SHAPING THE FUTURE OF COMPUTE

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FROM FRAGMENTATION TO A UNIFIED NATIONAL STRATEGY FOR INNOVATION, SOVEREIGNTY AND GROWTH

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TOWARDS A NATIONAL VISION ON THE FUTURE OF COMPUTE

THE NEED FOR A NATIONAL VISION ON THE FUTURE OF COMPUTE

The digital transformation, with artificial intelligence as its most profound game changer, is on the verge of changing our world in profound and revolutionary ways. Across science, industry, healthcare and countless other domains, AI is reshaping how we innovate, work and live. At the same time, the rapidly growing energy consumption of data centres increases concerns about sustainability, and Europe's dependence on US-based big tech companies underscores the need to safeguard our sovereignty and public values.

The speed and scale of this transformation demand an entirely new generation of compute capability. We are entering a paradigm shift in which advanced semiconductor technologies, quantum computing, photonics, and neuromorphic systems form the backbone of tomorrow's digital economy. These emerging technologies promise unprecedented performance, energy efficiency, and scalability. Together they will define the competitive strength of nations.

The Netherlands excels in these technologies. Our academic base is strong and offers a solid foundation for innovation across the value chain. Initiatives such as QDNL, PhotonDelta, Neuromorphic Computing NL and AIC4NL already build powerful ecosystems, and the National Technology Strategy (NTS) (coordinated by KIA ST and KIA D) provides an overarching governmental framework in which concrete action agendas for semiconductors, quantum technologies, integrated photonics, AI and cyber have already been established.

Despite these strengths, opportunities remain unused, as efforts are fragmented and programmes often operate in silos. A more coherent approach to the Future of Compute can unlock additional potential, turn individual successes into national impact and position the Netherlands as a leading European player. This approach should consider the full value chain: from raw materials and critical inputs, to chip design and manufacturing, including cloud and data centre infrastructures, and the role of AI and GenAI applications. Hence this call to develop a coherent national vision on the Future of Compute.

COMPUTE AS THE ENGINE OF VALUE CREATION

Developing novel computing paradigms matters because they directly enable the AI applications that will define our growth and resilience. For example, in healthcare, AI pushed to the edge – into wearables and medical devices – will enable rapid, on-device decisions from physiological signals, increasing responsiveness while preserving privacy and reducing cost. In advanced packaging and semiconductors, AI-driven metrology, design automation and thermal management will lift yield, speed innovation and reduce the environmental footprint of production. In science and materials, hybrid compute will accelerate discovery cycles in chemistry, climate and biology by combining quantum simulation, photonic acceleration and AI-assisted reasoning. Expectations are high – and rising.

According to Draghi though, AI is not only a transformative application that boosts productivity across European industries. It is also a foundational technology that depends on strong computing, cloud and data-sharing infrastructure. To remain competitive, Europe must therefore invest not only in AI use cases but also in the underlying compute capabilities and digital ecosystems required to sustain them – while equally relying on the software and application layers that drive real-world impact. This is what the Future of Compute is all about.

DEFINING THE FUTURE OF COMPUTE

The Future of Compute represents a structural shift beyond traditional architectures. At the lower layers of the digital stack, it combines advanced semiconductors with quantum, photonic and neuromorphic computing in heterogeneous, hybrid systems. Each paradigm contributes where it is strongest – quantum for specific classes of simulation and optimisation, photonics for ultra-fast and low-power communication, and neuromorphic computing for efficient, event-driven perception and learning. All are tightly integrated with classical computing.

To make this concrete, these key technologies are considered core ingredients of the future compute layer:

- **Advanced semiconductors** are moving toward novel architectures and in-memory compute, delivering major performance and efficiency gains in the near term while anchoring Europe's industrial base.
- **Integrated photonics** uses light to move and process information with far lower power and higher bandwidth than electronics alone, unlocking faster on-chip and chip-to-chip interconnects that relieve scaling bottlenecks.
- **Quantum computing** promises order-of-magnitude speed-ups for specific problems and will integrate into applications over the coming decades as a complement to classical systems rather than a replacement.
- **Neuromorphic computing** takes inspiration from the brain to perform analogue, event-driven processing with extreme energy efficiency – crucial for edge intelligence, robotics, and on-device learning.
- **High-performance computing** leverages large-scale parallel processor clusters to provide the computational power required for data-intensive scientific and engineering workflows, forming a core pillar for simulation, modelling and AI training within increasingly hybrid compute environments

Within this future compute layer, future mobile and edge devices will play a significant role. It also requires all sorts of new interconnects and advanced chip-packaging solutions. Taken together, these developments mark the beginning of a new compute architecture that not only forms the foundation for future applications but also shapes the broader value chain – from research and development to design, manufacturing and real-live applications – in which the Netherlands can claim a strategic position.

A LEADING POSITION FOR THE NETHERLANDS?

The Netherlands holds a strong European position in areas such as international connectivity, data centres, integrated photonics, neuromorphic computing and quantum technology. With Brainport, it also has a solid semiconductor legacy. The Dutch innovation ecosystem benefits from a collaborative culture, reinforced by NGF programmes, while the NTS sharpens priorities and improves coherence across initiatives. Both frameworks support companies translating deep-tech innovations into real-world applications. Combined with a digitally savvy society, these strengths create favourable conditions for the Netherlands to take a leading role in shaping the future compute infrastructure.

Yet despite our exceptional strengths in semiconductors and deep-tech, fragmentation continues to dilute our overall impact. As explained, computing is not a

single technology but a stack of tightly coupled layers – from semiconductors and advanced packaging to photonics, neuromorphic and quantum hardware – all unified by HPC/cloud/edge resources and a common middleware frameworks layer. Within the NTS and our NGF programmes the building blocks of that stack are well covered. However, current landscape remains fragmented across programmes. This makes it impossible to deliver the scale and coordination required to connect the layers into one hybrid compute fabric with clear cross-stack priorities, cross-technology KPIs and a unified orchestration/software approach. A single, integrated vision and strategy on the Future of Compute is lacking.

To take a leading role in the compute revolution, a coherent national vision is indispensable. By successfully connecting programmes that currently operate in isolation and better aligning roadmaps such as those in the NTS and the various NGF programmes, the Netherlands can turn its technological capabilities into economic and knowledge competitiveness strength and secure strategic control points across European and global value chains.

OPPORTUNITIES FOR THE NETHERLANDS

Developing a national Future of Compute vision would unlock innovation across sectors like healthcare, science, energy and industry, while reducing dependence on foreign providers. It would also give companies in the valorisation phase a stronger springboard for their first market introductions by improving conditions for market access, validation, talent and growth capital – areas in which Future of Compute ventures consistently face structural barriers. This would accelerate near-term economic impact and strengthen the foundation for securing the Netherlands' long-term strategic position. Such a vision would help to explore where private capital, industrial procurement, and market mechanisms can take the lead, and to identify where and how national policies and public investments can support public-private collaboration.

In addition, a unifying vision would create a natural framework for deepening international cooperation, as illustrated by the recent Netherlands-UK "Future of Compute" mission, where compute is explicitly treated as a system of interacting layers. At the European level, a shared vision on the Future of Compute would help align with EuroHPC, the Chips Act and IPCEIs by translating Dutch strengths into interoperable components and common software standards.

If we act now, the Netherlands could become a European frontrunner within ten years, with strong positions in both technologies and applications, supported by cross-cutting pilot lines, test facilities and advanced infrastructure such as cleanrooms and datacentres. Recent analyses of our founder ecosystem, by Techleap and TNO, show a broad and rapidly maturing Future of Compute cohort across semiconductors, photonics, and quantum, with Dutch companies capturing a growing share of European investment – evidence that the ingredients for scale are present when we act coherently.

WHY WE MUST ACT NOW

Acting now is essential, as new compute technologies will underpin Europe's earning power and strategic autonomy for decades to come, while rising energy constraints and rapidly increasing AI-driven compute demand intensify the pressure to innovate. Without a coherent national strategy, the Netherlands risks falling behind as other nations invest at multi-billion-euro scale in sovereign, secure and sustainable compute infrastructure, limiting Dutch education, research and startups, missing EU-wide opportunities and ceding leadership. A unified vision that connects today's fragmented programmes and aligns roadmaps is therefore indispensable to convert capability into economic strength and secure Dutch control points in European and global value chains.

Momentum is already building: national developments around Draghi, Wennink and the NTS, combined with growing European cooperation – including with the United Kingdom – create a window of opportunity. The question therefore is no longer whether we should act, but how quickly we can bring existing coalitions together.

INVITATION TO DEVELOP A SHARED NATIONAL VISION ON THE FUTURE OF COMPUTE

The authors of this manifesto aim to develop a shared, coherent national vision on the Future of Compute and a strategy to turn that vision into action. Innovation is a system of inventions, and coordinated prioritisation is essential to allocate effort and resources effectively. Key questions include how to establish a shared impact

destination where different computing paradigms meaningfully converge; how long-term missions can better guide national technology programmes; what types of dialogues, forums and convening structures the Dutch ecosystem needs to strengthen cross-disciplinary exchange; and how we can establish a more unified approach across technological domains.

Jointly addressing these questions will help shape national computing capabilities for sectors such as AI, banking, e-commerce and agriculture. It will clarify Dutch strengths and control points, align programmes to overcome fragmentation, and clarify which emerging technologies deserve a place in the national strategy. It will also provide guidance for policymakers and industry on required infrastructure and potential course corrections.

This manifesto offers initial directions and serves as an open invitation for others to contribute their perspectives. The aim is not to create yet another agenda, but to unite existing ones through a shared vision on the Future of Compute – one that is co-shaped from the start by all relevant stakeholders. From this blueprint, new actions may emerge, while implementation remains embedded in existing ecosystems. In the process, we will build on the NTS and existing roadmaps such as those of AIC4NL, NC-NL, QDNL and PhotonDelta, while incorporating the recommendations of the Wennink report. We will also draw inspiration from DARPA and comparable European innovation programmes such as the European Innovation Council (EIC), EuroHPC, Germany's SPRIN-D, and the UK's ARIA, where rapid, high-risk innovation and integrated test-to-deployment pathways are central to securing strategic technological leadership.

OUR WAY FORWARD

With this document, Digital Holland, together with TNO, SURF, imec, InvestNL and Holland High Tech have taken the first step. We now aim to bring the Ministry of Economic Affairs on board as co-initiator and sponsor of the next phase. What follows is a nationwide co-creation process in which we jointly explore the opportunities that compute offers and translate them into a concrete action plan for the Netherlands and all stakeholders – companies large and small, existing programmes, universities, knowledge institutions and governments – while remaining open to new players that will emerge in this rapidly evolving field. In this process, the five initiating partners offer to play the role of orchestrator.

Our ambition is clear: to strengthen the Dutch and European position in the global compute ecosystem, accelerate innovation in AI and advanced computing, support a deep-tech sector that scales internationally, and build a sustainable, energy-efficient and strategically autonomous compute infrastructure as the foundation for our digital future. Now is the moment to unite the full breadth of the ecosystem and shape a future in which the Netherlands plays a leading role in the next era of compute. Let us build that future together – will you join us?

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< BACK TO TOP

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Publication date:	May 2026

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