

Written evidence submitted by the Department for Science, Innovation and Technology (LEC0030)

1. Can neuromorphic computing and silicon photonics provide a solution to the sustainability challenge of increasing AI-related energy demands? If so, how

1.1. In the near term, silicon photonics may help improve the energy efficiency of AI by reducing the energy required to transfer information between, within and around next generation computer chips – replacing electricity with light as the mechanism of sending data.

1.2. Just as fibre optic cables have increased the volume and decreased the energy costs of information we can transfer at pace between devices in our information networks, the integration of silicon photonics features, including lasers, detectors and waveguides, have the potential to improve the efficiency of internal processes taking place within and around processors, reducing the heat needed for cooling.

1.3. In particular, in the traditional design of chips used in the ‘inference’ stage of AI processing, this speed of transmission will look to reduce the impact of the ‘Von Neumann’ bottleneck – or time taken to transfer information between the memory and the processor during a computer process – by making this transfer faster.

1.4. Some high-end companies are already ‘packaging’ photonics components alongside silicon chips, and the next step will be to fully integrate the creation of these photonics components into the design and manufacturing of semiconductor processors, within a single wafer.

1.5. In the long term, photonics technologies (including on silicon) may also increasingly be used to drive ‘optical computing’ systems, using the physics of light to replace the traditionally electronic components in a computer chip. Whilst such approaches could be drastically faster and lower energy than traditional transistor-based devices, the technology faces hurdles ahead of practical computing use.

1.6. Rather than improving the transmission of information, neuromorphic computing looks to carrying out computing processes (including for artificial intelligence applications) through a radically different design of computer chip, mimicking neurons in a brain.

1.7. Neuromorphic computers, whilst in their infancy, can reduce the energy required for computation by both a) co-locating memory and processing together, reducing the time of transfer between them (removing the ‘Von Neumann bottleneck’) and b) only activating parts of the processor when needed (known as a ‘spike’), mimicking our brains’ neurons and synapses to reduce the constant amount of energy required across the chip for it to function.

1.8. Whilst neuromorphic computing techniques (in particular, components known as Spiking Neural Network accelerators) are already being considered for application in

low power devices, these devices have yet to be practically deployed at scale in technology products, and further work is required to improve neuromorphic applicable software.

1.9. In theory, photonics components could be integrated into future nanoelectronics devices alongside neuromorphic techniques, combining the energy efficiency gains of both technologies.

1.10. Looking ahead, the Department will be monitoring advances in energy efficient computing architectures as part of the Government's wider work to support sustainable AI deployment and progress towards the UK's Net Zero objectives, including through our Innovation and Knowledge Centres focused on these respective fields, the NeuroSYNC UK Multidisciplinary Centre for Neuromorphic Systems and Computing, and the Inference Scaling Lab run by the UK's Advanced Research and Invention Agency (ARIA).

2. What other opportunities does the combination of neuromorphic computing and silicon photonics create? How well placed is the UK to take advantage of these?

2.1 The energy efficiency benefits of neuromorphic computing and silicon photonics can be mutually implemented into the architecture of future AI hardware systems, and the semiconductor chips that underpin them.

2.2. In the near term - devices are being considered with neuromorphic designs that reduce the amount of energy required per process, alongside photonics components packaged alongside or integrated within the chip to reduce the energy required for information transmission taking place as part of these processes. In the longer term – proposals for photonics integrated circuits for optical computing are designed with neuromorphic techniques in mind, as an enabler for future neuromorphic technologies.

2.3. The UK is home to world-leading research in both technology areas, with universities underpinning strong 'innovation clusters' for photonics in Southampton, Glasgow, and Northern Ireland, and neuromorphic computing in UCL, Sheffield and Manchester. In each case – research being carried out is leading to an ecosystem of 'spinouts', aiming to mature and commercialise these technologies.

2.4. The UK is also investing in infrastructure that can provide 'testbeds' to help bring advances across these two technologies out of the lab and into the market, and embed them inside UK sovereign AI when doing so. This includes the ARIA Scaling Inference Lab, and commitments made through the AI action plan towards guaranteed procurement.

2.5 The Department will continue to work across government to ensure that emerging computing technologies can be translated into economic opportunity, supporting long term productivity growth and the Government's ambition set out through the Industrial Strategy, and Digital and Technologies Sector Plan.

3. Where does the UK sit in terms of the scientific research underpinning these developments? Who are our main competitors in the field?

3.1. The UK is home to world-leading research in both technology areas, with strong centres of excellence across the UK.

3.2. In silicon photonics, ‘innovation clusters’ have built up in Southampton, Glasgow, and Northern Ireland, with cutting edge programmes including the Cornerstone ‘rapid prototyping foundry’, an Innovation and Knowledge Centre, and the Centre for Heterogeneous Integrated MicroElectronic and Semiconductor Systems (CHIMES) helping researchers and companies to rapidly iterate novel techniques and designs.

3.3. The UK photonics sector already represents a significant economic asset. Analysis by the UK’s Photonics Leadership Group estimates that it generated **£18.5 billion in turnover in 2024**, contributing **£8.6 billion to UK GVA**, and supporting over **80,000 jobs** across advanced manufacturing and high value services.

3.4. In neuromorphic computing, ‘innovation clusters’ have built up in the Neuroware Innovation and Knowledge Centre at UCL, alongside Sheffield and Manchester, with platforms like the spiking neural network architecture (SpiNNaker) now able to emulate and test cutting edge neuromorphic computing techniques and simulate brain circuits in biological real time.

3.5. The UK sits in the top 5 states worldwide for publications and research impact in both silicon photonics and neuromorphic computing, with a strong research base and dynamic start-up ecosystem alongside Germany, China, the US and Singapore. However, other international partners are making rapid progress in commercialising these technologies, leveraging pilot lines and strengths in downstream manufacturing to help bring products through into end-use products.

3.6. As international competition intensifies, the Department will continue to engage with partners across the UK research and innovation system to maintain and build on the UK’s comparative strengths in strategically important computing technologies, including through the upcoming AI Hardware Plan scheduled for launch in June 2026.

4. To what extent has the UK developed sovereign capabilities in this area?

4.1. Through the Cornerstone Photonics Innovation and Knowledge Centre, based at Southampton in collaboration with the University of Glasgow, the UK has access to a sovereign capability providing consultancy and open foundry for prototyping or small batch manufacturing silicon photonics products on Silicon, SOI, SiN, and Ge-on-Si platforms. Through to 2030, UKRI has committed over **£23.7 million** towards silicon photonics research across the UK.

4.2. Through the Manchester based spiking neural network architecture (SpiNNaker) model, the UK has a unique sovereign capability for large-scale, flexible neuroscience modelling, in comparison to smaller scale or higher efficiency programmes run by

international and commercial competitors. Through to 2030, the UK has committed over **£18.8 million** towards research into neuromorphic computing across the UK.

4.3. These capabilities both support the Government's broader objective to strengthen UK technological sovereignty and resilience in critical digital and semiconductor technologies.

5. How well have the Innovation and Knowledge Centres and other research centres supported by public funds delivered? What objectives should future IKC activities and other government policy interventions seek to deliver?

5.1. The UK's Innovation and Knowledge Centres in these research fields have only recently become operational, and so it would be too early to appropriately assess their delivery. However, both the 'CORNERSTONE' Silicon Photonics Innovation and Knowledge Centre at the University of Southampton and 'NEUROWARE' Neuromorphic Computing Information and Knowledge Centre at UCL have made progress towards their intended objectives, relative to programme maturity.

5.1.1. The CORNERSTONE Innovation and Knowledge Centre provides an open access foundry to the UK silicon photonics community, allowing for students and researchers to train and develop novel techniques on cutting edge manufacturing tooling. The hub has helped to establish Southampton as a globally renowned hub for silicon photonics research, with a number of commercial spinouts.

5.1.2. The NEUROWARE Innovation and Knowledge Centre has helped researchers around the UK to explore the viability of different approaches to / applications for novel neuromorphic computing, including on traditional Complementary Metal Oxide Semiconductor (CMOS) chips and alternatives (including using photonic structures), alongside supporting proposals for commercial ventures.

5.2. The UK's Innovation and Knowledge Centres play a vital role as 'translation hubs' for cutting edge technology innovation, linking universities, industry and government together to help support R&D, prototyping, skills development and spin-out formation. Moving forward, Government will be looking how in each case our Innovation and Knowledge Centres can move these UK technology ecosystems to the next stage of technology readiness – supporting the downstream commercialisation and scale up.

5.3. Looking ahead, the Department will consider how its innovation infrastructure can continue to support commercialisation, skills development and scale-up, in line with the Government's growth mission and long-term industrial strategy.

20 May 2026