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Making Europe a quantum industry powerhouse: a strategic EU roadmap for investment, talent and industrial scale

Executive summary

Quantum technologies promise to revolutionise Europe's economy and security. With quantum sensing, communications and computing set to play a foundational role in next-generation digital ecosystems, the potential contribution to the EU economy could reach €850 billion over the next 15-30 years.[1]

Yet, many quantum technologies are still in the early stages, requiring significant and sustained public and private investment to spur innovation, build industrial capacity and bridge the gap to real-world applications. Europe's efforts are fragmented across different EU programmes, national strategies and focus areas, risking inefficiencies and reduced competitiveness.

The upcoming EU Quantum Strategy must establish a coherent vision for the EU quantum ecosystem and take a coordinated approach across the supply chain – from basic research to commercial deployment – supporting strategic projects across the full technology stack. To stay ahead, Europe must invest at scale, close the talent gap, fast-track standards and build a truly frictionless Single Market for quantum ventures of all sizes.

For now, Europe's quantum ecosystem is driven by start-ups, with dozens of young innovative companies trying to establish themselves in different niches along the value chain and technology stack. To help them scale at home while preserving Europe's openness, the EU must:

- Avoid regulating the quantum ecosystem until technologies have matured and regulatory gaps can be clearly identified.
- Scale up public and private funding to boost demand for innovative quantum solutions.
- Bridge the quantum skills gap to meet the growing demand for talent.
- Foster industrial capacity to stay globally competitive and bring innovations to market.

[1] See *Mario Draghi, The future of European competitiveness – Part B: In-depth analysis and recommendations*.

Avoid regulating the quantum ecosystem too early

DIGITALEUROPE supports European efforts to streamline the governance of EU and Member State funding on quantum and set strategic priorities for technological development and deployment. However, many quantum technologies are still in their early stages. Regulating them now could freeze business models and hinder innovation before these technologies reach their full potential. To avoid stifling quantum innovation, the EU should:

- **Avoid regulating the quantum ecosystem too early.** The EU should be cautious about creating specific rules for the quantum sector and instead rely on existing horizontal laws at least until commercial use cases stabilise. Any future legislative initiative, such as a potential Quantum Act, must be preceded by a rigorous impact assessment and a structured, in-depth dialogue between policymakers and industry, with a particular focus on quantum start-ups and scale-ups.

- **Consider how upcoming legislation will impact incentive structures for the development and deployment of quantum technologies.** Relevant initiatives include the Advanced Materials Act, Space Act, Cloud and AI Development Act, AI gigafactories, revision of the European Chips Act, Union of Skills implementation, the Start-up and scale-up strategy, European Innovation Act, the 28th regime and future initiatives in defence. DIGITALEUROPE is active on all these initiatives.

- **Set concrete targets, deadlines and funding roadmaps for migrating sensitive communications and data to post-quantum cryptography**. To protect sensitive data and critical infrastructure from future quantum threats, governments must act now to initiate a coordinated transition to post-quantum cryptography. This includes setting clear goals, timelines and funding strategies for the public sector and critical sectors to be quantum safe. Cross-border coordination and alignment with international standards, such as those from NIST, are essential to ensure secure global communication and interoperability.

- **Deepen collaboration with like-minded partners.** Pursuing strategic autonomy must go hand in hand with deepening global partnerships that pool expertise and accelerate deployment of critical technologies. This means broadening existing R&I frameworks to bring together EU and trusted non-EU universities, labs and companies for joint development and validation of quantum technologies (i.e., by moving beyond the current limits set by the Digital Europe Programme to associated country collaboration). Dedicated funding windows for cross-border demonstration and validation projects and pre-commercial procurement would unlock new avenues for cooperation, demand creation and market uptake.

Scale up public and private funding

Europe risks losing the quantum race because investments are too small and too scattered. Between 2023 and 2024, private investments in quantum technology start-ups in the United States tripled while private investments in Europe declined by 40 per cent.[2] Australian quantum computing company PsiQuantum is in

[2] See Quantum Technologies Investment Report 2024, IOGS / Amires / Sonneberg Harrison conducted as part of EU-funded QU-Test & Qu-PILOT projects.

the process of raising $750 million, with Nvidia as one of the potential investors.[3] More generally, EU firms attract only 5 per cent of global private funding compared with 50 per cent attracted by US firms. Europe is also lagging in public investments. China has increased government spending in quantum research to at least €14 billion.[4] This represents more than double what the European Union has allocated so far.[5]

- **Create a favourable investment environment.** Introduce targeted incentives for the development and deployment of quantum technologies in Europe. This should include harmonised tax credits for investors and companies active in R&I, de-risking of private investment into the commercialisation of quantum technologies (e.g. first-loss guarantees to incentivise scaling up promising solutions) and better coordination of public funding (e.g. EIC Accelerator, TechEU programme) to crowd-in private capital for high-risk quantum ventures. It could also include Special Economic Zones or other tax freedoms resulting in super-deductions for quantum R&D, accelerated depreciation of quantum-related infrastructure and reduced tax rates for quantum infrastructure investments.

- **Unlock risk capital fast for innovative start-ups**. Encourage the EIB to lead investment rounds in quantum start-ups and enable the EIC Accelerator and Scale-up Budget to take bigger equity stakes in promising ventures. The EIC STEP Scale-Up budget is insufficient to compete with venture capital funding in the US and elsewhere. Align EIC STEP equity grants (€10-30m) with the EIB Scale-up scheme to offer blended finance for deep tech commercialisation. Accelerate funding decisions to match the speed of private venture capital – decisions need to be made within 3 months. Reserve funding envelopes for quantum hardware and applications.

- **Support public-private partnerships:** The EU should foster more strategic public-private partnerships in quantum by supporting national initiatives that align industry and public funding. A strong example is Denmark, where the Novo Nordisk Foundation committed €200 million over 12 years to build a general-purpose quantum computer in collaboration with the Niels Bohr Institute. This initiative helped establish Denmark as a host of NATO's DIANA Quantum Centre. Similar EU-backed efforts could accelerate innovation, deepen academic-industry links, and strengthen Europe's leadership in quantum technologies.

- **Provide a scalable and sustained public investment.** Launch strategic EU-level investments into a limited number of strategic quantum technology projects like quantum chip fabrication facilities, which face challenges attracting private capital due to the current low-throughput environment, or EU-wide procurement within protection of critical infrastructure, for example combined with AI for Cyber protection under the EU defence funding. Without scale of investment, EU-based innovations will be picked up outside EU. Companies need demand to scale up. For example, the EU should expand procurement of quantum computers and hybrid high-performance

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[3] See Matt Swayne, *NVIDIA Eyes Stake in PsiQuantum, Signaling a Strategic Shift Toward Quantum* (2025), Quantum Insider, available at NVIDIA Eyes Stake in PsiQuantum, Signaling a Strategic Shift Toward Quantum

[4] See Brad Smith, *Investing in American leadership in quantum technology: the next frontier in innovation - Microsoft On the Issues*, (2025) The Official Microsoft Blog, available at Investing in American leadership in quantum technology: the next frontier in innovation - Microsoft On the Issues

[5] See Mario Draghi, The future of European competitiveness – Part B: In-depth analysis and recommendations

computing via the EuroHPC joint undertaking to spur demand. Available EU and Member State funds should be channelled toward these high-impact projects and the interlinked downstream commercialisation of quantum applications, to maintain a strategic focus on key technologies, infrastructure and large-scale deployment. Additionally, earmark funding for lighthouse projects that combine quantum computing with other critical technologies like AI to identify synergies and accelerate industrial uptake.

- **Establish a unified EU procurement platform for critical technologies**, with mechanisms to de-risk and finance CAPEX-intensive innovation. The EIB's TechEU programme should play a central role – with the involvement of industry – in supporting scaled-up investments where private capital alone falls short. With EU budget talks (2028-2034) underway and TechEU funding in its design phase, 2025 is pivotal to shape the TechEU's €20 billion per year envelope and ensure a strong focus on quantum as a strategic technology.

Bridge the quantum skills gap

Europe leads in quantum research, with over 100,000 quantum-ready experts – the highest absolute number and density at 231 per million inhabitants.[6] Yet, talent shortages threaten to slow commercialisation of ideas. Demand for quantum experts already surpasses supply for interdisciplinary profiles that blend computer science, experimental physics, photonics, electronics and business acumen. At the EU level, this imbalance between the demand and availability of quantum talents is worsened by the outflow of talent to destinations with more and better employment opportunities.[7] As the quantum race accelerates, the gap will widen sharply. To secure a quantum-ready workforce, the EU must:

- **Scale interdisciplinary education.** Offer targeted funding for hands-on Master's and PhD programmes that pair quantum physics with chemistry, maths, AI, finance. Boost public-private partnerships to ensure students across these disciplines have early access to European quantum hardware and simulators. Map industry–university collaborations to identify critical gaps and align certifications with emerging needs across quantum and digital fields.

- **Launch rapid reskilling and upskilling schemes.** The upskilling and reskilling of professionals is of critical importance, as demand for ICT and STEM talents spans all industries. Use existing programmes like Erasmus+, Marie Skłodowska-Curie and Digital Europe to support short courses and fellowships that enable ICT and STEM professionals to pivot into quantum roles within one year. Research and Technology Organisations can act as training hubs, create synergies between industry and academia.

- **Attract and retain global talent.** Support Member States with introducing Critical Technology Visa that grant accelerated work permits across the Single Market. Harmonise and improve employee equity option schemes across Member States to attract and retain specialists in critical fields. Offer EU-level co-funding for industrial PhDs, post-docs and secondments and allow Horizon Europe projects to budget market-rate salaries to keep top researchers in Europe.

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[6] See Mario Draghi, The future of European competitiveness – Part B: In-depth analysis and recommendations

[7] See Mario Draghi, The future of European competitiveness – Part B: In-depth analysis and recommendations

- **Put forward a Council recommendation to certify two million ICT** specialists annually for the next five years and establish a coordinated tax deduction scheme for firms investing in certifying workers for critical technologies like quantum computing.

Foster industrial capacity

Europe's quantum ecosystem is still fragmented and Europe risks falling behind in hardware development. To stay competitive, the EU needs to move beyond primary research and focus on building manufacturing facilities and go-to-market applications. At the same time, the EU should integrate the current patchwork of national initiatives into a coherent Single Market for quantum. This means aligning rules, pooling funding and enabling cross-border procurement to enable scale-ups to grow seamlessly across the Union.

- **Streamline EU governance and strategic alignment.** Establish a high-level Quantum Coordination Board bringing together the Commission, Member States, industry and research organisations to set common investment priorities, track progress against KPIs measuring technological development and uptake and ensure that national strategies and funding instruments are consistent with – and complementary to – the EU Quantum Strategy. The Board should be empowered to set EU priorities and targets, select strategic cross-border projects and steer the allocation of EU and coordinated national funding accordingly.

- **Coordinate quantum plans across Member States.** Use EU funding to incentivise countries to specialise by focusing on research, design, software, evaluation and validation, fabrication, etc. and build on their respective strengths across quantum sensing, communication or computing. Avoid duplicating under-funded projects everywhere. Channel coordinated, EU-level grants towards shared European projects and production facilities.

- **Launch pan-EU quantum clusters to advance the industrialisation of quantum chip production.** Facilitate matchmaking to bring together research teams and integrators to allow commercialisation of quantum solutions. For example, incentivise semiconductor manufacturers and end-users (e.g. energy, aerospace, finance, healthcare companies) to accelerate co-investment into quantum ventures to accelerate industrial uptake and knowledge transfer. Supporting the integration of quantum technologies into the product portfolios of established market actors will generate demand and early anchor customers, helping nascent scale-ups to reach market readiness and bridge the critical funding gap between R&D and full-scale deployment.

- **Launch a procurement challenge to evaluate quantum computing applications and support their continued development**: Modelled on the US Defense Advanced Research Projects Agency Quantum Benchmarking Initiative (DARPA QBI), the EU should launch an initiative to expand public and private sector investments to fast-track the development of large-scale and industrially useful (fault tolerant) quantum computation systems.[8] Increase funding for government evaluation and validation programmes that are focused on identifying scientific breakthroughs and supporting their continued development, validate algorithms and hardware against common benchmarks and fund prototype testing and interoperability work.

[8] See DARPA Quantum Benchmarking Initiative

- **Stand-up an EU quantum chips joint undertaking.** Support first-of-a-kind projects to incentivise established semiconductor and equipment manufacturers to invest in quantum technologies. Coordinate funding, define benchmarks and align policies for fabrication capacity, system integration, Intellectual Property and go-to-market applications.

- **Boost uptake of quantum technologies for European defence and security.** Make full use of the European Armament Technological Roadmap to support the industrial deployment of quantum technologies. Co-design procurement priorities and better reflect operational needs and industrial potential across defence and dual-use markets via the new Strategic Dialogue with industry announced in the EU Defence White Paper.[9]

- **Link EU efforts with NATO's Innovation Fund (NIF) and Defence Innovation Accelerator for the North Atlantic (DIANA)** to incentivise deep tech innovation and stimulate early demand for quantum-enabled defence technologies like encryption, sensing and secure communications. These initiatives, together with the European Defence Agency's (EDA) Hub for EU Defence Innovation (HEDI) and its Capability Technology groups (CapTechs), serve as key instruments to prioritise, test and scale quantum technologies. By pooling resources with like-minded allies, the EU can help develop trusted, defence-grade supply chains for quantum applications, strengthen interoperability and accelerate the integration of quantum applications within a broader transatlantic innovation ecosystem.

- **Streamline dual-use export controls.** Enhance cooperation between the Commission, Member State authorities and industry on export controls for quantum technologies. Simplify export authorisations to allow frictionless collaboration with trusted partners, potentially modelled on the UK Export Control Joint Unit's open export general licence to cover exports of chip and quantum technologies to the EU and other allies like the US.[10]

- **Supporting quantum standardisation**: Boost skills training and financial support to advance standard-setting on quantum that is led by industry, including quantum start-ups and small and medium enterprises supported by EU-funded programmes as recommended by the Commission Multi-Stakeholder Platform Task Force Research & Innovation and standardisation. Provide companies, especially small and medium enterprises, with funding support to participate in quantum standardisation at international level as recommended by the High-Level Forum on Standardisation deep dive on funding.[11]

- **Preserve collaboration with the US and other key allies.** Engage the US and other key allies as strategic security and economic partners, including by coordinating export control lists and consult industry before adding restrictions so economic openness and European security advance together.

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[9] See European Commission White Paper on European Defence – Readiness 2030

[10] See UK Government Open general export licences (OGELs) - GOV.UK

[11] See European Commission's High-Level Forum (HLF) recommendations on increasing funding for standardisation activities at international level, available at https://ec.europa.eu/docsroom/documents/62954

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About DIGITALEUROPE

DIGITALEUROPE is the leading trade association representing digitally transforming industries in Europe. We stand for a regulatory environment that enables European businesses and citizens to prosper from digital technologies. We wish Europe to grow, attract and sustain the world's best digital talents and technology companies. Together with our members, we shape the industry policy positions on all relevant legislative matters and contribute to the development and implementation of relevant EU policies. Our membership represents over 45,000 businesses who operate and invest in Europe. It includes corporations which are global leaders in their field of activity, as well as national trade associations from across Europe.

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