THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

UK Semiconductor Handbook

A Project for the UK Government Digital Trade Network

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Disclaimer

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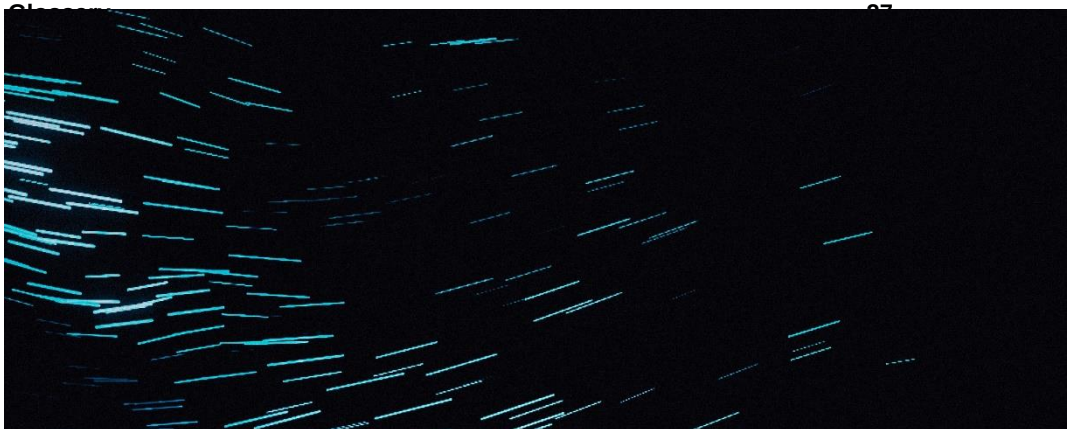


Summary

The UK semiconductor industry takes a unique position in the world thanks to its world-leading design capabilities – notably Arm that enables much of today's mobile computing – **and UK's dominance in compound chips**. The UK is the home of a major cluster for next-generation SiC and GaN chips that are critical for high-performance applications used for quantum computing, electric vehicles, 5/6G, Internet of Things (IoT), and immersive technologies (AR/VR).

The UK showcases **five world-leading clusters** for semiconductors:

- South Wales (compounds)
- Cambridge (HQ of Arm, the university and its science parks)
- Bristol (fabless designs)
- Scotland (photonics, compounds, prototype designs)
- Northeast (advanced materials and compounds)

The UK is one of the few **countries in Europe that can boast market presence across the supply chain** – from design automation tools, IP and design licensing and chip designs to capital and fabrication equipment, fabs and chip manufacturers to packaging and testing.

The UK benefits from a long history **(over 60 years) of nurturing talent and skills** for the semiconductor industry through its world-class universities and R&D system. Academia and industry collaboration have spearheaded new ventures, and several of today's industry market leaders began their journey as a start-up at a UK university – and they have all chosen to remain in the UK. Cambridge, Cardiff, Swansea, and Bristol are just a few of the universities that are home to Nobel Prize winners, backbones to our clusters, and continue to feed both innovation and talent to the industry.

There is a history of **consistent support, incentives, and funding** from UK government agencies to kick off innovative activities. The UK has an open, strong, and pro-business environment as well as a liberal economy and a corporate-friendly regulatory environment (that operates entirely in English) and hosts vibrant and affluent expat communities from Asia.

The UK enjoys extremely low vulnerability towards natural disasters. It also has one of the lowest geopolitical risks thanks to its standing in the multilateral system. And to date, **its semiconductor industry has not been subjected to any embargoes or coercive measures**.

In sum, the **UK is an ideal partner for companies looking to take their semiconductor business to the next level.** British private sector's **strengths in semiconductor design and innovation perfectly complement** the capabilities of other companies globally.

An Overview of the UK Semiconductor Industry

UK's Unique Position in Global Supply Chains

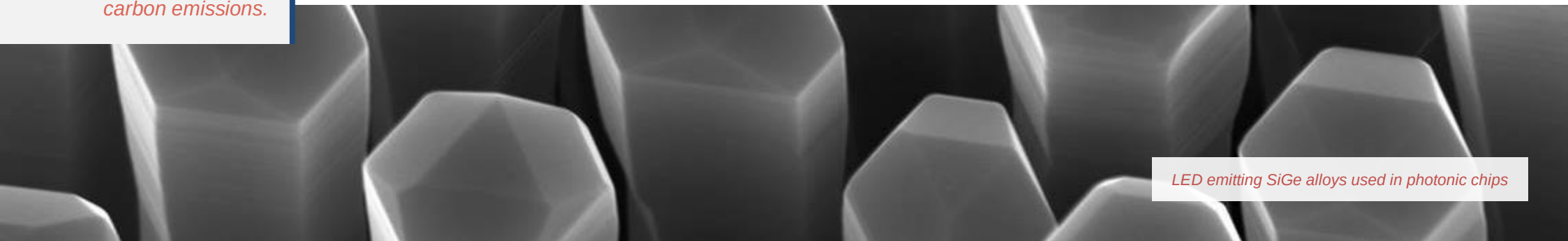
The UK is an eminent leader in compound semiconductors where it has capability across semiconductor design, manufacturing, and post-fab processes. The UK was an early adopter of compound semiconductors and spent close to £800 million in research and development of compound semiconductors, and one of the world's leading clusters for silicon carbide (SiC) or gallium nitride (GaN). Whereas silicon remains the most common material for mass-market chips,[i] compounds are fast-growing thanks to its more future-oriented and higher-performance applications, radio frequency (RF) units, wireline communications, power electronics, and sensors that are critical for electrification, 5/6G, IoT and immersive technologies. Also, advanced materials such as graphene or diamond are being used on an experimental basis and promise huge potential.[ii]

> *In 10 years, chips will feature some material different to silicone, especially because this is a way to reduce power in data centres as well as reduce carbon emissions.*

Fabs in South Wales, Newton Aycliffe in northeast England and in other sites in UK are engaged in manufacturing compound semiconductor chips and devices that are used for automotive, communications, and sensory technologies (used in IoT, 5/6G, and immersive tech like AR/XR), where the UK offers full manufacturing capabilities and integrated supply chains. As the demand for compound semiconductors used in these products will continue to grow in the future, the UK is expected to solidify its leading clusters and further integrate its supply chains.[iii]

Regarding traditional silicon-based chips, the UK is preeminent in design capabilities. Companies like Arm and Imagination Technologies have revolutionised personal and mobile computing, and count tech giants like Apple and Qualcomm among their customers. The UK also has noteworthy manufacturing capability with more than two dozen fabrication plants distributed from Manchester, Oldham and Hazel Grove in England to Greenock in Scotland to university fabs in Cambridge, Leeds, Cardiff and Swansea. These fabs cater to specialised markets that supplement the silicon-based fabs in Taiwan.

Semiconductors based on new materials are another area of strength and potential in the UK. Our research institutes and start-ups have been the centre for innovation in chip design in newer materials like graphene and diamonds. Andre Geim and Kostya Novoselov won the Noble Prize in 2010 for their discovery and experiments with graphene at Manchester University.[iv] Graphene Engineering Innovation Centre (GEIC) and the National Graphene Institute for research and application of graphene demonstrate the UK commercialisation of foundational research into capability for unrivalled chip design. The world's first company to mass-produce graphene semiconductors, Paragraf, is a UK company. In addition, the UK boasts of cutting-edge capability in diamond-based semiconductors, another up-and-coming semiconductor area. One will not struggle to find examples of the UK's potential in both world-class semiconductor research as well as in the commercialisation of that research.[v]



LED emitting SiGe alloys used in photonic chips

A historical background to the UK Industry

Geoffrey Dummer – father of silicon-based chips

The UK has been home to many pioneers in the semiconductor industry. The history of this industry cannot be written without the UK. It was a British engineer, Geoffrey Dummer, who popularised the idea of laying an electrical circuit on a silicon layer which led to the development of integrated circuits or microchips. In the 1960s, companies like Marconi-Elliott Microelectronics, Elliott Automation, Ferranti Semiconductors and Plessey Semiconductors emerged as the face of the British semiconductor industry. The UK government provided funding and support to these companies, with the government spending £8 million on chip research in 1968 alone, a sum comparable with the US government's research expenditure in that era. 1968 was also the year when CML Microcircuits was founded. CML Microcircuits has thrived as a designer and manufacturer of telecommunication semiconductors since then.

Many of these British companies would leave their mark on the global semiconductor industry. Plessey Co Plc is such an example as it served as a market leader in the 1980s in the development and marketing of Emitter Coupled Logic (ECL) logic arrays, the fastest bipolar devices at that time.[vi] British Telecom Research Laboratories (BTRL) designed 'gate arrays', a kind of prefabricated silicon chip, which had widespread usage in the telecommunication sector. Ferranti made the first silicon diode in Europe in 1959 and then went on to pioneer the commercial use of gate arrays with their Uncommitted Logic Arrays (ULA). Their products were overwhelmingly popular for many years including in the home computers of the 1980s.[vii] Imagination Technologies is a UK-based semiconductor design leader which was founded in the same decade. It presently supplies graphic processor and neural network accelerator technology for video games and mobile devices to customers like Intel and Samsung.

1990 witnessed the birth of another UK semiconductor champion, Advanced RISC Machines Ltd, later – Arm. It started as a joint venture by Apple with VLSI Technology and UK's Acorn Computers. Today, almost all big tech firms are dependent on their IP. It possesses almost a complete monopoly in the smartphone chips market with 99 percent share. It was also the top semiconductor design company in the world in 2022 in terms of company revenue, and in terms of royalties, it dwarfed its chip design competitors with 63.8 percent market share.

The history of the semiconductor industry in the UK is full of ground-breaking innovation by firms big and small. The story of semiconductors in the UK today continues with a mixture of legacy firms and rising industry stars.

Original founders of Arm

Timeline

The History of the Semiconductor in the UK

1952 — Geoffrey Dummer first proposed the idea of laying an electrical circuit on a silicon layer which led to the development of integrated circuits or microchips.

1959 — Ferranti made the first silicon diode in Europe.

1960 — In the 1960s, Marconi-Elliott Microelectronics, Elliott Automation and Plessey Semiconductors emerged as the face of the British semiconductor industry. The UK government supported these companies, spending £8 million on chip research in 1968 alone, a sum comparable with the US government's research expenditure in that era.

1968 — CML Microcircuits was founded and has thrived as a designer and manufacturer of telecommunication semiconductors since then.

1974 — The semiconductor distributor Memec was founded, bringing emerging, early-stage US IC products.

1978 — The UK government played a key role in the foundation of a startup called Inmos which will produce transputers.

1980 — Between 1980-82, the Inmos microprocessor factory was completed. Today, it is known as Newport Wafer Fab.

In the 1980s, Plessey Co Plc served as a market leader in the development and marketing of Emitter Coupled Logic (ECL) arrays, the fastest bipolar devices at that time. British Telecom Research Laboratories (BTRL) designed 'gate arrays', a kind of prefabricated silicon chip, which had widespread usage in the telecommunication sector. Ferranti pioneered the commercial use of gate arrays with their Uncommitted Logic Arrays (ULA).

1985 — Imagination Technologies, the UK-based semiconductor design leader, was founded.

1990 — 1990 saw the birth of another semiconductor champion in the UK: Advanced RISC Machines Ltd., later known as Arm.

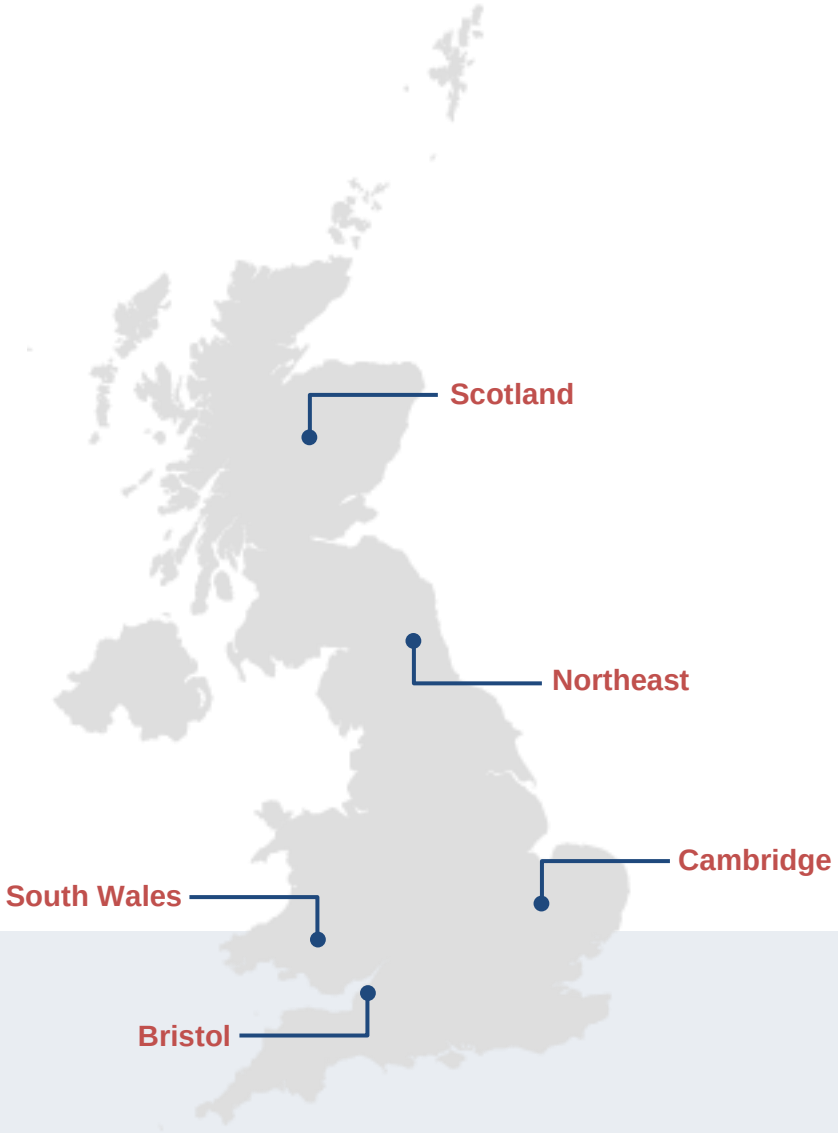
Unique Strengths of the UK Semiconductor Industry

Five World-Leading Clusters in the UK

The UK is home to five distinct semiconductor clusters, all of them boasting expertise in a variety of semiconductor products, materials, and processes.

- South Wales (compounds)
- Cambridge (HQ of Arm, the university and its science parks)
- Bristol (fabless designs)
- Scotland (photonics, compounds, prototype designs)
- Northeast (advanced materials and compounds)

These pools of semiconductor expertise sprung up around world-class fabs run by semiconductor champions and supported by the incredible talent in the local universities. These clusters, once established, act as centres of gravity for more investment, more research, and more expertise. They all have distinctive qualities but together, these clusters make the UK one of the leading semiconductor hubs in the world.



South Wales

The cluster in South Wales is **unique for being the first and only dedicated compound semiconductor cluster in the world**. Although compound semiconductor accounts only for 20 percent of chips used, this industry is growing worldwide at the rate of 6.1 percent annually and is predicted to reach $350 billion by 2030. The **future of AI, IoT, solar power, automotive, LEDs, and quantum computing rests on compound semiconductors, and South Wales is the centre of innovation** in this sector. IQE, Microchip, SPTS Technologies and Newport Wafer Fab have a long history in this region. Rockley Photonics, Microlink Devices, Vishay, Siemens and other semiconductor stars have also established their presence in the cluster. These compound semiconductor champions have set up a close partnership with Cardiff University and Swansea University, setting up the Institute of Compound Semiconductors (ICS) at Cardiff University and the Centre for Integrative Semiconductor Materials (CISM) at Swansea University and Compound Semiconductor Centre (CSC) as a collaboration between IQE and Cardiff University.

The UK government has, at various levels, also supported research and partnerships in the cluster through the UK Research and Innovation (UKRI), Cardiff Capital Region City Deal and the Welsh Government. Compound Semiconductor Applications Catapult and CSConnected are **umbrella bodies promoting collaboration between the industry, academia and government bodies**.

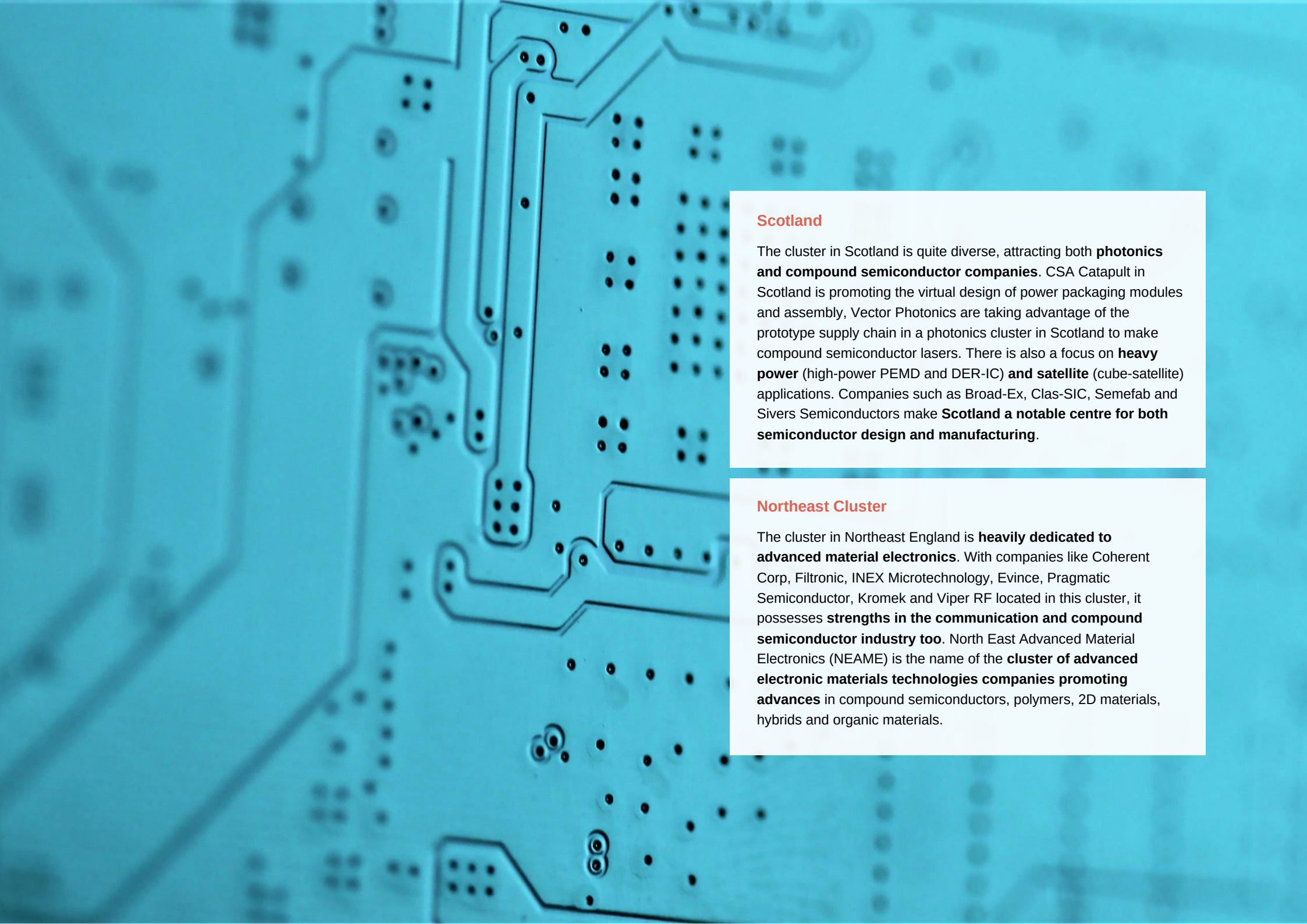
South Wales – World's first (and only dedicated) cluster for compounds.

Cambridge Cluster, UK's Silicon Fen

The Silicon Fen is clustered around Cambridge University, Cambridge Science Park and Cambridge Business Park. Home to Nobel Prize winners and a hub for the innovators of the semiconductor industry, the Silicon Fen has earned its title by serving **as the headquarters of companies like Arm and attracting the presence of semiconductor heavyweights such as Imagination Technology, Mediatek, Broadcom and Qualcomm**. Cambridge and its surroundings boast of many tech startups, such as Paragraf and Pragmatic, that carry the promise of transforming the semiconductor industry tomorrow. The **talent at Cambridge University and resources such as Maxwell Centre** at the University and Cambridge Innovation Capital are part of the attraction for many of the firms established in this region.

Southwest Cluster

Also known as Silicon Gorge, South West has served as **the home for many fabless semiconductor design companies**. Strengthened by the **pool of semiconductor talent at Bristol University**, many of the innovative startups in the semiconductor space like XMOS and Graphcore are based here. Veteran players like Codasip, Imagination Technologies, Qualcomm, Intel, Nordic Semiconductor, Infineon and STMicroelectronics have also established offices, design centres and R&D centres or, in the case of Cadence, its Europe, the Middle East and Africa (EMEA) Headquarters in the Bristol. Due to the presence of semiconductor design talent and start-ups, Bristol has been **recognised as an "innovation hot spring" by McKinsey and the World Economic Forum**.



Scotland

The cluster in Scotland is quite diverse, attracting both **photonics and compound semiconductor companies**. CSA Catapult in Scotland is promoting the virtual design of power packaging modules and assembly, Vector Photonics are taking advantage of the prototype supply chain in a photonics cluster in Scotland to make compound semiconductor lasers. There is also a focus on **heavy power** (high-power PEMD and DER-IC) **and satellite** (cube-satellite) applications. Companies such as Broad-Ex, Clas-SIC, Semefab and Sivers Semiconductors make **Scotland a notable centre for both semiconductor design and manufacturing**.

Northeast Cluster

The cluster in Northeast England is **heavily dedicated to advanced material electronics**. With companies like Coherent Corp, Filtronic, INEX Microtechnology, Evince, Pragmatic Semiconductor, Kromek and Viper RF located in this cluster, it possesses **strengths in the communication and compound semiconductor industry too**. North East Advanced Material Electronics (NEAME) is the name of the **cluster of advanced electronic materials technologies companies promoting advances** in compound semiconductors, polymers, 2D materials, hybrids and organic materials.

Innovation and Talent Delivered by UK Academia

The universities in the UK have been home to leading scientists and innovators of the world for centuries. The universities profiled have emerged as hubs for revolutionary breakthroughs in the semiconductor industry as well as the anchors for tech startups, spinouts and semiconductor clusters. Other universities, such as Imperial College London, University of Glasgow, Oxford University and Queen Mary's University, are also prominent in the advancement of chip design and innovation.

Paragraf has benefited from the incredible talent in UK universities.

Cambridge University: The incredible talent at Cambridge University has been the starting point for several stars of the semiconductor industry. Alphamosaic, acquired by Broadcom, and Cambridge Silicon Radio, acquired by Qualcomm, began their journey as spinouts from the university. The university has been home to serial innovators and founders, backed by government research grants, state-of-the-art equipment at Maxwell Centre and partnerships with firms like Arm. Arm and Cambridge University work together to develop the Morello prototype board while Arm supports PhD students at the university. Such close collaboration between academia and industry is a hallmark of the British innovation ecosystem. Cambridge Centre for Gallium Nitride conducting research into nitride based III-V semiconductors is also located here.

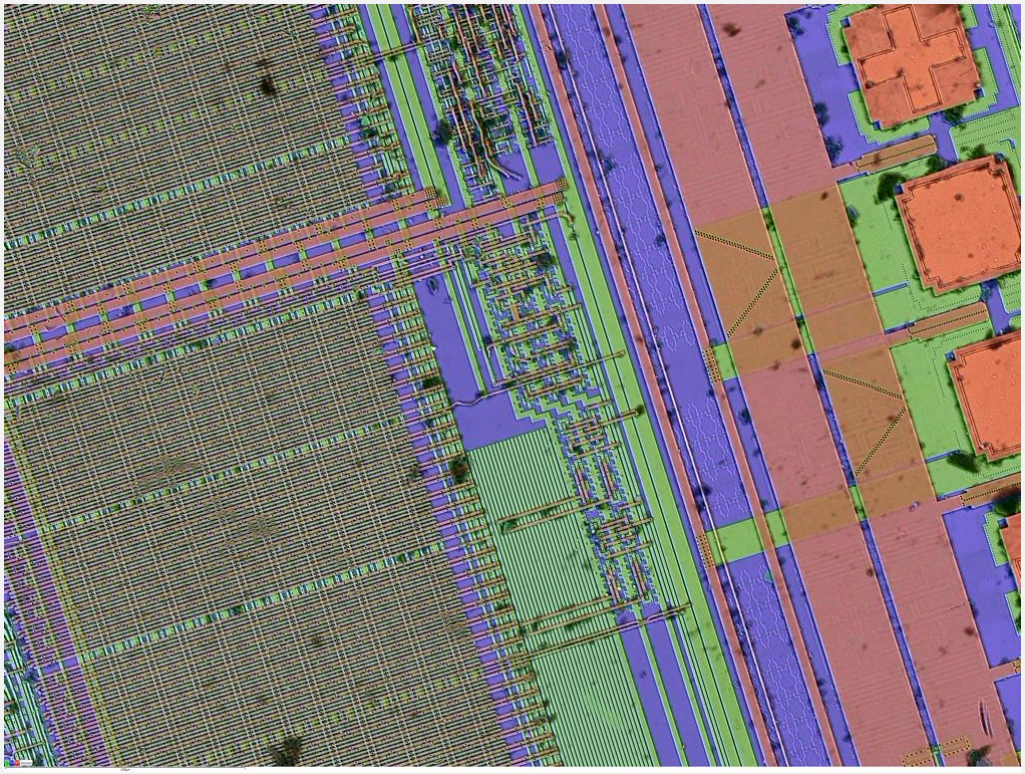
Cardiff University: Cardiff University has been leading the compound semiconductor innovation along with Swansea University in South Wales. Cardiff University and IQE collaborated in 2015 to establish the CSC dedicated to materials and commercial development. The ICS was also founded at Cardiff University with support from the European Regional Development Fund, UK Research Partnership Investment Fund, and the Welsh Government. ICS has a manufacturing facility as well as a semiconductor research centre. Researchers in the ICS and Cardiff Catalysis Institute (CCI) have joined together at Translational Research Hub (TRH) for Net Zero industry solutions and work across sectors such as energy, advanced materials, transport, communication, etc. CSConnected is another project which brings together Cardiff University with regional partners for semiconductor innovation and development. Researchers at the university have also won UK government grants for semiconductor R&D.

Swansea University: Swansea University is the other, equally important academic pillar supporting the compound semiconductor cluster in South Wales. CISM is an example of the close relationship between Swansea University and the South Wales semiconductor industry. It offers advantages such as "applied R&TD, prototyping and process development, specialist services, incubation, engagement, training and access to the UK and EU innovation grants portfolio". Additionally, it boasts manufacturing-grade clean rooms as well as materials integration and packaging capability. Swansea University is also a partner in CSConnected.

Bristol University: Bristol University has been the backbone of the Silicon Gorge and the flourishing semiconductor design industry at Bristol. It has been home to many spinouts such as XMOS, Forefront RF and Sensor Driven. Its Center for Device Thermography and Reliability serves as research centre for improved thermal and electrical performance of semiconductor devices. Its talent has also attracted R&D activities from international companies as well as government support in the form of research grants and funding.

XMOS benefits most of all from the talent in the UK. Many of their people came from the University of Bristol and then built their knowledge within the Bristol cluster. The combination of academic talent and commercial experience is also important, especially in early years.

University of Southampton: University of Southampton conducts research on Nonlinear Semiconductor Photonics to develop "new semiconductor material platforms for application in nonlinear photonics". Its School of Electronics and Computer Science is also part of Semiconductor Education Alliance, partnering with leading firms like Arm, Cadence and Taiwan's TSRI, to encourage a new generation of skilled engineers, designers and workers.



A Backscattered Electron and X-ray (BEX) image of an integrated circuit device collected using an Oxford Instruments Unity detector. BEX imaging enables high resolution imaging with elemental contrast in the scanning electron microscope. Credit: Oxford Instruments Plc

UK business environment

The wider business environment in the UK also adds to the advantages enjoyed by the semiconductor industry, along with the talent pool in the universities, established and rising semiconductor stars, government support, unique clusters, industry associations and business incubators. The benefits of the UK's business eco-system are discussed below.

Strong IPR Regime

The UK has been ranked second, only after the US, in the International Intellectual Property (IP) index prepared by the US Chamber of Commerce. In their words, the UK has "a strong and sophisticated national IP environment". The International Property Right Index by the Property Rights Alliance has also consistently ranked the UK in the top 20 countries for the protection and enforcement of intellectual property rights. Any entrepreneur coming to the UK for partnership on the tech front can rest assured about the safety of their IP products. In the semiconductor industry, where IP is everything for fabless semiconductor designers, the UK is the right place to be.

Connected Infrastructure

In the 'Most Well-Developed Infrastructure' rankings of 2022, the UK ranked in the global top 4, with Germany, Japan, and the US. The UK is home to over 40 major ports, 70 airports, outstanding rail links and toll-free motorways connecting it to the rest of Europe and the world at large. It has the second largest urban rail network in Europe and Port of Felixstowe, one of the top 10 largest ports in Europe. It has some of the most widely used airports and railways in the world and its digital infrastructure also matches the physical infrastructure in terms of excellence.

Low Vulnerability

The UK enjoys low vulnerability to natural disasters. According to the World Risk Index, the UK is much safer than the US, Japan, and South Korea based on vulnerability to natural disasters. Its low risk of disasters and high preparedness for disaster management make it a good candidate for diversifying the semiconductor supply chain and reducing geographic concentrations. As the crises of varied nature in the past few years have shown, strengthening the global semiconductor supply chain also requires diversification. As for macropolitical risks, its excellent relations with the major hubs of the semiconductor industry and strong transatlantic engagement lead to low geopolitical risks: Given its standing in the UN system, G7 member, and with a strong strategic deterrent, the UK semiconductor industry is better protected than many others.

Business Friendly Environment

The UK has an open, strong, and pro-business environment which has attracted businesses from all around the world to expand, trade and invest in its borders. The UK has a high-spending, affluential consumer market as well as a liberal economy and a corporate-friendly regulatory environment. London is one of the biggest financial hubs in the world for a reason. It has an effective legal system and a non-cumbersome tax regime. It is an inviting place for both the SMEs and the large MNCs. Thanks to its comprehensive network of trade and investment agreements, it enjoys a wider duty-free treatment across the semiconductor supply chain.

Government Support for Semiconductor Industry

In addition to the world-leading clusters, R&D, and supply chains, the UK around the world. Given the long history of support from different UK gove of the most stable and consistent in its region.

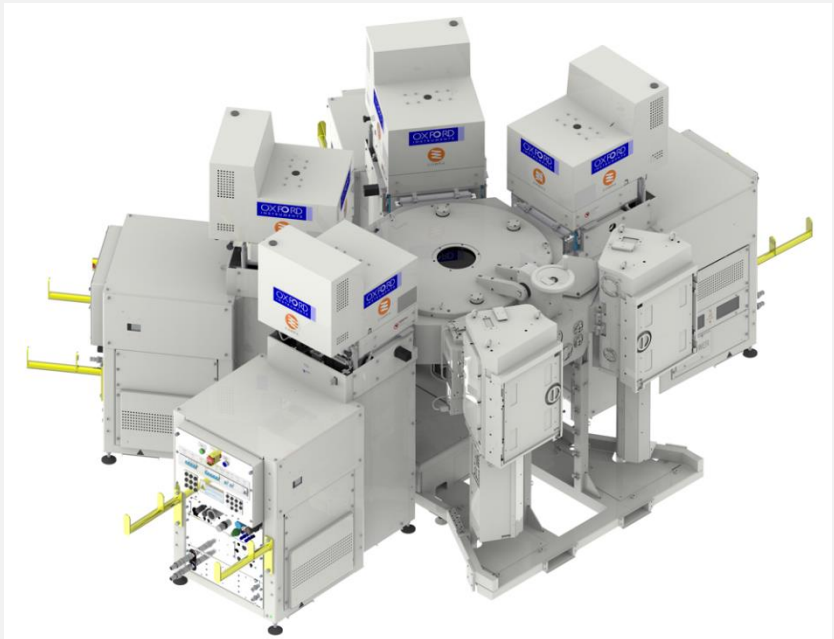
UK Research and Innovation (UKRI) is a public body of the UK Government that directs research and innovation funding, including for international cooperation, funded through the science budget of the Department for Science, Innovation and Technology. UKRI has provided research funds for many of the featured companies such as Newport Wafer, Salience Labs and Yelo.

The Welsh Government has served as a leading player in supporting and funding the activities of the compound semiconductor cluster in South Wales. It is a part of CSConnected as well as a partner in many of the research projects and infrastructure development that has happened in recent years. Cardiff Capital Region City Deal Investment is also another active supporter of the cluster.

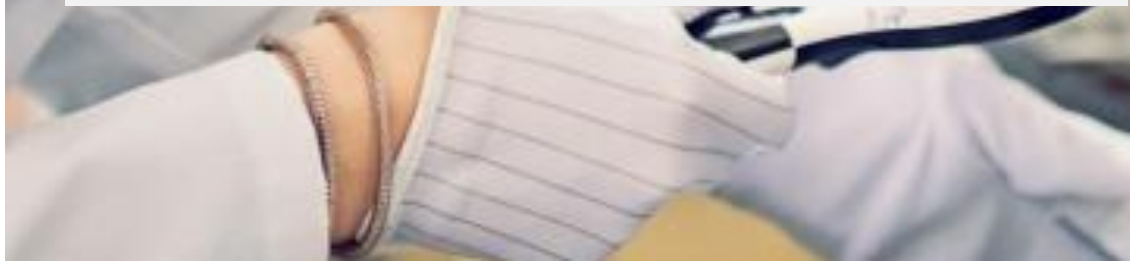
British Business Bank plc (BBB) is a state-owned economic development bank established by the UK Government. It is owned by the Department for Business and Trade. One of its subsidiaries, British Patient Capital has invested £10m in Pragmatic Semiconductor, a Cambridge-based designer and manufacturer of flexible electronics. Its mission is to enable long-term investment in innovative firms led by ambitious entrepreneurs who want to build large-scale businesses.

R&D Tax Credits: Many of the start-ups in the semiconductor industry have benefited from being able to claim Corporation Tax relief on their R&D projects. R&D tax relief supports companies that work on innovative projects in science and technology. R&D tax credits are used by the semiconductor industry and have generally been well received.

The Patent Box, piloted in 2013, is designed to encourage companies to keep and commercialise intellectual property in the UK. It allows companies to apply a lower



Oxford Instruments Plc supplies semiconductor fabrication equipment and solutions including its Cobra range to academic and commercial customers worldwide. Credit: Oxford Instruments Plc



10%. A Specialist Incentive and Relief team is available to support businesses that might be able to benefit from the Patent Box.

Enterprise Investment Scheme (EIS) is designed by the UK government to boost economic growth by providing tax relief to investors who invest their money in smaller, risky, and new businesses. The scheme offers tax reliefs to individual investors who buy new shares in a company with a relief of up to £5 million each year and a maximum of £12 million in a company's lifetime. Semiconductor companies like Kubos Semiconductor have praised the scheme for increasing the attraction of tech start-ups for investors.

ChipStart Programme, launched in Oct 2023, is a two-year pilot programme backed by the government that will provide early-stage companies involved in the design of semiconductors with the technical and commercial help they need to help bring new products to market – and ultimately improve lives and livelihoods in the long-term. The £1.3 million programme will be delivered by SiliconCatalyst.UK, the world's most experienced start-up accelerator, which has engaged with hundreds of chip companies on scaling up and growing. ChipStart will give companies access to bespoke chip design tools, commercial expertise, specialised mentorship, and networking opportunities with prospective investors and partners.

Other initiatives have been undertaken by the Government to support and nurture the semiconductor businesses. The UK government has played a key role in the promotion of networking and the development of deeper connections between UK semiconductor companies and potential investors, buyers, and tech partners from other nations, including by running trade missions to global semiconductor events. The UK Government also published a National **Semiconductor Strategy** in May 2023 and committed £1 billion for the further development of its semiconductor industry.

> *Semiconductors are the bedrock of our modern economy and an increasingly integral part of our lives. These firms are building on Britain's research leadership to open doors to innovation and growth, while designing chips that could truly change the way we live our lives.*
>
> **Paul Scully**
> Minister for Technology

Industry Associations and Support

Compound Semiconductor Applications Catapult (CSA Catapult): CSA Catapult brings together a team of more than a hundred employees in a state-of-the-art innovation centre to initiate projects over £100 million. It aims to make the "UK to be a global leader in developing & commercialising applications for compound semiconductors" and to “accelerate the commercialisation of compound semiconductors”. CSA Catapult began its journey in South Wales and has now set up offices in Bristol, Cambridge and other parts of the UK. They promote cooperation and development in power electronics, RF, microwave, photonic and advanced packaging. It is part of other trade associations like Automotive Electronics Innovation, European Photonics Industry Consortium, TechUK, Photonic Leadership Group, and Technology Connected. It has collaborated with several South Wales-based compound semiconductor companies and is supported by the UKRI.

TechWorks: TechWorks is a Deep Tech industry association in the UK with a wide focus on Manufacturing, Automotive, IoT and Power Electronics. Techworks’ mission is to build a better and stronger tech ecosystem in the UK while promoting brilliance with investments and partnerships that can accelerate speed and improve routes to market and growth. As many of TechWorks’ members are semiconductor companies in the UK, semiconductor technology has been one of its key areas of focus.

National Microelectronics Institute (NMI): The NMI is the semiconductor industry's trade body in the UK. It has a strong engagement with UK universities and has facilitated activities such as quality assurance, knowledge exchange, cost reduction, productivity improvements, and a dedicated suppliers’ forum. NMI is the semiconductor branch of TechWorks.

Silicon Catalyst: Silicon Catalyst, headquartered in the US, is the world's only incubator focused on semiconductor solutions, including sensors, microelectromechanical systems (MEMS), and IP. It accelerates startups from the idea stage to the prototype stage and eventually to full-volume production. Its UK branch has partnered up with the UK government for ChipStartUK, with funds from the Department for Science, Innovation and Technology and the management under Silicon Catalyst UK. The ChipStartUK project aims to help British semiconductor companies achieve greatness and provide access to tools, design IP, and foundry manufacturing.

SETsquared: SETsquared is a great example of efforts in the UK to commercialise the world-class research taking place in its universities. It is a collaboration between the six research-led universities of Bath, Bristol, Cardiff, Exeter, Southampton, and Surrey. It is a leading business incubator providing a wide range of support to students, researchers and entrepreneurs to help turn their ideas into thriving businesses. Since launching in 2002, it has supported more than 5,000 businesses to raise £3.9 billion in investment.

Technology Scotland / Photonics Leadership Group: Technology Scotland is the representative body for the Enabling Technology Sector in Scotland. Through their three networks, they support industrial and academic organisations that are developing technologies to deliver product advancement in markets from healthcare and communications to manufacturing and mobility. Together with the Photonics Leadership Group, they play an important role in connecting companies and investors and linking into UK policy initiatives. Their aim is to influence government policy at both Scottish and UK levels.

UK Semiconductor Industry Champions

The research and development (R&D) capability of the UK in semiconductor technology and products is without a doubt one of the strongest points of the UK's semiconductor industry in the world. There are hundreds of both small and large companies in the UK dealing with different aspects of semiconductors of all kinds and for diverse applications. Its fabless semiconductor design model has found great success, with Arm and Imagination Technologies being just two of the most impactful names in semiconductor design, with their IP and design reaching millions of people around the world.

These companies, however, barely scratch the surface of the true scope of the industry in the UK. While it is common knowledge that the US, Japan, and Taiwan are the home of some of the biggest semiconductor tech companies, these companies have an established presence in the UK through R&D centres, subsidiaries, offices, fabs and the acquisition of UK innovations. There are several truly innovative SMEs, manufacturers, and players in compound semiconductors in the UK with the potential to change the shape of the industry – and some of these star firms are featured here.

Design & IP Licensing

Arm: Arm, a UK-founded company, is a shining example of the UK's semiconductor design capability. Its processor IP is used in almost all modern smartphones and has virtually no competition in the smartphone's CPU sector. It is also a leading provider of other IP blocks such as for server CPUs, GPUs, microcontrollers, system-on-a-chip (SoC) infrastructure as well as software development tools. Its products are used in all types of computing devices including supercomputers, IoTs, cloud computing and even in space. It is headquartered in Cambridge and has offices in Manchester and Sheffield.

Imagination Technologies: Imagination Technologies, UK-founded company, is another semiconductor developer and licenser which figures in the list of top semiconductor design companies in the world. Founded in 1985 and headquartered in Hertfordshire, its chief products are the PowerVR mobile GPUs, AI processing neural network accelerators and network routers. Millions of people around the world use mobiles and tablets with Imagination Technologies chip design in them. It counts companies like Samsung, Apple, Intel and Qualcomm among its clients. It is also known for its support and collaboration with the UK's top universities. Its head office is in the picturesque village of Kings Langley in Hertfordshire, but it also has offices in Cambridge, Bristol and Manchester as well as in Japan, Taiwan, South Korea, India, China, Romania and Poland.

Qualcomm: Qualcomm, the designer of Snapdragon SoCs used in Samsung, Asus, Oppo and other mobile companies, also has a similar story of presence in the UK. It has Qualcomm UK Ltd. and Qualcomm Technologies International, Ltd. as its subsidiaries in the UK, as well as eight offices scattered across Cambridge (including Cambridge Business Park), Bristol, Belfast, London, and Farnborough. Its UK offices specialise in design, research, and development in the field of mobile telecommunications. It also acquired Cambridge Silicon Radio or CSR plc, another Cambridge Consultants split-away semiconductor company, in 2015.

Broadcom: Broadcom is an American innovator of semiconductors in wired and wireless communications and it runs major operations from Cambridge Science Park, one of the oldest and largest science parks in Europe. Over the years, it has acquired many UK semiconductor companies to broaden its base in the UK, such as Alphamosaic. Alphamosaic, a mobile multimedia processor company acquired by Broadcom for $123 million in 2004, was a spinout from Cambridge Consultants, established in 1960 to "*put the brains of Cambridge University at the disposal of the problems of British industry*". Broadcom also acquired Element 14 in 2000. Element 14 and Arm shared a common ancestor in Acorn, a Cambridge-based computer company from the 1980s.

Renesas Electronics Corporation: Renesas Electronics Corporation is a Japanese company manufacturing SoC, analogue, microcontrollers, and power products for billions of devices around the world. It has a subsidiary in the UK called Renesas Electronics Europe Ltd. with three units, namely, Automotive, the Broad-based and the Industrial Solution Business Unit. In 2021, it acquired Dialog Semiconductor Plc, a Reading, UK-domiciled provider of standard and custom chips for mobiles and other devices and Renesas offers its combined products and technology under the 'Renesas + Dialog' category. Dialog Semiconductor Ltd. now serves as a holding company for subsidiaries around the world involved in mixed-signal integrated circuits. In the UK, Renesas has locations in Bourne End, Buckinghamshire for engineering and applications services and a design centre in Harlow Innovation Park, Essex.

Microchip: Microchip is an American manufacturer of microcontrollers, analogue, mixed-signal, RF devices, wireless products, and Flash-IP integrated circuits. In the UK, Microchip has a subsidiary called Microchip Technology Caldicot Ltd., formerly known as 'Microsemi Semiconductor', based in Caldicot and with an office in Bristol. The subsidiary develops and manufactures semiconductor integrated circuits used in aerospace, defence, communication, and medical industries. Its Microchip Advanced Packaging Services operates in Caldicot, South Wales and assembles semiconductor components, both silicon and compound, and offers customisable semiconductor packages. Microchip operates three other sites across the UK. In Whiteley, it is focused on application, firmware development and R&D groups for the Human Machine Interface (HMI) product line and touchscreen controllers; Microchip Winnersh is focused on customer support; and Microchip Ely, part of Microchip's Wireless Systems Group (WSG), has been prominent in developing Wi-Fi SoCs and modules. It has been an active part of the South Wales cluster with active participation in many of the compound semiconductor projects being undertaken there, including CSConnected, Compound Semiconductor Centre and Horizon2020 EU-funded ZeroAMP Project.

Mediatek: Mediatek is a fabless Taiwanese IC design company with its SoC powering smartphones, tablets, Smart TVs and wearable technology. It has UK subsidiaries called MTK Wireless Limited and Mediatek Research UK Ltd with two R&D centres in Cambridge and Kent. The R&D centre in Cambridge develops smartphone software and cellular system technology while one in Kent develops RF technology. Both these R&D sites are instrumental in developing wireless handset technology in MediaTek.

Onsemi: ON Semiconductor Corp (Onsemi) is an American IC design company for applications in, for example, power, cloud, automotive, and mobile. ON Semiconductor Limited is the wholly-owned subsidiary of Onsemi based in Bracknell, Berkshire where it conducts design and solution engineering in Bracknell Design Centre focused exclusively on high-end Automotive & Medical Image Sensor design. This has applications in the automotive sector for e-mirrors, driver monitoring, and 360-degree sensing.

STMicroelectronics: STMicroelectronics is a mainland European semiconductor company serving the growing IoT and smart driving sectors with a broad portfolio of products including compound semiconductor power devices. It has a UK subsidiary, STMicroelectronics Ltd. which was incorporated in 1962. Its office is in Marlow, Buckinghamshire. It acquired and assimilated Inmos, a British semiconductor company which had R&D operations in Bristol and a microprocessor factory in Newport. Inmos microprocessor factory would later turn into Newport Wafer Fab. Its other acquisitions include Edinburgh-based VLSI Vision, supplying CMOS Image Sensor, an electronic chip to create images in digital cameras, which became the STMicroelectronics Imaging Division. STMicroelectronics Edinburgh Design Centre is currently the largest site within this division.

XMOS: XMOS, a UK-founded company, is a fabless semiconductor company headquartered in Bristol. It has specialization in semiconductors offering audio and voice solutions. It also possesses a leading edge in the IoT market with its xcore processors enhancing computation, connectivity, and intelligence in smart products. Its client list includes global brands like Lenovo, Microsoft, Amazon and Samsung. It has received government support through a Future Fund loan from the British Business Bank. It has been a beneficiary of the R&D tax credit scheme for science-based innovating companies.

NXP: NXP is a Dutch semiconductor designer and manufacturer with a legacy in the UK dating back to the 1920s. It presently operates three sites in the UK for product development, R&D and other activities. Its newest site opened in 2017 in Glasgow, Scotland, to develop advanced microcontroller solutions for electrification and vehicle networking in the automotive industry. Its Southampton site develops integrated circuits for secure car access systems, specialising in low-power analog and mixed-signal design. Its Redhill site is focused on intellectual property matters. NXP also partners with universities and schools in the UK for STEM promotion activities, research opportunities and career placements.

Graphcore: Graphcore, a UK-founded company, is a British IC design unicorn founded in 2016 in Bristol and specialising in the development of accelerators for AI and machine learning. It designs and sells Intelligence Processing Units (IPUs) which are processors allowing AI to function at a faster pace. This can be the future of AI and become an industry standard everywhere given its advantage over GPUs. It has received the benefits of the government's R&D tax credits.

Salience Labs: Salience Labs, a UK-founded company, is an Oxford-based startup developing a unique type of ultra-high-speed, multi-chip processor which uses light to execute operations. By combining photonics and electronics, it is expected to radically change the field of AI. It also has applications in the defence industry. Salience Labs began its journey as a collaboration between the University of Oxford and the University of Münster. It has received grants from the UKRI and European Innovation Council for its first massively parallel hybrid photonic and electronic accelerator chip. *"The UK landscape benefits from the support of the UK British Business Bank and from the use of tax credits, which provide another level of funding."* While it is not commonly recognised in the UK, in the early stage, companies can offer share options which is attractive from a tax perspective and is an incentive to join startups and innovative companies.

Codasip: Codasip is a supplier of customizable RISC-V processor IP based in Munich and running design centres in Bristol and Cambridge. These design centres are focused on further development of high-end RISC-V processors. Codasip was the first company to commercialise RISC-V and its design centres in the UK have a team of hundreds of engineers.

Foundries and Integrated Manufacturers

IceMOS Technology: IceMOS Technology, a UK-founded company, is a developer and manufacturer of 100-200 mm silicon on insulator (SOI) and Silicon–Silicon Direct Bonded (SiSi) wafers for use in integrated circuits and MEMS. Based in Belfast, it offers more than two decades of experience in manufacturing and boasts of one of the widest available specification ranges in the market.

MicroLink Devices UK: MicroLink Devices UK, a UK-founded company, is the designer, developer, and manufacturer of the world's highest specific power technology, with its advanced solar arrays having aircraft, spacecraft and terrestrial applications. Its high-volume solar cell fab stands in Baglan, Wales. It was awarded government funding for developing next-generation lightweight, flexible solar panels. Subsidiary of the American Microlink Devices Inc., it decided to set up a fab in Wales due to the semi-compound cluster existing there.

BAE Systems: BAE Systems is the largest British defence and security company and has developed semiconductor technology, circuits, modules, and subsystem critical for defence purposes. Its foundry in New Hampshire, US, is accredited as a US Department of Defense trusted foundry. The company is unique for its R&D and manufacture of compound semiconductors such as gallium arsenide (GaAs) and gallium nitride (GaN) materials and integrated circuit technologies with applications in avionics, surveillance, communications, and targeting systems. It has also developed products like Mixed-Signal Multifunctional RF Chips, Digital Read-Out Integrated Circuits (DROICs), high-power RF transistors and integrated circuits and Digital Phased Array (DPA) and small-form-factor semiconductor technology for RF and communication signals. It operates multiple offices throughout the UK.

Seagate: Seagate Technology is an American data storage company that has owned a major wafer fab in Northern Ireland since 1993. This fab manufactures the head component in a quarter of the world's hard disk drives (HDD). It is the most advanced nanotech facility in the UK producing sophisticated components using 200 mm diameter wafers, and one of the only five nanotech fab facilities in the world. It is a member of the NI Smart Nano Consortium promoting the next-generation nano-photonic chip technology.

Semefab: Semefab, a UK-founded company, is a semiconductor supplier from Glenrothes, Scotland with more than three decades of experience in silicon wafer manufacturing. It has two fabs in Scotland: Fab2 is a MEMS foundry and Fab3 manufactures integrated circuits for use in Semefab's own products as well as its global customers. Its products, made under the volume foundry business model and technology commercialisation model, are particularly in demand in electronics and sensor markets. Every year, it exports more than 500 million die and devices around the world.

Pragmatic: Pragmatic, a UK-founded company, is a British manufacturer headquartered in Cambridge and with two fabs in Sedgefield and Meadowfield (near Durham). Pragmatic makes ultra-low-cost, flexible integrated circuits (FlexIC) which can potentially replace mainstream silicon chips. Their revolutionary foundry service takes flexible integrated circuits from tape-out to delivery in just four weeks, at a fraction of the cost of silicon semiconductors. By omitting the most resource-intensive parts of traditional production processes, their unique, silicon-free fabrication achieves production cycle times of less than 48 hours. It also consumes significantly less water and energy – making Pragmatic one of the most sustainable semiconductor manufacturers in the world.

Paragraf: Paragraf, a UK-founded company, is the first company in the world to have achieved mass production of graphene-based electronic devices using its patented contamination-free technology. The technology deployed by it can produce single-atom thick materials such as graphene on a crystalline substrate. The company's sensor is the only one that can operate in extreme temperatures and has several niche applications in cryogenics and quantum computing due to its ability to operate in low and high temperatures, and places where the change in temperature is important. The company is actively developing sensors for higher volume applications such as EV batteries in cars, healthcare and agri-tech. These require large investments but offer an alternative to silicon-based solutions. It began its journey as a spinout from Cambridge University. With its head office located in Cambridgeshire, it is spearheading commercialisation of graphene devices in semiconductor, energy and sensor markets. It received backing from UK government via British Patient Capital's Future Fund: Breakthrough in 2022. The company is collaborating with corporates in Korea, Japan, Germany and the US to develop sensors for EV Battery manufacturing. Their product can monitor battery status and identify when batteries may be subject to thermal runaway to warn about and ultimately prevent explosions.

Specialists on Compounds

The UK has a special place in the global semiconductor industry in terms of expertise at compound semiconductors and photonics. It is home to the first major compound semiconductor cluster in the Europe. While the companies listed below are involved in the growing compound semiconductor industry in varying capacities, they all have been active in supporting further research, innovation and expansion of this industry. We cover the main players in compound semiconductor manufacturing in the UK below.

IQE: IQE is a British manufacturer of advanced compound semiconductor wafers for mobile, aerospace, cloud, IoT, solar, automotive, healthcare, and industrial sectors, serving as a prominent member of the South Wales compound semiconductor cluster. It is the largest compound semiconductor epiwafer manufacturer in the world, founded in Cardiff, Wales in 1988. Today, it runs a manufacturing facility in Cardiff, a state-of-the-art mega foundry in Newport and another manufacturing facility in Milton Keynes. It also operates facilities in Taiwan and in Massachusetts, North Carolina, Pennsylvania and Washington State in the US along with offices in Japan and South Korea. Its other subsidiaries include Wafer Technology Ltd. with a focus on InSb and GaSb wafers for advanced infrared technology; NanoGN which owns patents in Photonic Quasi Crystal technology; a Singaporean subsidiary called MBE Technology Pte Ltd. for R&D and manufacture of Molecular Beam Epitaxial or MBE epiwafer; and a US-based Galaxy Compound Semiconductors, Inc which supplies InSb and GaSb substrates. IQE has played a prominent role in advancing R&D in compound semiconductors in partnership with Cardiff University, Swansea University and other Welsh-based companies. Their collaborative projects on compound semiconductors include Compound Silicon Centre and CSConnected. These projects have received government support through UK Research and Innovation's flagship Strength in Places Fund (SIPF) and the Welsh government's SMARTExpertise programme. IQE was also a member of the Horizon 2020 EU-funded project, ChipAI, along with the University of Glasgow and the University of Strathclyde, IBM Research Gmbh and other mainland European universities.

Newport Wafer Fab: Newport Wafer Fab is the largest semiconductor manufacturing plant in the UK producing "high-end silicon devices in 200 mm wafer fab" and servicing compound silicon, power and photonics semiconductor products. It has been operational since 1982 and currently ships thousands of wafers every week for use in products ranging from Jaguar Land Rovers to vacuum cleaners. It has also served as one of the world's leading centres for R&D in MOSFET, a product crucial to EV engines. As it also has the ability to make compound semiconductors,

it is the “world’s first integrated Silicon and Silicon-on-Compound Semiconductor Foundry”. It plays a central role in South Wales semiconductor cluster through projects like CSConnected, Centre for Integrative Semiconductor Materials at Swansea University and Compound Semiconductor Centre at Cardiff University. Newport Wafer Fab has received various awards by UK Research and Innovation, and the Automotive Transformation Fund (ATF) by Advanced Propulsion Centre UK (APCUK) to develop low-carbon technology projects in support of the UK’s ‘Net Zero 2030’ challenge.

Nexperia: Nexperia is a leading European producer of essential semiconductors, shipping billions of its products every year. It has fabs in Manchester, Newport and Hamburg and its headquarters are in Nijmegen, the Netherlands. It acquired Newport Wafer Fab in 2021 and renamed it Nexperia Newport. Its Manchester fab is one of the largest semiconductor manufacturing facilities in the UK and the centre of power FET production which is used in computing infrastructure, automotive industry, robots and household appliances. Nexperia also has a subsidiary called Nexperia UK Ltd. based in Cheshire, near Greater Manchester. This subsidiary started as a part of Phillips and then became an independent company called NXP Semiconductors before being acquired by Nexperia. *“Startup companies receive expansive support from InnovateUK and other funders and most importantly these grants pay for activities and are target-oriented, rather than output oriented. UK startup companies are seeking both venture capital but also longer-term corporate investment, which can also provide synergies in terms of technology, access to markets and channels for new sales.”*

Clas-SiC Wafer Fab: Clas-SiC Wafer Fab, a UK-founded company, derives its name from Silicon Carbide (SiC), a semiconductor compound. It is the world’s first dedicated open foundry manufacturing SiC semiconductors in Lochgelly, Scotland. SiC wafers designed and manufactured by it can be used for lighter, smaller and more energy-efficient power systems in the batteries in the EVs. It has received funding under the Driving the Electric Revolution challenge and Innovate UK.

Kubos Semiconductors: A **Silicon Fen** company, Kubos is developing a new material, cubic Gallium Nitride (GaN) to improve the efficiency of green light emitting diodes (LEDs) and red microLEDs. A key advantage is they manufacture their material in an industry standard and scalable way. It began its journey in 2017 in Cambridge from a partnership between the University of Cambridge and Anvil Semiconductors. Today, it is overseeing the commercialisation of one of the first major breakthroughs related to LEDs since the early 1990s. With exclusive licenses for cubic growth and silicon substrates, the LED stacks produced by them are low in cost and highly efficient. This in turn enables energy savings in products like LEDs, microLEDs, displays, and other end-user products and can address the problem of red microLED efficiency hindering the growth of the Augmented Reality and Virtual Reality (AR/VR) industry. It also benefited from the Enterprise Investment Scheme (EIS) for tax relief to investors, which the company sees as a major benefit of UK-based investment. Due to their focus on the development of a fundamental material technology, it has benefited from a range of UK grants including the Innovate UK grant, BEIS Energy Entrepreneur Grant 6 Fund (University of Cambridge), as well as FastStart Innovation.

EDA, WFE & Capital Equipment

Oxford Instruments: Oxford Instruments plc, a UK-founded company, has a broad reach across both the growing compound semiconductor market and the more established silicon chip and electronic device market. Within these markets, the company provides solutions to support fundamental developments, applied R&D and manufacturing-related applications, ranging from etch and deposition processing equipment and solutions to atomic scale imaging and analysis equipment to enable quality control and defect analysis.

> *From our earliest days as the first commercial spinout from Oxford University more than 60 years ago, we have deployed the skills and expertise of some of the UK's leading engineers and scientists. We firmly believe there is no better place in the world from which to serve our global network of customers, and that's why we continue to invest in our highly trained specialist workforce and high-tech manufacturing facilities across a breadth of applications, including an investment of £70 million in a new compound semiconductor facility set to open in 2024.*
>
> **Richard Tyson**
> Chief Executive, Oxford Instruments plc

Oxford Instruments' proprietary semiconductor processes support volume manufacturing, yield and quality control of the high technology devices used today, as well as the development of next-generation technology. This includes the critical transistor components needed to operate devices more safely, at higher voltage, while using less energy – facilitating increased 5G connectivity, truly wireless charging, new forms of LIDAR remote sensing, and energy-efficient data centres.

Vector Photonics: Vector Photonics, a UK-founded company, is a Glasgow-based company responsible for a major breakthrough in semiconductor laser technology: Photonic Crystal Surface Emitting Lasers (PCSELs). PCSELs have lower costs and higher speed and are more powerful than Vertical Cavity Surface Emitting Lasers (VCSELs) and Edge Emitting Lasers (EELs). This next-generation laser addresses currently unmet needs. It is a spinout from an academic group at the University of Glasgow conducting world-class research. From a cluster point of view, it is benefiting from a photonics cluster in Scotland where they have access to everything the company needs, from wafers to packaging. It has received extensive support of £5.3 million from the Innovate UK government grant.

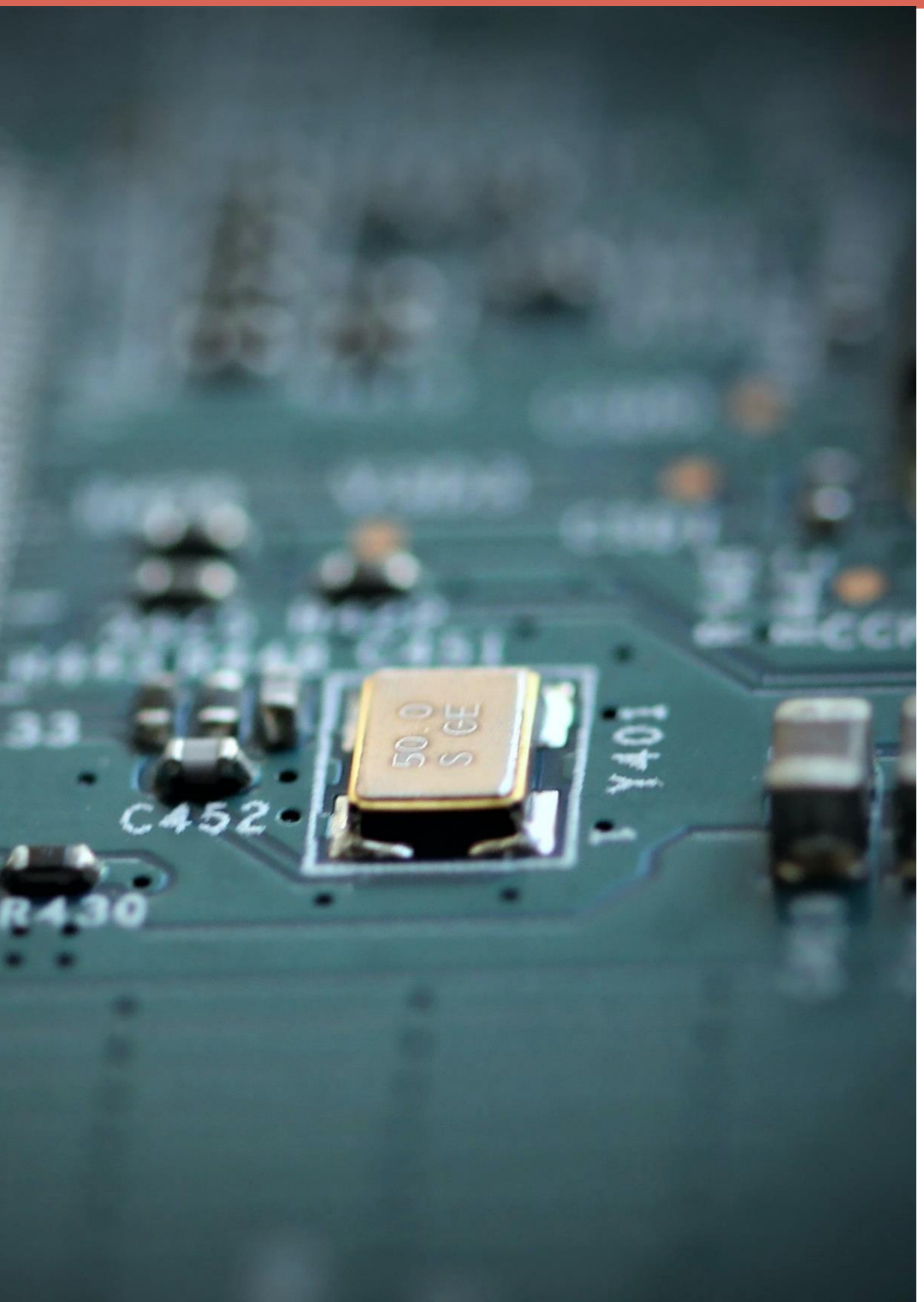
Cadence: Cadence is a California-based producer of silicon structures for designing chips which has a multi-faceted presence in the UK. In 2023, it acquired the British microchip design company Pulsic, converting the latter's Bristol Headquarters into Cadence's EMEA (Europe, the Middle East and Africa) Headquarters. Pulsic has worked in close partnership with memory chip designers and other leading semiconductor companies for placement, floor planning, routing, and implementation software for custom integrated circuits.

SPTS Technologies: Newport-based SPTS Technologies Ltd. is a part of the American semiconductor equipment manufacturer KLA Corporation group. Its main activities are designing, manufacturing, and testing equipment used by its clients to make semiconductor devices such as MEMS, power semiconductors, LEDs, RF chips, and advanced packaging applications. From its Newport facility, it has manufactured and exported semiconductor processing equipment worth more than £1.5 billion. Additionally, it is building a new state-of-the-art innovation and manufacturing centre in Newport under its plan for expansion. It has been a beneficiary of the UK Research and Innovation funding for its research projects and has also collaborated with universities and companies in the South Wales Cluster in projects like CSConnected.

Sivers: Sivers Semiconductors AB is a Swedish company specialising in photonics and wireless but with a UK subsidiary called Sivers Photonics. The subsidiary, Sivers Photonics, has its global main office in Glasgow and its registered office in Edinburgh. Its photonics devices have integrated compound semiconductor laser devices with silicon chip technology turning it into the most advanced supplier of customised III-V compound semiconductor laser devices in the world. Its devices have game-changing applications in quantum technology.

Yelo: Yelo is a company from Carrickfergus, Northern Ireland, undertaking R&D and manufacture laser diodes, photonics burn-in and life test equipment and a range of other products. It is part of the Northern Ireland Smart Nano Consortium which succeeded in securing £42.4 million in funding from the UKRI Strength in Places Fund.

Coherent: Coherent UK and Coherent Scotland are subsidiaries of the American tech giant, Coherent Inc. It manufactures its diode-pumped solid-state laser, a type of semiconductor laser, in West of Scotland Science Park, Glasgow. It has been based in the UK for decades.



Glossary

Chips – A semiconductor chip refers to an electric circuit possessing various components such as transistors and wiring with a semiconductor wafer base. There are different categories of chips such as memory chips, microprocessors, system-on-a-chip and commodity integrated circuits or standard chips.

Cluster – A semiconductor cluster, in the UK context, refers to the concentration of companies and expertise around established fabs and designers. The existing companies and expertise from universities act as gravitational centres further attracting semiconductor companies of all sizes.

Compound semiconductor – Compound semiconductors are semiconductors made from two or more elements such as Gallium and Antimony (GaSb) or Silicon and Carbon (SiC). This sets them apart from silicon semiconductors made from a single element.

Fab – Fab, short for fabrication, refers to semiconductor fabrication factories or facilities which turn semiconductor wafers into integrated circuits based on designs either owned by them or by others. They are also called foundries occasionally.

Fabless – Fabless designers or fabless refers to companies that do not own any semiconductor foundries to manufacture chips but instead design and sell semiconductor chips and related hardware devices.

Semiconductor – A semiconductor is a substance such as silicon, graphene or gallium nitride that has electrical conductivity between that of a conductor and an insulator, with its conductivity changing based on temperature and impurities.

SoC – A system on a chip (SoC) is an integrated circuit that combines elements of a computer system like CPU, system memory, peripheral controllers or even GPU into a single chip to perform complex tasks quickly and efficiently, while possessing a small size, low weight and lesser power requirement.

Spinout – University spinouts are companies that take the technological inventions developed in the universities out in the world, commercialising academic research and turning them into real-world products and services.

Next Steps

Department for Business and Trade's Services

The services DBT provides to overseas companies include:

- **Accessing market opportunities:** helping international companies assess market opportunities in the UK.
- **Access and introductions to the right people:** working with every UK government department to support access to a vast network of industry experts.
- **Connecting overseas buyers with UK businesses:** DBT services allows international companies to connect with UK businesses, including through meet-the-buyer events, networking receptions, and product launches.
- **Setting up in the UK:** DBT provides a range of support from applying for visas and entry to the UK to set up procedures, to the UK tax system and site selection.
- **Helping UK businesses sell and expand into overseas markets:** engagement through the network of overseas posts and UK-based trade advisers.
- **Bespoke market research:** compiling in-depth factual reports including market entry support, research and development collaborations and cost analysis.
- **On-going government support:** continued support after your business is established in the UK, providing assistance on expansion and representing your interests in government.
- **Entrepreneurial assistance** through a network of mentors to help make a commercial success of early-stage companies.
- **Doing business with integrity:** assisting companies to mitigate the potential impacts of unethical practices in business operations and supply chains.

For more information, get in touch with:

A. **Department for Business and Trade:** https://www.great.gov.uk/international/contact/

B. **Department for Science, Innovation and Technology (DSIT):** semiconductorteam@dcms.gov.uk

C. **Business/Digital Team at your Local Embassy:**

1. *Contact in South Korea: sarah.mcguire@fcdo.gov.uk*
2. *Contact in Japan: euan.edwards@fcdo.gov.uk*
3. *Contact in Taiwan: jessica.reilly@fcdo.gov.uk*
4. *Contact in Singapore: elsie.yim2@fcdo.gov.uk*
5. *Contact in Malaysia: bryan.yeoh@fcdo.gov.uk*

D. Learn more about companies participating in SEMICON Taiwan 2023 here.

E. Read the UK's National Semiconductor Strategy here.

F. Find out about 2023 ChipStart UK here.

G. Find out more from the local government sources: *Wales Government: https://tradeandinvest.wales/key-sectors/compound-semiconductors*

> *With a wealth of resources and expertise at its disposal, the Department for Business and Trade provides a wide range of services, from market research and trade promotion to regulatory guidance and financial support, all tailored to your business' needs.*

Abbreviations

APCUK	Advanced Propulsion Centre UK
AI	Artificial Intelligence
AR/VR	Augmented Reality and Virtual Reality
AESIN	Automotive Electronics Innovation
ATF	Automotive Transformation Fund
BBB	British Business Bank
BTRL	British Telecom Research Laboratories
CSR	Cambridge Silicon Radio
CCI	Cardiff Catalysis Institute
CPU	Central processing unit
CISM	Centre for Integrative Semiconductor Materials
CSA Catapult	Compound Semiconductor Applications Catapult
CSC	Compound Semiconductor Centre
BEIS	Department for Business, Energy & Industrial Strategy
DPA	Digital Phased Array
DROICs	Digital Read-Out Integrated Circuits
DER-IC	Driving the Electric Revolution Industrialisation Centre
EEL	Edge Emitting Laser
EV	Electric vehicle
ECL	Emitter Coupled Logic
EIS	Enterprise Investment Scheme
EMEA	Europe, the Middle East and Africa
EU	European Union
FET	Field-effect transistor
GaSb	Gallium antimonide
GaAs	Gallium arsenide
GaN	Gallium nitride
GEIC	Graphene Engineering Innovation Centre
GPU	Graphics processing unit
HDD	Hard disk drives
HMI	Human Machine Interface
InSb	Indium antimonide
ICS	Institute of Compound Semiconductors
IP	Intellectual Property
IPU	Intelligence Processing Units
IoT	Internet of Things
LEDs	Light-emitting diode
Ltd	Limited
MOSFET	Metal Oxide Silicon Field Effect Transistors
MEMS	Microelectromechanical systems
MNC	Multinational corporation
NMI	National Microelectronics Institute
NEAME	North East Advanced Material Electronics
PCSELs	Photonic Crystal Surface Emitting Lasers
PEMD	Power Electronics, Machines and Drives
RF	Radio frequency
RISC	Reduced Instruction Set Computer
R&D	Research and Development
SiC	Silicon Carbide
SOI	Silicon on insulator
SiSi	Silicon–Silicon Direct Bonded
SME	Small and medium-sized enterprises
SIPF	Strength in Places Fund
SoC	System-on-chip
TRH	Translational Research Hub
UKRI	UK Research and Innovation
ULA	Uncommitted Logic Arrays
VCSEL	Vertical Cavity Surface Emitting Laser

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XMOS automotive noise suppression. Credit: Xmos