

Written evidence submitted by NeuroWare Innovation & Knowledge Centre, UCL (LEC0017)

Science, Innovation & Technology Committee: Call for Evidence on Low-energy computing

UCL's [Policy Impact Unit](#) provides professional policy engagement expertise across the Faculty of Engineering, collaborating with leading researchers to help incorporate evidence into the policy decisions.

The [NeuroWare](#) Innovation and Knowledge Centre (IKC) is a UK-wide initiative led by UCL in partnership with a consortium of leading UK institutions, bringing together researchers, industry partners, investors and policymakers. Inspired by the human brain, neuromorphic systems offer exceptional energy efficiency, real time processing and robustness, making them well suited to low power AI, edge devices and sustainable computing. NeuroWare accelerates the development, commercialisation and adoption of neuromorphic hardware, translating world class research into scalable technologies, competitive UK companies and real-world impact, while supporting a more efficient and secure UK AI ecosystem.

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

1. Neuromorphic, or brain-inspired, computing is an emerging technology that mimics how the human brain works to process AI and complex data at greater speed, security and efficiency, all while using only a fraction of the energy required by traditional computing. This technology presents a major opportunity to positively transform the way in which we operate as a society, by offering the UK an alternative pathway to scale AI capability without exponentially increasing energy consumption. As AI demand accelerates and Net Zero commitments cap overall energy use, neuromorphic computing can help bridge the gap by supporting sustainable data-centre growth, easing pressure on the energy system, and enabling the UK to meet rising AI needs responsibly.

2. The scale of the energy challenge is clear. Data centres are now consuming 6% of electricity in the UK and US, according to recent reports.¹ The rise of AI is accelerating the deployment of high-performance accelerated servers, leading to greater power density in data centres. On average, servers now account for around 60% of total data-centre electricity use, driven largely by AI workloads.² Beyond these energy challenges, the dominant von Neumann computing architecture³ – where data and programme instructions are stored in the same memory place – was built for predictable, batch-processed workloads, yet modern AI requires continuous, real-time inference that is vastly more energy-intensive. Neuromorphic computing offers a structural alternative.
3. Neuromorphic chips operate in a fundamentally different way to the silicon chips used in traditional computers. In the human brain, processing and memory functions are performed by neurons and synapses in a single location. Where conventional computer chips separate memory and processing – constantly transferring data between the two at significant energy cost – neuromorphic chips integrate these functions into a single stack, processing information where it is stored. This removes the need to transfer data between memory and processing units, which speeds up processing time and reduces the energy use involved.
4. It is important to be honest about neuromorphic computing's role within the broader compute landscape and how this will evolve over time. New computing paradigms, including neuromorphic, are unlikely to fully replace traditional computing in the near term, though they will transform large scale AI over a longer timescale. Instead, they will be increasingly integrated into hybrid systems, improving performance in specific, high-value applications.
5. An example of this potential in the near term can be seen with neuromorphic (or “event based”) cameras, which take inspiration from the human eye. Rather than capturing full images at fixed intervals, each pixel operates independently, registering only changes in movement or light. This enables highly efficient detection of motion and anomalies, particularly where changes are subtle or fast.^{4 5} These are explored more in the case study below.
6. As neuromorphic hardware matures, it has the potential to replace GPUs⁶ (graphics processing technology that has been repurposed to provide the parallel processing underpinning current AI systems) and significantly reduce energy use. It could also provide the hardware to enable far more efficient data centre infrastructure compared to current GPU- and TPU-based systems. Whilst data centres will remain essential, they are likely to become substantially more sustainable – but only if these technologies receive the support needed to develop, and if we act now to harness these advances. **The long-term gains**

¹ Booth, R. [Datacentres using 6% of electricity supply in UK and US, research says](#) *The Guardian* (2016).

² IEA. [Energy and AI](#). *The International Energy Agency* (2025).

³ S, H. [The Basic Structure of Computer Systems: Von Neumann Architecture](#) *Medium* (2025).

⁴ Cohen, G. *et al.* Event-based Sensing for Space Situational Awareness. *The Journal of the Astronautical Sciences* 2018 66:2 **66**, 125–141 (2019).

⁵ Ralph, N. *et al.* Real-Time Event-Based Unsupervised Feature Consolidation and Tracking for Space Situational Awareness. *Frontiers in Neuroscience*. **16**, 821157 (2022).

⁶ [What Is a GPU? Graphics Processing Units Defined](#) *Intel*.

from neuromorphic computing are only achievable if investment happens now – the countries that act early stand to benefit the most.

Case study: Neuromorphic event cameras

One real-world application of these cameras is in defence, with the detection of drones. Small drones, like quadcopters, are hard to detect reliably: they move quickly, are physically small, can be confused with other flying objects and can appear against bright sky or cluttered backgrounds. Neuromorphic event cameras can detect quadcopters by directly picking up the characteristic frequency of their rotating blades – a signal rare enough in natural environments to make false positives highly unlikely. Recent research shows that the same lightweight computation can not only signal that a drone is present but also localise it within the camera's field of view. A complementary system, combining event cameras with spiking neural networks on a neuromorphic chip, creates a "virtual tripwire" in restricted zones. As well as a difference in how they detect drones, conventional cameras and vision systems struggle to run continuously at high speed in remote or contested areas without substantial power and compute infrastructure. But systems which use neuromorphic computing can deliver drone detection that is several orders of magnitude more energy-efficient than an equivalent edge-GPU solution, and capable of operating for over a year on battery power alone.

These approaches point toward compact, low-power, always-on drone-detection systems that can be scattered around critical infrastructure or deployed in locations with minimal power or networking, while maintaining high robustness and low false-alarm rates. For defence, Counter-Unmanned Aircraft Systems policy, civil aviation safety, and the protection of sensitive sites, neuromorphic sensing represents a deployable near-term capability where conventional sensors would be too power-hungry, too infrastructure-heavy, or too unreliable.

What other opportunities does the combination of neuromorphic computing and silicon photonics create?

7. Neuromorphic technology sits at the intersection of three priority areas: energy-efficient AI, semiconductor capability and sovereign compute infrastructure. In doing so, it occupies a distinct position within the government's "tech as a growth driver" strategy.⁷ The **global neuromorphic computing market is forecast to grow from \$5.3 billion in 2023 to \$20 billion by 2030**,⁸ reflecting the rising demand for low-power, real-time AI systems across sectors including next-gen semiconductors, and autonomous systems such as robotics, drones and autonomous vehicles. **By positioning itself at the forefront of this technology, the UK would be well placed to benefit from this market growth.**

⁷ Dept. for Business & Trade. [Digital and Technologies Sector Plan \(2025\)](#).

⁸ Grand View Research. [Neuromorphic Computing Market | Industry Report 2030](#) n.d.

8. Beyond energy efficiency, neuromorphic computing opens new possibilities because of its architectural properties. Its unique design enables new kinds of applications, which offers significant advantages over conventional computing, particularly in the near-medium term.
- **Edge intelligence and low-latency processing:** neuromorphic chips enable power-efficient edge computing, allowing for information to remain on local devices – such as wearables, smart cameras, medical sensors and autonomous vehicles – rather than being transmitted to the cloud. Sending data to the cloud creates delay because it must travel long distances, be processed remotely, and then returned. By keeping computation local, neuromorphic edge devices can react almost instantly, reducing latency – the time it takes for data to travel across a network – by 2x-10x compared to cloud-based computing.⁹ The lower the latency, the better the productivity and user experience.¹⁰ In autonomous vehicles, this translates directly into improved navigational skills, quicker course correction and more reliable collision avoidance while lowering energy emissions.¹¹
 - **Secure and resilient AI:** by analysing sensitive data locally, neuromorphic systems lower the risk of interception and minimise reliance on centralised cloud infrastructure that represents a single point of failure. It also means a reduced reliance on one company's product, where any potential outages¹² could cause significant delays worldwide, including for UK government departments, and pose a threat to critical national infrastructure.
 - **Continuous, smart sensing:** the event-driven nature of neuromorphic processing – reacting to change rather than processing at fixed intervals – makes it highly efficient for persistent monitoring applications. Event-driven computation reduces the average power consumption of these applications (for example, Space Domain Awareness on satellites) by 100-1000x because processing occurs only when signals exceed detection thresholds. During quiet periods, neuromorphic chips consume microwatts of energy compared to watts for conventional processors.¹³
9. **The sectors that stand to benefit most in the near-to-medium term include defence and national security, healthcare and medical devices, advanced manufacturing and robotics, communications infrastructure, and financial services – each of which has significant UK industrial presence and strategic importance.**¹⁴

How well placed is the UK to take advantage of these? Where does the UK sit in terms of the scientific research underpinning these

⁹ Gdali, Z. [Edge Computing vs Cloud: Latency Impact](#) *firecell* (2026).

¹⁰ Goodwin, M. [What Is Latency?](#) *IBM*.

¹¹ Caballar, R. D. & Stryker, C. [What Is Neuromorphic Computing?](#) *IBM*.

¹² Kleinman, Z. [What caused the AWS outage - and why did it make the internet fall apart?](#) *BBC News* (2025).

¹³ Wang, Z. *et al.* NeuroREC: A 28-nm Efficient Neuromorphic Processor for Radar Emitter Classification. *IEEE Transactions on Circuits and Systems I: Regular Papers* **71**, 6215–6228 (2024).

¹⁴ Dept. for Business & Trade. [The UK's Modern Industrial Strategy](#) (2025).

developments? Who are our main competitors in the field? To what extent has the UK developed sovereign capabilities in this area?

10. The UK is well placed to take advantage of neuromorphic computing but realising that potential requires an honest assessment of both its strengths and its limitations. The UK holds a strong research position but faces intense competition from the United States and China, who are investing at a scale the UK cannot currently match. Closer to home, European partners are also accelerating their own neuromorphic programmes, presenting both a competitive challenge and a collaborative opportunity. To maintain sovereignty and secure its place as a vital partner within the global neuromorphic supply chain, the UK must address three key priorities: building a robust skills pipeline, tackling longstanding industrialisation challenges, and maximising the current commercialisation window now.
11. **The UK has a world-class academic research base, ranking first globally for research impact,¹⁵ with leading capabilities in large-scale neural computing systems** and algorithmic development for AI-optimised hardware. This is not a recent development: a 2021 review by eFutures,¹⁶ which convened international experts to evaluate the UK's capabilities in brain-inspired computing, concluded that the UK possess significant strengths in this space, but realising this potential requires a coordinated national effort. That coordination is now underway. The Initiatives including NeuroWare,¹⁷ NeuroSYNC,¹⁸ and NeuMat¹⁹, together form a connected national capability spanning hardware design, algorithms, materials science, and systems integration. These are areas where UK institutions and companies are already operating at or near the global frontier, and where focused investment could translate research leadership into durable industrial advantage.
12. A clear example of this is SpiNNaker,²⁰ the Spiking Neural Network Architecture developed at the University of Manchester, and one of the world's most significant neuromorphic computing platforms. This represents a globally recognised UK capability. Other examples include Optera,²¹ a spin out company from Western Sydney University, which is now headquartered in Newcastle, UK and has ongoing research contracts with the University of Manchester to further their work. Optera is developing Space Domain Awareness systems products to the UK Ministry of Defence: the first two have been delivered to a defence site in the UK and a third is being built.
13. Neuromorphic computing is inherently multidisciplinary, requiring expertise that spans neuroscience, materials science, chip design, algorithm development, and domain-specific application knowledge across sectors including defence, healthcare, and advanced

¹⁵ Government Office for Science. [RTA: Future Computing](#) (2025).

¹⁶ Indiveri, G. & Najjar, W. [The UK Landscape in Artificial Intelligence and Brain-Inspired Computing Hardware eFutures](#) (2020).

¹⁷ [UCL to lead UK's brain-inspired computing push with new innovation centre UCL News](#) (2025).

¹⁸ [NeuroSYNC - UK Multidisciplinary Centre for Neuromorphic Computing](#).

¹⁹ [Neumat](#).

²⁰ [SpiNNaker](#). *The University of Manchester*.

²¹ [Optera | Neuromorphic Solutions for Real-World Problems](#) (2025).

manufacturing. Therefore, **a skilled and multidisciplinary workforce is essential to the UK's long-term success** in neuromorphic technologies both from a research perspective and progressing into industry.

14. NeuroWare has initiated coordinated engagements and activities to identify current skills gaps and future workforce requirements, including industry-focused skills workshops, policy roundtables, and early planning for doctoral training partnerships and industry-funded PhDs. Early feedback from our roundtables identified the following areas for improvement:

- Ongoing market analysis and the creation of a solid business case for neuromorphic skills and workforce needs.
- Updates to the education curriculum from primary school through to higher education. This means involving teachers, parents and utilising already established programmes to further attract home-grown talent.
- The need for multidisciplinary training centres that bring together different strands of neuromorphic technologies.

15. NeuroWare's work to establish a coherent, end-to-end talent pipeline – from technical specialists to future leaders – is now underway, with impact expected to scale over time. **These are important first steps, but they need to be matched by government commitment to sustained funding for Centres for Doctoral Training specifically oriented toward neuromorphic and low-energy computing.**

16. The case for Centres for Doctoral Training in this space is strong: the technology is multidisciplinary by nature, the skills gap is already visible, and the lead time for doctoral training means that action taken now will determine the workforce available at the point of peak commercial demand. The government should ensure neuromorphic computing is named explicitly alongside quantum and photonics as a priority area for skills investment.

17. **The UK government has recognised the vital role neuromorphic systems will play in future computing**, and this marks an important step forward.²² This is most evident through the work being done to establish the UK's global standing through foundational research and targeted international partnerships. For example, the UK-Netherlands Innovation Partnership,²³ which identifies AI and computing as priority areas, offers a promising bilateral platform for collaboration.

18. **The UK's performance weakens significantly as research moves along the innovation pipeline**, in areas that translate into economic value such as intellectual property, private investment, and exports.²⁴ This is a well-recognised structural challenge, but carries particular urgency in neuromorphic computing, where the commercialisation

²² DSIT. [UK Compute Roadmap](#) (2025).

²³ [UK-Netherlands Innovation Partnership - GOV.UK Dept. for Science, Innovation & Technology](#) (2025).

²⁴ Government Office for Science. [RTA: Future Computing](#) (2025).

window is open now and global competition is intensifying.²⁵ **Targeted, coordinated intervention – across academia, industry, and government – is needed to retain and build on these strengths, and to prevent promising UK firms from relocating overseas to access the investment, manufacturing infrastructure, and talent needed to scale.**

19. Looking at the international research and innovation landscape, **the United States and China are the clear global leaders**,²⁶ operating at a much higher level than the UK, with substantially greater investment in research and development. In the US, the Defence Advanced Research Projects Agency (DARPA) has invested over \$1.1 billion in brain-inspired computing research between 2022 and 2025.²⁷ This is backed by the CHIPS Act, which offers further funding for major tech companies like Intel, who recently built Hala Point, the world's largest neuromorphic system.²⁸ ²⁹ China has also made neuromorphic computing a national priority, with state-backed investment spanning the full stack from chip fabrication to application deployment.³⁰
20. Across Europe, countries are moving quickly to establish their own footing in this space. For example, The Netherlands recently announced a new €30m initiative to build a national neuromorphic ecosystem, which includes a €9m grant from the Dutch Research Council.³¹ Germany,³² France,³³ and Switzerland³⁴ are similarly investing in brain-inspired computing as part of broader AI strategies. This is important because it shows the global landscape is growing and evolving rapidly, making it crucial for the UK to take the necessary steps to capitalise on this momentum.
21. Whilst the UK cannot match some of these international levels of investment right now, the UK does not need to compete across the entire value chain to build strategic advantage. We need to be realistic about what is achievable and focus on where we have the greatest expertise and continue to grow in these areas. To achieve sovereign capability, this means identifying where the UK has clear strengths and becoming the best at a small number of critical elements that other countries depend on. For example, ASML in The Netherlands is the world's leading supplier of high-end lithography tools for the semiconductor industry,

²⁵ [Global Neuromorphic Computing & Sensing Market 2026-2036](#) *Globe Newswire* (2026).

²⁶ Grand View Research. [Neuromorphic Computing Market Size | Industry Report 2030](#) n.d.

²⁷ Sharma, R. [Neuromorphic Computing for Defense Market Research Report 2034](#) (2026).

²⁸ Intel, Biden-Harris Administration Finalize \$7.86 Billion Funding Award Under US CHIPS Act *Intel Newsroom* (2024).

²⁹ Intel Builds World's Largest Neuromorphic System to Enable More Sustainable AI *Intel* (2024).

³⁰ [World's first 2-billion-neuron brain-inspired computer unveiled by ZJU](#) *Zhejiang University* (2025).

³¹ [€9M NWO grant positions the Netherlands to lead next-generation brain-inspired computing](#) *University of Groningen* (2026).

³² Jedikovska, G. Brain-inspired neuromorphic computer uses tiny LEDs to cut AI energy use *Interesting Engineering* (2026).

³³ [EBRAINS makes bid to enter the European Research Infrastructure Roadmap with ten-country strong coalition and France as Lead Country](#) *Human Brain Project* (2020).

³⁴ Meldem, A. [Swiss AI Enters a New Era: The Rise of Digital Brains](#) *Deep Tech Nation Switzerland* (2025).

creating a monopoly on a critical need.³⁵ **The ambition should be for the UK to be a producer and shaper of neuromorphic computing, not merely a customer of it.**

22. This means also focusing on areas where the UK risks losing ground it currently holds. For example, the SpiNNaker 2 neuromorphic supercomputer – the successor to the SpiNNaker system developed here in the UK – is now being developed at TU Dresden in Germany, due to additional funding from the state government in Dresden.³⁶ Whilst the University of Manchester is still involved, it is now a minor partner. SpiNNaker 2 is also being commercialised through SpiNNcloud Systems, which is also based in Dresden.³⁷ **The risk here is that UK flagship capabilities of this kind end up moving overseas. This should be treated as a policy priority, with the necessary government intervention to prevent similar cases in the future.**
23. **The UK currently has the research foundation and early industrial base to be a global leader in neuromorphic computing. The decisions made now, on research investment, supply chains, and talent pipelines, will define the neuromorphic computing sector for decades to come** and will be vital to ensuring we build and maintain sovereignty. The sector needs to see a coordinated commitment from the UK government to build on the country's existing strengths and convert our strong research foundation into lasting economic and strategic advantage.

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

24. **Since its launch in January 2026, the NeuroWare Innovation and Knowledge Centre (IKC) has made rapid and tangible progress against its initial objectives, establishing clear momentum as a national focus for neuromorphic technologies.** While still in its initial phase, the IKC is already delivering concrete national value: shared research infrastructure, active industry co-creation with major UK and international firms, policy leadership and strengthened international access to fabrication, insight and expertise.
25. NeuroWare is actively establishing a distributed national facility for neuromorphic technologies, hosted at Cambridge, Imperial, Manchester and UCL. Investments include new neuromorphic computing platforms, custom vision sensors, advanced probe stations and high-end micro-packaging equipment. Together, these facilities address long-standing bottlenecks in device testing, packaging and benchmarking, and are being made accessible to academic and industrial users alike. This shared infrastructure is already enabling the UK to accelerate the journey from university laboratory to deployable technology – including through cross-partner collaborations such as a joint Sheffield and UCL project developing technology with the potential to reduce the power consumption of

³⁵ [ASML | The world's supplier to the semiconductor industry.](#)

³⁶ [SpiNNaker 2 - University of Dresden. Open Neuromorphic.](#)

³⁷ [Brain-Tech in action: German Spinncloud computing startup secures funding of 10 million Euro EBRAINS \(2025\).](#)

renewable generation control systems, including those used in PV farms, by 25%. Further technologies are currently under development.

26. Building on this infrastructure, **NeuroWare has quickly established itself as a national convener for the UK neuromorphic community.** Through co-hosted national meetings and workshops, it has brought together researchers, industry, investors, catapults, policymakers, funders, regulators and technology trade associations, strengthening connectivity across the ecosystem. Strategic collaboration with EPSRC-funded initiatives NeuroSYNC and NeuMat has been reinforced through joint activities designed to amplify collective impact. In parallel, NeuroWare is working with the UK Semiconductor Centre and the three other semiconductor-focused IKCs (CHIMES,³⁸ Cornerstone³⁹ and RE-WIRE⁴⁰) to improve integration across the UK capability base, leading to a better-coordinated national offer to government, industry and international partners for future engagement.
27. This convening role is already producing tangible industry traction. NeuroWare has held substantive discussions with over 20 organisations, spanning UK SMEs, major industrial players, regulators and venture capital representatives. **These discussions are shaping a co-created research and innovation programme aligned to national semiconductor priorities, with partners committing expertise, time and doctoral funding** – totalling £12 million in support to date. A clear focus on defence and security applications has emerged, with partners including Northrop Grumman, Leonardo and QinetiQ already engaged. This early industry commitment reflects both the credibility of the IKC model and the strategic relevance of neuromorphic computing to sectors with immediate operational requirements.
28. The commercial pipeline is also developing. Clear pathways to commercialisation are being strengthened through active engagement with venture capital networks, UKRI's pre-accelerator programme (ICURe) and UCL's technology transfer office (UCLB). These relationships are directly informing the design of structured support for high-potential spinouts and start-ups, ensuring that emerging companies benefit from early commercial insight alongside technical excellence. Retaining that value within the UK ecosystem is both an economic and a strategic imperative.
29. **Looking ahead, NeuroWare is providing early leadership by developing a national neuromorphic roadmap to 2050,** due to be published in the summer of 2026. Drawing on a series of cross-sector roundtables and supported by a dedicated research fellow, this roadmap will set out the key actions that policymakers, industry and the wider community need to take to ensure the UK becomes a global leader in safe, sustainable and accessible brain-inspired computing. Designed for a broad, non-expert audience, it will identify the changes needed to drive growth across the sector and realise the benefits of neuromorphic technology to transform everyday lives.
30. International engagement has scaled quickly, with strategically significant partnerships now in place across Europe, North America and Australia:

³⁸ [University of Sheffield to lead £16.7m national centre for next-generation semiconductor systems](#) *The University of Sheffield* (2026).

³⁹ [CORNERSTONE | Silicon photonics foundry service.](#)

⁴⁰ [REWIRE | Transforming Net Zero with Next Generation Power Semiconductors.](#)

- In Europe, NeuroWare has formalised a relationship with the CogniGron Centre at the University of Groningen in The Netherlands,⁴¹ through reciprocal advisory roles, providing the UK with valuable insight into translating fundamental research into demonstrators and start-ups. Complementary engagement with the Embassy of The Netherlands has strengthened connections with the wider Dutch neuromorphic ecosystem, supporting alignment with European research and policy priorities.
- Partnership development with the Tyndall National Institute⁴² in Ireland has focused on advanced technology platforms for next-generation neuromorphic devices, with the purpose of unlocking UK access to state-of-the-art fabrication capabilities that do not currently exist at scale in the UK. By securing trusted access to world-class fabrication through allied partners, the UK reduces its dependence on non-allied supply chains for a technology it has identified as strategically critical.
- Beyond Europe, NeuroWare is part of CANUTE (Canada-UK NetworkPlus in Semiconductor Research),⁴³ a £1.125 million 3-year partnership designed to foster collaboration, innovation and talent development within the semiconductor sectors of the United Kingdom and Canada. NeuroWare secured this partnership through coordinated effort with the three other semiconductor IKCs – demonstrating the value of cross-IKC collaboration as a model for future international engagement. This partnership positions UK researchers and companies within the North American semiconductor networks, strengthening the UK's position in global supply chains – which is particularly key at a time when geopolitics is reshaping the semiconductor landscape.⁴⁴
- Furthermore, new links have been established in Australia with Macquarie University's Minds and Intelligences Initiative,⁴⁵ connecting neuroethology and computer neuroscience communities and laying firm foundations for joint workshops and future collaboration.

31. Taken together, the IKC has been effective in building the national coordination, international access, and underpinning the translation of research into early commercial activity. The next phase should build on this success by shifting the centre of gravity toward commercialisation and the development of sovereign capability.

14 May 2026

⁴¹ [CogniGron | University of Groningen](#).

⁴² [Tyndall National Institute](#).

⁴³ [Canada-UK NetworkPlus in semiconductor research UKRI](#).

⁴⁴ Gankar, S. [The great decoupling: how geopolitics is reshaping semiconductor supply chains](#) *Omdia* (2025).

⁴⁵ [Minds and Intelligences](#) *Macquarie University*.