-TRL production facilities to research and improve the performance of qubit processors, since many essential process parameters can be modified. As with all qubit modalities, it will eventually be necessary to bridge the gap to the higher-volume foundries. Supporting the incorporation of quantum devices as part of the Process Design Kit (PDK) and qualifying the existing PDKs (e.g. @7nm FD-SOI) to operate at cryogenic temperatures (4K, 70K) will be necessary to build quantum computers with the thousands of qubits needed for utility-scale quantum computing for those quantum technological platforms not operating at room temperature. To accelerate scalable quantum computing, the fabrication of semiconductor photonic components, quantum processors, electronics for qubit control, on-chips lasers, integrated chips for error-correction, and general purpose cryogenic integrated chips where applicable should fully **exploit existing semiconductor foundry capabilities**, together with their **mature ecosystems** in designing, advanced packaging and integration. This will

[8] *Equal1: https://www.equal1.com/post/commercial_cmos_process*
Quobly: https://quobly.io/news/quobly-announces-key-milestone-for-fault-tolerant-quantum-computing/

ensure reliable, manufacturable, and more rapidly deployable hardware products at scale.

Currently, the qubit control electronics are outside the cryostat and connect to the quantum processing unit (QPU) via a wiring harness. As the number of qubits increases, the wiring becomes unwieldy[9]. Solutions can include replacing the wires with fibre-optic connections, increasing signal multiplexing, and relocating the control electronics inside the cryostat, closer to the QPU. Moving the control electronics into the cryostat can advance the frontier of development. As the operating temperature decreases, it is necessary to reduce power dissipation or increase the cryostat's ability to manage the additional heat generated. Solving these problems for quantum systems, not operating at room temperature, will also benefit all semiconductor devices using the same foundry processes, creating a virtuous cycle of continuous improvement. In addition, support is needed for the development of high-power cryostat solutions by challenging the industry to deliver compact cryostats with >1W of cooling power by 2029.

5.2 Superconducting

Superconducting quantum processors form one of the most active industrial segments in Europe, with multiple scale-ups and a visible share of publicly reported system shipments since 2020. This makes superconducting technologies an important part of Europe’s quantum manufacturing landscape, while remaining one of several modalities that require dedicated support.

The requirements for superconducting quantum processor manufacturing differ substantially from those of traditional semiconductor production. Superconducting quantum chips rely on specialised materials and device structures that are partially incompatible with the cutting-edge technology nodes used in modern semiconductor fabrication. At the same time, the pilot-scale quantum facilities available today, and those expected in the near future, will not meet the large-scale manufacturing needs associated with error-corrected quantum computing; instead, they will serve a more limited role focused on R&D, process stability and prototype validation.

The challenges and scope of quantum manufacturing have profound implications for equipment design, clean-room protocols, and overall investment priorities, which differ markedly from those of mainstream semiconductor production. While many methodologies used in deposition, lithography and etching remain relevant, **the specialised features required for quantum chips necessitate dedicated production lines**. Moreover, scaled-up quantum chips require new approaches to quality control, including **high-volume cryogenic characterisation**, which is not yet standardised or widely available.

[9] *https://thequantuminsider.com/2025/11/20/quantum-progress-demands-manufacturing-revolution-martinis-says/*

Establishing a **greenfield quantum foundry** is a complex and expensive undertaking, requiring major investment in infrastructure and tooling. Although wafer volumes for quantum chips are relatively small compared to traditional semiconductor production, they still represent a significant challenge for any new facility. In light of the upcoming **2028 Multiannual Financial Framework (MFF)**, early investment decisions are critical to ensure that quantum foundry capabilities are developed in time. In this context, **repurposing an existing foundry**—where feasible—offers a realistic and faster pathway, allowing process refinement and early product manufacturing without starting entirely from scratch.

In the long term, however, **large-scale dedicated quantum foundries** will be essential for achieving economies of scale, high utilisation rates, and competitive cost structures. A foundry-style approach in which production tools are shared by multiple start-ups within a dedicated clean-room facility can accelerate the fabrication of superconducting quantum processors, reduce contamination risks, and optimise tool utilisation. Such shared-infrastructure models can significantly strengthen Europe's capacity to industrialise quantum technologies under Pillar 3 of the Chips Act.

Policy Recommendations:

1. **Provide dedicated financial support to quantum computing companies to lower the barrier in making use of design and manufacturing services of semiconductor foundries and the stability pilot lines.**

2. **Prioritise the creation of dedicated quantum-manufacturing capacity in Europe, including repurposed foundries and shared cryogenic testing facilities, to secure sovereign industrial pathways for technology areas where conventional semiconductor infrastructures cannot provide**

3. **Ensure alignment and strategic coordination between stability pilot lines, existing semiconductor foundries, and industrial roadmaps, ensuring industrialization of dedicated quantum chip manufacturing processes and know-how.**

6. How: Strategic global partnerships (Pillar 4)

International collaboration has historically been a fundamental driver of technological progress. Global value chains, comparative advantage and specialisation have enabled economies and industries to thrive, with different regions developing expertise in specific technological domains. Europe's semiconductor and ICT landscape includes notable examples of successful global interdependencies, such as **ASML**, whose core markets are primarily outside the EU, or **ARM**, whose European-developed IP is largely manufactured abroad. These cases illustrate how international cooperation and open supply chains can create mutual benefit.

However, recent geopolitical developments have renewed concerns about **technological sovereignty**, highlighting risks related to loss of access to critical materials, manufacturing capacity, or strategic components. In this context, the **Chips Act 2.0** must carefully balance the benefits of global collaboration with the need to protect Europe from over-dependence. The optimal balance will differ across global partners, as geopolitical risk profiles are not uniform.

The original Chips Act recognised this principle for classical semiconductors, identifying certain non-EU countries—such as **Israel** and the **United Kingdom**—as trusted partners. Further diversification towards additional "like-minded" countries could strengthen Europe's technological capabilities while expanding the demand base for future European fabrication facilities.

In contrast, collaboration with non-EU partners in **quantum technologies** has been considerably more restricted. National security provisions have limited eligibility to entities that are both *located* and *ultimately controlled* within a narrow subset of Horizon-associated countries. These constraints can inadvertently hinder European companies from accessing rare or unique technologies emerging outside Europe, particularly in a rapidly evolving field such as quantum. Moreover, the "ultimate control" criterion may disincentivise foreign direct investment—even when it concerns companies from countries with deep security, defence and science cooperation with the EU.

While strong safeguards are appropriate in cases involving clear risks (e.g., concerns over state influence or IP leakage), a more **differentiated and risk-based approach** would better support industrial growth. We recommend reassessing these control mechanisms to enable deeper collaboration with trusted allied nations and to facilitate the participation of genuine European R&D centres that are part of non-EU companies but operate independently within the EU.

Strategic partnerships also extend beyond countries that are EU-associated. **Non-EU European countries**, including Switzerland, Norway or the UK (post-Brexit), remain essential scientific and industrial partners for Europe's quantum and semiconductor ecosystems. Ensuring that Chips Act actions are coherent with collaboration frameworks covering these countries would strengthen Europe's collective innovation environment.

A second dimension of global partnerships relates to **critical raw materials**. Worldwide demand for rare earths and other critical inputs has increased sharply, and processing is dominated by a small number of countries, particularly China. Processed materials are now being leveraged as tools of geopolitical influence. The EU's **Critical Raw Materials Act** and emerging "supply-chain clubs" aim to stabilise access to these materials. However, coordination with the specific needs of the **quantum chip industry** remains limited. Ensuring that the requirements of quantum hardware—especially superconducting circuits, specialised substrates, and cryogenic materials—are integrated into these discussions will be important for long-term resilience.

Finally, as Europe invests heavily in quantum pilot lines and future fabrication capacity, clarity will be needed on **access rules**, including:

- Access to pilot-line services (primarily for EU entities with IP generated in the EU and be kept in the EU), given the size of the public investment),
- Access to pilot-line *products* by non-EU entities (potentially via licensing, under appropriate conditions upon agreement by the consortia's members of each of the pilot line),
- Treatment of companies that undergo changes of ownership or control during multi-year projects,
- And conditions under which non-EU companies can participate in EU-funded programmes, potentially with caps (e.g., "no more than X% participation by non-European companies"), similar to practices in existing initiatives like EuroHPC.

As the geopolitical landscape evolves, the Chips Act 2.0 provides an opportunity to **rethink current and future strategic partnerships**, ensuring that the EU remains open, competitive and secure—while leveraging cooperation with trusted partners to strengthen its semiconductor and quantum capabilities.

Policy recommendations:

1. **Adopt a differentiated, risk-based framework for global partnerships, enabling deeper collaboration with trusted allied nations while safeguarding against high-risk dependencies.**
2. **Align Chips Act 2.0 with EU actions on critical raw materials, ensuring that the needs of quantum semiconductor supply chains are directly considered in future supply-stability agreements.**

7. Suggested actions/Policy option

1. **Make Quantum Chips a core pillar of Chips Act 2.0**, with increased funding for pilot lines, enabling technologies, and quantum-specific manufacturing and testing capacity.

2. **Support small-scale in-house prototyping facilities** that can accelerate **design iteration** and **IP retention**, while still enabling controlled access for scientific communities under appropriate agreements.

3. **Create flexible, industry-oriented funding instruments** to support design, prototyping, fabrication and testing of quantum-enabling integrated circuits leveraging existing semiconductor value chain to reinforce the robustness of the quantum supply chain.

4. **Adopt a risk-based international partnership framework**, enabling cooperation with trusted allies while ensuring security of critical materials and technologies.

5. **Support manufacturing and test infrastructure** for all quantum modalities, considering areas where Europe already shows early commercial traction.

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