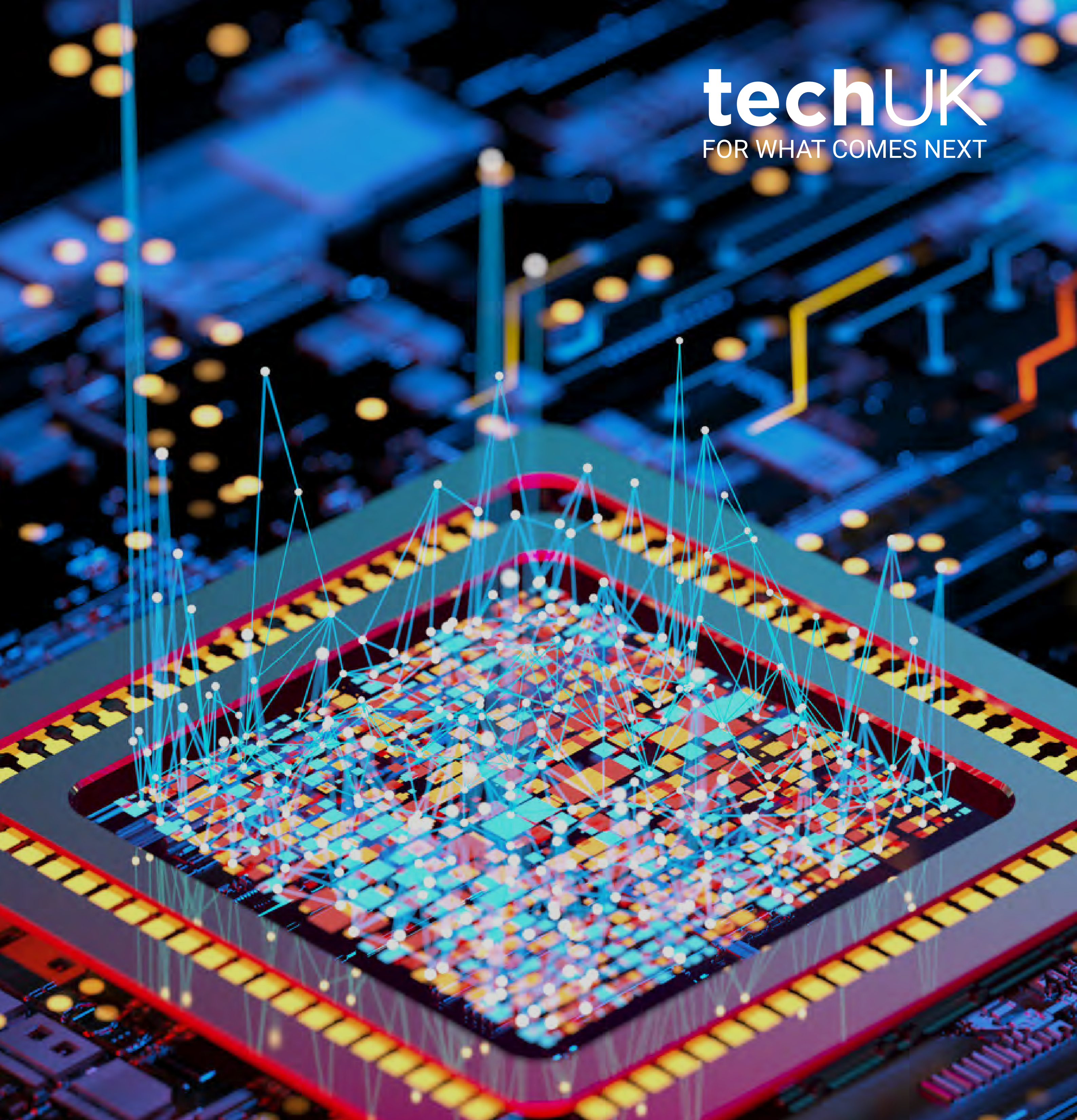


UK Plan for Chips
A new techUK blueprint

February 2025

Contents

Introduction

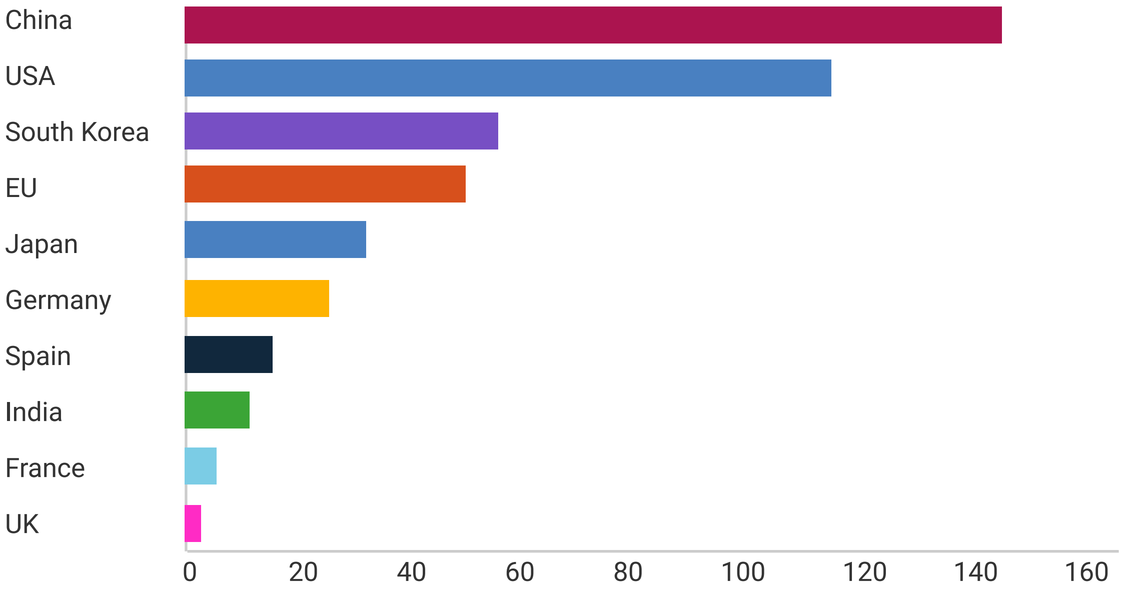
Semiconductors, also known as 'chips,' are present in almost every device we use: from day-to-day consumer electronics, vehicles, defence, healthcare, to the data centres powering AI. Virtually every piece of digital technology is built upon a bedrock of semiconductors. It is understandable, then, why the semiconductor market is predicted to be worth at least $1 trillion by 2030.[1]

Alongside their foundational role in the modern economy, semiconductors are also part of a global supply chain that has significant susceptibility to external shocks: the semiconductor supply shortage in 2020 was estimated to have reduced global GDP growth by 1%.[2] Alongside economic insecurity, supply chain disruption can also threaten critical national infrastructure, such as power and transport networks, making the semiconductor supply chain essential to UK resillience. As such, semiconductor capabilities have assumed critical importance for many governments.

The mix of vulnerability, necessity, and economic promise presented by semiconductors has led to other governments, such as in the United States, the European Union and China, announcing significant investment into their domestic semiconductor sectors. For example, the European Chips Act announced €43 billion to support semiconductor infrastructure, skills, startups and more across Europe.[3] In November 2024, the European Commission's Executive Vice-President for Tech Sovereignty, Security and Democracy, underscored this commitment to semiconductors by recognising their role as a key technology to securing Europe's future, alongside AI, cloud, quantum and space.[4]

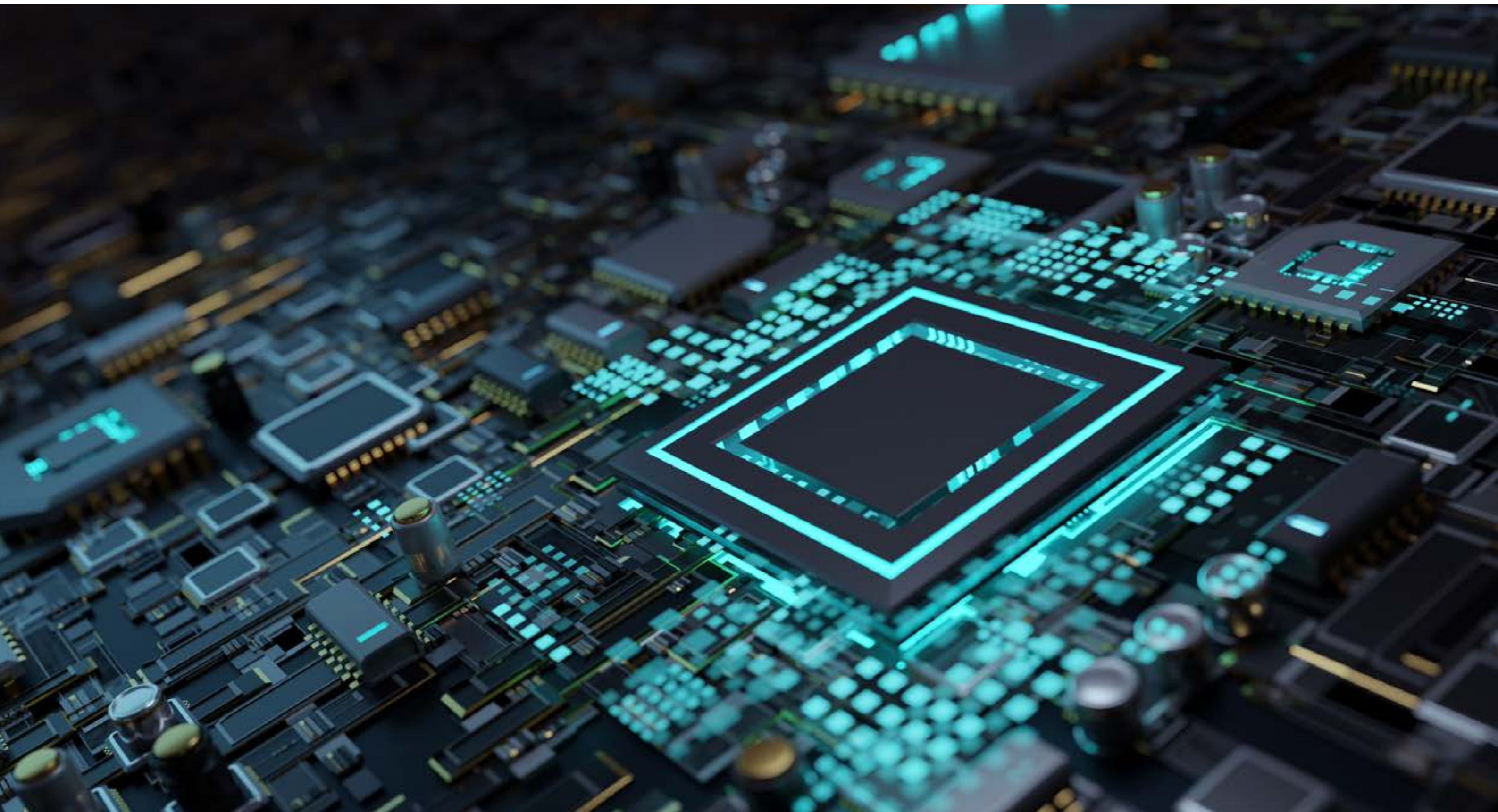
These national strategies, supported by legislation, government investment, and subsidised schemes, are far more competitive than that offered by the UK (see below).[5] The UK must use its existing resources tactically, playing to its globally recognised strengths within the semiconductor value chain to bolster its domestic capabilities and meet the competition presented by these global strategies.

Figure 1: Global Chip Sector Financial Support, $bn



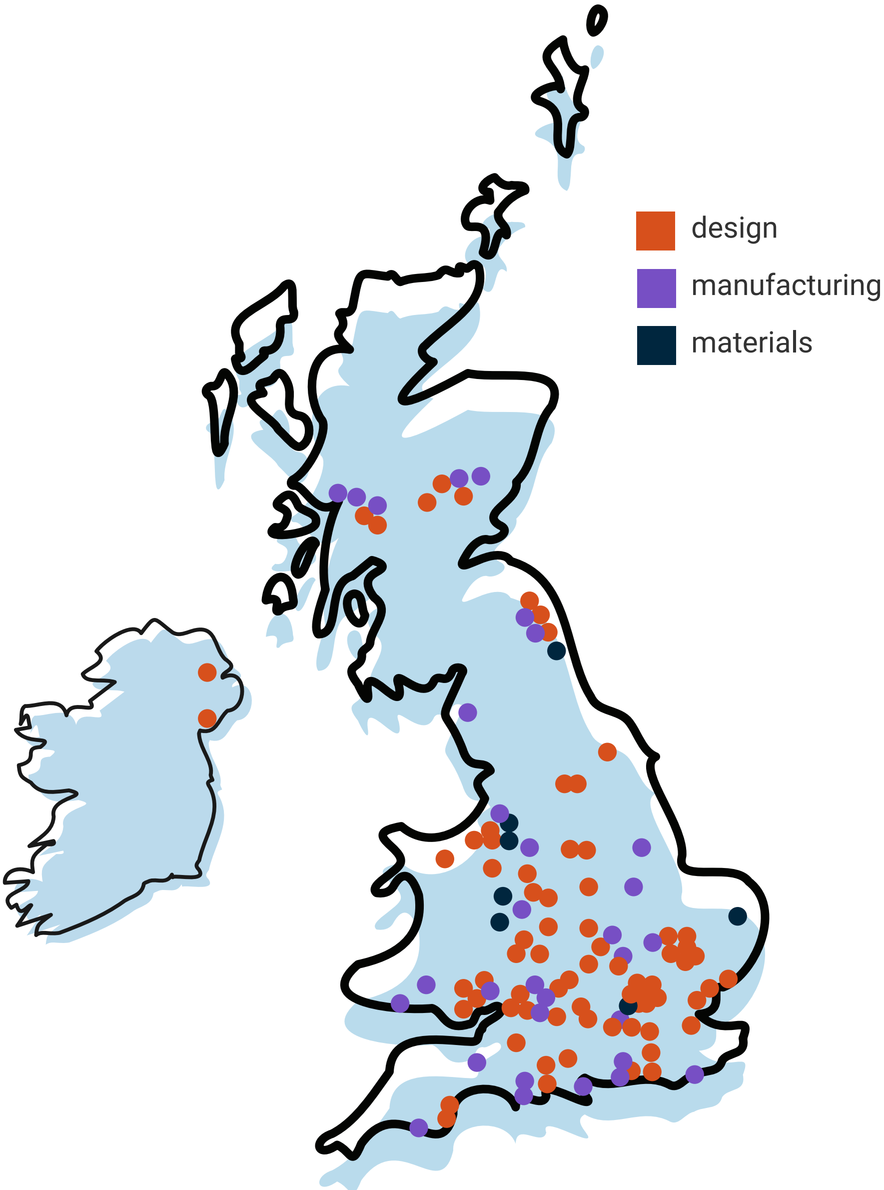
Digital futures at work research centre, Towards a data-driven UK semiconductor strategy (Oct 2024)[6]

This chart shows the amount of national support for the semiconductor sector, demonstrating how the UK compares to similar leading economies.



Overview of the Semiconductor ecosystem

In 2021, the UK's semiconductor industry contributed £12 billion in turnover, comprising 12% of R&D spend in the UK that year. Across over 200 businesses, dedicated semiconductor companies are estimated to generate £635,000 in revenue per employee. The sector is also poised for significant growth, with 90% of surveyed semiconductor companies expecting to see rapid or moderate growth over the next two years. The locations of these companies are widely distributed, with almost half of dedicated semiconductor companies located outside of London, the East and Southeast. The value of this technology to a regional economy can be demonstrated in South Wales, where the semiconductor workforce on average provides salaries 60% higher than the Welsh average, with 80% of staff residing in Wales.[7]



Dedicated UK semiconductor company locations (UK headquarters only). Data from Glass.ai and perspective economics[8]

The semiconductor value chain

While it is helpful to view semiconductors as a vertical technology, their production is the end product of a complex, specialised, global and capital-intensive sector, that requires several businesses working within their own specialisms. The semiconductor supply chain is comprised of a complex set of global, specialised players that each serve a distinct role within the overall process. This production can broadly be categorised into three processes: Design, fabrication and packaging. It should be noted that the semiconductor value chain is far reaching, and some businesses working in this space do not fall into these categories.

Design and IP

Semiconductor Design and Intellectual Property are integral to the semiconductor value chain, estimated to have accounted for about half of all sector value add in 2021.[9] Design refers to mapping the physical specifications of a chip's architecture, with Intellectual Property (IP) referring to components used that have been pre-designed or pre-verified by an entity before being licensed to a different body. Approximately two thirds of UK dedicated semiconductor companies operate primarily in R&D, design and IP, including 72% of internationally headquartered companies in the UK. This speaks to the enormous strength of UK design and IP, but also the importance of supporting our strengths with specific and tailored support.[10]

Fabrication

These designs can then be used for semiconductor fabrication to **manufacture** a physical wafer. This wafer production is usually the most capital-intensive part of the process, often requiring specialised equipment. Although the UK does not currently compete with the global mass-volume semiconductor chip manufacturing, there are ongoing discussions about how to compete in this space. There are at least 23 commercially successful semiconductor fabrication facilities, or "fabs" which supply unique and valuable products across the globe.[11] Examples include Pragmatic Semiconductor, who opened the UK's first 300mm semiconductor wafer manufacturing facility in 2023 at a brownfield site in the Northeast of England.[12] In contrast to the UK, many countries and regions have provided manufacturing incentives to build fabs within their borders, notably the US, EU, Japan, South Korea, and China. They are investing in both advanced fab capabilities to build the most complex silicon semiconductors critical for compute and AI, with each facility costing more than £15 billion, as well as what are known as legacy or non-leading edge fabs, that produce the vast majority of chips used in household appliances, Internet of Things (IoT) devices, vehicles, and other applications.

Packaging and testing

Finally, this wafer is sliced, **packaged and tested to become** an integrated circuit or chip. Utilising multiple technologies to efficiently combine wafer slices into a package, known as Advanced Packaging, is becoming increasingly important. This can improve the performance of the final chip making it increasingly important for advanced chips. The UK's emerging capabilities here would align well with capabilities in compound semiconductors, photonics and design, allowing UK researchers to test and develop new techniques.[13]

Over two decades ago, companies commonly handled all these processes, but as use cases are more diversified and the production of semiconductors becomes more complex, most semiconductor companies specialise in one of the three areas. The UK has a particular strength in the first part of this process, design and IP, with home grown global leaders like Arm. This, in turn, has developed a UK talent base in semiconductor design in Cambridge, and attracted a high number of multinationals to invest and build offices in the UK to focus on semiconductor design.

techUK's UK Plan for Chips

In January 2023, techUK released the five-point UK Plan for Chips.[14] The Plan urged the government to focus on building areas of world leading strength in semiconductor technologies by focusing on emerging strengths in research and development (R&D), design and IP, and compound semiconductors. These recommendations, among others, would be incorporated into the National Semiconductor Strategy released by the government later that year.

One year on from the National Semiconductor Strategy- where are we?

In May 2023, the UK Government published its National Semiconductor Strategy. This focuses on the UK's strengths in the initial part of the development process detailed above- R&D, design and IP- with an additional strength in compound semiconductors. Compound semiconductors refers to chips which contain more than one element, leveraging their unique properties across elements such as indium (In), gallium (Ga), aluminium (Al), nitrogen (N), arsenic (As) and phosphorous (P). The Strategy committed to invest up to £1 billion over the next decade, significantly less than comparable commitments in other jurisdictions.

Despite the ambitious rhetoric, since the announcement of this Strategy progress has been incremental.

This means further action is now required to turn ambition into reality: Governments across the world are acting quickly to attract semiconductor companies while also building domestic capability, as the industry moves to diversify geographically and prevent future disruptions like those experienced in 2020 and 2021.

There have been some welcome steps taken to push forward the National Semiconductor Strategy. For example, in January 2024, the government published its Critical Imports and Supply Chain Strategy to develop the UK as a leader in supply chain risk management and assessment.[15] The creation of ChipStart, a £1.3 million programme by Silicon Catalyst also showed commitment to develop the UK as an incubator for startups. Progress has also been made in skills development. For example, in February 2024, Innovation and Knowledge Centres in Southampton and Bristol University each received £11 million to develop their work in photonics and compound semiconductors. An additional £4.8 million was also announced to back eleven semiconductor skill projects across the UK.[16]

techUK has welcomed these positive announcements. However, several aspects of the National Semiconductor Strategy require bolder action and renewed priority, for example supporting the skills pipeline and scale-ups, wile recognising that tailored support across the value chain is needed to strengthen the sector. Semiconductor technology will be an inevitable and fundamental enabler of the government's ambitions. For example, the infrastructure for large-scale AI ambitions as outlined in the January 2024 AI Opportunities Action plan, or each of the eight growth-driving sectors identified in the Government's Industrial Strategy Green Paper.[17] The UK Government should look to its semiconductor ambitions, and the delivery of the National Semiconductor Strategy, as an essential part of delivering the wider Industrial Strategy and securing not just the fastest growth in the G7, but also secure and resilient economic growth.

What needs to happen?

UK Government must turn the rhetoric of the National Semiconductor Strategy into action and support the UK semiconductor industry to thrive. This paper sets out three fundamental missions that techUK member organisations believe will unleash UK excellence in semiconductors. These are underpinned by a six-point delivery plan to turn strategy into action.

To be a world-leader in the future of semiconductors techUK proposes three fundamental missions

1. Turn current strengths into leadership

The UK is not starting from zero. The UK has globally competitive capabilities in design and IP, primarily around Cambridge, (with other key sites in Manchester, Sheffield and Bristol), as well as a strong cluster in niche non-leading-edge manufacturing such as compound semiconductors, primarily around South Wales. These strengths have been enabled by intelligent and tailored policy, supporting innovative ideas to flourish, and building the right infrastructure for these businesses to scale.[18] The UK Government should take up the mantle of this critical sector to deliver an ambitious and co-ordinated plan of action, tailored to each subsector, enabling the UK semiconductor industry to thrive. Government must act quickly on delivery and utilise the wealth of knowledge, expertise, and potential that the domestic semiconductor industry has. **This means doubling down on UK strengths in IP/design, R&D and compound semiconductors. To compete internationally, tailored support is critical to ensure the financial means for high-potential, globally competitive sub-sectors to scale and grow.**

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2. Ensure greater investment into UK strengths

To focus on UK strengths, the government must ensure semiconductor businesses have sufficient access to both public funds, and private capital. Despite hosting the third-largest tech sector in the world, second only to the US and China, many semiconductor startups state access to large scale private investment as one of the most fundamental challenges. Finding qualified, lead investors within the UK is difficult, with an attendee at techUK's 2024 roundtable on this subject commenting only 5% of their funding originates in the UK.[19] The UK needs to provide a rich environment for investment, collaboration and talent across leading sub-sectors. That can't happen if too many companies are hindered by high costs and low investment. **The UK Government must ensure that there are a diverse range of funding options available, including throughout the entire scaling life cycle of a semiconductor business.**

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3. Capitalise on UK strength's in the global supply chain by forming strategic partnerships with peer countries

The semiconductor supply chain is both interconnected and co-dependent, with certain countries- and even companies- having market dominance. Taiwan Semiconductor Manufacturing Company (TSMC), for example, is the producer of approximately 90% of the world's most cutting-edge chips.[20] The UK also has strengths; over 99% of the world's smartphones run on chips designed by Arm, a company headquartered in Cambridge. Ultimately, whether intentional or accidental, disruptions to the global supply chains have and will impact the UK's semiconductor capabilities. We can, and must, build resiliency in the face of these challenges. **The interconnected nature of semiconductors means that whilst the UK is reliant on the rest of the world, the rest of the world is also reliant on the UK. The Government must leverage this interdependence by supporting our strengths and wield them proudly on the international stage, creating opportunities for joint research, investment and innovation.**

How we can achieve these missions

This report outlines how UK Government can transform the ambitious rhetoric of the National Semiconductor Strategy into action. This cannot be achieved through a standardised delivery approach, but instead tailored support reflecting the precise needs of subsectors including IP, R&D and compound semiconductors.

Developing a thriving semiconductor sector will require a long-term vision beyond a single election cycle. To recognise their integral role in developing new markets, delivering a greener approach to industrialisation, and supporting the commercialisation of emerging technologies such as quantum and AI, semiconductors require consistent and clearly defined support to overcome the barriers limiting growth.

The recommendations in this report will identify and address the top challenges facing UK semiconductors, outlining the precise support which can allow the UK to:

1. Retain our position as a global leader on chip design intellectual property
2. Support applied R&D and manufacturing
3. Incentivise investment into new areas of growth, including advanced designs, emerging technologies, and end user readiness.
4. Promote innovation and support scale-ups through access to markets and private capital
5. Nurture the skills we need for the chips industry
6. Strengthening the UK sector through global partnerships

Chapter 1: Retain global leadership in design and IP

Background

Semiconductor design and IP are integral to the semiconductor supply chain. As identified in the National Semiconductor Strategy, semiconductor design and IP are world-leading strengths for the UK. Approximately two thirds of UK dedicated semiconductor companies operate primarily in design and IP, including 72% of internationally headquartered semiconductor companies in the UK.[21] For example, Cambridge significantly contributes to UK leadership in design and IP: It is home to world-leading global semiconductor businesses such as Arm, and significant inward investment from large global semiconductor firms, and supported by the research facilities and academic expertise at University of Cambridge that has spun out at least eleven semiconductor businesses in recent years.[22]

The Challenge

The requirements necessary for a design businesses to operate vary from those of a manufacturing business; general support for the amorphous semiconductor sector does not always address the specific needs and challenges of each sub sector of the semiconductor value chain, including design and IP.

There are specific challenges faced across the design and IP value chain. Intellectual property protection and licensing can be a burdensome process, particularly for smaller companies that may lack the resources to effectively navigate the patent system, reducing the opportunity for UK firms to engage with global supply networks.

The cost of failure in testing designs carries high financial risk, even more so with advanced nodes. This can discourage companies from experimenting and innovating in new designs, especially SMEs and scale-ups who struggle to access the technical support needed for developing multi-vendor EDA tool design flows. This lack of support is a major barrier in getting designs to production, especially at the cutting edge of semiconductor innovation.

Finally, design and IP companies working in the semiconductor supply chain frequently cite the UK skills shortage as a barrier to growth. This means UK firms heavily rely on international and specialist talent. According to the Semiconductor Industry Association, 20% of the worlds semiconductor design engineers are based in India.[23] Not enough UK students are developing the skills required to fill skills gaps in semiconductor design and IP, especially electronic engineering qualifications. This prevents UK companies from operating at their full potential and more needs to be done to upskill UK workers into high-quality, high-paying jobs in the semiconductor sector. Recommendations to address skill specifically can be found in Chapter 5.

Cambridge: A Hub for Semiconductor Design and IP

Cambridge is at the core of the UK's leading strengths in semiconductor design and IP. The city is renowned for its burgeoning tech ecosystem, worth more than Italy and Spain's ecosystems combined, and representing 18% of the UK's total tech sector.[24] In 2023, the Global Innovation Index calculated that Cambridge was ranked number one globally, tied with San Jose.[25] It is within this ecosystem where much of the UK's design and IP activity lies.

The National Semiconductor Strategy identifies a range of prominent companies in this cluster, namely Agile Analog, spinout Cambridge Gan Devices, Paragraf and Arm. In 2022, approximately £7.4bn was generated by dedicated UK semiconductor companies; Arm alone generated £3.4bn of this GVA with its specialisation in chip design and IP.[26] This environment of academia, highly specialised industry, and access to talent has acted as international magnets for further innovation and investment. Within two miles of Arm's headquarters in Cambridge, for example, design sites for other significant global players in the semiconductor supply chain such as Microsoft, Samsung and Siemens, all of whom can mutually benefit from concentrated design expertise.[27] Fed into this expertise are world leading facilities, for example the Cambridge Centre for Gallium Nitride which collaborates across academia and industry to research semiconductor material quality, characterisation and device development.[28]

There are a number of ingredients that have led to a snowball effect in success for the Cambridge cluster. For example, the University of Cambridge can generate new talent, spin out companies and support industry-academia partnerships. In describing the cluster, Cambridge Ahead notes that of the eighteen semiconductor companies they identified within the city, half of them were spinouts from the University of Cambridge, with many comprising of academic researchers within key positions. In 2023, 39.2% of high-growth semiconductor companies were originally spinouts, demonstrating the strong role academic institutions have. Of those eighteen companies, the cluster employed approximately 3,000 people, compared to approximately 2,300 in the South Wales cluster.[29 30]

Given the UK Government is operating on a financial scale much smaller than international peers, it is clusters like this, with a strong proven record of innovation, where targeted support should focus.

Recommendations

The importance of design and IP to the UK's semiconductor sector, combined with the unique challenges companies in this area face, means the Government must provide tailored business support for design and IP development. This notably includes the availability of domestic and international talent (see Chapter 5). techUK presents the following four recommendations to address these challenges.

Recommendation 1: Establish a National Semiconductor Centre

One of the key recommendations by the Institute for Manufacturing's Semiconductor Infrastructure Initiative Feasibility Study was to establish a central National Semiconductor Centre. techUK supports this recommendation as it can both drive and build upon, many of the goals outlined in the National Semiconductor Strategy.

This Centre would act as a hub to address other recommendations in this report, acting as a key umbrella body, with a focus on delivery and coordination across other key facilities such as the Design Competence Centre (please see recommendation 2). The National Semiconductor Centre would focus on outward facing representation and support, allowing both semiconductor businesses and end users to navigate the UK's semiconductor market.

The Centre could also play a pivotal role in fostering industry readiness through a "Semiconductor Readiness Programme", akin to initiatives taken by the National Quantum Computing Centre Sparq programme. By connecting semiconductor companies with key sectors such as energy, automotive, and healthcare, it would ensure the adoption of advanced technologies while providing education and collaboration opportunities for new users of semiconductor innovations.

Finally, the Centre would also be well placed to support and advise on regional skills gaps and supporting industry clusters. This effort would include tailored solutions for workforce expansion, additional R&D support, and streamlined planning processes for critical infrastructure like fabrication plants. Outreach to investors would generate new funding opportunities, fostering a supportive environment for scale-ups throughout their entire lifecycle.

By consolidating these efforts, the National Semiconductor Centre would deliver a clear vision for the sector, ensuring long-term capital, global leadership, sustained growth, underpinned by a commitment to support commercialisation of this technology. Drawing inspiration from the success of initiatives like the National Quantum Technologies Programme, this approach would position the UK as a world leader in semiconductors, unlocking its full potential in innovation and industry collaboration.

Recommendation 2: Establish a Design Competence Centre to maximise chip designers ability to innovate

Leadership in design and IP requires increasingly large investments in research and development. It is estimated that between 2006 - 2020, costs of designing advanced semiconductor chips increased more than 18-fold.[31] Design centres seek to pool resources and provide a facility for research, knowledge transfer and collaboration between different organisations and disciplines. This will help design and IP firms, especially SMEs, to spread the risk when innovating and remove the need to invest in expensive fabs to produce their experimental designs, especially for advanced nodes. This could also benefit areas like AI, in which next generation architectures are a key university research focus.

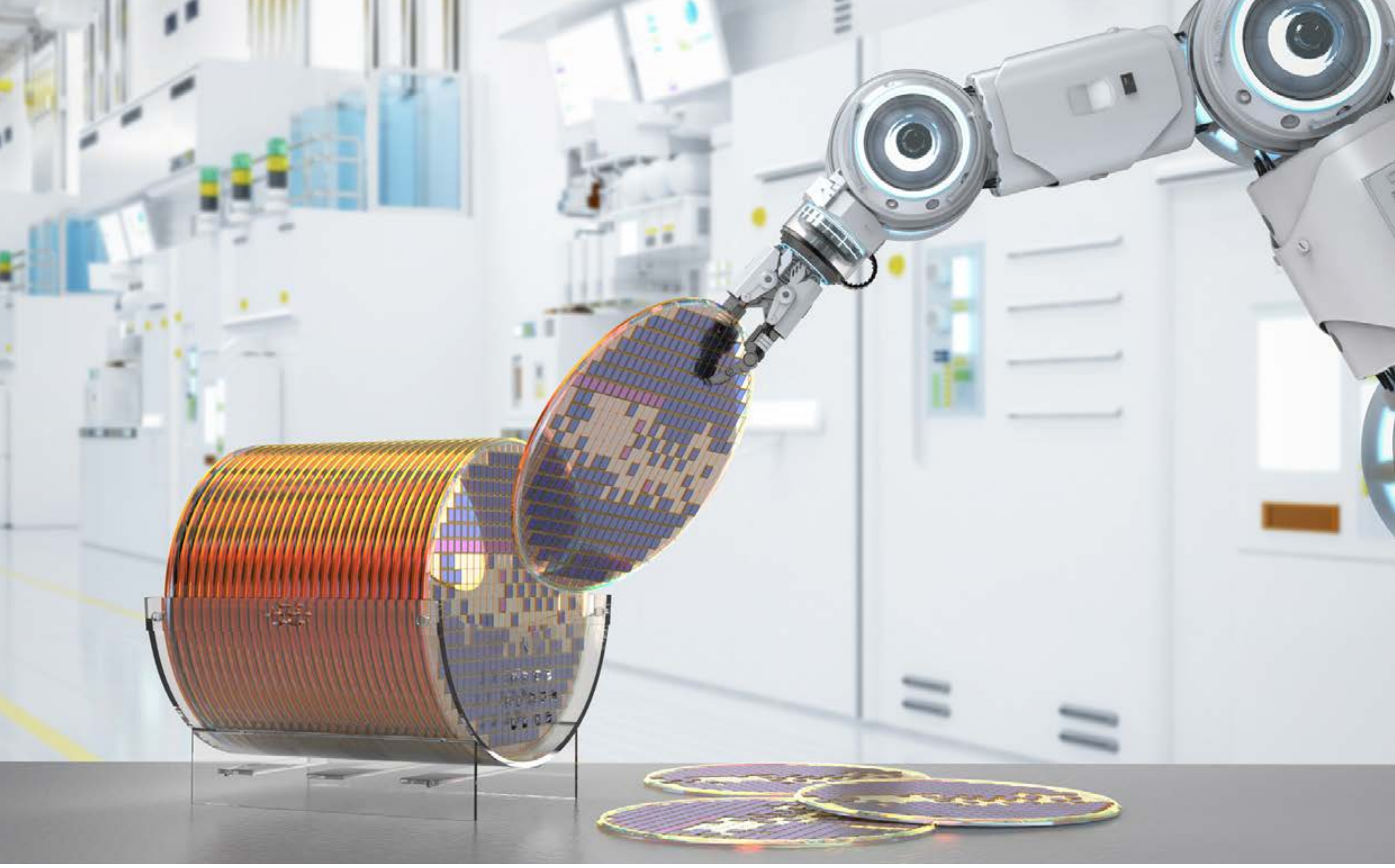
Providing shared facilities will pool risk and spur innovation in design and IP to support the UK's status as a world leader in this space. This could build on existing strength, such as UK leadership in design and IP seen in Cambridge, as well as exploring roadmaps for opportunities and engagement with future emerging technologies.

Recommendation 3: Establish a Semiconductor design and IP taskforce

Building on the UK's strong track record of protecting IP rights, and to effectively represent the unique set of challenges facing design and IP, a dedicated taskforce should be established to represent and advocate for design and IP business needs. This includes identifying and addressing specific skills gaps, proactively creating new IP opportunities and encouraging investment into the right facilities. For example, this could be through tax incentives for design activity which may be necessary to keep the UK globally competitive with foreign counterparts. Furthermore, this taskforce should be integrated into the institutional structure of the Government's Industrial Strategy, to ensure that the UK semiconductor IP and design firms are aware of and responsive to the needs of the wider economy. This taskforce could help assess the creation of a Design Competence Centre, directly monitoring and shaping their work synergistically to maximise output.

Recommendation 4: Support semiconductor licensing protections and patents

In techUK's 2023 Plan for Chips, we called on the Government to create a taskforce on licensing and IP protections between industry, government and the Intellectual Property Office (IPO). This is especially important when it is considered that startups who have applied for a patent are 6.4 times more likely to receive venture capital (VC) funding.[32] Given the importance of intellectual property rights to semiconductor design and IP, as well as Patent Box incentives for innovation, a licensing and IP protections taskforce would empower UK firms to operate overseas more effectively and protect their assets.



Chapter 2: Support applied R&D and low volume manufacturing

Background

Before semiconductors can be produced in mass volume, an extensive R&D phase involves the designing, testing and prototyping of the chip. For a semiconductor business, developing new innovative designs requires dedicating a significant amount of time an and financial resource. The capacity to manufacture chips in low volumes is therefore key to the semiconductor ecosystem.

Beyond prototyping, the UK also has manufacturing capability in compound semiconductors, with South Wales as home to many of these fabs. For certain use cases, compound semiconductors are often more robust, such as whilst operating at extreme temperatures. This makes them essential components in electric vehicles, aerospace, IoT devices, and 5G communications. As the UK heads towards Net Zero and building a green economy, they will provide much of the key infrastructure necessitated to deliver the UK's Industrial Strategy. Established clusters exist not only in South Wales, but in Bristol, Cambridge, the Northeast, Central Scotland, and Northern Ireland.

Semiconductor manufacturing is extremely capital intensive. A cutting edge, modern fab can cost between $10-20 billion. Due to the limited availability of manufacturing infrastructure to develop designs or create proof of concepts, many UK startups must go abroad for prototyping. This can be costly and time consuming for start-ups, who may not have the information or capability to develop strong international partnerships.

Meanwhile, upgrading a production site to keep pace with latest advancements and its associated energy can be costly, taking around two years complete.[33] This means that the UK's domestic semiconductor manufacturing base relies on competitive R&D tax relief schemes to keep pace with innovation and compete globally. All types of manufacturing, whether this is compound semiconductors or otherwise, requires an internationally competitive R&D ecosystem with support in place to mitigate expenses for capital expenditure. Capital expenditure refers to money invested into physical machines, equipment and buildings, an essential growth mechanism within the R&D process. In 2010, 5.2% of all business R&D expenditure was in capital investments, this rose to 8.3% in 2019, accounting for about £2.1 billion.[34]

Challenge

R&D incentives are a key tool for policymakers to enable innovation. The UK has developed a competitive R&D tax credit, where every £1 of tax forgone through R&D tax relief results in up to £2.70 of additional investment in R&D by UK companies. However, repeated changes to the scheme have shaken business confidence and driven some R&D investment abroad - one techUK member reported several of their clients falling to qualify for enhanced R&D support, despite seemingly fitting the profile. Furthermore, capital expenditure cannot be claimed under the existing R&D tax credit. This contrasts with competitive semiconductor specific tax relief schemes seen in other nations, including the US. The cornerstone of productivity, highly skilled jobs and sustainable economic growth will be the international competitiveness of UK R&D. However, in 2023, SMEs in Iceland, France and Portugal were offered more lucrative R&D tax incentives than in the UK, regardless of whether they were at a profitable stage yet.[35]

For semiconductor scale-ups working in advanced design, lack of adequate allocation of resources to test their latest designs, and undertake low-volume manufacturing, is cited as a common challenge. There remains a gap in this process for pilot lines, which allows for the development, testing and validation of designs before scaling manufacturing. The EU is looking to capitalise on this gap. In April 2024, the EU's Chips Joint Undertaking announced plans for the creation of four new pilot lines, focusing on; leading edge silicon chips below 2nm, low power FD-SOI silicon chips, heterogeneous integration and wide bandgap compound semiconductors.[36]

> ***"...a stronger early test bed for domestic manufacturing is needed, which if available would support commercialisation through effective and efficient testing of new products."***
>
> techUK Roundtable: Semiconductor Scale-ups Roundtable: Navigating Growth Challenges September 2024[37]

Recommendations

Recommendation 5: Extend the qualifying categories of R&D eligibility to include capital expenditure, such as plant and machinery, used solely for R&D purposes.

While the UK's flagship R&D tax relief scheme is key to driving innovation, the qualifying categories for the R&D tax credit do not extend to capital expenditure. techUK recommends making claiming tax relief on capital expenditure for R&D as accessible as possible, by extending the qualifying categories to include capital expenditure, such as plant and machinery, used solely for R&D purposes.

A 2021 analysis showed that expanding the qualifying expenditures in the UK Research and Development Expenditure Credit (RDEC) scheme to cover capital expenditure (such as new plants and machinery) could generate an additional £4 billion over ten years, providing 12,200 new R&D jobs.[38] Acting on this will incentivise smaller and scaling businesses to make investments. This would also better align with international governments such as France, Spain and Japan who all recognise capital expenditure within its R&D tax credits system. Alongside this, taking this approach would enhance productivity by upgrading research facilities, making the UK more attractive for capital investment from both existing R&D-intensive companies and new investors. This will boost UK competitiveness in attracting and retaining skills and investment.

Recommendation 6: Ensure long-term stability of the R&D tax credit by maintaining current rates and expanding the ERIS.

The Enhanced Research and Development intensive support scheme (ERIS) is supported by techUK. However, we believe it could still better support innovative SMEs by expanding to include profitable SMEs. The process of scaling or transitioning from loss-making to profitability brings many SMEs out of the scope of ERIS which can make incentives drop from 27p to 15p per £1 that they can claim back. Furthermore, the threshold to qualify for ERIS is based on R&D intensity, calculated as a percentage of total business expenditure. The current threshold is set at 30%. However, lowering this could bring more businesses into this scheme and allow them to capitalise on its benefits.

Recommendation 7: Introduce regional teams to provide specialised R&D support

Introducing regional specific expert teams within HMRC will enable tailored support for the semiconductor sector. This is due to the clustered nature of R&D investments, such as the compound semiconductor cluster in South Wales.[39] This would also better link regional incentives with centralised services, ensuring businesses in underserved regions can better access the support offered to them, whilst also capitalising upon the concentrated yet unique innovation taking place in different regions.

Recommendation 8: Establish an open access foundry with Pilot Lines capability to bolster R&D in areas where the UK can be internationally competitive

There remains a gap for pilot lines, which allow for the development, testing and validation of designs before scaling manufacturing. Given the large capital expenditure requirements to develop these pilot lines by each company individually, providing an open access foundry with pilot lines would support small volume domestic manufacturing and allow for the effective testing of new designs in a local, more cost-friendly manner. This is especially true when considering the multiple synergistic technologies that could be supported with an open access foundry, namely compound semiconductors, nanofabrication, quantum and silicon photonics. Due to their widespread applications, piloting capabilities will be especially needed to meet the rising demand of compound semiconductors, namely gallium arsenide, gallium nitride, indium phosphide and silicon carbide.

The material in which these pilot lines would focus is important, especially in the wake of the EU's intention for four new pilot lines. The area which the government may wish to consider is gallium nitride. This is used in photonics, lasers and power electronics, but the UK does not have a readily available pilot line. Furthermore, the government should explore a hybrid foundry to integrate semiconductors with photonics and other advanced materials for applications in quantum, sensing and communications. This hybrid approach would allow the government to support the development of photonics, semiconductors and photonics with one foundry, furthering the UK's leadership across multiple technologies.

Recommendation 9: Classify semiconductor capabilities as Critical National Infrastructure (CNI)

The UK Government should create a new category of Critical National Infrastructure focused on key strategic technologies as laid out in the Science and Technology Framework and the Invest 2035 Industrial Strategy. This would help to attract investment by providing potential investors with guarantees of greater government support to identify and mitigate potential security threats, including enhanced access to the National Cyber Security Centre and support from emergency services if an incident were to arise. Concurrently, ongoing reforms to national planning policy need to make it much easier for investors to build fabs and R&D capabilities in the UK. In September 2024, Data Centres were designated as CNI, thus leading to a dedicated team of government officials to anticipate disruptions and provide priority access to infrastructure and security agencies.[40]

Case Study | Compound Semiconductor in South Wales

Across South Wales, particularly in Newport and Cardiff, an integrated network of academia, industry and public funding has created a high-growth ecosystem for semiconductor innovation.

Development of the South Wales cluster has been supported by strong collaborations between key academic and industrial institutions such as IQE, Vishay, Swansea University, and Cardiff University.

These ties between academia and industry have resulted in industry-ready facilities, where research conducted by universities has led to commercially viable concepts, further enhancing the region's innovation capabilities.

South Wales provides accessible infrastructure that supports the entire manufacturing process, making it an attractive location for both established companies and startups. For example, open-access facilities like IQE's epitaxy manufacturing allow fabless companies to produce devices without needing to invest in expensive equipment. This allows for low volume testing of products without the need for businesses themselves invest in the capital-intensive equipment. This is also a crucial and attractive resource for SMEs and startups, offering a cost-effective way to enter the market.

This cluster shows that it is possible for the UK to be home to successful ecosystems of R&D and manufacturing.

"Estimates indicate every job in the semiconductor industry gives rise to another six in the wider supply chain. Microchips made here, in Newport, could improve the efficiency of energy systems and accelerate the country's transition to net zero."
Ruth Jones MP Collaboration and big picture thinking: The key to unlocking Britain's semiconductor potential May 2024

Case Study | ForrestBrown

ForrestBrown supports companies large and small across the UK's semiconductor ecosystem to access funding for innovation, helping the sector stay competitive in a fast-moving global market.

Clients range from semiconductor component designers to engineers specialising in the construction of manufacturing facilities. ForrestBrown has worked with these businesses to successfully claim R&D tax relief, resolve HMRC enquiries to enable them to plan future investment with confidence, and access grant funding.

Important to the ecosystem, is the ability to navigate through changes to R&D tax relief, including the impact of restrictions on overseas R&D expenditure and the introduction of new rules on contracting out R&D. Both reforms are particularly relevant in the semiconductor sector where supply chains can be complex and often extend across the globe.

These changes have created challenges for many businesses accessing the relief, underscoring the importance of exploring a range of innovation incentives. Businesses must be empowered to access grant funding by helping them identify relevant grant opportunities, assessing application feasibility, and providing comprehensive support throughout the grant application process.

Our recent experience in the sector includes assisting businesses in securing funding from the Improving and Scaling-up Semiconductor Manufacturing fund, a £12 million initiative aimed at enhancing UK supply chain resilience.

Beyond grant applications, the ForrestBrown team offers strategic location advisory services to help businesses make informed decisions about expanding or relocating their operations within the UK.

We're passionate about the transformative power of innovation for the semiconductor industry and the UK economy. That's why we're strong advocates for policies which encourage innovative businesses in the sector, and the supporting ecosystem required to make it successful. Our expert team, consisting of chartered tax advisers, grant funding experts and industry-experienced technology specialists, provides practical and insightful advice for semiconductor businesses.

Case Study | Pragmatic Semiconductor

Pragmatic Semiconductor is pioneering flexible semiconductor technology, sustainably delivering edge and item-level intelligence at scale.

In 2023, the company unveiled Pragmatic Park, its flagship semiconductor wafer fabrication line (fab) in Durham, UK. The advanced manufacturing facility is the UK's first 300mm semiconductor fab producing thin-film, flexible semiconductors (FlexICs), and has the capacity to produce billions of FlexICs per year.

Pragmatic FlexICs are ultra-thin, physically flexible semiconductors. Quick to produce – and highly customisable – they deliver low-cost, low-carbon intelligence. Lightweight, thin, and bendable, these FlexICs integrate seamlessly into items with curved or irregular surfaces unlocking opportunity for innovation. Their comparatively low cost makes it viable to bring intelligence at scale to high-volume products, making insights available wherever they're needed.

While silicon chips take many months to go from final design stage to delivery, FlexICs can be delivered in as little as four weeks. The FlexIC Foundry's agile, 48-hour cycle times allow innovators to amend and refine designs on the fly, iterating to achieve optimal performance. Modest non-recurring engineering costs also lower the barrier to entry, making it easier and more affordable than ever before to bring designs to life.

A silicon fab typically requires thousands of square metres of cleanroom space. By contrast, the FlexIC Foundry enables high-volume commercial production in a footprint of just a 600m2, maximising productivity per square metre. This 'mini fab' also requires around ten times less capital expenditure and can be operational in around half the time – bringing the potential for rapid, economical deployment within existing production sites.

In addition, the FlexIC Foundry's unique fabrication method uses less energy, water, and fewer harmful chemicals than standard semiconductor fabs, reducing the carbon footprint of production. This makes FlexICs some of the most sustainable semiconductors in the world.

Chapter 3: Incentivise investment into new areas of growth; advanced designs, emerging technologies, and end user readiness

Background

Semiconductors are fundamental to the UK becoming a world-leader in the development and deployment of emerging technologies. They sit at the core of an interconnected technology chain that will contribute to transforming productivity and growth across industries and sectors. The UK Governments ambitions, including the delivery of the Industrial Strategy, the AI Oppurtunites Action Plan, and the National Quantum Strategy, will all be enabled by a strong domestic semiconductor industry in the UK. Furthermore, other high-potential emerging technologies such as photonics, telecoms and Net Zero technologies, will all require increasing volumes and complexity of chips.

To unlock the potential of innovation driven by semiconductors, UK Government and the semiconductor industry need to work together to develop readiness across end users, such as energy, automotive and healthcare, so that they can benefit from the world leading semiconductor innovation in the UK and capitalise on the ambition set out in the Industrial Strategy.

Artifical Intelligence

The UK boasts the world's third-largest AI sector, hosting 20 AI unicorns—startups valued at over $1 billion—and more than 1,800 venture-backed AI startups, solidifying its position as a global leader.[41] [42] The semiconductor industry is intrinsically linked with the development of AI. They are a fundamental enabler of the future development of AI, primarily – though not exclusively - through Graphics Processing Units (GPUs). These chips are becoming more powerful, efficient, miniaturised and specialised than ever due to shrinking transistor sizes and improved fabrication techniques. The current GPU value chain is heavily concentrated across leading design firms, with most manufacturing taking place in Taiwan and other parts of Asia. Access to compute for AI is a critical concern for many Governments, and is addressed in the UK's Government's AI Opportunities Action Plan.[43]

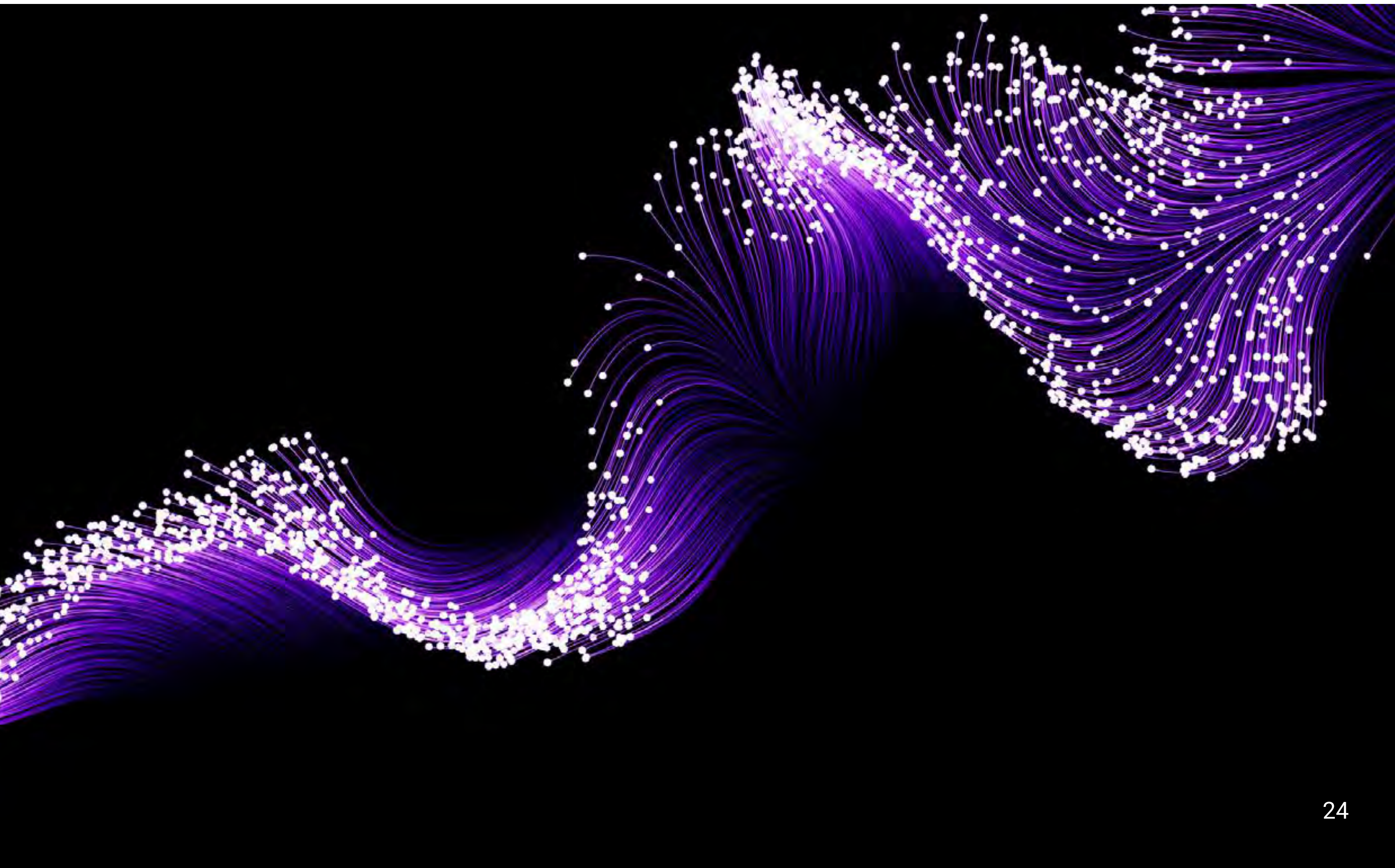
The UK's strengths in chip design and R&D puts the UK in a strong position to lead on the development of new chip architectures for AI that may be needed in the future. For example, over time, advancements could mean devices move beyond current dominating architectures to incorporate new architectures such as neural processing units (NPUs). These next generation of semiconductors will rely on new materials and processes and will require investment into their design and development as they move towards commercialisation. If properly supported, the UK semiconductor sector can play a leading role in the AI future through designing chips capable of supporting the advanced AI algorithms that are expected to drive forward the next generation of research and innovation.

Quantum

The UK is a global leader in quantum with a thriving business community, hosting 11% of the world's quantum startups - the largest number in Europe - and 12% of global private equity investment into this technology.[44] Parallel development of initiatives like the National Quantum Strategy and the National Quantum Technologies Programme, alongside the National Semiconductor Strategy and proposed National Semiconductor Centre, is key to enabling collaborative leadership in these technologies. The UK will need to support the development of testing, prototyping and potential manufacturing of quantum chips in the UK as this industry moves towards commercialisation. To support both the quantum and semiconductor sector, the government could explore a hybrid foundry that would allow the Government to further the UK's leadership across multiple technologies.

Photonics

The UK is the second-largest photonics manufacturer in Europe and ranks ninth globally.[45] More than 40 universities across the UK are engaged in photonics research and development, alongside over 1,200 companies, underscoring



its strategic importance to the nation's economy.[46] One such centre is the University of Southampton's semiconductor foundry CORNERSTONE.[47] The UK strengths in design, IP, and R&D are perfect tools for the advancement of silicon photonics, especially as the capital expenditure requirements to manufacture these components are significantly lower than for other semiconductors.[48]

Conventional integrated circuits (ICs) combine functional IP blocks. They are capable of millions of calculations per second, but each calculation consumes energy, making them energy intensive. In comparison, photonic integrated circuits (PICs) combine high performance optical components, such as lasers and detectors, on a chip. They process data at the speed of light and are highly energy efficient. photonics and electronic chips could play a key role in pursuing Net Zero goals, especially in data processing and high-performance computing applications.[49]

Future telecommunications

Strengths in compound semiconductors and underscore the opportunity for leadership in future telecoms, with silicon photonics improving data transmission rates whilst also reducing energy use and latency.[50] In 2022, telecoms contributed £32.7 billion to the UK economy, while semiconductors and future telecoms were both included in the Department for Science, Innovation and Technology's (DSIT) five technologies of tomorrow.[51] [52]

> ***As the telecom industry moves to higher frequencies, such as mmWave for 6G and >6GHz for WiFi 6 and beyond, it will require performance that only compound semiconductors can provide.***
>
> Future Capability Paper Semiconductors for Telecoms, UKTIN, July 2024[53].

Net Zero technologies

Semiconductors, in particular compound semiconductors, play a pivotal role in advancing clean energy technologies. Clean energy refers to power derived from renewable, non-polluting sources, such as wind, solar, and hydroelectric power. Further dependence and growth in the use of renewable energy is a key priority for the government, as evidenced by the Industrial Strategy highlighting clean energy as a key vertical and growth driving sector.[54] Compound semiconductors enable the efficient harnessing, conversion, and storage of renewable energy.[55] For instance, solar panels rely on semiconductors to convert sunlight into electricity, a process critical for scaling renewable energy adoption.[56] Furthermore, advancements in semiconductor technology contribute to the development of an efficient electrical grid capable of distributing clean energy with minimal loss. The Compound Semiconductor Applications (CSA) Catapult has highlighted the UK's expertise in this area, underscoring how it supports more efficient power conversion and distribution systems.[57]

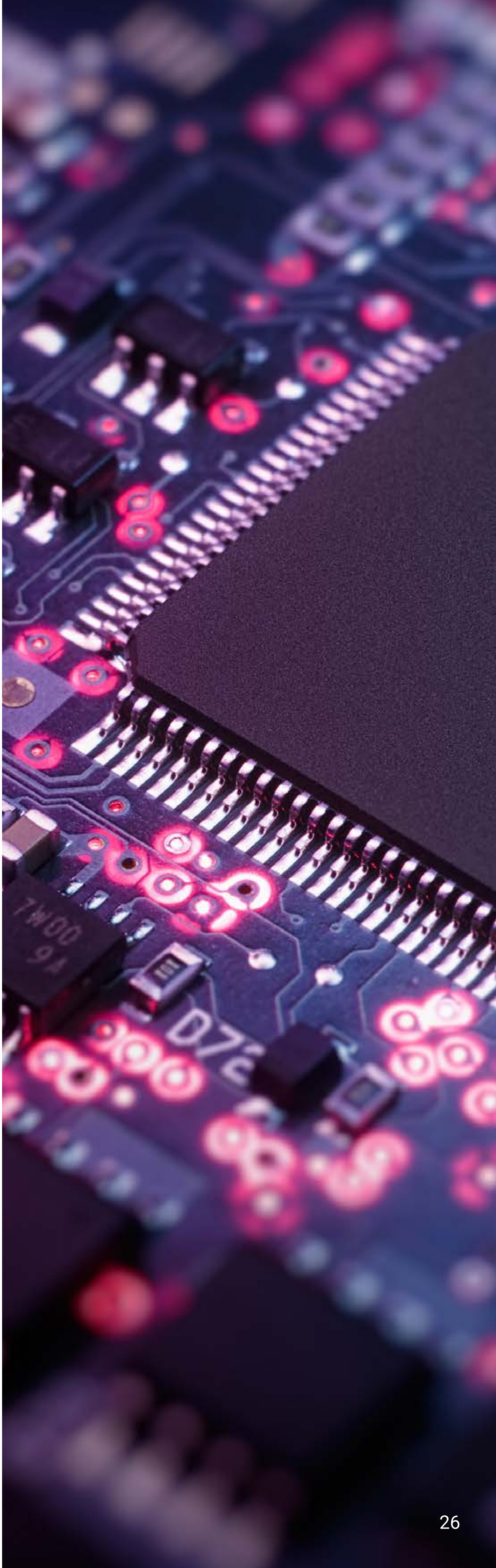
Compound semiconductor strengths also complement new electric vehicles, which need semiconductors for functions like power electronics, controlling the battery and motor. It is expected that EVs will use double the semiconductor chips that a traditional car requires, using up to 3,000 separate chips.[58]

The semiconductor sector itself is increasingly embracing sustainability practices to become more environmentally friendly. Companies are implementing energy-efficient manufacturing processes and investing in renewable energy sources for their operations. Seagate technology in Northern Ireland, for example, uses 100% renewable energy at its wafer fab manufacturing site.

Challenges

This technology chain is only as strong as its weakest link, and insufficient investment into semiconductors will imperil our broader goals across these areas. techUK believes that the government should seize the opportunity presented through strengths and find areas where multiple technologies can be supported together.[59]

The automotive, aerospace, and defense industries are highly reliant on advanced semiconductor technologies for the development of next-generation products, including electric vehicles, autonomous systems, and advanced defence equipment. However, fragmentation and a lack of strong integration between these end user industries and the UK semiconductor ecosystem slows innovation and creates potential risks in supply chain security. Addressing these challenges is crucial to ensuring technological leadership and reducing time-to-market for next-generation products.



Recommendations

Recommendation 10: Continue to view semiconductors within the Government's five key technologies and within the Industrial Strategy

The UK Government must continue to view semiconductors as a key enabler in achieving its long-term science and technology ambitions. As previously identified as one of the five key strategic technologies for UK Government, it is important this is continued to deliver the appropriate support to delivering action to support the UK's semiconductor ecosystem. As mentioned above, emerging technologies, including semiconductors, should also be recognised within the Industrial Strategy to help secure resilient economic growth.

Recommendation 11: Proactively engage in a cross-government approach to deliver semiconductor support

Work needs to be undertaken to join up thinking between different technology teams across government, especially in horizontals with high coordination demands and overlapping opportunities.

The Department for Science, Innovation and Technology and the Department for Business and Trade should co-ordinate opportunities for semiconductors within the Industrial Strategy. Meanwhile, the National Semiconductor Centre should act as a central body to coordinate cross-department delivery, aiming to remove silos wherever possible. This includes exploring opportunities for semiconductors across the government bodies that are working across emerging and transformative technologies, such as photonics and quantum. Co-ordination needs to be both within and beyond DSIT, including UKRI, the Department of Business and Trade, and the Treasury.

Recommendation 12: Support the adoption of advanced semiconductors into UK industries and sectors

Government should invest in a semiconductor readiness programme to foster strategic engagement between semiconductor companies and its end users. This support for UK headquartered semiconductor companies and strategically significant OEMs in the UK's automotive, aerospace and defence sectors could, in turn, further support UK-led development of new and emerging semiconductor technologies.

This is an area where the National Semiconductor Centre could play a leading role, delivering an access point for new users to the semiconductor industry, while also providing education and opportunities to collaborate with the sector. Recommendations around the need for coordination has been made by others in the semiconductor ecosystem.[60] The National Quantum Computing Centre already provides an example improving end user readiness within industry with its Sparq programme.

Recommendation 13: Support the development of advanced designs and the intersection of semiconductors with emerging technologies through targeted funding

UK Government should identify overlapping quantum and semiconductor design, or semiconductors for future telecoms, and explore where targeted support could bring benefits across both areas. In a difficult economic climate, tailored investment could grow complementary capability and expertise. Overlapping strengths means the UK could develop robust leadership through moderate strategic investments into industry-facing open access facilities that complement existing capability.

For example, the UK quantum ecosystem requires upgraded open-access infrastructure.[61] As highlighted in the Royal Academy of Engineering's Quantum Infrastructure Review, compound semiconductor material platforms can offer the flexibility to control and manipulate quantum states, create miniature lasers, exploit unique optical properties, and enable the development of practical quantum devices. These could unlock applications across communications, quantum key distribution (QKD), sensing, imaging, lasers, and quantum computing.[62]

Case Study | Photonic Inc. The Convergence of AI, Quantum, and Photonics

The convergence of several fast-growing technology sectors - artificial intelligence (AI), quantum computing, and photonics – presents unique opportunities. AI is already seen as one of the most transformative technologies of our time; quantum computing is poised to follow. Forbes estimates the AI market will reach $1.3 trillion by 2030, and BCG predicts the quantum computing market will grow up to $170 billion by 2040. However, the combined potential of these technologies could surpass these individual forecasts, driving even greater societal and economic impact.

It is likely there will be two types of quantum computing and AI integration.

The first will be the use of quantum generated training sets in AI model training. Applications for this approach include chemistry and materials science, where quantum effects are relevant and experimental data sets are scarce. Known algorithms in quantum chemistry can be leveraged to generate training data for applications in carbon conversion and high-temperature super-conductors, among others.

The second, available with greater quantum capabilities, will be the delivery of a true quantum AI, where quantum computing is used in training protocols and/or the AI itself. This is an area of active exploration, with promising results in specific areas of machine learning and optimization. Together, quantum computing and AI could address challenges that neither may be able to tackle effectively on their own, leading to innovations in additional fields like drug discovery, financial modeling, logistics, and more.

Photonic integrated circuits (PICs) promise to help both quantum computing and AI overcome scalability challenges. Integrated photonic interconnects are critical to scale quantum computers to the tens and hundreds of thousands of logical qubits required for commercially relevant quantum algorithms. Similarly, although deep learning networks have revolutionised machine learning, their growth is fundamentally constrained by the power and throughput limitations of CMOS electronics.

Photonic Inc. is actively driving innovation at this intersection, leveraging its expertise in photonics and quantum technologies to enable scalable solutions and accelerate progress in these transformative fields.

Nick Morris, Managing Director, UK & Europe, Photonic Inc.

Photonic Inc. is a quantum computing company with operations in Canada, the UK, and the US. Its innovative Entanglement First™ architecture uniquely integrates the essential capabilities of computation, connection, and error correction, enabling scalable modular quantum systems. Collaborating with leading customers, Photonic Inc. is delivering commercially relevant quantum solutions at the intersection of AI, quantum computing, and photonics.

Case Study | Leonardo

The defence industry is evolving rapidly and responding to meet the changing needs of military operations. Data acquisition rates are increasing and the volumes of sensor data that must be processed to extract useful information in high-tempo and dynamic operations places increased emphasis on high-speed data processing, interconnectivity and high bandwidth free space optical communications.

Leonardo is at the forefront of this development. Sensors such as: advanced multi-target tracking radar, high resolution and high frame rate thermal imagers and electronic warfare systems, rely on new generations of semiconductors and photonics. These underpin next-generation high power microwave generation for advanced radars, high sensitivity thermal imaging, infrared single photon detectors for 3D lidar and innumerable requirements for modulators, beam combiners, switches and optical interconnects.

However, the increasing electrical power consumption of semiconductor chips is unsustainable in military equipment that must conform to size, weight and power (SWAP) limits. This is driving the need for photonic-based processing. The photonic integrated circuit (PIC) provides the bedrock for a new generation of processing. Integrated with semiconductors and underpinned by advanced packaging concepts, new system-on-a-chip modalities can be realised, such as:

- 2D Non-mechanical beam steering for tracking
- Compact optical transceivers for free space optical communications
- Compact lidar systems for remote sensing
- Integrated neuromorphic data processing for cognitive sensing

These require hybrid semiconductor/photonic devices provided by an open access manufacturing infrastructure that is able to integrate multiple modalities with advanced packaging into single systems for use in extreme environments.

That manufacturing infrastructure will also benefit the wider economy, beyond defence. The UK's new industry strategy and the technology strategies for AI, Quantum and Space all depend on hybrid semiconductor/photonic integration. These strategies must therefore endorse advanced manufacturing as the vision for commercial success.

Case Study | Seagate's Photonic Capabilities in Northern Ireland

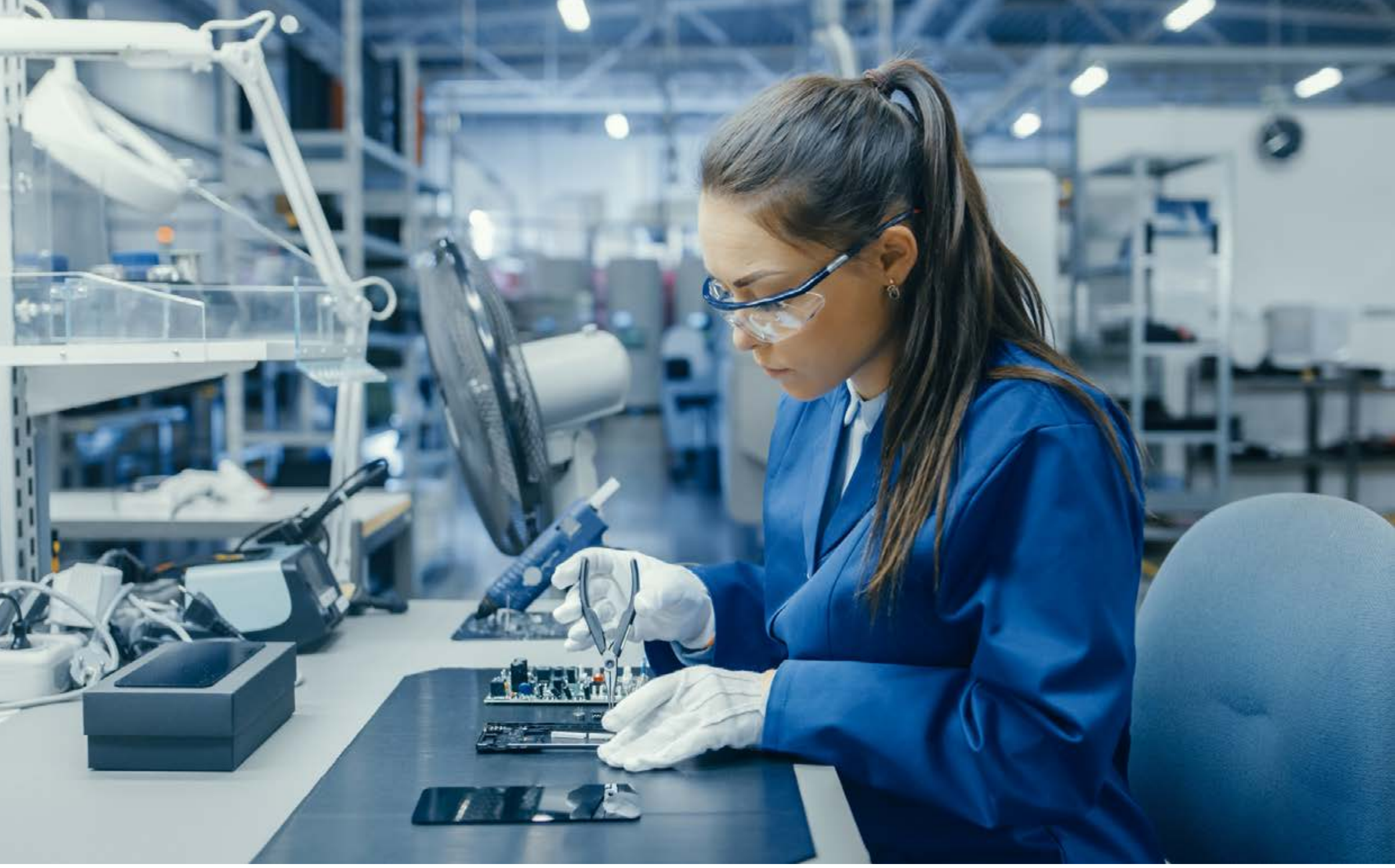
For over 30 years, Seagate Technology has been a cornerstone of innovation in Northern Ireland, establishing its state-of-the-art facility in Springtown, Derry, in 1993. This site, home to one of the world's largest nanomanufacturing cleanrooms, plays a pivotal role in Seagate's global strategy, producing over 25% of the world's read/write transducers and driving advancements in photonic technologies.

Photonics, the science of light-based technology, is a transformative innovation that Seagate is leveraging to address the exponential growth of data demand. At the Springtown site, researchers are developing cutting-edge photonic components integrated into semiconductor chips. These advancements enable faster, more energy-efficient data processing, supporting the next generation of data storage solutions.

Seagate's commitment to sustainability is evident in its Northern Ireland operations, where the wafer fabrication plant operates on 100% renewable energy. Photonics-based hard drives developed here improve power efficiency by 40%, setting new industry benchmarks for sustainable technology.

Collaboration is central to Seagate's success. Through strategic partnerships with Queen's University Belfast, Ulster University, and the Smart Nano NI initiative, Seagate is fostering local talent and positioning Northern Ireland as a global hub for photonics and semiconductor innovation. The Smart Nano NI project, supported by significant UK Research and Innovation funding, is projected to create 500 jobs and boost GVA by £220 million over the next decade.

Seagate's photonic innovations in Northern Ireland exemplify its legacy of technological excellence, sustainability, and collaboration, cementing the region's critical role in shaping the future of data storage and semiconductor technologies.



Chapter 4: Promote innovation and support scale-ups through access to markets and private capital

Background

Scale-ups have an outsized contribution to the UK economy, making up just 1% of SME firms, but account for 8% of SME employment and 22% of SME turnover according to an analysis from the Social Markets Foundation.[63] Equally, the UK has a thriving ecosystem to grow a business. Interventions such as the Seed Enterprise Investment Scheme (SEIS), Enterprise Investment Scheme (EIS) and Venture Capital Trusts (VCT) scheme are world leading and have supported firms to start and scale in the UK. Whilst employment and GVA of the semiconductor sector tends to be concentrated by a few large businesses, most companies in this sector are SMEs (95%), with 41% classed as Micro, employing 1-9 people.[64] The UK is home to several prominent startup success stories in the semiconductor sector; Icera was founded in Bristol in 2002, a fabless company acquired by Nvidia for $367m, or the Bristol founded Graphcore which was acquired in 2024 for approximately 500 million.[65]

The importance of semiconductor scale-ups has been recognised by the creation of ChipStart, which launched in 2023 as part of a £1.3 million semiconductor incubator led by Silicon Catalyst. UK. The first cohort of this scheme transformed an initial government investment of £600k into £20m of private sector investment following the programme.[66] This speaks to the huge return on investment that is possible if semiconductor scale-ups are properly supported, and why techUK believes this should be an area of targeted support for UK Government.

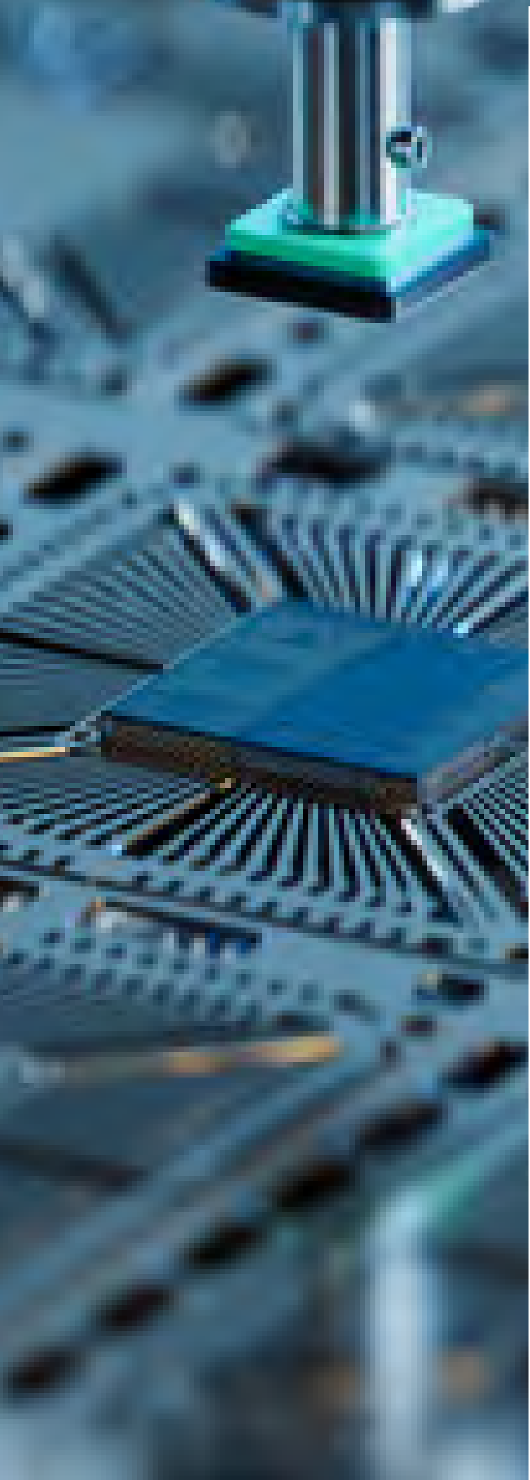
Challenge

The first challenge for early-stage semiconductor companies is attracting investment. Scale-ups in the semiconductor industry struggle to find "qualified" investors who understand the sector's complexities, timelines, and capital needs. In a roundtable on semiconductor scale-up investment, techUK members stated that they believe many investors are not sufficiently signposted toward the huge potential of the semiconductor industry.[67]

Finding or identifying lead investors, especially in growth stages, is crucial; yet many UK-backed funds do not take the role as a private lead investor, meaning this often sourced from outside the UK. Despite an already disproportionately early-stage sector in the UK, about 70% of total fundraising has been secured by only five firms. This shows that there is a gap in the scaling ecosystem, which must be addressed.[68] The UK is currently home to the world's second-largest VC base after the US, however, there remains a considerable disparity between the two nations. UK companies receive approximately one tenth of the VC funding received by their American counterparts.[69]

Raising visibility for semiconductor scale-ups is also difficult, with limited platforms to showcase or connect with investors. This is particularly challenging given the complex technical nature of semiconductor companies, with tailored representation needed for scale-ups with different specialisms, who may wish to access different investors.

techUK welcomes government support offered to scale-ups, such as SEIS, EIS and VCT schemes. Furthermore, Government-backed funds, such as the National Wealth Fund, the British Business Bank, and the National Infrastructure Bank have successfully supported semiconductor businesses in the UK. In 2023, Pragmatic Semiconductor received £60 million through the UKIB in direct equity investment to scale-up domestic supply chains.[70] However, these funds can be challenging to access for semiconductor scale-ups. For example, the visibility or awareness of these schemes, the resource allocation required in applying or the eligibility of certain initiatives are all cited as common challenges. This highlights the importance of having in place tailored support for semiconductor scale-ups. Existing pilot scheme ChipStart is certainly a step in the right direction, however, there is ambiguity as to its long-term continuation or whether this will be scaled further.



Demystifying Finance- The UK Funding landscape

The UK has several grants, loans and schemes designed to support business growth and expansion that can be useful for semiconductor businesses. These can be broken down across regions, incentive training and skills development, sector specific which often focus on innovative areas like sustainability or energy, focuses on scaling startups or international expansion, some schemes also focus on underrepresented founders. While the below list is not exhaustive, it hopes to give an example of the funds available from the National Wealth Fund, British Business Bank and UK Infrastructure Bank that semiconductor businesses may be eligible for. Did you know? Just 3% of UK SMEs are currently using a Grant.[71]

National Wealth Fund (NWF)

In October 2024, the Government announced the creation of a new National Wealth Fund to increase the impact of public investment and strategic alignment with government missions. This new fund will be equipped with the products, mandate and risk capital to more effectively catalyse private capital, including support for large growth projects which may otherwise not be possible.[72] This includes the facilitation of equity finance, guarantees and loans in key areas including the Industrial Strategy and green energy. The NWF will have a total financial capacity of £27.8 billion, with £22 billion of this being inherited from the remit of the UKIB (see below) and an additional £5.8 billion.[73][74]

British Business Bank (BBB)

Created in 2014, the British Business Bank is wholly owned by the Department for Business and Trade, seeking to help small businesses scale and grow effectively. As explained throughout this chapter, the financial landscape does not always guarantee the conditions required to grow a business, especially when huge amounts of investment are required to research, design, test and scale a product. The National Wealth Fund and it's expanded financial capabilities, will utilise the BBB to support finance for smaller companies that underpin the industrial strategy.[75] The British Business Bank has a track record of investing in UK innovators, as well as the venture and growth capital markets that support the industrial strategy and will work in concert with the National Wealth Fund to deliver against the Industrial Strategy's aims. BBB has directly backed companies like Paragraf and Pragmatic as well as quantum computing companies relying on semiconductor companies such as Oxford Quantum Circuits and Quantum Motion Technologies.

UK Infrastructure Bank (UKIB)

UK Infrastructure Bank, launched by HM Treasury in 2021, offers incentives to private capital to invest in key areas around driving economic growth and supporting sustainability, becoming now the NWF. The UKIB and now NWF, will support semiconductor companies by enabling a fertile ground for investment in areas that support economic growth and further the industrial strategy. This includes work around EV batteries, supply chains and domestic manufacturing.[76]
In 2023, Pragmatic Semiconductor received £60 million through the UKIB in direct equity investment in order to scale-up domestic supply chains.[77]

Recommendations

Recommendation 14: Renew the ChipStart pilot scheme and expand its scope

The original Chipstart programme, launched in October 2023 as a two-year pilot with £1.3m, has resulted in the startups raising almost £20m of investment from private sector investors and grants.[78] The ChipStart programme received 27 applications in its first wave, accepting eleven in total. There are several beneficial ways this could be expanded.

The ChipStart UK programme should transition from a pilot scheme to a continuous scheme, providing advanced notice for startups to plan ahead. Furthermore, the time frame of the ChipStart accelerator should be extended, from 9 months to a 12-month rolling programme, allowing a longer runway for startups to prepare for commercialisation and expansion.

ChipStart UK is currently designed to support companies that are too early-stage to join the Silicon Catalyst US programme, which provides access to experienced angel investors. However, businesses should be supported as they scale and require access to increasing levels of investment. Expanding ChipStart's capacity to support in these ways would help build upon the proven success of this pilot programme.

Recommendation 15: Utilise public institutions like the National Wealth Fund to create more funding support for semiconductor scale-ups

Public institutions like the NWF, BBB and UKIB have a key role in supporting the development of the semiconductor sector. However, each fund has its own remits and investment criteria, which can lead to the large-scale needs of semiconductors companies falling through the gaps.

Similarly, the National Security Strategic Investment fund is targeted at several technology innovation areas but doesn't meet the needs of semiconductor manufacturing. These initiatives are important vehicles to stimulate economic growth but there is a need to develop a joint mechanism to fill funding gaps across high-potential areas outlined in Chapter 3, support longer term investment, and to provide a greater vehicle to pool private investment.

The scale and capabilities of these public institutions to support semiconductors should be expanded, focusing on chip firms which are driving industrial strategy priorities. The ability to directly invest and play a leading role into these companies should also be expanded through the Future Fund: Breakthrough. Government should utilise public finance institutions at an increased scale, bringing together expertise from both groups to provide longer term patient capital for promising UK scale-ups, particularly with regards to large semiconductor infrastructure projects. Targeted support in UK's high potential areas at this scale could unlock a large stream of semiconductor growth and innovation.

Recommendation 16: Use a National Semiconductor Centre to establish long term support and representation for scale-ups and as a vehicle for outreach to investors

The National Semiconductor Centre should serve as an easily accessible showcase for UK semiconductor companies, enabling them to present their innovations, expertise, and market potential to an international audience. This should involve the outreach and education of potential investors, generating new avenues for funding and enabling qualified investors to back new ventures.

In its pursuit of global competitiveness, the UK must adopt a forward-thinking approach where academic excellence can turn into the next world-leading businesses. With the Centre acting as a vehicle to international partners, UK organisations can become a accesible international partner. Particular support should be provided for semiconductors across key areas of UK strengths like photonics, quantum or AI.

Recommendation 17: Help UK scale-ups build international connections

Less than 10% of SMEs in the UK are currently exporting, compared to 44% of those in Germany. Offering new capabilities for international connections, R&D, mentorship or investment would equip UK semiconductor scale-ups with the tools needed to scale both within, and then outside of the UK. Here, the National Semiconductor Centre could play an important role alongside existing initiatives from UKRI and DBT to forge connections for UK businesses.

Recommendation 18: Support Industry and Academic partnerships

Partnerships between the UK's world-leading universities and semiconductor businesses are essential for transforming academic research into practical, real-world solutions. To bolster these partnerships, the UK Government should increase funding to support joint research and development initiatives, creating opportunities for academia and industry to collaborate closely on innovative semiconductor technologies.

The UK's globally renowned universities are uniquely positioned to drive semiconductor innovation. In Northern Ireland, for example, Seagate Technology collaborates with Smart Nano and Queen's University Belfast on a doctoral training program and R&D in photonics, demonstrating the potential of regional partnerships. By replicating and scaling such models, the UK can further harness its academic strengths to support local and national semiconductor ecosystems.

Chapter 5: Nurture the skills the chips industry needs

Background

The growth of the UK semiconductor sector is contingent on our ability to upskill, attract and retain the brightest people. Organisations involved in semiconductor technology require a high bar of theoretical expertise, practical experience and commercial knowledge. Skill shortages are already being felt by the semiconductor industry. Without a targeted approach, the current trajectory of skills demand threatens to exceed supply, undercutting the sector's growth.

Right now, the reality is that private sector initiatives are addressing the skills demand in this space. For example, the Semiconductor Education Alliance, initiated by Arm in collaboration with academia, government, and industry, aims to address the semiconductor skills gap.[79] The alliance seeks to unite diverse partners to improve STEM and Computer Engineering education, which includes teaching and learning resources, research support, and free online courses.[80] The alliance partners with institutions like Anglia Ruskin University, Cornell University, the Taiwan Semiconductor Research Institute, and the UK Electronics Skills Foundation. Together, they develop competency frameworks and accelerated training pathways tailored to regional needs.

Investing in skills development is especially critical as the semiconductor has been shown to support regional inward investment and economic growth. The UK is home to several regions with expertise in the semiconductor sector, with the skill set available varying as a reflection of these specialities. For example, Northern Ireland has a growing photonics cluster, Scotland has expertise in advanced packaging and South Wales has the compound semiconductor cluster, as mentioned in Chapter 3. Average salaries are approximately £61,000 in the South Wales cluster, with estimated GVA contributions of £265m. This compares to an approximate Welsh median salary of £32,000.[81] It is anticipated that the total employment impact, including both direct and indirect jobs supported in Wales, will exceed 4,000 by the end of 2025.[82] This shows how targeted investment and skills development in semiconductor clusters can support regional success and economic revitalisation. Targeted support also allows regional ecosystems to tailor their skills delivery to match the needs of the local area. For example, Cardiff University's Institute for Compound Semiconductors provides research facilities for academic and commercial researchers, in addition to product development and testing. Cardiff University's close collaboration with industry is reinforced through their Compound Semiconductor Electronic Engineering master's courses, creating a direct pipeline into the sector.[83]

Challenge

Skill shortages are already being felt by the semiconductor industry. If this is not addressed, the current trajectory of skills demand threatens to exceed supply, undercutting the sector's growth. Furthermore, there must be a tailored approach to skills development across the semiconductor value chain. The skills requirements will vary greatly between businesses, depending where in the development process they operate.

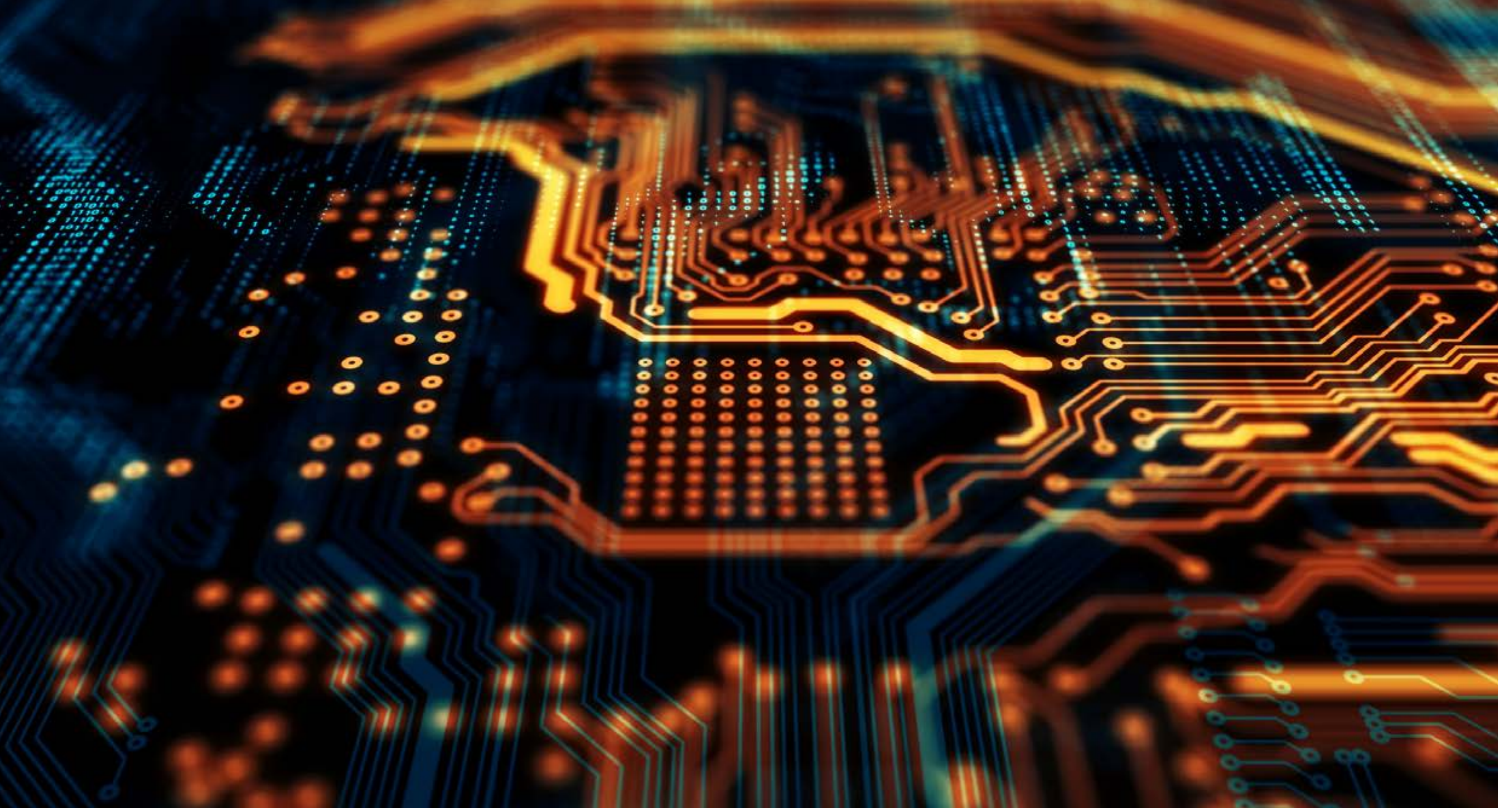
Manufacturing, for example, requires a local talent pool of highly experienced process engineers, material scientists, and technicians, supported by construction workers and area operators that hosts these facilities.[84] This contrasts with those in the design sector who require experts in electronic design automation, signal processing, microarchitecture and understandings of System-on-a-Chip (SoC) development. This exemplifies the need for an intricate and targeted approach to addressing the skills needs of this sector. However, some techUK members believe that support so far has not reflected the deeply specific needs within certain subsectors or regions. This is an area where action is needed from UK Government and the semiconductor sector alike, especially as emerging technologies and new materials place further demands on the levels of skills training needed.

Underpinning the ability for the UK to generate a strong pipeline of skills, is the perceived accessibility and general attractiveness of the sector. The limited size of the current talent pool suggests not enough people are drawn to the sector. This is particularly evident amongst underrepresented communities and younger individuals, who are not engaging with or pursuing opportunities in the field at sufficient levels. Only 3.51% of semiconductor companies were founded by all-female teams, and only 8.77% of founders were mixed gender teams. Whilst this is a problem broadly within the tech sector- female founded startups accounted for less than 2% of VC investment in 2023- it is a problem within semiconductors disproportionately. Of all UK high-growth businesses, about 57% are exclusively male founders, dedicated semiconductor companies are exclusively male 87% of the time. [85] [86]

Attracting a long-term talent pipeline of young people into the semiconductor sector is also an increasing challenge felt by much of the industry.[87] Research from Barclays Eagle Labs showed that founders aged 20-29 make up a mere 1.47% of semiconductor founders. Whilst some of this may be a consequence of accumulated knowledge, industry experience, connections and personal wealth, there is indeed scope for greater inclusivity and diversity in the sector.[88] The semiconductor sector would benefit from encouraging a long-term pipeline of young people and those from underrepresented communities studying STEM related subjects. In particular, techUK members have highlighted how electrical engineers play a pivotal role across this sector, designing and testing chips.

Some members also expressed that there is a shortage of education and training providers specialising in semiconductor skills at an advanced level across the UK. Level 4/5 qualifications, which are comparable to the first and second years of university, in areas such as semiconductor manufacturing, material characterization, and quality assurance, are not accessible enough across education providers. UK Government could help by offering multiple routes into a career in the semiconductor sector, including encouraging those to study STEM and other semiconductor related subjects at an advanced level.[89]

Finally, attracting global talent is also a challenge. Migration plays a vital role in sustaining ongoing innovation, competitiveness, and employment opportunities in the UK. However, the steep visa costs act as a deterrent for businesses and adversely affect the UK's attractiveness as a hub for tech companies. In early 2023, some techUK members reported that obtaining a



visa for a UK-based staff can be up to six times more expensive than for EU-based staff. As of October 2023, a five-year work visa costs around £9,000. Despite the already high costs, the UK immigration fees have been raised further.[90]

The cost of a Certificate of Sponsorship (CoS) for Skilled Workers has increased by 20% since 2023. Similarly, skilled worker entry clearance with CoS of three years or less, and with CoS of more than three years has increased by 15%. The annual cost of the Immigration Health Surcharge is set to increase by 66% from £624 to £1,035. This surcharge for children and students will increase from £470 to £776.

Additionally, the current visa rules and system are exceedingly complex, making navigating it a challenge. Streamlining the visa application process and making it more straightforward would not only benefit businesses but could reduce administrative burdens for both applicants and government agencies, leading to more efficient processes. This will prove especially fruitful for SMEs, who are set to benefit most through saved financial and resourcing costs.

Recommendations

Recommendation 19: Undertake a gap-analysis of key skills needed to scale the UK semiconductor industry to better understand specific needs of the semiconductor value chain

The ecosystem requires a wide breadth and detailed level of skills. For example, the needs of a Welsh Compound Semiconductor company that manufactures chips is different to those of a fabless company in Northeast England. The requirements vary per business, with the local talent pool from which they can draw also differing. To better understand where specific skills are needed across regions and sectors, techUK suggests undertaking a gap analysis to understand the precise demands of a region, which can then be targeted with a high level of effectiveness. An analysis specifically focusing on the precise skills needs of each region would illuminate the key skills missing across IP, design and manufacturing, and is key to understand where targeted investment could be most effective. A gap analysis would also support the development of proactive tailoring of skills and career frameworks to meet projected demands in emerging technologies.

Recommendation 20: Create targeted regional skills support for place-based innovation

Skills support at the regional level would enable UK Government to bolster regional specialisms. This can build upon the success of established clusters, by addressing the direct challenges of each region. A National Semiconductor Centre could help inform this apportioning of support.

Recommendation 21: Make the UK the most attractive place for international talent

Developing advanced technologies requires a diversity of skills both from within and outside of the UK. Visa applications can be lengthy and expensive for businesses and overseas skilled workers. This could be reduced by lowering cost burdens and waiting times for specific categories of high priority overseas skilled workers. Government should work with business to map out in demand roles and reduce visa burdens.

Semiconductor companies should be supported throughout the immigration process, by the

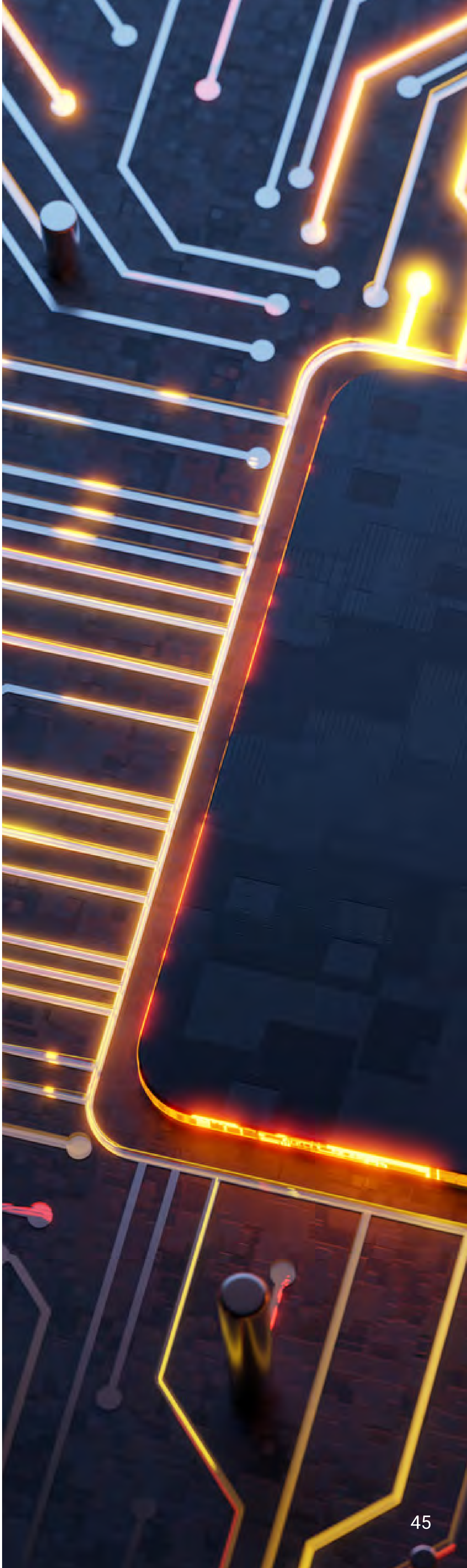
Government addressing backlogs or high costs of sponsorship. This could also come in the form of leveraging shortage occupation lists to enable an easily route to talent for semiconductor-specific requirements, such as for design and new manufacturing techniques.

Recommendation 22: Support campaigns to boost visibility of UK semiconductor excellence

Despite the huge impact the semiconductor industry has on our daily lives, and will continue to have on emerging technologies, many people simply don't know much about it. This sentiment has been reported from stakeholders spanning multiple UK regions and semiconductor specialisms.

Demystifying the semiconductor industry, including efforts to make it more diverse, can go a long way to supporting the skills pipeline, especially at an early stage. Diversity of thought in addition to attracting, recruiting and retaining a diverse workforce is critical to establishing a strong skills pipeline.[91]

The National Semiconductor Strategy originally promised to create a semiconductor-specific page as part of the Great Talent Campaign. The UK Government should recommit to delivering in this area, which could also include supporting industry led campaigns which seek to showcase the sector. This support could come in the form of financial backing or contributing resources to events or showcases. techUK would be delighted to support and facilitate industry and government in this pursuit.



Chapter 6: Strengthening the UK sector through global partnerships

Background

As emphasised throughout this paper, the UK's semiconductor sector is part of a competitive international supply chain, and this global network must be leveraged to maximise opportunities for the domestic sector. UK semiconductor businesses will not operate in silos. International engagement will be essential to leverage partnerships, investment and talent. Perspective Economics data found that 23% of new semiconductor company hires come from abroad.[92]

In addition to finding new partners and talent, international cooperation is essential to access the physical materials that semiconductor companies use, especially in manufacturing. Expertise in importing materials and exporting products is critical to the success of the UK ecosystem. In 2023, for example, the South Wales cluster alone is estimated to have exported a value of at least £514m, exporting 90% of its total products.[93] Ensuring UK companies can identify and collaborate with global partners, access international markets and end users, as well as comply with a vast array of trade security frameworks is, of great importance.

The UK sector is susceptible to future vulnerabilities. The resilience of this supply chain refers to the ability for the UK semiconductor sector to remain prepared and adaptive to disruptions. This includes undertaking measures to secure access to critical materials and protecting UK imports and exports.

Challenges

Navigating the challenges and opportunities in the global market is no easy feat, especially for the resource-strapped 41% of UK semiconductor businesses with under ten employees. Visibility to potential partners and investors, including easy avenues in which to connect with the global ecosystem are lacking. While DSIT, DBT and UKRI have been leading international trade initiatives and delegations, there is no centralised government voice advocating for the UK sector internationally. techUK has hosted delegations from Japan and wider Asia Pacific regions, which has shown there is great demand to learn more about the UK market.

Semiconductors are a foundational technology, key to not only driving innovation in day-to-day technology, but also in applications in defense. As such, semiconductor capabilities are understandably viewed by global governments as key to national security, due to the role they play in developing equipment in aerospace, sensors, electronics or lasers, all of which can fall under "dual-use".[94] Dual-use categorisation refers to products or technologies that have primarily

a civilian end user but could also be used for military purposes. Whilst this categorisation is not inherently deleterious, if it does lead to a narrowing of potential partners then the importance of ally partnerships is even more critical. Escalating geopolitical tensions have led to a surge in export controls and sanctions globally. Whilst sanctions and export controls are key strategic tools for economic security, they can also penalise firms innovating in key emerging technologies by reducing access to global clients and partners.[95] Export controls and regulations- whilst an important tool in national security- can complicate global trade for UK firms. The dual-use categorisation of semiconductors adds another layer of regulatory complexity, limiting the flexibility and market potential for these technologies. As of April 1st, 2024, the UK expanded its export controls regime to encompass key emerging technologies, including semiconductors, requiring a general license for exports.

Dependence on fundamental raw materials adds to the challenges and risks associated with ensuring security of supply. For example, materials used in packaging, such as silicon carbide, have not had a steady supply in the UK, and US export controls restrict the import of this material.[96] Furthermore, recent conflicts, such as the Russian-Ukraine war, has affected the technology industry. For example, Ukrainian companies previously produced 70-80% of neon gas and 40% of krypton supplies globally.[97]

Recommendations

To help build international collaboration for the UK semiconductor industry, techUK recommends:

Recommendation 23: Use the National Semiconductor Centre to support UK companies in international markets

Part of the responsibility of a National Semiconductor Centre would be to act as a centralised voice for the UK industry on the international stage. Working alongside DSIT and groups like techUK and the Chips Coalition, this Centre should create a navigable database of UK semiconductor companies, providing clear information about the range of organisations working throughout the supply chain. This could take inspiration from the Department of Business and Trade's Digital Health Playbook, allowing full visibility to international and domestic collaborators and investors to the breadth and expertise within the UK semiconductor industry. This database would serve the double advantage of helping the domestic sector connect and collaborate. techUK would be happy to support the Government's work in this, encouraging access to new markets for semiconductor companies, for example through our international delegations and utilising the key connections of groups like the Tech7.

Recommendation 24: Identify commercial opportunities for UK semiconductor companies as part of partnerships with allied countries

There are opportunities for the Government to work with international partners to deliver new opportunities for semiconductors that fall under dual-use. In September 2021, AUKUS was announced as a trilateral Defence and Security agreement between Australia, the UK, and the US. Pillar 2 of this agreement seeks to support mutual innovation in areas key to national capabilities, such as in quantum, AI and autonomy, hypersonic capabilities and advanced cyber.[98] The essential role of semiconductors in these areas opens the door for new areas of support. The UK Government should look at securing international partnerships which could include joint R&D or collaboration in ally-nation facilities for semiconductor companies which develop dual-use technologies. This would enable concurrent growth for the private sector whilst fulfilling the Government's defence ambitions.

Recommendation 25: Work with allies to ensure access to key strategic materials

Key partners of the UK, including the members of the G7, are also facing challenges with their semiconductor supply. The UK Government should work with its partners to develop a common strategy to reinforce the semiconductor supply chain and access to core materials. This should include identifying bottlenecks and vulnerabilities in the supply chain which impact the availability of equipment or raw materials imperative to the growth of UK businesses.

Recommendation 26: Increased transparency of the National Security and Investment Act

The application of the National Security and Investment Act (NSIA) has been non-transparent and difficult for companies caught in the regime. The NSIA has also unnerved investors and created a more cautionary approach to investment in UK semiconductors. The UK Government should seek to provide increased transparency around the implementation and scope of the National Security and Investment Act to ensure that low risk investments are not held up.

Recommendation 27: Ensure export controls do not place UK semiconductor companies at a competitive disadvantage

While export controls and sanctions are an essential part of the UK's foreign and economic security policy toolkit, it is important that we align our controls with those of allied nations. This not only strengthens the international effort to limit the capacity of adversaries to secure cutting-edge technologies, but also ensures that UK controls are no more restrictive than those of other allies, which would place UK semiconductor companies at competitive disadvantage vis-a-vis competitors from friendly nations. The Government should prioritise consultation with industry to gain a clear understanding of UK entities' ongoing activities in affected regions. It is equally important to assess the impact of sanctions and controls on UK businesses, including any challenges they encounter in maintaining compliance. In cases where businesses are expected to face significant disruptions, UK Government should provide adequate support and clear guidance to mitigate these effects. Additionally, the government should ensure that countries with which the UK has signed Free Trade Agreements (FTAs) are granted Open General Export Licenses. This would help ensure that the advantages of trade agreements extend to technologies affected by export controls.

Case Study | UK and Japan Semiconductor opportunity

UK- Japan semiconductor R&D funding should focus on demand-driven, end-user applications in automotive, power electronics, renewable energy, and industrial AI. Industry has noted that current bilateral R&D funding is too limited, and both governments should increase it, prioritizing collaborative projects between industry, government, and academia. For example, building on the University of Bristol's REWIRE centre, the UK and Japan should jointly fund efforts to reduce data centre energy consumption through next-generation semiconductors, including photonics-electronics convergence technologies. This should be repeated at scale, with particular focus on design, IP, and R&D.

UK-Japan stakeholder roundtables have suggested that the Japanese Ministry for Economy, Trade and Industry (METI) and DSIT collaborate to facilitate academic research, as academic routes are often more accessible to international partnerships. Joint work around compound semiconductors, supported by Japanese universities close ties to the automotive sector presents a lucrative growth opportunity.

Full list of recommendations

Chapter 1 | Retain global leadership in design and IP

1. Establish a National Semiconductor Centre
2. Establish a Design Competence Centre to maximise Chip Designers ability to innovate
3. Establish a Semiconductor Design and IP taskforce
4. Support semiconductor licensing protections and patents

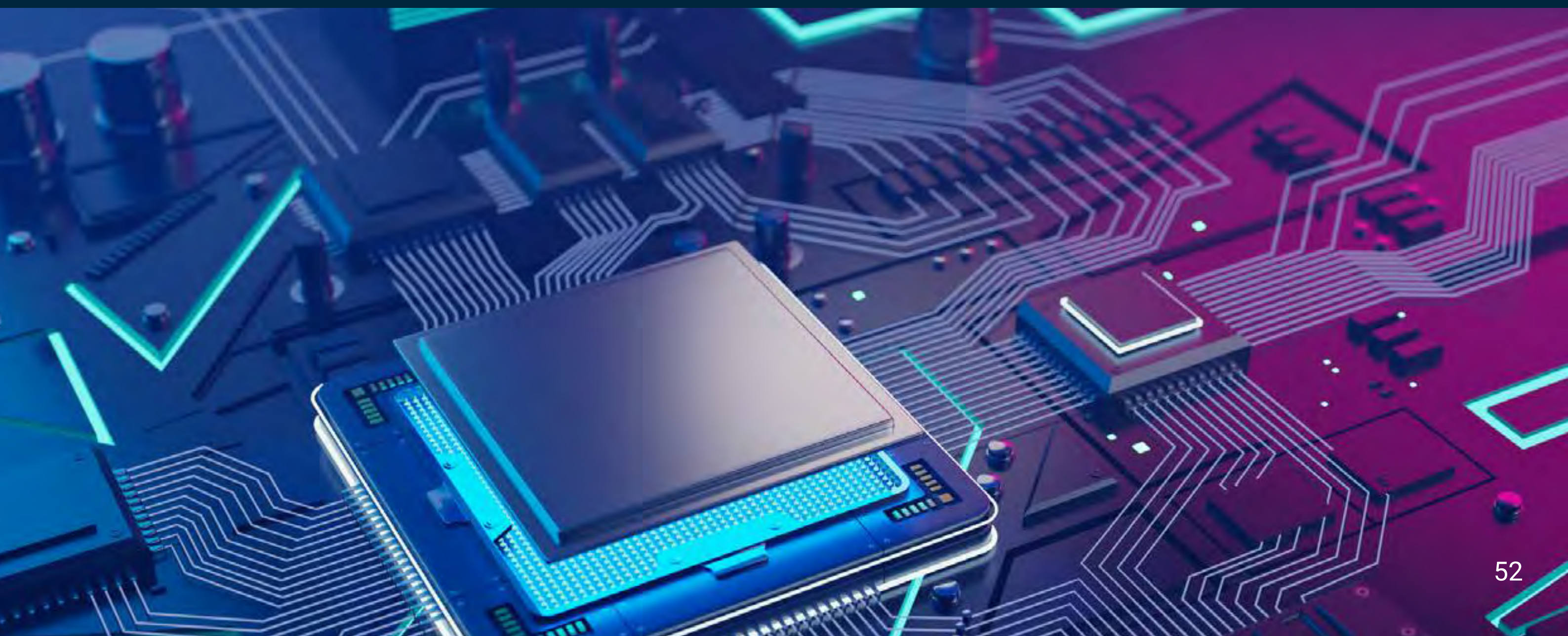
Chapter 2 | Incentivise investment into new areas of growth, including advanced designs, emerging technologies, and end user readiness

5. Extend the qualifying categories of R&D eligibility to include capital expenditure, such as plant and machinery, used solely for R&D purposes

6. Introduce regional teams to provide specialised R&D support

7. Ensure long term stability of the R&D tax credit by maintaining current rates and expanding the ERIS

8. Establish an open access foundry with Pilot Lines capability to bolster R&D in areas where the UK can be internationally competitive



Chapter 3 | Incentivise investment into new areas of growth; advanced designs, emerging technologies, and end user readiness

9 Classify semiconductor capabilities as Critical National Infrastructure (CNI)

10 Continue to view semiconductors within the Government's five key technologies

11 Proactively engage in a cross-government approach to delivery semiconductor support

12 Support the adoption of advanced semiconductors into UK industries and sectors

13 Support the development of advanced designs and the intersection of semiconductors with emerging technologies through targeted funding

Chapter 4 | Promote innovation and support scale-ups through access to markets and private capital

14 Renew the ChipStart pilot scheme and expand its scope

15 Utilise public institutions like the National Wealth Fund to create more funding support for semiconductor scale-ups

16 Use a National Semiconductor Centre to establish long term support and representation for scale-ups and as a vehicle for outreach to investors

17 Help UK scale-ups build international connections

18 Support Industry and Academic partnerships

Chapter 5 | Nurture the skills the chips industry needs

19 Undertake a gap-analysis of key skills needed to scale the UK semiconductor industry to better understand specific needs of the semiconductor value chain

20 Create targeted regional skills support for place-based innovation

21 Make the UK the most attractive place for international talent

22 Support campaigns to boost visibility of Semiconductor technology

Chapter 6 | Strengthening the UK sector through global partnerships

23 Use the National Semiconductor Centre to support UK companies in international markets

24 Leverage Dual-use categorisation to support the semiconductor industry

25 Work with allies to ensure access to key strategic materials

26 Increased transparency of the National Security and Investment Act

27 Ensure export controls do not place UK semiconductor companies at a competitive disadvantage

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