IQBN

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Executive Summary

Quantum technologies are a strategic cornerstone for Germany's and Europe's technological competitiveness, sovereignty, and long-term value creation. With the High-Tech Agenda Germany (HTAD), the Federal Government provides an important strategic orientation that rightly identifies quantum computing, quantum communication, quantum sensing, and workforce development as priority areas. Germany benefits from strong research, a growing industrial ecosystem, and high future potential in quantum technologies. At the same time, international competition and geopolitical developments are intensifying rapidly. While Germany and Europe remain strong in research, momentum in industrialization is picking up speed globally, and Europe still lacks sufficiently coherent, application-driven strategies and large-scale initiatives to systematically bridge the gap from research to industrial deployment. Without decisive action to translate scientific excellence into scalable industrial solutions, resilient value chains, and globally competitive markets, there is a tangible risk that Germany and Europe fall behind at this critical phase. Experience from previous industrial transformations demonstrates that long-term technological leadership can only be sustained where research, application, and value creation are tightly interconnected. If a substantial share of the value creation generated by quantum technologies is not anchored within Germany and Europe, the consequences extend beyond immediate competitive disadvantages and structurally limit the ability to finance and shape future key technological developments through own resources and capabilities.

The German Quantum Industry, represented by QBN, welcomes the HTAD as an important strategic orientation and supports its overall direction. Rapid and effective implementation of the measures already outlined in the HTAD is considered essential to maintain momentum and international competitiveness. The recommendations and comments provided in this paper are intended to complement and inform subsequent measures and roadmap processes.
In this context, gaps in ambition, concreteness and execution readiness are identified. In particular, stronger application-driven roadmaps, clearer value-chain integration, improved coordination of initiatives, and more robust pathways from research to deployment and an industrial policy that strategically drives adoption and long-term value creation in Germany and Europe are needed to fully realize Germany's quantum potential and avoid fragmentation and loss of momentum.
On this basis, concrete recommendations emerge to strengthen and sharpen the HTAD, including application-focused flagship use cases, explicit support for enabling technologies and full value chains, agile funding and procurement mechanisms, and a broader, practice-oriented skills strategy. With coordinated governance, European alignment, and sustained investment, the HTAD can be a powerful lever to position Germany and Europe as globally competitive locations for quantum technologies. The German Quantum Industry and QBN stand ready to actively contribute to the upcoming roadmap processes and to strengthen implementation with expertise, infrastructure, and market insight.

Imprint

This position paper was developed based on the outcomes of the Meeting of the German Quantum Industry, convened and coordinated by QBN, on 1 December 2025 in Munich. It provides a consolidated industry assessment of the quantum chapter of the HTAD.

Authors

Amado Bautista, QUDORA Technologies
Markus Bendele, IQM Finland
Xenia Bogomolec, Quant-X Security & Coding
Anja Bräuning, eleQtron
Markus Buchberger, Novarion
Pascal Debus, Fraunhofer AISEC
Roland Degelmann, takatoa
Helmut Fedder, Single Quantum Germany
Michael Förg, Qlibri
Alexander Franz, Volkswagen
Haissam Hanafi, QBN
Hans Tholl, Diehl Defence
Jens Sokat, Hessen Trade & Invest
Imran Khan, KeeQuant
Milja Kalliosaari, IQM
Tim Kaumann, Ventum
Johannes Lang, Diatope
Mark Mattingley-Scott, Quantum Brilliance
Michael Marthaler, HQS Quantum Simulations
Jan Meijer, SaxonQ
Oliver Muth, Bundesdruckerei
Florian Otto, Attocube
Viola Paszkiewicz, Hightech Gründer Fonds
Benedikt Poggel, Fraunhofer IKS
Florentin Reiter, Fraunhofer IAF
Alexander Regnat, Kiutra
Anurag Saha Roy, Qruise
Stefan Schmid, ParityQC
Julius Selchow, Terra Quantum
Werner Seel, heqa
Nikola Strah, Classiq
Nicola Tyler, QuiX Quantum
Johannes Verst, QBN
Thomas Volz, Quandela
Jörg Weiser, Kvantify
Henning Weier, Quantum Space Systems

Industry Assessment of the HTAD Quantum Goals

The HTAD sets out to increase Germany's competitiveness, value creation and sovereignty through research and technology, and focuses initially on six key technologies, including quantum technologies. For quantum, the government defines four overarching goals for 2030.

To complement the qualitative discussion, an industry assessment was conducted on Germany's current position, future potential, and the perceived adequacy of the HTAD's quantum ambitions.

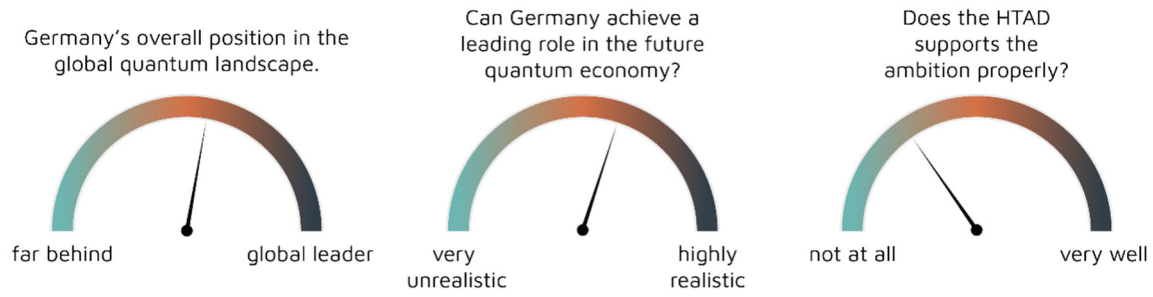

Figure 1: Consolidated industry perspective across key indicators.

The voting results indicate a broadly shared view within the industry: Germany is perceived as well positioned in the global quantum landscape, though not yet at the level of established global leaders. At the same time, there is a high level of confidence in Germany's ability to achieve a leading role in the future quantum economy. The assessment of the HTAD indicates that, while the agenda sets an important and positive direction, its current level of ambition and degree of concreteness are regarded as only partially sufficient to fully realize this potential.

Goal 1 – Quantum Computing

The ambition to realize error-corrected quantum computers at European top level, supported by pilot lines, test centres and application programs, is widely regarded as a strong foundation. At the same time, several concerns were raised:

- Ambition level and market perspective: A target framed around a fixed number of two fault-corrected quantum computers by 2030 risks falling short as a market and ecosystem vision. What ultimately matters for industrial scaling is the availability of useful, scalable quantum computing systems that address concrete application needs. To remain competitive globally, quantum hardware providers will need to deploy, operate and sell quantum systems and related services at meaningful scale, rather than focus on a small number of isolated flagship installations.
- Application focus: The current measures risk remaining technology-driven. Application-driven scaling to "utility-scale" quantum computers and demonstrable quantum advantage in utilization-oriented industrial use cases is as essential.

- Platform-specific roadmaps: Transparent, platform-specific roadmaps (e.g. for superconducting, trapped-ion, photonic and solid-state approaches), with clear milestones and a perspective on building European industrial champions would provide greater clarity than a purely generic competitive process. These roadmaps should also address the scalability of QC architectures, including pathways towards error-corrected quantum systems.
- Value chain perspective: Key enabling technologies such as control hardware, cryogenics, microelectronics, packaging and specialized software tools are not yet sufficiently reflected in the QC goal, although they are critical for sovereignty and competitiveness, and Germany has existing strengths in several parts of the quantum value chain that should be systematically built upon.

Overall, Goal 1 provides a suitable foundation but will benefit from greater precision, particularly with regard to value chains, application relevance and European industrial positioning.

Goal 2 – Quantum Sensing

Quantum sensing is widely recognized as a strategic field with significant potential across health, semiconductor manufacturing, mobility, security and space. However:

- Scope of applications: The current headline "detect diseases earlier" is too narrow and not fully representative to capture the broader range of potential sensing applications and to leverage their impact for pressing economic and societal challenges.
- Commercialization pathways: The transition from research to market remains insufficiently defined, especially due to missing strategies and funding instruments beyond R&D, as well as a lack of clarity on concrete products and services and on mechanisms that support early industrial adoption.
- Coverage of strategic domains: Several strategically relevant application areas are not explicitly addressed, including gravity cartography, navigation and timing (PNT), security-related sensing, and quantum instrumentation for semiconductor manufacturing, testing and advanced electronics

Goal 2 addresses an important area but would benefit from a broader, more application-oriented formulation that more clearly connects to Germany's industrial strengths.

Goal 3 – Quantum Communication

The ambition to develop long-range quantum communication and to embed it in national and European infrastructures in support of cybersecurity sets a clear strategic direction. At the same time, several aspects require further clarification:

- Definition of strategic objectives: The "Grand Challenge for Quantum Communication" and related measures need clearer objectives, scope and success criteria.

- End-user integration: Systematic involvement of operators, critical infrastructure providers, public-sector users and defence stakeholders remains limited, despite being essential for validating technologies and enabling deployment.
- Ecosystem coordination: The current landscape of initiatives and testbeds is fragmented; stronger coordination or consolidation can create added value by avoiding duplication, enabling meaningful comparison and competition between approaches, and fostering technological excellence so that the most capable solutions, including those from smaller players, can emerge and scale.
- Certification and standardization pathways: Clear and predictable pathways from research and development to certification and standardization are necessary to support market creation, particularly for QKD and quantum-safe communication infrastructures. Without timely and credible certification frameworks, there is a risk that externally certified systems set de facto market standards, to the detriment of domestic and European providers.

Goal 3 provides an appropriate strategic direction, but its current level of detail is not yet sufficient to support large-scale deployment.

Goal 4 – Skills and Talent

The quantum skills agenda forms a consistent element within HTAD's wider talent initiatives. At the same time:

- Breadth of talent profiles: Current measures focus predominantly on quantum experts and on academic-level training, while the industrialization of quantum technologies requires a broader talent base, including engineers, technicians, fabrication personnel, software developers and product managers alongside quantum specialists
- Practice-oriented training formats: Hands-on, use-case-driven training approaches remain limited, although they are essential for bridging the gap between technical development and industrial application.
- Entrepreneurial skills: Structured entrepreneurship education remains underrepresented, despite their importance for technology transfer and industrial uptake.

Goal 4 is essential but should be significantly expanded and made more practice-oriented to support industrialization.

Cross-Cutting Priorities and Recommendations

Across all four goals, several cross-cutting priorities and structural bottlenecks are identified.

Application-Driven Roadmaps and Flagship Use Cases

The industry strongly advocates starting from applications and use cases, not solely from technology platforms. This includes:

- Defining a small number of flagship use cases per domain (QC, QCom, QSens) with clear KPIs that focus on value creation rather than being symbolic.
- Aligning hardware, software, infrastructure and talent measures with these use cases.
- Designing the "1000 Qubits – 100 Applications" initiative as a focused program with depth and commercial relevance, systematically building on existing industrial expertise and solutions to generate demonstrable economic value, rather than restarting development in predominantly research-driven projects or becoming a broad collection of loosely connected demonstrations.

This approach allows better alignment with industry and end-user commercial roadmaps and the needs of key strategic sectors, including health, finance, decision preparation, manufacturing, mobility, defence and public services.

Value Chains and Enabling Technologies

To achieve technological sovereignty and competitiveness, Germany must develop full quantum value chains in close coordination with European partners. This requires:

- Explicit recognition and support for enabling technologies such as control electronics, cryogenics, chip fabrication and packaging, specialized optical components, software tools and system integration.
- Integration of value-chain and supply-chain aspects into HTAD measures and public procurement, including critical raw materials and specialised manufacturing capabilities.
- Particular attention should be given to sovereignty at the component level, especially for security-critical elements (e.g. FPGAs and similar components) used across quantum technologies. Strengthening European capabilities in these components is essential to reduce strategic dependencies and to ensure the integrity and trustworthiness of quantum systems and infrastructures.

Funding Models, Procurement and Capital

The HTAD already signals a shift towards milestone-based funding, new financing instruments and a stronger role for the state as anchor customer. In this context, several considerations arise:

- Calls and projects should be designed with clear milestones, but with reduced bureaucracy, simplified reporting and higher flexibility, especially for SMEs and start-ups (e.g. lump-sum schemes).

- Funding instruments should enable higher-TRL, contract-like projects that support product development, certification and early market deployment of quantum technologies.
- The state as well as the Bundeswehr should act as an early and demanding customer for quantum systems (QC, sensing, communication), including fast-track procurement processes and city-, region- or sector-scale pilots.
- Quantum technologies require substantial growth and scale-up capital. Dedicated funds, co-investment schemes and instruments that crowd in private and corporate investors are needed. Here, the state should create the right framework conditions to enable growth financing from private investors, such as pension funds. Incentives and the right framework conditions are more effective and sustainable than the state directly taking over private-sector tasks.
- In a high-risk, high-reward environment, public funding instruments could be complemented by equity-based approaches, allowing the state to take minority stakes in promising quantum ventures to support scaling and long-term value creation.

A coordinated mix of R&D funding, procurement and capital instruments is essential to bridge the gap from lab to market.

Technology Transfer and Start-ups

Despite strong research and significant public investments, Germany still faces a well-recognised transfer gap. In this context:

- Transfer instruments should support full-stack, co-design projects that include hardware, software, infrastructure, end-users and system integrators.
- Pilot lines and test centres should be systematically linked to industrial production environments and concrete customer use cases.
- Strengthening cross-ministerial collaboration to remove structural barriers arising from fragmented mandates, responsibilities, and decision-making authority.
- Opening additional transfer channels and integrating industrial end users into the transfer process through appropriate incentive mechanisms.

The goal should be to create clear, predictable commercialisation pathways for quantum start-ups and scale-ups in Germany and Europe, which are supported by end user industries.

Governance, Coordination and European Alignment

The quantum ecosystem is currently characterised by a growing number of programs, testbeds and initiatives at federal and regional levels. The HTAD rightly calls for better coordination between Bund and Länder and a systematic roadmap process for each technology.
To address these issues effectively, the following steps are relevant:

- Clear definition of Germany’s role within the European quantum ecosystem and a coherent strategy for European collaboration and division of roles

- Avoidance of duplication and competition between regions and ministries at the expense of effectiveness and critical mass.
- Providing transparency and orientation regarding legal and regulatory frameworks, in particular with respect to export controls, security requirements, and other regulatory provisions relevant to research, technology transfer, and market deployment.
- Quantum technologies encompass diverse sub-fields with distinct skill sets that are distributed across Germany. Governance and funding approaches should reflect this diversity.
- Consolidated or networked testbed structures in quantum communication and computing, with clear national governance and interfaces to EuroQCI, EuroHPC and other EU programmes.
- Structured involvement of industry associations and networks in roadmap governance and monitoring.

Skills, Talent and Industrial Readiness

Skills and talent are a decisive success factor in the global race for quantum. This points to the need to:

- Broaden the scope from academic quantum experts to include engineers, technicians, software developers, product managers and operators.
- Create practice-oriented training formats such as use-case labs, industrial internships, dual study programmes and hands-on workshops.
- Support the translation between physics, engineering and business language, enabling cross-functional teams in companies.
- Ensure long-term funding horizons and attractive career paths to attract and retain global talent in Germany.

Conclusion and Next Steps

The HTAD offers a unique opportunity to position Germany and Europe at the forefront of quantum technologies and to secure long-term competitiveness, sovereignty and domestic value creation.
The German quantum industry is ready to contribute actively to this endeavour. It offers:

- Deep technical, strategic and market expertise across quantum computing, quantum communication and quantum sensing, as well as across relevant enabling technologies along the value chains.
- A broad network of hardware and software vendors, providers, enabling technology companies, investors and end-users.

This position paper is offered as input for the HTAD roadmap process. As the next step, the Germany quantum industry and QBN stand ready to:

- Establish efficient structures for coordinating and implementing the next steps
- Participate in focused roadmap working groups for quantum technologies.
- Co-develop flagship use cases and KPIs with policymakers and funding agencies.
- Provide continuous feedback on the implementation of measures and the effectiveness of governance and funding instruments.

With clear, application-driven roadmaps, strong value chains, agile funding and a robust talent base, Germany and Europe can become globally competitive locations for quantum technologies, delivering both technological sovereignty and sustainable economic growth.

About QBN

QBN is the global industry network for quantum technologies promoting commercialization, collaboration and the trialogue between industry, science, and policy, and actively drives the industrial adoption and deployment of quantum technologies in Germany, Europe, and worldwide.

Founded in 2020, QBN, represents over 100 international members across the entire value chain, incl. world-leading startups, enterprises, RTOs, investors, and governmental organisations, developing and using quantum technologies, including quantum computing, quantum sensing, quantum communication, and quantum cybersecurity.

QBN builds the industrial quantum powerhouse, driving national security, technological sovereignty, economic growth and a sustainable future.

From Germany to Europe and worldwide - Together we build a resilient Quantum Economy!

Contact

Dipl.-Phys. Johannes Verst, CEO

Quantum Business Network UG
Fürkhofstr. 9, 81927 Munich, Germany
+49 89 9545 9079
contact@qbn.world
www.qbn.world