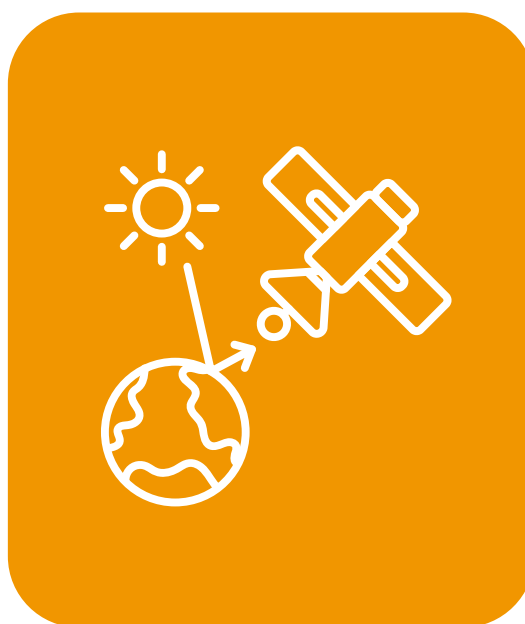
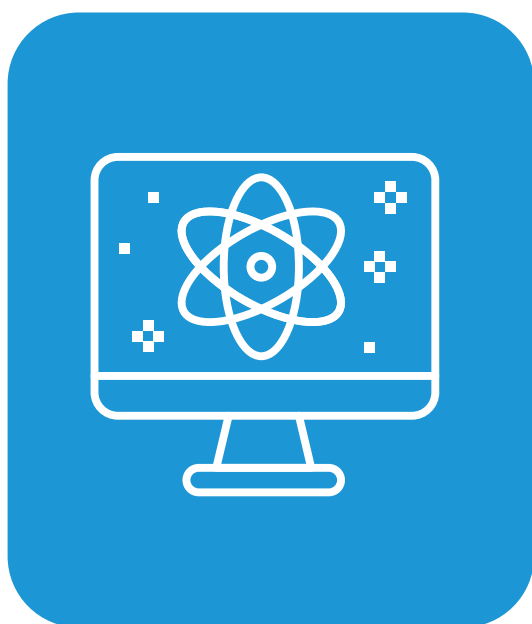
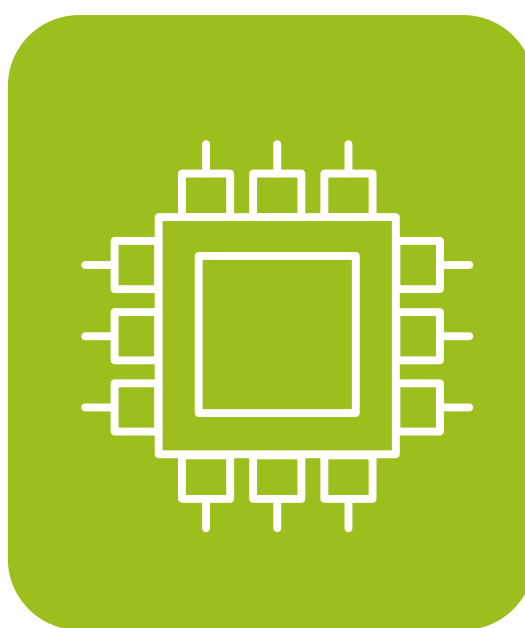


Scotland's Critical Technologies Supercluster: Challenges and Opportunities



Contents

Executive Summary	3
Strategic Context	3
Governance and Coordination	3
Investment and Incentives	4
Technological Opportunities and Challenges	4
Talent Attraction, Development and Retention	4
Introduction	6
Context	7
Strategic focus, governance and coordination	9
Investment in the critical technologies	11
Technological opportunities and challenges for a supercluster	13
Talent attraction, development, and retention	15
Final reflections	17
Recommendations	18
Strategic focus, governance and coordination	18
Investments and incentives	18
Technological opportunities and challenges	18
Talent attraction, development and retention	19
Acknowledgements	20
Annex A – Overview of key critical technology facilities in Scotland	21
Annex B – Questionnaire	22
Annex C – Roundtable programme, attendees and breakout group notes	26
Annex D – Roundtable presentations	36
Annex E – Summary of questionnaire responses	59
Annex F – Canada's global innovation clusters	63
Annex G – CSConnected: the semiconductor cluster in Wales	65
Annex H – Map of critical technologies companies in Scotland	66

Executive Summary

Scottish Science Advisory Council (SSAC) has produced this report in response to the Scottish Government's strategic initiative to establish **Scotland's Critical Technologies Supercluster (SCTS)**¹. This supercluster aims to harness the potential of four key technologies – **photonics, quantum, semiconductors, and connectivity and sensing** – to drive economic growth, innovation, and national resilience. These technologies already support nearly 11,000 highly skilled jobs and generate over £4 billion a year in revenue, with ambitions to grow to £10 billion and 18,000 jobs by 2035.

The report outlines the opportunities, challenges, and strategic actions required to realise the full potential of SCTS, drawing on stakeholder engagement, questionnaires, roundtables, and desk research.

Strategic Context

Scotland's innovation ecosystem is well-positioned to support and grow its critical technologies. It benefits from:

- world-class research institutions
- a strong pipeline of graduates and skilled workers
- established industry networks and supply chains
- a mix of small, medium, and large firms, many with global reach

Scotland's Critical Technologies Supercluster is intended to build synergies across these technologies, enabling collaborative growth that exceeds the sum of individual efforts. The concept of a supercluster emphasises coordinated, cross-sectoral collaboration supported by government policy, infrastructure, and investment.

Governance and Coordination

The establishment of the SCTS **Advisory Board** in 2025 marks a foundational step in providing leadership and strategic direction. Our key recommendations include:

- **co-creating a shared vision and brand** for SCTS that aligns with Scottish and UK policy goals
- **developing a promotional strategy** to raise the supercluster's profile nationally and internationally
- **acting as a single point of contact** for stakeholders, including investors, regulators, and collaborators
- **providing specialist support** in areas such as regulation, intellectual property, and business development
- **creating a 'sandbox'** to enable innovation around business models and policies
- **expanding leadership to include financial expertise**, such as representatives from the Scottish National Investment Bank (SNIB)

The Advisory Board should consider evolving into an **Industry Leadership Group (ILG)** to formalise its representative role.

¹ <https://technologyscotland.scot/new-initiative-launched-to-build-10bn-critical-technologies-supercluster-in-scotland/>

Investment and Incentives

Access to finance remains a critical barrier for scaling innovation. Key issues include:

- the “**Valley of Death**” between early-stage grants and growth capital
- limited access to venture capital, especially for investments over £10 million
- geographic disadvantages compared to the UK's Golden Triangle of London, Oxford and Cambridge

Recommendations include:

- **prioritising patient capital** through public sector support
- **creating a Critical Technologies Growth Capital Fund**, co-invested by public and private sectors
- **developing a shared spin-out support portal** to streamline commercialisation
- **implementing a spin-out terms template** to reduce equity stakes of higher education institutions and attract investors
- **launching an international investor attraction programme**, showcasing Scotland's talent, infrastructure, and cost advantages

Technological Opportunities and Challenges

Scotland's CT industries are well-placed to scale, but face challenges in moving innovations to market. Key barriers include:

- difficulty advancing technologies to higher **Technology Readiness Levels (TRLs)**
- lack of environments for early testing compliant with international standards
- limited access to capital equipment and shared facilities

Strategic actions could include:

- **investing in shared R&D infrastructure**, such as labs and clean rooms
- **creating a national facilities hub**
- **pooling intellectual property portfolios** and developing digital platforms for collaboration
- **strengthening links to adjacent sectors**, including space, defence, and life sciences
- **engaging with UKRI and Innovate UK** to ensure Scottish representation in funding and policy

Scotland's Critical Technologies Supercluster must seek to balance investment in emerging innovations with support for market-ready technologies to ensure resilience and economic benefit

Talent Attraction, Development and Retention

Skills shortages are a pressing concern across all CT sectors. Challenges include:

- gaps in technician-level and mid-skilled roles
- under-representation of women and workers from rural communities
- visa restrictions affecting international talent recruitment
- limited vocational and non-university pathways into the industries

Recommendations include:

- **developing a short-term skills plan** with Skills Development Scotland
- **creating a long-term workforce strategy**, aligned with industry needs
- **embedding practical knowledge** through apprenticeships, dual-training schemes, and modular qualifications
- **supporting cross-sector mobility** through bridge programmes and retraining initiatives
- **promoting business skills** within science, technology, engineering, and mathematics (STEM) education and through supercluster-led training
- **launching targeted campaigns** to attract underrepresented groups and international talent

Scotland's Critical Technologies Supercluster can act as a translator between academia, industry, and government to support talent development and retention.

There is a consensus on the need for **sustained strategic focus and investment** in critical technologies. Scotland's Critical Technologies Supercluster represents a transformative opportunity for Scotland to lead in innovation, economic growth, and global competitiveness. Success will depend on coordinated action across governance, investment, infrastructure, and skills.

Introduction

The Scottish Government has identified four critical technologies² as a key opportunity for the future. The four critical technologies are: 1) photonics, 2) quantum, 3) semiconductors, 4) connectivity and sensing. Critical technologies can be understood to be current and emerging technologies with the capacity to significantly enhance, or pose risk to, a country's national interests, including a nation's economic prosperity, social cohesion, and national security. To promote the growth of these technologies, the Scottish Government's Minister for Business and Employment, Richard Lochhead MSP, announced in November 2024 the creation of the Scottish Critical Technologies Supercluster (SCTS). In line with the ambitions outlined in the Programme for Government which focuses on the importance of economic growth, the supercluster brings together industries that currently support nearly 11,000 highly skilled workers and generate annual revenues of £4.2 billion³. The action plan for the supercluster will support growth to £10 billion between now and 2035, creating an additional 7,000 jobs.

Scientific excellence is already deeply embedded within Scottish higher education institutions (HEIs) and research and technology organisations (RTOs) providing crucial research and innovation in these technologies. Scotland has a track record of both supporting small businesses in these sectors, often as spin-outs from scientific breakthroughs, as well as partnering with large organisations based here. This ecosystem is also supported by a strong supply of graduates, although as we note later there will be future skills demands that need consideration. The industries are also linked through their supply chains and customer bases. Many of the existing HEIs, RTOs, companies, and other organisations work closely with one another in a dense network of activity engaging with organisations within and beyond Scotland as customers and suppliers.

The vision of a critical technologies supercluster aims to build on these strengths to deliver substantial growth in the decade ahead. The Scottish Science Advisory Council (SSAC) were approached to produce a report with the following objectives:

- to identify future opportunities for the Critical Technologies industries over the next five years aligned with Scotland's research and industry strengths and opportunities to contribute to Scottish Government priorities
- provide an assessment of Scotland's research capability and associated set of actions to help Scotland's research community be well positioned to support Scotland's Critical Technologies industries to capture identified opportunities, including respective strengths of industry, academia, government, capital and entrepreneurs
- to provide an assessment of the infrastructure needs across the Critical Technologies industries and a prioritisation of what infrastructure would make the most difference to existing industries
- to evaluate the main challenges and alternatives that will need to be considered when deciding how to proceed to achieve identified opportunities and including input from industry with significant specialist knowledge of these sectors

In the preparation of the report, members of the SSAC working group engaged a wide group of stakeholders within these industries to explore the opportunities and challenges ahead. The approach taken in preparing the report included: 1) a literature review and desk research to examine existing academic and industrial activities, 2) a questionnaire informed by the desk research and expertise of our working group that was circulated to key stakeholders, 3) an online roundtable of key stakeholders from industry, academia and the public sector. These sources are summarised in Annexes B and C. The report drew on all of these sources to arrive at the key findings and conclusions.

2 <https://technologyscotland.scot/scotlands-critical-technologies-supercluster-showcases-strength-and-sets-ambitious-goal-of-10bn-in-revenue-by-2035-at-holyrood-reception/>

3 This is the most recent figure, for 2022, was derived by Scottish Enterprise from Office for National Statistics data, using a granular, bottom-up methodology to assess the Scottish sites of approximately 150 companies within the supercluster.

Context

Following on from the National Innovation Strategy⁴, Scottish Enterprise has a strong focus on developing and supporting new market clusters. The critical technologies have been identified as a significant opportunity for Scotland not only in terms of driving economic growth, but also innovative technological breakthroughs and good quality jobs. The Scottish critical technologies are:

- photonics
- quantum
- semiconductors
- connectivity and sensing technologies

These technologies are vital for security and defence, while also driving many of the breakthroughs that will allow the achievement of strategic national ambitions in areas such as net zero, smart transport, energy, and other advanced industries. Crucial to delivering economic and social security, these technologies also provide high quality jobs in often high margin sectors that are not easy to relocate once established. We note that there is a slight variation between the critical technologies defined by the Scottish Government and those identified by the UK Government Department for Science, Innovation and Technology (DSIT). DSIT's list⁵ is: advanced connectivity technologies, artificial intelligence, engineering biology, quantum technologies, and semiconductors. The SSAC will publish a report on engineering biology in Scotland in the next few months and recognises the existence of the Scottish Government's Artificial Intelligence strategy where the specific challenges of those sectors are considered.

The wider industrial landscape is explored in more detail in Annex A which shows that these industries already support complex ecosystems where they, for example, share many supplier and customer organisations, work closely with HEIs and RTOs and work with similar partners in public and private spheres (investors, support agencies, etc.).

Scotland's landscape for the critical technologies is therefore already well-established. The supercluster aims to build synergies between these technologies and the industries they support to become more than the sum of the parts. By these clusters working together, there is opportunity to scale up the ambition and delivery of strong growth, technological innovation, and good jobs.

'Supercluster' is a term that emerged in the late 2010s to describe a group of industry clusters working together to achieve synergistic growth at a scale that would not otherwise be possible. Central to the delivery of developing successful synergies within superclusters is the conscious choices of governments.

Industry clusters are often understood as geographic concentrations of related businesses, interconnected with research and training institutions, entrepreneurial support from the State and other sources of capital, and corporate entities. They typically focus on a specific industry or technology (life sciences, media, space travel, maritime, etc.) that mature naturally over time. Specific technologies can be relevant to one or many industrial clusters. Increasingly research has identified factors that support and facilitate the emergence and success of clusters. At the same time, governments have become interested in how to develop policies and practices to support more impactful clusters and in helping regions and nations to navigate economic shifts. Superclusters have emerged as having the potential to bring together industries that share similar characteristics and technologies to benefit from synergistic

⁴ <https://www.gov.scot/publications/scotlands-national-innovation-strategy/>

⁵ <https://www.gov.uk/government/publications/science-and-technology-framework/science-and-technology-framework>

relationships.

Much of this ecosystem already exists around the Scottish critical technologies. Scotland already benefits from strong research groups within HEIs producing world-leading research and graduates in these fields; corporate investment supports good jobs as well as customer and supplier relationships; entrepreneurs come from both industry and academic backgrounds ensuring that emerging technologies in these areas can be spun out and scaled up; large prime contractors (often in the defence sector) support innovation around them; and the technologies already have interest representation groups (e.g. Photonics Scotland) that have existing relationships with governments.

The Scottish Government recognises that it can play a key role in supporting these industries both directly and indirectly through State agencies. The dominance of small and medium sized enterprises (SMEs) in the critical technologies, combined with the significant influence of a few very large employers, shapes to at least some degree the challenges and opportunities of maximising the opportunities of a supercluster.

To facilitate the delivery of these ambitions, the Scottish Government announced⁶ the establishment of the Scottish Critical Technologies Supercluster. An Advisory Board has been established and has started to meet regularly, and Technology Scotland is taking a leading role in coordinating the supercluster, expanding the remit of its own interests and activities. By bringing together key stakeholders from across the industrial and technological clusters, this report draws on evidence around the opportunities and challenges facing SCTS in its future years.

6 <https://technologyscotland.scot/new-initiative-launched-to-build-10bn-critical-technologies-supercluster-in-scotland/>

Strategic focus, governance and coordination

The core advantages of industrial clusters are flows of knowledge, spillover effects, and mutually beneficial infrastructure. Clusters are self-organising groups of co-located actors with similar ambitions and working on similar activities.⁷ The concept of the 'quadruple helix' (Afonso et al 2012)⁸ of innovation emphasises the importance of government support agencies, academic institutions, industry and business, and civil society, in creating and supporting clusters to facilitate vital knowledge production, value creation and spillovers.

The establishment of the Scottish Critical Technologies Supercluster Advisory Board in 2025 provides a foundation for giving SCTS strong and visible leadership. Scotland's Critical Technologies Supercluster initiative builds on existing bodies that represent individual technologies such as Photonics Scotland. As the leadership team moves forward there is important scope to develop clear and prioritised ambitions that secure buy-in from the wider stakeholders. As a first step, SCTS Advisory Board and leadership **can play a key role in co-creating shared ambitions and goals for the supercluster which refer to and take into consideration existing policy goals from individual technology groups, and wider Scottish Government and UK Government ambitions.** Scotland's Critical Technologies Supercluster Advisory Board will require resources to support the implementation of this vision.

While the overarching body will play a crucial role in promoting the supercluster, **it is also important to create an identifiable 'brand' for SCTS** and to develop a more distinct promotion campaign that cuts across industry, education and policy. Participation in international trade fairs and exhibitions can be a part of this promotion to boost the profile of the supercluster. An example mentioned by several roundtable participants was the perceived success of the Welsh compound semiconductor cluster (see Annex G) which was seen to be highly effective at promoting that industry to the UK government and beyond. This also would work to position the supercluster as a preferred partner for government challenge-led innovation funding (e.g. the Advanced Research and Innovation Agency (ARIA), Department for Science, Innovation and Technology (DSIT)).

There was clear support expressed both in the questionnaire responses and the roundtables for the role of SCTS to coordinate stakeholder interests to **provide both a single voice for the technologies, and to become a single point of contact** for anyone seeking to engage at Scottish, UK, and international levels. The opportunity to, for example, coordinate responses to consultation exercises, and to promote the value of these industries in national and international contexts is a potential area of benefit to companies, especially those that individually would be too small to do so. **The potential to build new partnerships and strengthen existing relationships** with customers and suppliers was welcomed by participants.

Other responses focused on the **opportunity to give specialist support around areas of activity that can be challenging to navigate including, for example, regulatory systems.** Critical technologies underpin innovation but are not marketable, end products themselves. Scottish companies and HEIs conduct research and development, **and SCTS can help identify and exploit commercial opportunities.** Academic founders may find lab-developed concepts do not meet industry specifications. Engaging pilot customers early is vital but often underfunded. Business model innovation may be needed in both business-to-business (B2B) and business-to-consumer (B2C) markets. Long qualification cycles (e.g. in automotive, medical, telecommunications) can delay revenue. Early collaboration can support turning inventions into market-ready innovations. The potential of the supercluster to **provide specialist advice**, tailored to the specific industries and technologies, was seen as beneficial.

7 Nelles, J., Vallance, P., Vorley T., Wallace, P. Understanding Cluster Growth Potential. Available: https://innovationcaucus.co.uk/app/uploads/2022/06/ClusterReport_Final.pdf

8 Afonso, O., Monteiro, S., & Thompson, M. (2012). A growth model for the quadruple helix. *Journal of Business Economics and Management*, 13(5), 849–865.

Questionnaire respondents and roundtable participants reported concerns around regulation and constraints on their ability to experiment with the technologies they are developing. **Scotland's Critical Technologies Supercluster Advisory Board and Executive Committee could therefore consider implementing a SCTS sandbox** to support firms to share experiences and experiment with different business models, technologies, and policies. This has been applied elsewhere in the UK in financial services, energy, and personal data. Funding to support these activities could be provided by the Scottish Government.

Additionally, the **possibility of attracting new investment from Scotland, UK, and international partnerships** was identified as a further potential aspect of the supercluster. Participants were very aware of the potential challenges in trying to secure new investment as such decisions on this are typically shaped by factors far beyond the control of the Scottish Government. Nonetheless, there was considerable support for the idea that a supercluster could represent the industries collectively and more effectively than single industry or single company representation with the suggestion that building a brand for SCTS was a major opportunity. Similarly, while there was a strong acknowledgement that the investment decisions within large firms in critical technologies often lie far beyond Scotland in the boardrooms and finance departments of multinationals, the existence and promotion of a supercluster offers the chance to position Scotland as an attractive location for continued and new investment.

The newly established SCTS Advisory Board and Executive Committee comprises a wide range of stakeholders but does not currently have representation from private investment or the Government's financing arms such as Scottish National Investment Bank (SNIB) or the Scottish Co-Investment Fund. **If we are to address the perceived lack of financial support, it may be appropriate to consider how to further develop the leadership of SCTS to incorporate financial provider expertise into its operations.** Programmes such as the Scottish Impact Investor Readiness Programme supported by the SNIB were noted as examples of effective assistance.

The critical technologies do not currently benefit from having an Industry Leadership Group (ILG) and a supercluster structure would have the opportunity to build this kind of consultation, voice and advisory capacity if it were appropriately resourced. Technology Scotland confirmed that this idea is being discussed. There is clearly **opportunity for SCTS Advisory Board and Executive Committee to give further consideration to becoming an ILG** with attention to representation structures, issues covered and establishing regular contact with SG and other relevant bodies and agencies.

Investment in the critical technologies

There are strong opportunities for SCTS leadership and the Scottish Government to work to improve access to finance for companies in these sectors. Whilst Scotland has a well-developed and broad range of financial support mechanisms for technology development (including substantial public sector provision), respondents identified a number of frustrations with the availability of financial and non-financial support. Like all new companies, Scottish tech companies can face the “Valley of Death” between early-stage grants and growth capital, primarily due to what they perceive as a geographic disadvantage, as proximity to London was understood to provide a significant funding advantage for companies nearby through network effects and investor access. As noted elsewhere in this report, in comparison to the infrastructure and shared facilities that benefit many companies in the Golden Triangle⁹, Scottish companies are significantly disadvantaged.

The challenging financial context of State agencies is firmly acknowledged, but **enterprise agencies and other partners such as the Scottish National Investment Bank (SNIB) should continue to prioritise these industries and the companies within them**, to give confidence to investors, staff and potential customers. There was a strong view that a strategy of ‘patient capital’ was needed to support some of these technologies as they build markets and customers and that the Scottish State agencies should prioritise supporting those ambitions. Consistent with this was the feeling that in some cases there was too little access to financing. In particular, venture capital levels of investment at £10 million and more was identified as particularly challenging. Although Scotland has a very mature angel market with significant ties into venture capital providers, the provision of higher levels of venture financing is a recognised issue more generally, especially in comparison with the South East of the UK where the Golden Triangle attracts many more private investors. **Thus, there remains an opportunity to help encourage investment into critical technologies at higher levels than are at present typically available to support the maturation of these technologies into applications.**

A significant concern that was widely shared amongst participants relates to the spin out and scale up pathways for small companies. Given the predominance of small and medium sized enterprises (SMEs) in these industries, many participants identified **opportunities for the Scottish Government to support and invest in pathways to scale up**. A supercluster could offer the opportunity for companies to work together to build synergistic partnerships and increase their reach.

Scotland's Critical Technologies Supercluster clearly has an **opportunity to identify and support the emergence of further new technologies and companies** in these areas perhaps through a ‘Venture Builder’ approach. The supercluster can help develop and embed shared resources that serve multiple institutions as outlined in the new Scottish Funding Council initiative around shared services¹⁰. This aligns with the recommendation in a recent review of UK University Spin-Outs¹¹ to “create shared Technology Transfer Offices (TTOs) to build scale and critical mass for smaller research universities.” Deep-tech ventures often develop over five to 10 years requiring very different kinds of investments than other sectors. There is therefore opportunity for **Scotland's Critical Technologies Supercluster to work with the Scottish Government and relevant stakeholders to establish a shared spin-out support portal** where resources, templates, and FAQs are centralised for all stakeholders thereby opening opportunities to wider innovations.

9 The term ‘Golden Triangle’ refers to the world-leading cluster of universities, research institutions, and businesses in the life sciences and technology sectors between London, Oxford and Cambridge.

10 SFC [catalyst fund](#) for shared research and innovation services.

11 https://assets.publishing.service.gov.uk/media/655e0bf7046ed400148b9e34/independent_review_of_university_spin-out_companies_government_response.pdf

Concern was also raised by stakeholders about the risk of excessive HEI equity ownership of spin-out companies, and was cited by some participants as a deterrent for investors and founders. In line with UK Government proposals, there is opportunity for SCTS to **implement a “spin-out terms template”** making processes more transparent and accessible. There is also **opportunity for the Scottish Government and SCTS to work to encourage HEIs to follow the lead of HEIs like Aberdeen, which recently announced it is reducing its default equity stake** to better support an “enhanced spin-out culture.”

There is scope for SCTS to work with key Scottish Government agencies to explore the creation of a dedicated critical technologies growth capital fund along the same lines as the original version of the Scottish Co-Investment Fund with the private sector leading on investment deals, supported on an equal footing by the public sector. This fund could partner with specialist venture capital funds who understand critical technology risks and have connections to international markets, helping bridge the gap between early-stage government grants and the large institutional rounds that typically require London proximity.

There is also scope to develop a direct investor attraction programme targeting international capital. This would require launching a coordinated effort between Scottish Government agencies to systematically identify and court international critical technology investors, positioning Scotland as a cost-effective destination for international capital. This could include investor roadshows highlighting Scotland's technical talent pool, lower operational costs, and government support packages, while providing concierge-level support to help international investors navigate Scottish opportunities and reduce perceived investment friction.

Technological opportunities and challenges for a supercluster

The companies in the technological clusters have a history of investing in the skills of their workforces, as well as enviably strong connections into the university and college sectors. This means that they are well-placed to take advantage of new approaches and techniques that may emerge from advanced research. One of the key challenges to adoption and scale up is the translation of new technologies to market, particularly the ability to move to higher Technology Readiness Levels¹² (TRLs). Even when some technologies can be taken through the qualification and certification phases, opportunities tend to emerge as they move towards being viable applications. Niche capabilities (such as compound semiconductor fabrication) often need the support and intervention of government to generate new products and markets. **We note that sometimes markets are not yet in existence and early adoption by governments through purchasing choices can support the development and upscaling of these technologies.**

We note the historical strength of these technology clusters in Scotland over time and note the important role of investment from bodies such as UK Research and Innovation (UKRI) in supporting the growth and retention of expertise in Scotland. **There is an important space for the Scottish Government to ensure that the future needs of these technologies and the supercluster are effectively represented in discussions with bodies such as UKRI and Innovate UK to support companies to move up TRLs.** Supporting companies to engage with these bodies (both directly and through representative bodies) is also an important opportunity.

The supercluster might also aspire to improve the security of international supply chains by, for example, **being a local primary or alternative supplier for technology and materials required elsewhere in the cluster.** There are clearly limits to this approach, since some materials supplies are inherently international in nature but stakeholders identified potential opportunities to shorten and derisk supply chains.

More generally, **there are technological opportunities to strengthen links to space¹³, defence, and life sciences clusters, especially around dual-use technologies.** Support from SCTS leadership, as well as from the Scottish Government could facilitate these opportunities.

Stakeholders identified the opportunity for the supercluster to explore the **potential to pool intellectual property (IP) portfolios** between member companies to speed-up access to market. There is scope to consider **mechanisms for IP sharing between companies** to reduce barriers to collaboration. This might include developing a digital platform for collaboration, IP sharing, skills mapping, funding announcements, etc., although the challenges of confidentiality are acknowledged.

Capital equipment is perceived as a key challenge for the supercluster's technological commercialisation moving forward. This could be overcome by creating shared research and development facilities and equipment, particularly where it is challenging to secure alternative funding for this equipment. There is therefore opportunity to **seek funding for further shared physical facilities such as laboratories, fabrication facilities, and clean rooms, building on existing spaces within HEIs.** For example, the Harwell campus in Oxfordshire and the Daresbury campus in Cheshire both provide the usual incubator services, and are also co-located with advanced facilities such as the Diamond synchrotron light source¹⁴ and the Hartree Centre for data science and AI¹⁵. These provide an essential boost to their

12 Technology Readiness Levels are a method for estimating the maturity of specific technologies.

13 Note the previous [SSAC report on Scotland's Space Sector](#) published in 2024.

14 <https://www.diamond.ac.uk/Home.html>

15 <https://www.hartree.stfc.ac.uk/>

client companies, and in doing so act as a magnet for further company co-location and co-operation. There is opportunity to develop similar infrastructure in Scotland. It was also noted that on-going investment is often needed to support the running costs of these facilities. Scottish Critical Technologies would certainly benefit from investment in facilities similar to those found in the Golden Triangle. A national Scottish facilities hub, building on the example of the UKRI-funded Photonics and Quantum Accelerator¹⁶, would provide a geographic focus for support and investment.

We note that this approach also comes with potential trade-offs for the Scottish Government and companies within the supercluster. Focusing only on emerging innovations risks under-investment in processes that retain more of the downstream value of any innovations, both so that they provide economic benefit and so that they increase the resilience of the supercluster by balancing local and global supply. **Navigating the balance between investment in shared facilities and developing and supporting innovations that are already at market or closer to being market-ready is a likely role for the leadership of the supercluster.** Robust and resilient governance will be essential to demonstrating the open decision making of the supercluster leadership and achieving buy-in from stakeholders.

Because the Critical Technologies are novel innovations, there may well be a need for new standards for compliance and new manufacturing techniques and standards as part of the technology translation and maturation phases. **Scotland's Critical Technologies Supercluster could take an important role to ensure that key stakeholders are effectively represented in any future processes to negotiate and agree new standards.**

16 <https://photonicsaccelerator.ac.uk/>

Talent attraction, development, and retention

Across responses to the questionnaires, existing and expected skills shortages were flagged as a key challenge. There is a clear need for a range of skills in both the immediate and longer term from technician-level staff, to scientific and enterprise skills. There is a strong consensus about the need for a skills ecosystem (i.e. a self-sustaining concentration of skills and knowledge in these industries in Scotland¹⁷) that facilitates better development of skills and knowledge transfer, encouraging opportunities for all; therefore it must be of high priority for the supercluster. **This points to the need for a skills strategy that equips both an immediate and future workforce.** Indeed, one aspiration of the supercluster might be to grow the demand sufficiently to absorb a high proportion of the relevant graduates produced by HEIs.

Immediate skills shortages can present challenges. Stakeholders noted a range of skills needs that were exacerbated as a result of tightening visa regulations at UK level. A further concern was the need to strengthen the already constructive relationships between companies and HEIs to support graduates into skilled jobs in these industries and to expand relationship-building into technical and business areas. **There is clear opportunity for leadership of SCTS to work with Skills Development Scotland to develop a short-term plan to address pressing skills shortages at all levels in these industries,** perhaps by coordinating with the Engineering Skills Leadership Group who have worked on the skills challenges facing that sector.

Developing from immediate skills shortages and concerns, a central theme in the responses centred on the importance of long-term policy and planning. While the supply of graduates from higher education institutions is promising, shortages are most acute in mid-skilled positions. Respondents spoke of the need to build confidence in the long-term jobs opportunities and to address under representation of women across the sector, noting that gender imbalances are even more pronounced within Scotland in comparison to the international labour market. **There is clearly an important role for SCTS leadership to work closely with relevant Scottish Government bodies to ensure long-term workforce and skills planning, underpinned by appropriate promotion and funding.**

In building talent strategies for both long and short term, **it is important to integrate practical knowledge.** To support this, apprenticeship and other technical and vocational education and training would be highly beneficial. Collaborative HEI programmes that teach across conventional technology boundaries are promising ways to promote both shared and specialised skills. Interdisciplinary and multi-institutional degree programmes and apprenticeships could increase industrial skills and knowledge, and fortify established partnerships between educational institutions and industry, perhaps looking to dual studies programmes in countries such as Germany¹⁸ for inspiration and learning. This could include building on existing funding for doctoral training (e.g. UKRI support for Centres for Doctoral Training and research hubs that already specialise in some of these technologies) and by continuing to develop and coordinate industrial placements for students. Further development and expansion of micro-credentials may also be a benefit here. Similarly, there is opportunity to grow student numbers in key trades, since projects may be delayed by, for example, a shortage of skills in trades such as welding.

There is clearly opportunity for SCTS leadership to work with the Scottish Government, Skills Development Scotland and the Scottish Funding Council to 1) **embed cross-sector apprenticeships in priority areas**, co-developed with universities, colleges, and industry, 2) **encourage dual-training schemes** (e.g. part-time industry roles during degree study) and 3) **develop and promote modular, stackable qualifications** that blend technical and non-technical skillsets.

17 See [ILO website](#) for further expansion on this point.

18 <https://www.daad.de/en/studying-in-germany/universities/dual-studies/>

The very nature of the innovation goals of the supercluster raises specific challenges regarding the agility of the labour force and the ability to re-skill workers as the focus of activity transforms. Therefore, there is opportunity for SCTS to work with stakeholders to **map and create talent pipeline development programmes that help talented individuals transition into critical technologies from adjacent fields**. For example, “bridge programmes” that support software engineers to move into quantum computing software, or so that materials scientists could transition into photonics device development.

It is important to recognise that beyond technical and scientific skills, these industries have distinct needs for business skills shaped in part by the structure of the industry which has many spin-outs and SMEs. This speaks to a need for **specific forms of commercialisation training and support, such as mentorship for scaling and growth**, which are often provided for in similar cluster structures. While some technical doctoral training does include such training, wider provision of workshops around finance and technical skills would boost enterprise skills, especially for SMEs. There is potential for the supercluster to act as a ‘translator’ could strengthen links between academic, government, and private sector stakeholders to help spin-out companies learn the vocabulary to meet and influence venture capital investment.

Promoting the importance of incorporating business skills into STEM programmes, either through institutions or external supercluster trainings and/or certification, could support the development of appropriate skills among technical specialists. Collaboration between the supercluster, as a representative body for the associated sectors, could impact the offering of appropriate courses by further and higher education institutions.

Relating to the recommendation to develop long-term planning around workforce and skills needs in these industries, there is clearly a need to **promote these industries as providing sustainable careers**. There is opportunity to do that through advertising campaigns, roadshows, and support of existing activity. In line with recommendations of many reports produced by the SSAC, there is also opportunity to embed positive messages about STEM careers in general, and these industries specifically, for groups who may not have considered them as opportunities in the Scottish labour market.

Some respondents expressed concerns around a ‘brain drain’ to England, and the demand on software companies to recruit hardware engineers as well as upward pressure on salaries to compete with the defence sector and similar. Many saw a clear role for the supercluster to develop a **strategy to widen the talent pool, improve rural inclusivity, and support cross-sector mobility in order to bolster the workforce**. Support from the Scottish Government could focus on investment in education, including those noted as priority areas in the Innovation Strategy, and on developing skills to meet supercluster needs.

Attracting overseas talent is also an area of potential of talent attraction, development and retention. This could be done at early stages (e.g. PhD) as well as in supporting recruitment of trained talent. Showcasing the wider capability of the Scottish critical technologies could attract existing talent to fill existing skills needs (e.g. lab technicians), provided that policies allow workers to stay for the long term. There are opportunities to build on existing strategies such as job fairs and degree qualifications as well as building up research and development collaboration with key countries.

There is also clearly opportunity for targeted programmes aimed to **encourage participation in the sector by women and girls** who are underrepresented across the supercluster.

Final reflections

A clear consensus emerged around the need for a sustained strategic focus for investment in, promotion of, and support for critical technologies. We have outlined recommendations to support the short- and longer-term aims of the Critical Technologies Supercluster, but emphasise the need for a long-term, strategic vision for these industries. There is a clear case for the Scottish Government to support the leadership of SCTS through allocation of financial and other resources. This aligns well with the Programme for Government and the outlined priorities, especially those around economic growth.

Recommendations

Strategic focus, governance and coordination

The Critical Technologies Supercluster leadership and Scottish Government should:

- provide a united voice and single point of contact for the critical technologies including:
 - co-creating with member organisations an identifiable 'brand' for the Scottish critical technologies
 - supporting the leadership of SCTS with appropriate financial and other resources
 - being a united voice representing the industries at Scottish, UK and international levels
 - being a single point of contact for stakeholders wishing to partner and engage with the industries and supercluster e.g. finance, consultations etc.
 - coordinating support for supercluster stakeholders around regulatory systems, business advice, IP support etc.
- give further consideration to the structure of the leadership of the supercluster by:
 - considering inviting representation from private investment and/or the Scottish National Investment Bank or Scottish Co-Investment Fund into the leadership structures of SCTS
 - considering the value of creating an Industry Leadership Group

Investments and incentives

Scotland's Critical Technologies Supercluster leadership should work with the Scottish Government and other relevant bodies to:

- support and invest in pathways to scale up by engaging with enterprise agencies and other partners (e.g. SNIB) to encourage continued prioritisation of these industries
- work with HEIs to develop a shared portal for Scottish HEIs to share knowledge about spin-out expertise and support
- work to improve access to long-term finance in these industries
- consider creating a dedicated Critical Technologies Growth Capital Fund
- consider developing a programme to target direct investors aimed at attracting international capital

Technological opportunities and challenges

Scotland's Critical Technologies Supercluster leadership should work with the Scottish Government and its relevant agencies to:

- continue to seek funds to invest in shared facilities that support the critical technologies
- work to promote the interests of SCTS as support from UK Government is discussed and designed (e.g. in UKRI, Innovate UK, DSIT etc.)
- strengthen links to sectors such as space, defence and life sciences
- consider supporting niche capabilities to generate new products and markets
- develop mechanisms for sharing IP between companies to reduce barriers to collaboration, perhaps through development of a digital platform used across SCTS
- increased focus on the maturation and scale up of Critical Technologies

Talent attraction, development and retention

Attracting, developing and retaining an appropriately skilled workforce is crucial to delivering long-term success in these technologies. Scotland's Critical Technologies Supercluster should therefore work with the Scottish Government and its relevant agencies to:

- develop with Skills Development Scotland a short-term plan to address pressing skills shortages at all levels in these industries
- develop a long-term workforce and skills strategy underpinned by appropriate funding and promotion
- work with education providers to embed practical knowledge into qualifications pathways through, for example, apprenticeships, dual-training schemes, modular qualifications etc.
- develop programmes to support talented workers to transition into the critical industries from related fields
- attract workers with appropriate business skills to these industries
- work to incorporate business skills into specialist and technologically focused education and training pathways
- promote these industries as supporting long-term careers
- widen the appeal and promotion of jobs in these industries to under-represented groups including: women and girls, rural workforces, and non-UK nationals

Acknowledgements

The authors acknowledge with gratitude the contributions made by the questionnaire respondents and roundtable participants, an essential element in developing this report. We thank the SSAC Secretariat and Scottish Government New Market Clusters Team for their support in the practical arrangements for the roundtable.

We are grateful to the members of the Working Group who are not existing members of the SSAC:

- Professor Niall G MacKenzie
- Dr Lauren Tuckerman
- Dr Bernd Wurth

We are particularly grateful to Ms Grace Dey for her input as the project intern and hope that this experience has helped give insight into policymaking.

The recommendations are the responsibility solely of the SSAC and have been agreed by the Council as a whole.

Annex A – Overview of key critical technology facilities in Scotland

- [Centre for Doctoral Training in Applied Photonics](#) – Heriot-Watt University
- Centre for Engineering, Education and Development (CEED)
- [CodeBase Edinburgh](#)
- [Compound Semiconductor Applications \(CSA\) Catapult](#)
- Critical Technologies Accelerator – University of Glasgow
- Deep Tech Growth Programme – Scottish Enterprise
- [Fraunhofer UK](#) – University of Strathclyde
- [Glasgow City Region Investment Zone](#)
- [Higgs Centre for Innovation](#)
- [High Value Manufacturing Catapult](#)
- [Integrated Quantum Networking \(IQN\) Hub](#) – Heriot-Watt University
- [Institute of Photonics](#) – University of Strathclyde
- [James Watt Nanofabrication Centre \(JWNC\)](#) – University of Glasgow
- [National Manufacturing Institute Scotland \(NMIS\)](#)
- [Photonics Scotland](#)
- [Photonics & Quantum Accelerator](#) (PQA) – Heriot-Watt University, University of Glasgow, University of Strathclyde, St Andrews University
- [Quantum Alliance for Research Challenges \(QuantumARC\)](#)
- [Quantum Computing Applications \(QCA\)](#)
- Quantum Software Lab (QSL) – University of Edinburgh
- [Scottish Enterprise](#)
- Scottish Microelectronics Centre – University of Edinburgh
- [Scottish Universities Physics Alliance \(SUPA\)](#)
- [Scottish EDGE](#)
- [Scottish Microelectronics Centre](#) – University of Edinburgh
- [Smart Things Accelerator Centre \(STAC\)](#)
- Space Scotland
- [Technology Scotland](#)
- TechWorks
- [Techscaler](#)
- [UK Hub for Quantum-Enabled Position \(QEPNT\)](#) – University of Glasgow
- West of Scotland Space Cluster

Annex B – Questionnaire

INVITATION LETTER AND QUESTIONNAIRE

21 March 2025

Dear Colleague

Invitation to collaborate on exploring future opportunities for Scotland's Critical Technologies Supercluster

We are contacting you on behalf of the [Scottish Science Advisory Council](#) (SSAC) – Scotland's national independent scientific advisory body. The SSAC has recently established a Short-Life Working Group (SLWG) to engage with key stakeholders across Scotland. Our goal is to gather valuable insights to consider and assess the longer-term future opportunities for the Critical Technologies [Supercluster](#).

This initiative is crucial for placing Scotland at the forefront of advancements to the related critical technologies of photonics, quantum, semiconductors, and connectivity and sensing. The supercluster brings together expertise in these industries to ensure that our nation remains globally competitive and reaps both economic and social benefits of growth. Working as a group of industry clusters, there is a clear ambition to ensure that the Scottish economy can benefit from synergies both within and between the technologies.

To this end, and working with policy officials in the Scottish Government's (SG) Division for New Market Clusters, the SLWG has identified several key areas of focus. These include:

- Identifying prioritised future opportunities in the critical technologies over the next 10-20 years, aligning with Scotland's research and industry strengths.
- Outlining actions to position Scotland's research and industry communities to support and capitalise on these opportunities, including delineating the roles of industry, academia, government and society.
- Addressing challenges across these opportunities and considering the potential for international collaboration and partnerships.

Our approach seeks to gather responses from a diverse range of stakeholders through the attached questionnaire, due no later than **10 April 2025** by email. We will subsequently host a virtual roundtable for key stakeholders on 15 May 2025, 13.00-16.00.

We may also follow up with some stakeholders requesting meetings to explore these issues further. Further details about the roundtable will be issued to those completing the questionnaire in due course.

As an esteemed expert in this area, your insights would be immensely valuable to this national initiative. We encourage you to share your perspectives by completing the attached open-ended questionnaire either in its entirety, or by responding to specific questions as you feel able. If you are only able to respond for your industry or sector, we nonetheless welcome your input and reflections. Please do feel free to collaborate and discuss with colleagues.

Please note that the questionnaire responses may be shared with the relevant policy team within the Scottish Government. Should you prefer your responses to remain anonymous, please indicate this in your response and we will ensure confidentiality.

Please send your responses no later than **10 April 2025**. The insights gathered from the various engagement processes will be examined by the SLWG to inform a formal report to be published on our website in due course and shared with all respondents.

We appreciate your engagement in this important initiative.

Yours sincerely,

Professor Julian Jones
SSAC Chair

Professor Melanie Simms
SSAC Project Lead

SSAC QUESTIONNAIRE

Exploring future opportunities for Scotland's Critical Technologies Supercluster

Thank you for being willing to complete this survey! We would appreciate your responses to the key questions below. Please respond to as many questions as you are able. Feel free to collaborate with colleagues to provide a comprehensive response.

Name:					
Organisation					
Contact email:					
Which of the technologies does your expertise and knowledge most closely align with? (Please indicate as many as you wish.)	Photonics	Quantum	Semi-conductors	Connectivity and sensing	Clusters in general

SECTION ONE: Data protection

Please highlight how would you like your response to be considered (please indicate as preferred):

- ☐ Kept confidential to the SSAC and used solely for informing this study.
- ☐ Quotes from your response could be used (in the Roundtable and/or report) but not attributed
- ☐ Quotes from your response could be used (in the Roundtable and/or report) and attributed to your organisation.
- ☐ Quotes from your response could be used (in the Roundtable and/or report) and attributed to you.
- ☐ Your response could be shared in whole or part with relevant policy officials in Scottish Government.

SECTION TWO: Questions for consideration – please answer as many as you feel able.

1. What are the strengths of the Scottish Critical Technologies? You may choose to answer this question with regard to specific technologies (photonics, quantum, semiconductors, and connectivity and sensing) or more generally. Please indicate the focus of your response.
2. In your experience, what connections and collaborations exist across these technologies and industries in Scotland, and beyond?
3. What are the greatest opportunities for these industries (photonics, quantum, semiconductors, and connectivity and sensing) in the next two decades? What actions and policies are needed to gain synergies across and between these sectors in future? You may choose to highlight potential in technological developments, applications, market opportunities, and beyond.
4. How can we develop and enhance synergies that take advantage of the strengths in academia, industry, government and society to maximise the benefits of these clusters and technologies to Scotland over the next two decades? Again, you may choose to respond with regard to specific areas, or more generally.
5. In your view, what opportunities are presented by considering the technologies collectively as a potential supercluster? (Noting that a supercluster aims to support synergies between these technologies and industries). What actions would achieve the development of the supercluster and enable organisations from the different technologies to work synergistically? Are any technology-specific actions required? And are there any risks in considering the technologies collectively and as a supercluster?
6. Where, in your view, should Scotland focus its priorities in developing, promoting and supporting these industries?
7. In your experience, what policies and actions are required to maximise the benefits of these industries for the Scottish economy and society?
8. What barriers and blockages are there to supporting these industries in general, and as a supercluster?
9. Does Scotland have the skills needed to support these industries in the next two decades? What opportunities and barriers have you experienced with regard to developing skilled workforces in these areas?
10. Does Scotland have appropriate mechanisms in areas such as finance, regulation, and infrastructure to support these industries? If there are other areas you would like to raise, including identifying blockages and hinderances, please do.
11. Are there particular national and international collaborations that are required to ensure that Scotland is at the forefront of the critical technologies?
12. Are there any other comments you would like to make?

SECTION THREE – Availability

We will be arranging an online workshop on 15 May 2025, 13.00-16.00 hrs to discuss the results from this survey and related issues with a subset of respondents. Would you (or a representative of your organisation) be available and willing to join us?

- ☐ **Yes**
- ☐ **No**

Annex C – Roundtable programme, attendees and breakout group notes

Held on 15 May 2025 13.00-16.00 hrs via MS Teams

1300-1310	Welcome and objectives	Professor Melanie Simms SSAC Project Lead
1310-1315	Brief Background to SSAC	Professor Julian Jones, SSAC Chair
1315-1320	Overview of Scottish Government policy on CT supercluster	Jack Keays, Team Leader – New Market Clusters
1320-1335	Brief overview of project - Summary of information collated - Pose a definition of a supercluster - Introduction to questions	Professor Melanie Simms SSAC Project Lead
1335-1425	Breakout Session 1 – (50 mins) What is super about a supercluster? 1. Focusing on the idea of synergy and that a supercluster is more than the sum of the parts, what features would a well-functioning supercluster have, and what would it do for you and your organisation? a. Is a supercluster valuable to your organisation? 2. How could your organisation's existing networks and relationships contribute to and benefit from a supercluster? a. Do you have examples where your organisation has benefited from a cluster approach previously? And what would be different about a supercluster? 3. What are the challenges you might foresee in further developing a CT supercluster?	Chaired by: Breakout Group 1 Graham Kerr Breakout Group 2 Qammer Abbasi Breakout Group 3 Bernd Wurth Breakout Group 4 Connor Blair
1425-1440	Comfort Break	

1440-1530	Breakout Session 2 – (50 mins) Short-, medium-, and long-term opportunities – what does it take to get there? 1. What features and resources does a supercluster need in terms of supporting infrastructure? 2. Focusing on practical suggestions, please identify possible recommendations for actions, including: a. One very practical suggestion b. One 'like to have' suggestion c. One 'wave a magic wand' suggestion 3. Again, focusing on practical suggestions, please identify a. Short-term actions and support that could develop the synergies of a supercluster b. Medium-term actions and support that could develop the synergies of a supercluster c. Long-term actions and support that could develop the synergies of a supercluster	Chaired by: Breakout Group 1 Graham Kerr Breakout Group 2 Qammer Abbasi Breakout Group 3 Bernd Wurth Breakout Group 4 Connor Blair
1530-1555	Plenary	Professor Julian Jones, SSAC Chair
1555-1600	Summing up and next steps	Professor Melanie Simms SSAC Project Lead

FRAMEWORK FOR BREAKOUT DISCUSSION

Our goal is to gather valuable insights to consider and assess the longer-term future opportunities for the Critical Technologies Supercluster.

This initiative is crucial for placing Scotland at the forefront of advancements to the related critical technologies of photonics, quantum, semiconductors, and connectivity and sensing. The supercluster brings together expertise in these industries to ensure that our nation remains globally competitive and reaps both economic and social benefits of growth. Working as a group of industry clusters, there is a clear ambition to ensure that the Scottish economy can benefit from synergies both within and between the technologies.

The roundtable and discussion groups will identify strengths, opportunities and challenges for the critical technologies in working together as a supercluster, as well as actions and support needed to secure the benefits of strengthening synergies between the technologies.

Breakout Groups

Attendees will be split into four pre-determined breakout groups. While each group will discuss all of the questions outlined in the programme, they will do so in a different order to ensure each question gets sufficient consideration if some groups do not get round to discussing all four.

SSAC Working Group Members

Julian Jones – SSAC Chair
Melanie Simms – SSAC Member (Project Lead)
Qammer Abbasi – SSAC Member
Simon Dobson – SSAC Member
Graham Kerr – SSAC Member
Connor Blair – SSAC Associate Member
Bernd Wurth – University of Glasgow
Lauren Tuckerman – University of Glasgow
Grace Dey – University of Glasgow
Niall Mackenzie – University of Strathclyde

Roundtable Attendees:

Mostafa Afgani, Pure LiFi
Alan Anderson, Optos
Richard Bates, University of Glasgow
Jim Bown, Abertay University
Jim Brown, Renesas
Allan Colquhoun, Leonardo
David Cumming, University of Glasgow
Mark Cummins, University of Strathclyde Institute of Photonics
Tristan Elliott, I4 Product Design
Michael Gardiner, South of Scotland Enterprise
Evert Geurtsen, University of Glasgow
James Gourlay, Forvia (Design LED Products Ltd)
Allan Gowans, Strathclyde Business School Global Practitioner Group
Steffan Gwyn, University of Glasgow
Johannes Herrnsdorf, University of Strathclyde Institute of Photonics
Muhammad Ali Imran, University of Glasgow
Allan James, Semefab
Alistair Kean, The University of the Highlands and Islands
David McGloin, University of Aberdeen
Alastair McInroy, Technology Scotland
Loyd McKnight, University of Strathclyde Institute of Photonics
David McMenamin, NXP Semiconductors
Andrew Mount, University of Edinburgh
Kia Nazarpour, Neuramics
Sara Pellegrini, ST Microelectronics
Sujan Rajbhandari, University of Strathclyde Institute of Photonics
Stephen Slack, Logitech
Michael Strain, University of Strathclyde Institute of Photonics
Graham Turnbull, University of St Andrews
Jen Walls, Clas-SiC Wafer Fab
Mark Western, Scottish Enterprise
Paul Winstanley, CENSIS (no longer in operation)
Derek Young, Institute of Physics

Roundtable Observers:

Grace Dey, SSAC Working Group member
Simon Dobson, SSAC Working Group member
Jack Keays, Scottish Government

Breakout Group Chairs – SSAC Working Group members:

Qammer Abbasi
Connor Blair
Graham Kerr
Bernd Wurth

Breakout Group Scribes – Scottish Government:

MaryJane Connelly
Emily Norris
Ellen Starkey
Elliot Whitnall

NOTES FROM BREAKOUT SESSIONS

These notes were prepared to enumerate key points made by individuals in the sessions. They do not necessarily reflect majority or consensus views.

Breakout Session 1

Focusing on the idea of synergy and that a supercluster is more than the sum of the parts, what features would a well-functioning supercluster have, and what would it do for you and your organisation? Is a supercluster valuable to your organisation?

- Small companies might not be fully aware of the other companies and expertise that exist in Scotland. Aware of catapults in England and Wales but nothing in Scotland. Contacts that could make connections would be useful in allowing Scotland to move forward. We cannot beat competitors on price, so we need to use supercluster to be there first in marketplace.
- Supercluster idea presupposes that companies could work in synergy. How do we identify them and get them to work closely together? Academic links exist and there are companies in their supply chain in Scotland who depend on each other.
- Aware of various players who are present in Scotland and see that at Technology Scotland gatherings, but it does not feel cohesive and does not lead to anything. How can we foster sense of collaboration with existing companies? The Far East is far more advanced and cost effective than companies here. There is a lack of maturity in the Scottish supply chain.
- We can learn a lot from Wales cluster – Welsh Government really help; they are often represented at conferences to promote Wales in the UK and internationally. Cohesiveness is a good marketing tool. Companies tend to come together in moments of crisis rather than everyday business. How can businesses get together to ensure that correct college courses are there to help skills gap? Need to make sure activities are value driven.
- Need to identify what the maturity of the sector is to inform what we do. Look at academic collaboration, infrastructure and finance allocation. How do we manage and govern that. One stop shop is good idea but how does it work? Space Scotland has a good triple helix model that could be studied.

- Different companies are at different stages of their own maturity so cannot make assumptions about funding. Cannot be a one size fits all. It can get too complex, and then people step back because of the complexity.
- This is going to require some funding to act as a catalyst to make this work and stimulate additional relationships. Some form of metric (such as GVA) could be used as part of a mini business plan and funding allocated. The problem with Innovate UK is competitive tenders, it is hard to get a project awarded, does not require jobs to be created or GVA increase.
- From an SME perspective, there are concerns that this metric may just add another layer of management.
- There needs to be an environment where all the components you need for innovation are readily accessible, convenient and routine for participants.
- Clusters which overlap and with complementary skills, technologies etc. is where additionality is achieved.
- The workforce that clusters generate creates a sustained network for Scotland which is crucial for overlap.
- From a large company's perspective, a single point of contact is invaluable and key to breaking barriers and encouraging investment and opportunity.
- Feeling like you are part of something bigger helps to build momentum on the ground.
- Scotland has small amounts of venture capital funding, meaning start-ups come out of our universities but need to move elsewhere due to lack of scale up funding. The supercluster should help prevent this.
- Is there a contradiction between the venture capital approach and supercluster approach?
- There is an investor outlook on access. Companies can be retained locally but the innovation environment must be healthy and access to markets must be open with access to funding. Large numbers of SMEs do not know how to do so and a supercluster should address this.
- Marketing and branding is crucial to inspire international investment and grow the supercluster. We need to reduce silos: if we are to attract talent and investment we need to showcase the wider capabilities. This is where Scotland's value proposition is. This makes us unique in a UK sense and makes us more competitive internationally.
- The policy and implementation around superclusters needs to be long term to ensure confidence and buy-in.
- Attracting the necessary skills (e.g. lab technicians) to stay for the long term is an ongoing challenge.

How could your organisation's existing networks and relationships contribute to and benefit from a supercluster? Do you have examples where your organisation has benefited from a cluster approach previously? And what would be different about a supercluster?

- Look at EU Horizon programmes: they come together and work on a project.
- Concerns about EU Horizon programme bureaucracy – it is counterproductive. Innovate UK is difficult too. There needs to be a slicker process, concentrating on innovation and not paperwork.
- Attitude to risk – must prove yourself with international companies. Attitude to risk is less in UK than other countries. Funding concentrates on R&D, needs to change to achieve growth. Disconnect between government departments. Must review the understanding of what superclusters are looking at – different type of export products.

What are the challenges you might foresee in further developing a CT supercluster?

- Issues with how grants are awarded. Consortia come together to draft proposals and then go separate ways if not successful and/or when the grant funding ends. There should be some continuation.
- How do you balance the needs of the customer against government strategies, which may not directly support commercial growth of businesses?
- Innovate UK requires a lot of paperwork. Small Businesses Research Initiative is a far slicker process, with project plans including key milestones, giving more latitude to deliver rather than reporting against aims that were set months previously.
- Would like to see government procurement for projects rather than grants.
- Standards must be defined around products.
- There are not yet enough people in Scotland's AI community, and relevance to the supercluster should be considered.
- Impact will come from the applications rather than from the technologies themselves. Systems thinking and systems engineering require collaboration, which the supercluster could champion.
- Many capable software engineers start life as hardware engineers. Skills are critical.
- Skills shortages are resulting in multi-national workforces which have been complicated by recent UKG announcements around migration and the high proportion of multinationals working in the sectors. Skills shortages across the board. Need to have a change at the school level to make it more appealing to youth. Shortages are getting worse with a high churn of staff that pushes salaries up due to competition.
- Challenging to find young talent; supercluster could engage society more and generate enthusiasm.
- Supercluster might help companies to pay higher wages if other requirements and overheads could be shared, such as market research.
- Shared resources could help where CapEx has a shortfall.
- How do we scale up and drive levels of maturity rather than working on pilots and prototypes? Get the necessary supply chain in place to bring down cost and increase volume.
- There is a need to share resources, such as Open Access facilities to spread the costs across the sector.
- Semiconductors have a reasonable supply chain in Scotland (although for many critical technologies, very specialised semiconductors are required). The degree of access to the facilities is important. Moving from prototypes to final entity means gap needs to be bridged. Funding is needed. Access to open access facilities would assist.
- Sales and marketing is crucial – need to identify what the customer needs globally. Need to find customers, target market etc.
- People with the necessary skills, in particular experienced entrepreneurs.
- Who and what are we competing with? Is it other industries or is it more attractive locations?
- Financial services, the energy sector, and green initiatives in Scotland are strong competitors for talent in Scotland.
- The supercluster should educate investors and financiers on what opportunities they should pursue and why.

- Quantum technology has intellectual leadership and this should feed down to technical roles – build industries around this expertise.
- We need to build on and continue to grow laser technology capability in Scotland. It underpins many of the critical technology opportunities.
- Bringing back the manufacturing of strategic technologies to Scotland is a priority. Build on the base we currently have.
- To get long-term success, buy-in from people working on the ground is crucial and there needs to be a strong incentive. The articulation for this is necessary.

Breakout Session 2

What features and resources does a supercluster need in terms of supporting infrastructure?

- How to decide who to ask to participate in the supercluster – will membership be limited and will projects be limited? Need to define scope. Risk of becoming a free for all. What procedures will govern the supercluster?
- Framework to manage Intellectual Property (IP): how much is shared collaboratively during innovation? Cyber security needed.
- Many of those likely to be involved in the supercluster are already members of Techworks and Technology Scotland etc. How can they help manage the supercluster? Use what is there.
- IP should not stop innovation: find ways to navigate around it rather than hide behind it.
- Businesses work in silos. Techworks brings together companies that would be in the supercluster. Can they not be used to manage them?
- Think about what people/business can bring to the supercluster. Some could provide assistance in kind – make it light touch, not bureaucratic.
- Will there be a physical centre? There are several existing ones, such as the National Manufacturing Institute Scotland.
- It does not sound like good value to build a bricks and mortar building and concentrate it in one place. Fraunhofer UK is an example of a model that might be appropriate for next steps.
- Policy objectives can often be limited to a single technology. There are two challenges: what actions would enable the technology organisations to come together better to work together; and how to scale up?
- The supercluster should be the front door for investors, for example in coordinating investor visits. Recycling commercial expertise: Scotland is not good at doing this in comparison to well established ecosystems such as California.
- An ecosystem needs to combine technical and economic expertise. The importance of hiring a CEO is understated and this blend could improve scaling.
- A structure that encourages investors to invest in people in addition to technologies and products is beneficial.

Focusing on practical suggestions, please identify possible recommendations for actions, including:

- **One very practical suggestion**
- **One 'like to have' suggestion**
- **One 'wave a magic wand' suggestion**

Practical:

- Creation and access by supercluster users to a knowledge repository that everyone could tap into may help increase synergies.
- Breakdown of organisational structure across companies – e.g. who to speak to, and a record of infrastructure and capabilities of the companies. This would be a first step for those needing a specific resource (this currently exists with Techworks).
- Map/website of the players in Scotland across industries that you could drill down into to break down who they are, what they do etc.
- Think about how to impact other superclusters with their activities that could be inventoried so that interested parties can identify what exists on their doorstep.
- Something that records what financial assistance is available.
- An online presence for the supercluster (it was revealed this has been developed and is being worked on in the short-term).

Like to have:

- Close the skills gap: better STEM education in terms of critical technologies and more broadly.
- Scottish Government (SG) to stimulate primary school interest in manufacturing and STEM subjects more generally.
- SG to make funding easier to access and less 'overhead driven'.
- Providing specific support to enable export growth by small companies.
- Skills, lack of funding, and export issues can hinder scale up. Often government support concentrates on start-ups rather than scale up.
- Government initiatives that would provide pilot trials in the real world including financial support. Scotland is ideally situated to provide real world testing.
- Innovation impact acceleration that can help graduates go where they want to go and stimulate entrepreneurs from university.
- Scaling up requires access to testbeds and trials. Could the government support this? Relaxed regulation for test deployments at scale would be beneficial. Scotland is an ideal sandbox for testbeds (rural/urban/marine/islands/mountains etc.).
- A logo has been developed for the supercluster – companies adopting this in the future would be desirable.

Magic wand:

- Bulletins from government that set out export opportunities (this used to come from SDI but no longer exists). Set up a match-making service that could focus on export opportunities and help link up companies national and international.
- Resolving areas where companies cannot operate at present due to government policies – particularly exports (think about relationship with China at the moment, security concerns etc.). More support from government is needed.
- A mechanism to get relevant government updates and information to companies.
- Have a recognisable brand.
- Need to be able to market globally, and government needs to be part of the sales and marketing.
- Learning from existing superclusters (Canada).

Again, focusing on practical suggestions, please identify: short-term actions and support that could develop the synergies of a supercluster, medium-term actions and support that could develop the synergies of a supercluster, and long-term actions and support that could develop the synergies of a supercluster.

- A better networking system to collate and communicate what is going on with government.
- A central repository of trusted resources and information.
- Influencing the Scottish Government to tilt the playing field towards the skills we need. There is a lack of undergraduates in important courses.
- The Innovation Strategy notes priority areas. Is there a follow up to facilitate the skills development around these clusters?
- We should better use career guidance in schools to intervene at an earlier stage.
- Improve visibility of science parks and exhibitions for young people, to provide something tangible for them to see, that is perhaps hidden and not seen with completed products.
- Counter the idea of an 'island of strangers': Scotland has an opportunity to deny this and help attract global talent.
- The supercluster provides a stronger voice and gives more weight to pursue opportunities and speak to government. Overlapping industries should be united instead of working in silos.
- Learning from the Life Sciences and Space clusters about marketing achievement and opportunity.
- Rebranding school subjects to align with industries.
- Changing attitudes to risk – many would rather work for a large organisation than pursue entrepreneurship.
- Could the government fund the universities with full economic cost of teaching undergraduates by subjects instead of current fee arrangements?
- Venture capital investment is very geographical. We need investors to come and help scale. How could the supercluster achieve this?
- Investors who know what the technologies are: the supercluster achieves this through educating investors.
- On venture capital funding – Scotland needs representatives at VC firms. Northern Ireland has representatives and therefore VC firms have mandates to invest.
- Help spin-out companies learn the vocabulary to meet and influence venture capitalists.
- If the supercluster can support companies with recruitment of technicians it would solve a huge ongoing skills issue.
- We need stakeholders within the supercluster ecosystem to help to deliver. Where do roles and responsibilities sit (needs to be decided)? How do stakeholders within the cluster help it function best?

What sort of leadership is needed in a supercluster?

- A board – does not need to know everything but should know about running large organisations. Needs financial acumen if providing government funding.
- Drive inward investment.
- Global promotion.
- Influence government policy.
- Work at triple helix of industry-government-academia.

In 5 years, what would success look like for this supercluster?

- Organisations such as Technology Scotland have been looking after technologies and industries for years and will help to maintain longer term sustainable growth.
- Building industries of scale that stay in Scotland (grow and scale) and produce products that are exported with a 'Made in Scotland' sticker: a 'Scottish Apple'.
- Growth of foreign investment, to enable scaling of spin-outs and startups which currently does not compare favourably to the level of academic and research potential that exists in Scotland. Needs to be monitored.
- A culture that helps retain people with great skills is crucial for spin-outs to employ high quality staff and hence enable scaling up and growth.
- An ecosystem that facilitates better development of skills and knowledge transfer, encouraging opportunities for all.

The plenary session delivered feedback from each of the breakout rooms.

Annex D – Roundtable presentations



ANNEX D – SSAC REPORT – Exploring the potential opportunities for Scotland's Critical Technologies

SSAC Critical Technologies Supercluster Roundtable 15 May 2025



SSAC Critical Technologies Supercluster

Introduction to SSAC
Professor Julian Jones
SSAC Chair

SSAC – Who are we?



- SSAC was created in 2002
- **Council** – currently chaired by myself since December 2023; along with 17 members and two associate members some of whom are with us today and five *ex officio* members: CSA; Chief Scientist (Health); CSA Environment, Natural Resources and Agriculture (ENRA); Chief Social Policy Adviser and CSA (Marine).
- **Secretariat** – the Science Advice and Engagement team within Scottish Government in the Office of the Chief Scientific Adviser Division – **contact:** scottishscience@gov.scot

Distinctive features of SSAC



- a remit that cuts across all sectors and policy areas
- we provide independent science advice at “arm’s length” to SG
- we have no disciplinary or sectoral “agenda”
- our combined knowledge of Scottish science skills and context enables us to ensure that advice sought from outside Scotland is appropriate to the Scottish context

Current SSAC Projects



- In addition to this project we are also looking at:
- Engineering Biology – roundtable event completed in March and final report expected to be published this summer for Scottish Government policy colleagues and ministers.
- Flexible Energy Demand Management – roundtable due next week
- Suggestions from our newly recruited members in March are under consideration for future workstreams that align with SG's Programme for Government.

Recent reports:

All reports can be found here:
<https://scottishscience.org.uk/publications>



Scottish Science Advisory Council



Quantum Technology: Opportunities for Scotland

Scottish Science Advisory Council



Scotland's food systems – the contribution of local production

Scottish Science Advisory Council



Use of Science and Evidence in Aquaculture Consenting and the Sustainable Development of Scottish Aquaculture

Scottish Science Advisory Council



Scotland's Space Sector: Exploring potential future opportunities

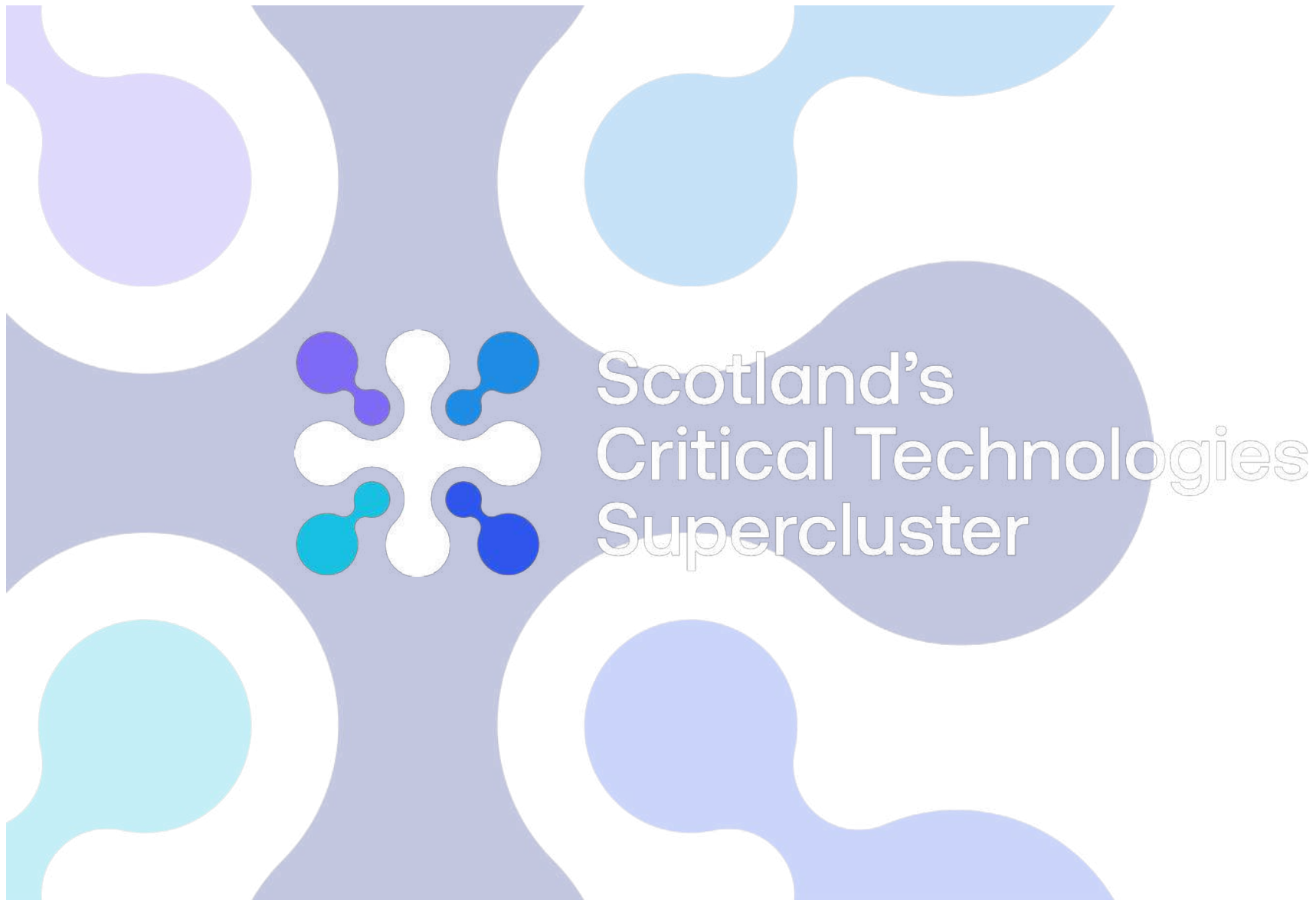


SSAC Critical Technologies Supercluster

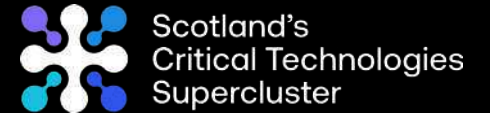
SG Policy Perspective

Jack Keays

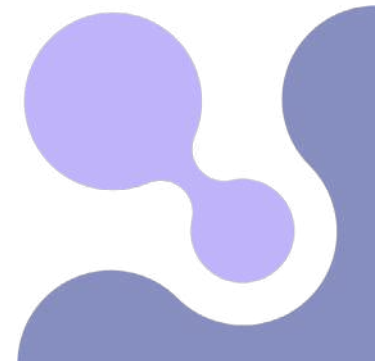
SG New Market Clusters Team



Contents

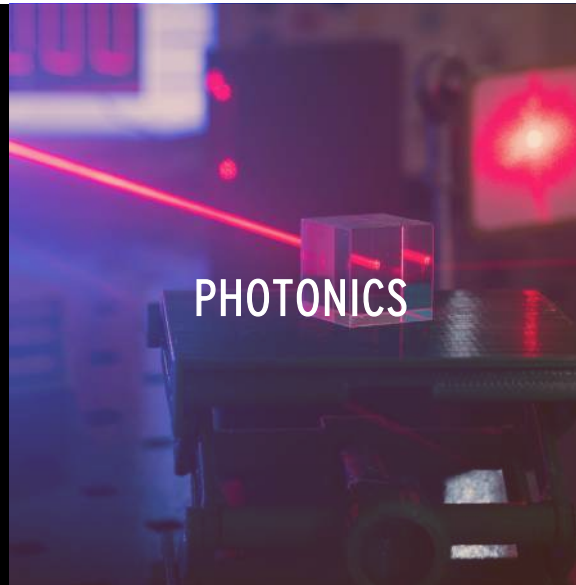


- 1. What do we mean by critical technologies?**
- 2. The supercluster approach**
- 3. Policy context**





The four critical technologies



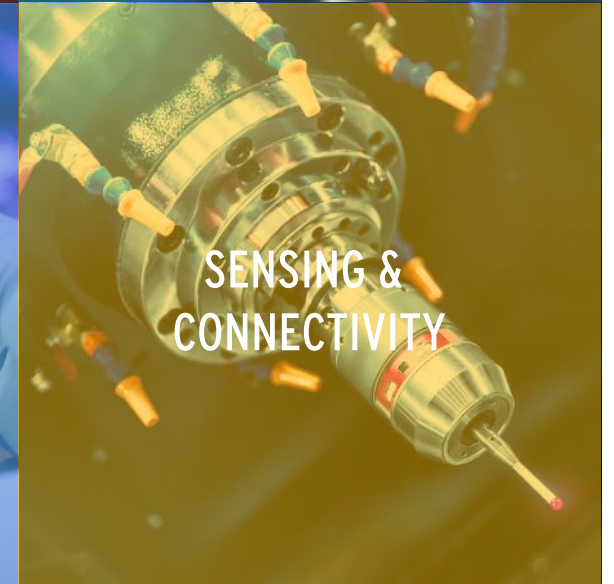
PHOTONICS



QUANTUM



SEMICONDUCTORS



SENSING &
CONNECTIVITY

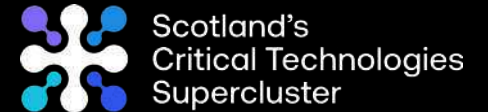
The supercluster approach



1. **Exploit synergies, strengths and scale of subclusters to address fast- growing global markets and accelerate growth.**
2. **Simplify policy interventions and allow more powerful government support.**
3. **Ease connectivity between overlapping areas of the supply chain.**
4. **Create a distinct value proposition for Scotland and an attractive proposition for international stakeholders.**



Policy context



World leading Clusters of Excellence

Supports UK National Quantum and Semiconductor strategies (2023)

Critical technologies have an important role to play in delivering Scotland's:

- Green Industrial Strategy (2024)
- Innovation Strategy (2023)
- National Strategy for Economic Transformation (2022)





SSAC Critical Technologies Supercluster

Overview of Project
Professor Melanie Simms
SSAC Project Lead

What are the critical technologies (CTs)?

- Photonics
- Quantum
- Semiconductors
- Sensing and Connectivity

What makes these technologies critical?

- Produce high levels of export income
- Supporting future public services
- Secure the supply chain for our advanced industries
- Vital for our security, defence and economic independence
- Enable smarter cities e.g. in transport and energy networks
- Generate secure, well-paid employment for the future
- Essential for driving towards net zero

What is a cluster?

- Concentration of related industries, usually in one geographical location
 - Companies
 - Suppliers
 - Service providers
 - Education
 - Research
 - Training
 - ... and their relationship with policy-makers
- Clusters drive growth – supporting investment in research and development, further innovation, new products and services, etc.

A cluster-based approach to driving growth

- Pursue initiatives to support those industries to achieve synergy
 - Form a productive and effective ecosystem
 - Strengthen overall business environment
 - Skills
 - Access to finance
 - Physical infrastructure
 - Focus of government action
 - Support local demand
- Leadership from within State agencies is helpful to support these activities

What is a supercluster?

- A supercluster aims to achieve synergies between clusters e.g. of different technology groups, but with common objectives
- A magnet:
 - Connect and collaborate
 - Build better innovation systems
 - Build new growth industries
- Practical opportunities in Scotland: a Scottish CT supercluster by design
 - Skilled workforce with a common skills pipeline in both tech and business skills
 - United by access to similar (sometimes the same) markets and applications
 - Drives collaboration within and between the cluster actors to achieve scale, and scale-up
 - Government support can be more targeted and cohesive
 - Drives investment cycles both for individual companies and for consortia

What are the potential advantages of a CT supercluster in Scotland?

- Much of the ecosystem already exists here
 - Excellent companies
 - Excellent universities and Research and Technology Organisations (RTOs)
- Some infrastructure exists – although we will be asking you if it is adequate
- Specialist IP, legal and recruitment firms exist here
- Some existing focus from Scottish Government
- ... and there are potential opportunities to achieve synergy, by different technology sectors working together, that have not yet been achieved

Experiences from other countries

- Canada: 5 Global Innovation Clusters
 - \$750m (c£400m) over 5 years to support Global Innovation Clusters
 - Building on \$2bn invested in 2017-2024 round
 - Canada population c. 41 million
 - General view that efforts have yielded results but takes long-term perspective and commitment
- Key lessons:
 - Time
 - Investment
 - Active leadership
 - Anchored in existing industrial excellence

Work to this point

- Survey asking for stakeholder views about the opportunities and challenges of a supercluster
- Sent to:
 - All Scottish companies identified as working in these sectors
 - Other stakeholders: HEI representatives, RTOs, representative bodies etc.
- 41 detailed responses received to date (12th May)
 - Some from groups, some from individuals
- Purpose of today's session is to explore further some of the questions about the opportunities and challenges of creating an effective CT supercluster

Over to you

Breakout Discussion 1

What is super about a supercluster? (50 mins)

1. Focusing on the idea of synergy and that a supercluster is more than the sum of the parts, what features would a well-functioning supercluster have, and what would it do for you and your organisation?
 - a. Is a supercluster valuable to your organisation?
2. How could your organisation's existing networks and relationships contribute to and benefit from a supercluster?
 - a. Do you have examples where your organisation has benefited from a cluster approach previously? And what would be different about a supercluster?
3. What are the challenges you might foresee in further developing a CT supercluster?

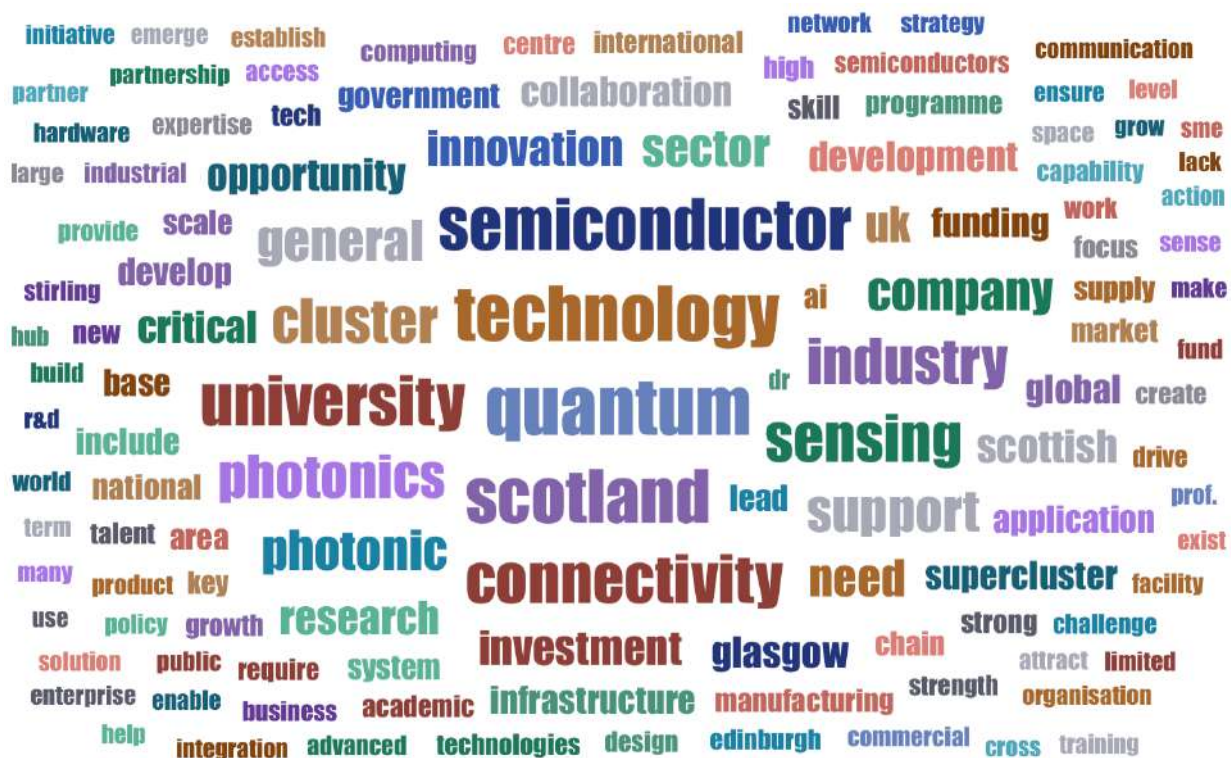
Over to you

Breakout Discussion 2

What does it take for us to get to a high functioning CT supercluster? (50 mins)

1. What features and resources does a supercluster need in terms of supporting infrastructure?
2. Focusing on practical suggestions, please identify possible recommendations for actions, including:
 - a. One very practical suggestion
 - b. One 'like to have' suggestion
 - c. One 'wave a magic wand' suggestion
3. Again, focusing on practical suggestions, please identify:
 - a. Short-term actions and support that could develop the synergies of a supercluster.
 - b. Medium-term actions and support that could develop the synergies of a supercluster.
 - c. Long-term actions and support that could develop the synergies of a supercluster.

Annex E – Summary of questionnaire responses



Note: the text below reflects the views of the respondents with no edits other than removing repetitive views and personal identity information. Not all respondents have provided a response to every question asked.

Strengths of the Scottish Critical Technologies

- strong academic and research base across photonics, quantum, semiconductors, and sensing, supported by significant HEI investment and UKRI programmes
- existing well-established networks and infrastructure, including Technology Scotland, Photonics Scotland, RTOs, and testbed facilities
- recognised talent pool with strong graduate supply, cyber security excellence centres, and openness to industry collaboration
- industrial base featuring large companies (e.g., Thales, Leonardo) alongside innovative SMEs
- good export knowledge and commercial ambition in parts of the ecosystem
- deep technological interconnection across photonics, semiconductors, quantum technologies, and connectivity/sensing
- strong personal and informal networks with shared history across sectors
- participation in all five UK Quantum Technology Hubs, demonstrating national relevance

Existing Connections and Collaborations

- universities act as key links through alumni networks, collaborative R&D, and joint skills programmes.
- examples include Clyde Space's collaborations with Scottish Forestry and NASA, the Canopy project, and NHS partnerships.
- innovation networks enabled by EPSRC, RTOs, and Horizon projects facilitate cross-sector collaboration.
- informal and formal supply chain integration exists across the technologies.
- collaboration between SMEs and large corporates remains inconsistent and needs more structured industry-facing frameworks.
- interconnectivity between universities, RTOs, and companies is weaker than in leading UK regions such as Cambridge and South Wales.
- organisations like Technology Scotland and Photonics Scotland provide support but often lack sustained impact.

Future Opportunities

- growth expected in quantum computing, AI-enabled sensing, 6G, green energy, and medical devices.
- Scotland has the opportunity to become a global leader through supercluster branding and strategic partnerships.
- strategic infrastructure such as CTNF (University of Glasgow), NMIS (University of Strathclyde), clean rooms, and shared facilities offer expansion potential.
- increased access to patient capital and enhanced support for spin-outs and start-ups will aid commercialisation.
- government support through procurement, funding, investment incentives, and aligned policies is critical.
- international partnerships with Canada, Singapore, EU, and others can leverage geopolitical shifts to attract R&D.
- open access to specialist infrastructure and improved translational infrastructure, including IP frameworks, are necessary.

Enhancing Synergies

- boundary-spanning roles ("translators") are needed to connect academic research with industry, government, and society.
- long-term funding support is essential for university initiatives and joint R&D programmes.
- skills development must align with industry needs and include non-university pathways.
- consistent, action-oriented policy coordination across Scottish Government, UK Government, and funding bodies is required.
- digital and physical knowledge exchange platforms should be established to support collaboration.

Supercluster Potential and Recommended Actions

Benefits:

- amplified international visibility.
- enhanced cross-sector collaboration.
- joint funding leverage and shared branding.

Recommended Actions:

- develop a “Supercluster Gateway” digital platform.
- establish a central coordination team within Technology Scotland.
- launch challenge-led innovation programmes focused on healthcare, energy, and defence.
- create implementation hubs aligned with industry demand.
- foster joint venture templates for commercialisation.
- invest in quantum foundries and semiconductor fabrication infrastructure.
- support optical wireless standards and certification efforts.

Risks:

- overextension of resources.
- misaligned priorities across sectors.
- potential neglect of other sectors (e.g. pharma).
- complexities with IP and regulatory frameworks.

Priority Areas for Development

- expand shared, co-located, and specialist infrastructure and facilities.
- establish a Scottish National Technology Investment Fund to support spin-outs, scale-ups, and startups.
- develop continuous learning strategies, funded internships, and non-HEI routes for skills development.
- support SMEs in exploring new markets and improving commercial ambition.
- implement an action-based, challenge-focused policy framework.
- enhance bilateral and multilateral international science, trade, and R&D partnerships.

Policy and Action Recommendations

- prioritise local innovation through public procurement mechanisms.
- encourage regulatory sandboxes for safe experimentation in emerging technologies.
- develop standards and design tools for the technology sectors.
- establish coordinated national strategies and cross-agency support mechanisms.
- promote inclusive innovation, engaging urban and rural communities.

Barriers and Blockages

- gaps in patient capital and high-cost infrastructure investments.
- fragmented efforts across government and industry sectors.
- complex and slow IP ownership and licensing processes.
- skills shortages in technical, business, sales, and operations areas.
- limited industrial premises and geographic challenges.
- cultural barriers favouring competition over collaboration.
- geopolitical uncertainties including Brexit, UK isolationism, and Scottish independence.

Skills Readiness and Workforce Development

- strong graduate pipeline and notable excellence centres, such as Cyber Security.
- lack of skilled workforce in business, sales, and operations roles.
- few vocational or non-university pathways to support talent development.
- skills are often not aligned with industry needs.
- recommendations include SDS/SFC-led initiatives, curriculum reform (e.g., photonics in physics), and promotion of cross-sector hiring through the supercluster model.

Finance, Regulation, and Infrastructure Support

- limited patient capital and early-stage investment.
- underdeveloped national computing and fabrication infrastructure.
- regulatory and IP frameworks lag behind industry needs.
- public investment needed to de-risk private capital.
- stronger government role required in licensing, procurement, and funding.
- better alignment with UK Industrial Strategy and Innovate UK initiatives.

National and International Collaborations

- recommended development of bilateral partnerships with Canada, Singapore, Australia, and the EU.
- attraction of global companies focusing on R&D rather than manufacturing.
- engagement in joint collaborative R&D and standardisation efforts.
- promotion of exchange visits and shared delegations.
- learning from other supercluster models such as Canada, Norway, and Denmark.

Annex F – Canada's global innovation clusters

Canada's 'Innovation Superclusters Initiative' (now known as '[Global Innovation Clusters](https://ised-isde.canada.ca/site/global-innovation-clusters/en)') launched in 2018. Canadian superclusters bring industry, higher and further education institutions, and third sector organisations as well as Indigenous groups as partners in five 'Global Innovation Clusters', or areas of intense business activity made up of companies, academic institutions, and not-for-profit organisations that boost innovation and growth in a particular industry.¹⁹ The key aims of the clusters are to promote investment in innovation and commercialization, expand national and global presence, cross-sectoral collaboration, skills development, and support for small and medium enterprises (SMEs).

The five clusters, Digital Technology, Protein Industries, Advanced Manufacturing, Scale AI, and Ocean, are run as independent non-profit organisations with fee-based (tiered) or free memberships for large and small companies, researchers and academics, not-for-profit organisations, accelerators, and incubators. Co-investment constitutes about half of overall funding. Innovation Science and Economic Development Canada oversees the clusters, managing operations and activities, outlining strategic priorities, selecting, and funding projects through fair assessments and independent assessors, monitoring of success via measuring benchmarks and funding cluster-based strategies.

Total investment sits above two billion CAD, gained through multiple funding rounds (\$950 million in Budget 2017, \$60 million in Budget 2021 with \$20 million each allotted to the Digital Technologies, Protein, and Advanced Manufacturing clusters, and \$750 million in Budget 2022). Canadian government funds are matched dollar-for-dollar by industry through fee-based memberships or other means and distributed by project to the various clusters. Digital Technologies has received approximately \$208 million, Protein \$323 million, Advanced Manufacturing \$427 million, Scale AI \$284 million, and Ocean \$278 million.

Since their inception, clusters have produced more than 855 new IP granted assets, maximising commercial potential, economic impacts of the clusters and allowing distinct IP portfolios to support members and SMEs in commercialisation of innovations with accessible IP-sharing to facilitate collaboration amongst members. IP oversight is managed by a senior official in each cluster. Clusters deliver: educational IP engagements such as workshops, project-specific guidance for members and SMEs; exploration of opportunities to use or protect IP developed through cluster projects; facilitation of relationships to drive commercialisation of higher education IP; maintenance of a member-accessible IP database; and cluster-based IP commercialisation plans outlining expected IP generation for projects; sharing agreements amongst partners; and licensing of product and service revenue generation. The actions service revenue generation and strengthen the supercluster through mutually beneficial member and government cooperation.

Capital attraction is also top priority. The supercluster attracts national and global presence and boosts cross-sectional collaboration. Clusters connect approximately eight thousand members across Canada, encouraging large and small-to-medium enterprise and post-secondary institutions to work synergistically on large-scale projects.

Among cluster priorities is skills development, namely through talent attraction and job creation. Clusters deliver educational support and promote job creation, with a focus on creating opportunities for women, racialised and Indigenous communities, and under-represented groups through dedicated roles, commitments to gender parity for all cluster boards, and targeted workshops and formalised training in response to emerging skills and talent needs as they develop (e.g. AI skills).

¹⁹ <https://ised-isde.canada.ca/site/global-innovation-clusters/en>

Superclusters enable SME growth by focusing efforts and funding on projects developed through shared cluster interests. This connects partners and collaborations with common industry-level challenges to attract talent, research, capital, and new enterprise through grants and marketing. Support for innovation through creation of new products and processes increases productivity of industries, producing job growth and business success. SME growth is also supported through knowledge exchange, market discovery tools and IP access, all of which contribute to speeding SME growth.

Canada's commitment to emissions reduction and a green economy influences the clusters, with Protein Industries Canada developing plant-based proteins, NGen focuses on technological developments such as zero-emission vehicles, Scale AI focuses on supply chain efficiency utilising AI capabilities, and Canada's Ocean Supercluster contributes to greenhouse gas emissions reduction in marine transport.

Annex G – CSConnected: the semiconductor cluster in Wales

CSConnected is the brand name for the semiconductor industry cluster in Wales, which in some respects is the first of its kind in the world (see its website [here](#)). It represents organisations that are directly associated with research, development innovation and manufacturing of compound semiconductor-related technologies, as well as organisations along the supply chains whose products and services are enabled by compound semiconductors.

The cluster developed from a series of investments from 2015 onwards from Cardiff University including industry partnerships, a UK Government Catapult Centre, the Engineering and Physical Sciences Research Council (EPSRC) and the Cardiff Capital Region to undertake a series of initiatives to develop synergies between key actors around semiconductors. Total investments from those four sources total around £175 million.

In 2020, UKRI's Strength in Places Fund funded CSConnected to formalise cluster activities with a further £43 million support. The focus is on four programmes: 1) next generation optical communications and sensing, 2) large Scale Gallium Arsenide-based wafer manufacturing, 3) novel and efficient CS Wafer Fabrication Tools, and 4) advanced processes for 5G and Electric Autonomous Vehicle systems.

The [leadership team](#) comprises:

- Director and Chair
- Director
- Business Development Manager
- Marketing Manager
- Communication Coordinator
- Business Support Officer
- Skills Manager
- Engagement Coordinate

The cluster has attracted a good deal of attention, especially given its relatively small size and investments. It is promoted on UKG [websites](#) as a potential investment opportunity and was frequently cited in the research for this report as an example of good practice where the benefits of working to create synergies have ensured significant attention for the industry cluster.

The cluster activity includes:

- developing a sense of identity for stakeholders from multiple areas related to the semiconductor industry in Wales
- working with companies to develop a specific [industry-focused](#) set of quantifications at all levels
- promoting the sector to multiple audiences in [Wales](#), the [UK](#) and [beyond](#), focusing on both investment and supply chain opportunities
- innovating around existing technologies to support future commercial opportunities
- the cluster stands as a good example of working collaboratively to leverage funds from a wide range of sources to support the development of a cluster, and then give clear leadership to grow the ambitions of the industry. It also emphasises the collaborative and deliberate approach, albeit incrementally over time, to developing a vision for the cluster

Annex H – Map of critical technologies companies in Scotland

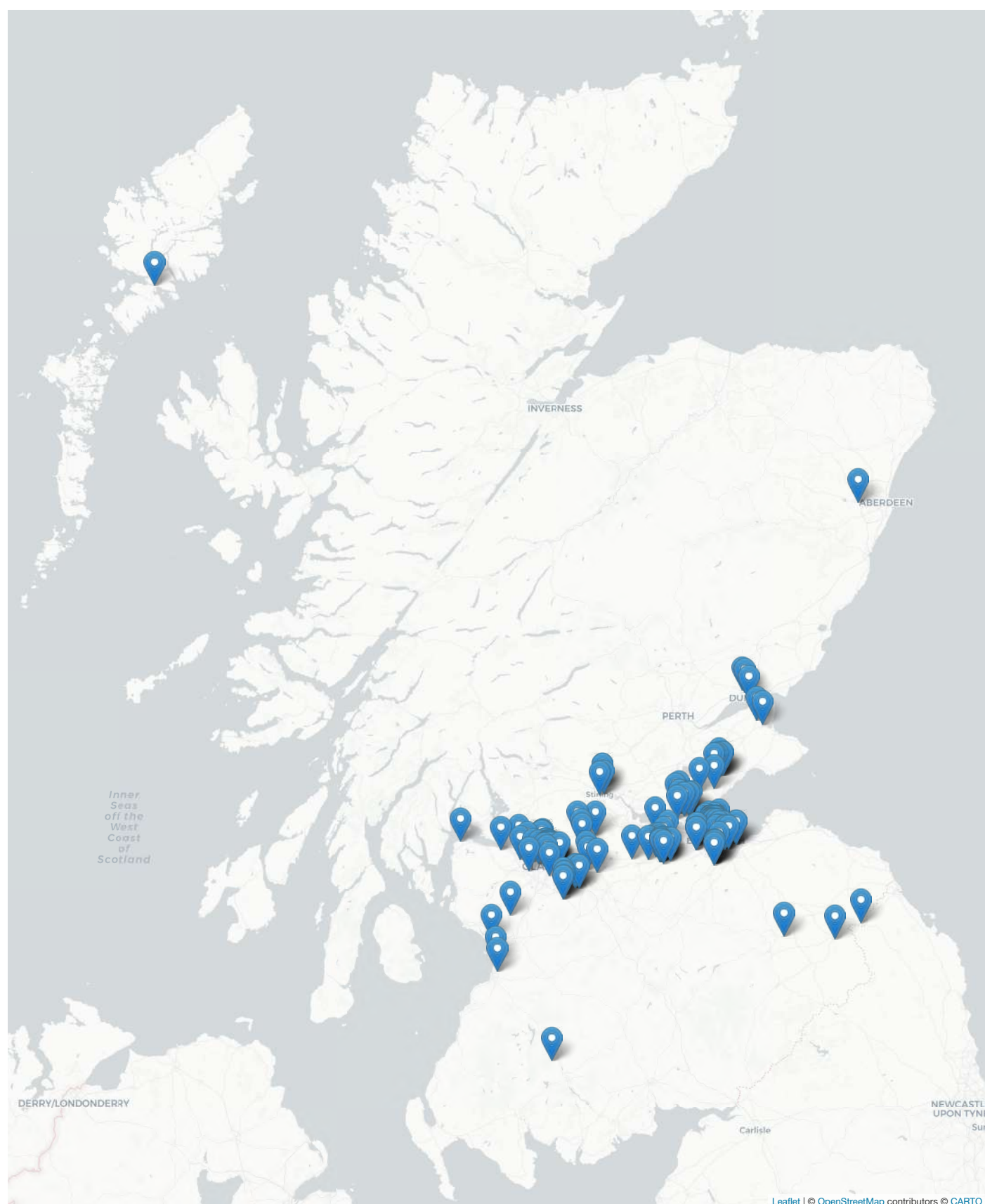


Figure 1: Geographical location of critical technologies companies (data source: Scottish Enterprise)

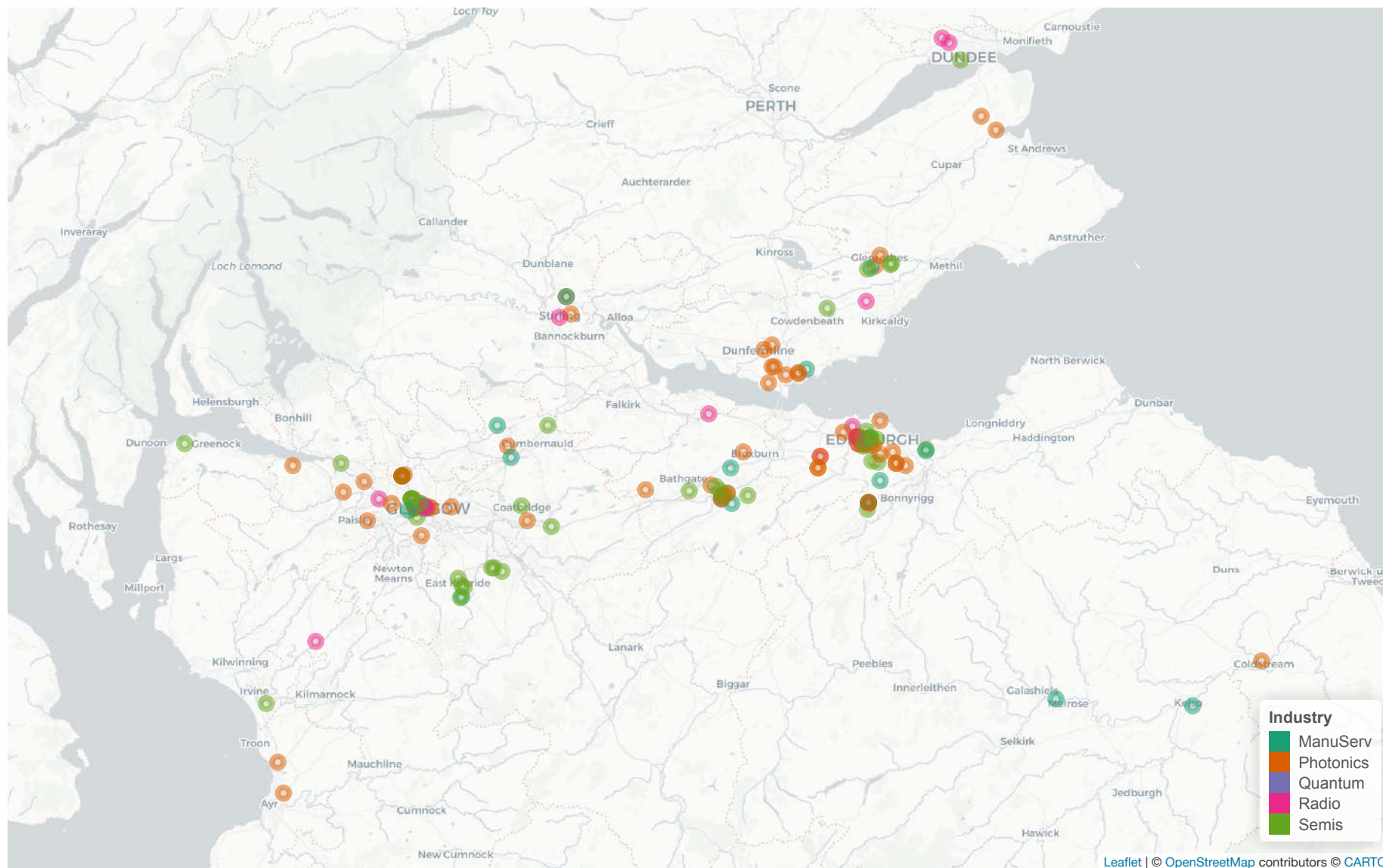


Figure 2: Geographical location of companies in and around the Central Belt by main technology (data source: Scottish Enterprise; for companies that span multiple technologies, we use the one with the higher percentage and, in the case of an equal split, a random assignment was made)

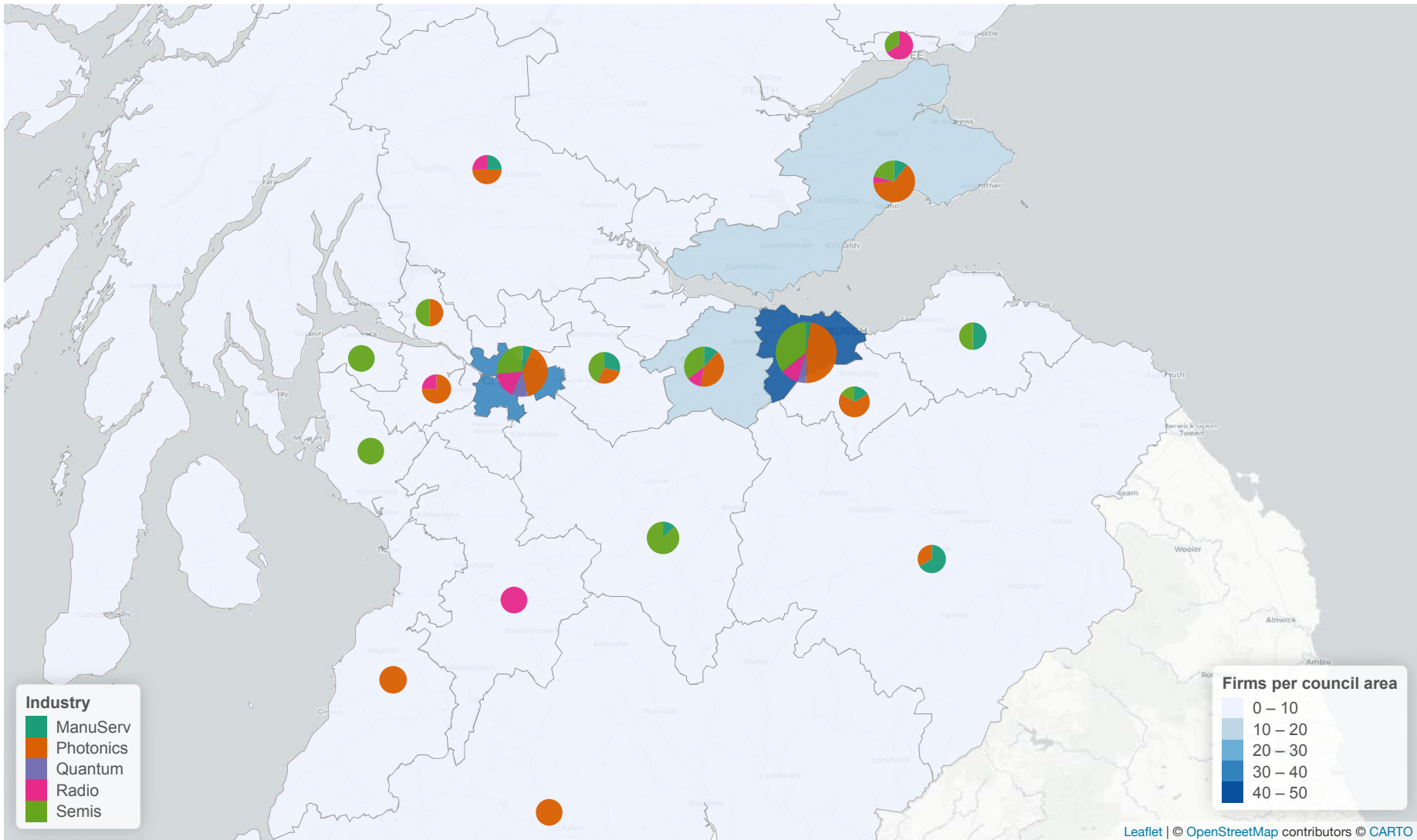


Figure 3: Number of critical technologies companies and composition based on main technology per council area (data source: Scottish Enterprise; for companies that span multiple technologies, we use the one with the higher percentage and, in the case of an equal split, a random assignment was made)



© Crown copyright 2025
Produced for Scottish Science Advisory Council by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
(November 2025)

scottishscience@gov.scot