

Scottish Gov't Innovation Consultation

Question 1

- What are the innovation-rich sectors and sub-sectors where Scotland has existing or emerging competitive strength?
- How can we support these sectors to compete, collaborate and seek out global opportunities? What are our most exciting and promising areas of research and innovation where we have an opportunity to grow a significant industrial base in Scotland?
- What are the disruptive global megatrends that we want to harness and capture in Scotland? What steps will we need to take to support our businesses, universities and citizens to be able to engage with those opportunities?
- Should we prioritise our support for early-stage research to create the discoveries and innovations of the future, or shift the balance of our support towards research translation and commercialisation of today's new ideas?
- To what extent should we align our support for early-stage research with our economic and societal ambitions?
- International comparators

How do we make Scotland one of the most innovative small economies in the world?

Deep tech chemistry is a highly innovative sector

Chemistry underpins innovative research and development in many sectors, including those critical to the UK economy and to solving global challenges. These include green technologies, sustainable energy generation and storage, pharmaceuticals, and food security among many others. Many companies using chemistry fit in the category of “deep tech”, i.e. have R&D as fundamental to their business and the potential to introduce disruptive, novel technologies and/or products to the market. 39% of chemistry-intensive SMEs invest in R&D, compared to 20% across the whole SME landscape. Royal Society of Chemistry research into these companies, published in *Igniting Innovation*, has revealed specific requirements to enable innovation: typically, patient capital that allows for an uncertain timeline of research and development, and access to suitable laboratory and scale-up facilities.¹ Accounting and providing for these needs could enable Scotland to become a hub of deep tech chemistry innovation and realise the benefits of game-changing new technologies.

Chemistry strength in Scotland

Scotland has an established chemical industry cluster at Grangemouth, but chemical technologies are used by innovative SMEs across the country in a wide variety of sectors. Scotland has shown growth in the number of chemistry-using professionals (exc. academic staff and teachers), from 23,433 in 2013 to 27,855 in 2019, as detailed in our report *Chemistry's Contribution*.² Royal Society of Chemistry membership data shows concentrations of chemists around Edinburgh, Aberdeen and Fife in particular. There is also significant chemistry expertise at universities across Scotland and a fertile landscape of spin-out companies using chemical technology. Increasing the ability for chemists to move their career focus between industry and academia would lead to more successful innovation activity and technology transfer from university research.

¹ Igniting Innovation, Royal Society of Chemistry 2022, <https://www.rsc.org/new-perspectives/discovery/the-case-for-supporting-uk-deep-tech-chemistry/>

² Chemistry's Contribution, Royal Society of Chemistry 2020, <https://www.rsc.org/new-perspectives/talent/chemistrys-contribution-workforce-trends-and-economic-impact/>

Question 2

- Net Zero
- Wellbeing economy
- Improved productivity
- Inclusive growth
- International comparators

How can we better use innovation to help achieve Scotland's broader economic and societal ambitions?

Chemistry has broad relevance to economic and societal challenges

Innovation in chemistry is fundamental to achieving transformational breakthroughs in a range of areas, including: energy and climate change; medicine and healthcare; pollution and environmental technologies; and more. The discipline has extremely wide applicability, with chemistry-based companies (and particularly SMEs) active in every one of the UK government's seven technology families highlighted in the Innovation Strategy.³ Even if Scotland chooses to focus on a subset of these technologies, or others entirely, chemistry will underpin the innovation that drives the progress desired by the Scottish Government.

Question 3

- Jobs created in high-value, innovation-rich sectors
- Companies created / supported / scaling
- Levels of private and foreign direct investment
- International comparators

How can we measure progress and what metrics and indicators should we use?

Economic contribution

While we do not have figures specifically for Scotland, chemistry-using professionals contributed an average of £83 billion to UK GDP over the years 2013-2019.⁴ This shows that chemistry is an impactful and valuable sector. The proposed metrics of investment and job creation would be an effective progress measure if the data is sufficiently granular to identify chemistry-intensive companies and the roles for chemistry professionals within them.

The most recent available figures, from 2019, show that Scotland spent 1.66% of GDP on research and development.⁵ This is below the UK average, and not on track to meet the UK government target of 2.4% of GDP being spent on R&D by 2027. The RSC has called for additional action towards this target to drive national prosperity;⁶ Scotland could gain a good share of the returns from this by acting quickly to increase R&D support and leverage private investment. Chemistry, and the technologies it underpins, will be a critical sector to drive this investment and the corresponding economic returns.

³ Igniting Innovation, as above

⁴ Chemistry's Contribution, as above

⁵ <https://www.gov.scot/publications/gross-expenditure-on-research-and-development-scotland-2019/>

⁶ RSC Position Statement - Increasing R&D investment for UK prosperity, January 2020, https://www.rsc.org/globalassets/04-campaigning-outreach/policy/uk-research-funding-policies/rsc_uk-investment-in-rd_policy-position_2020.pdf

Question 4

- What are the innovation-rich sectors and sub-sectors where Scotland has existing or emerging competitive strength?
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- International comparators

What sectors and sub-sectors should Scotland aim to be a world leader in?

[No response – covered in question 1]

Question 5

- How can we improve the connections between academia and industry?
- How can we further encourage and support the successful commercialisation of university research, including through spinouts and licensing?
- How can we work with universities and colleges as educators and trainers, as performers of research and knowledge exchange, and as supporters of new business formation to make a transformational change in innovation performance?
- International comparators

How do we ensure that our universities, and other research and innovation performing institutions, act as anchors for the economy, playing their fullest role in helping grow businesses at the cutting edge of innovation?

Build on strength in university tech transfer

Research from the Royal Academy of Engineering shows that Scotland's universities are already quite successful in forming spinout companies, with Edinburgh, Glasgow and Strathclyde in the top 20 UK universities forming spinouts since 2011.⁷ Many of the most active sectors for spinout company formation are heavily based on chemistry technology and research. University investment arms and tech transfer offices are well placed to understand the needs of innovative deep tech companies and provide the patient capital that can underpin their continuing R&D efforts. Access to university facilities can also spare companies from having to buy costly equipment for synthesis and testing of their technologies.

Business skills for innovative scientists

⁷ Spotlight on Spinouts, Royal Academy of Engineering 2022, <https://www.raeng.org.uk/publications/reports/spotlight-on-spinouts-uk-academic-spinout-trends>

The skills required to establish and grow a small R&D intensive company are different to the skills required to develop and succeed in scientific research. In order to grow the deep tech innovation sector in Scotland, researchers in university (particularly postgraduate students) should have access to training in business and leadership skills, and the chance to experience collaboration with the private sector where possible. Many PhD graduates will go on to form the critical workforce in these innovative SMEs; our research shows that PhDs are well represented in the chemical industry workforce. Of respondents to our 2019 RSC Pay and Reward survey, 55% held a doctoral qualification.⁸

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Catapult Network model

Scotland already hosts some centres that form part of the UK-wide Catapult Network of innovation centres. Research and innovation systems perform best when they are porous and collaborative, with staff able to move between academia and commercial activities; Catapult centres can be an effective driver of this model, as the Fraunhofer Institutes are in Germany. Building upon this network, or expanding the model to create a Scotland-specific innovation network that works closely with Scottish universities, could be an effective way to boost innovation.

Question 6

- How can we ensure regions across Scotland contribute to and benefit from a more innovative and productive economy?
- How do we build innovation systems that deliver regional economic priorities and attract talent and investment to the region?
- How best do we connect companies with Scotland's existing innovation assets and major place-based projects to drive competitive advantage?
- International comparators

How do we support and grow clusters of excellence to deliver on our vision for innovation?

Build on existing strengths

As we have shown, Scotland already has an existing innovation ecosystem with strength and expertise in the chemical sciences. Building on this, and adding facilities needed to grow existing deep tech companies such as scale-up laboratories, will bring additional investment and expertise that will catalyse the formation of clusters. Scotland also has local advantages that could be further exploited to incentivise chemistry clusters such as significant renewable energy resources and petrochemical facilities based around Aberdeen.

Question 7

- What does a business innovation user journey look like? How could this be improved?
- How can we encourage and support more businesses to innovate?
- What can we do to improve skills and training?
- How can we encourage a culture of entrepreneurship in Scotland?

⁸ Chemistry's Contribution, as above

- How can we ensure that the most innovative businesses can start and scale in Scotland?
- Have we got the right mix of incentives and regulations?
- International comparators

What can we do to help businesses innovate today?

[No response]

Question 8

- How do we engage and bring in additional private funding?
- What steps can Scotland take to attract additional international investment, and what role does public funding for innovation play in this?
- How can we engage more effectively with UK, European and international agencies in order to maximise the proportion of funding that gets spent in Scotland?
- Is the financing landscape in Scotland one that helps people start and grow businesses and supports business investment in research and development?
- International comparators

How can we maximise the funding and investment available to businesses that innovate?

Leveraging of private funding through early support

Early signs of support for a new deep tech SME can act to reassure potential private investors as to the viability of the company. Similarly, supporting a deep tech SME to reach a proof-of-concept stage means they can then provide the evidence behind their technology that may bring in future private investment. Early-stage support needs to be at a level where the company has the freedom to proceed without spending all its effort on securing the next slice of funding. It must not be tied to an expectation of quick returns, as the early R&D stages of deep tech development can have a very uncertain timeline, and setbacks are not uncommon. The administrative burden attached to receiving early support must be proportional and not overbearing.

Investors understanding the deep tech world

Many private investors are accustomed to a model of relatively quick development and returns from a service company or software product. Deep tech does not follow this same model, with lab-based R&D needing a much longer, and often quite uncertain, timescale. This can be in the order of 5-20 years, and it is unlikely the company will be profitable in that timeframe. However, due to the disruptive nature of deep tech R&D, the eventual rewards can be massive.¹⁰ Investors who make the effort to understand the technology and provide patient capital can be in a strong position for future returns. The Scottish government should ensure strength in this form of the investment market, rather than the “quick wins” attitude that can be prevalent.

Question 9

- Digital adoption
- Diffusion of technology
- Training and skills
- Management and leadership

¹⁰ Igniting Innovation, as above.

- International comparators

How can we become one of the best places in Europe for the adoption and diffusion of technology?

[No response]

Question 10

- Process innovation
- Technological adoption and diffusion
- Product-based innovation e.g. business models, product design and speed of iteration
- Peer learning and cooperation
- International comparators

How can we better support businesses to improve their ways of working and be adaptive and responsive to changing markets?

[No response]

Question 11

- How can we ensure that public sector spend is a driver of innovation?
- How can we influence sectors like construction and health to embrace innovation?
- What can we do on pre-commercial procurement?
- International comparators

What levers do we have in terms of public sector procurement which would encourage greater innovation within key sectors?

Government spending on innovative solutions to critical issues

As discussed above, innovation based on chemical technology will be critical to solving the societal issues that face us. Public procurement can be used as a driver of innovation through the adoption of novel solutions promising transformative capabilities rather than furthering the status quo with existing technology. The Scottish government should create ambitious tenders designed and structured to attract innovative proposals, allowing an element of potential risk to create the opportunity to foster innovation. Efforts to minimise the bureaucracy involved in submitting proposals may increase accessibility for SMEs with lower resources and/or little experience in submitting proposals to government.

Question 12

- Do we have the right mix of institutions, assets, programmes and agencies?
- Do they operate with sufficient scale and ambition?
- Do they collaborate sufficiently?
- Is there anything missing from the landscape? Are there overlaps or duplication that we need to address?
- International comparators

Do we have the infrastructure and architecture in place to become a world leading innovation ecosystem?

[No response]

Question 13

- Leadership and co-ordination and coherence
- Structures, processes and mechanisms
- The ability to move quickly when opportunities arise
- Connections and relationships between academia, industry and the public sector
- International comparators

What opportunities are there for greater co-ordination and collaboration across the ecosystem?

[No response]