



Engine of the North

Making Scotland a European Innovation Leader

Chris Bond, Jamie Gollings, Will Sutton

Our
Scottish Future

Economy Commission Report

Foreword by Eddie Barnes

In his speech at the beginning of this year, Prime Minister Rishi Sunak set out the vital importance of innovation to the UK's future. He noted that over the last 50 years innovation has been responsible for around half of the UK's increase in productivity. Innovation creates new jobs, boosts wages and reduces the cost of goods and services. "The more we innovate, the more we grow," he said.

So we are publishing this report today to focus the attention in Scotland on the urgent need to get our economy growing through the power of innovation.

By innovation we mean simply this: it is the quest to find better, more efficient ways to do things. That quest is becoming ever more intense as the technology revolution explodes the opportunities to develop these better methods. Across the world, every nation is throwing billions of pounds at innovators in the hope they can find the solutions that can make companies more efficient and profitable.

What is clear is that Scotland needs to change its mentality quickly if we are to compete in this global innovation race.

Entrepreneurs and business figures are telling us that, for all its many strengths, Scotland lacks a clear strategy and vision to build a more innovative economy. As the authors say in this report, while we have all the necessary ingredients, too often we have no recipe.

Partly this is because we're not driving "bottom up" innovation in small firms and regional businesses.

Partly it's because we lack a "top down" national plan. A third of the economy is earmarked in Scotland as a key growth sector. When everything is prioritised, nothing is prioritised.

This report makes it clear that we need our Governments to be much, much bolder. They need to take some bets. Scotland is a small country: it can't do everything. We should make some choices within key sectors: wind and tidal and renewable heat within energy; pharma and R&D in life sciences; the advanced manufacturing of anything from beverages to medical equipment; finance, legal and consulting in business services. Our initial analysis suggests that these all offer the best potential rates of return. Let's back them with real funding that seeks to make them more and more innovative in what they do.

Underlying this report is a growing sense of frustration: many of its recommendations are familiar and have been talked over before. The problem as ever in Scotland comes down to implementation.

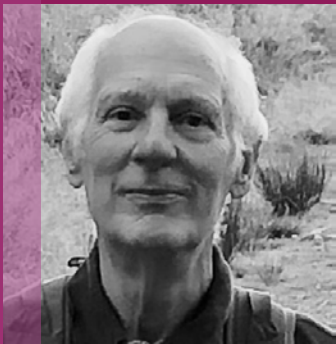
Let us hope that in 2023, the Scottish and UK Governments can work together to agree a way forward on this vital agenda. Economic development is an area of shared responsibility. With the cost of benefits and public services rising, we need our governments to collaborate and make sure our economy becomes far more productive.

Bluntly, Scotland must innovate to survive. We believe this report can show how.

Executive Summary

- Innovation is vital for economic growth, but Scotland is not living up to its potential; it is being caught up by other parts of the UK in productivity terms, and has poor rates of business start-ups
- Productivity is especially lagging in Southern Scotland, and in manufacturing industries
- We see the solution here as driving 'bottom up' innovation – helping the smaller organisations in the foundational economy to make improvements that can sometimes seem incremental, but sum up to big productivity boosts
- This is all about the power of networks – a national network of specialist facilitators to get organisations thinking about how they can improve; local innovation forums to plug them in with those who can help them solve these problems; skills audits and plans at a local level to ensure that communities have everything they need to make these ideas a reality
- Looking at the national level, we can see that Scotland still boasts many of the assets that drive innovation - a high rate of degree holders and hefty rates of R&D investment by its top quality universities, and a robust financial services industry
- The appetite is clearly there, and everyone knows to point to renewables, life sciences and the rest as the future of Scotland's economy, so why aren't these strengths being capitalised on?
- There are also gaps in some of the things that power innovation - private R&D investment is poor, not many Scots are taking up more vocational skills training and the appetite to set up new businesses is weaker than in the rest of the UK
- Part of the answer is that Governments in Edinburgh and Westminster are lacking a plan that dares to make choices, take bets on a small subset of industries, and then give them the backing they need – the Scottish Government designating a third of the economy as 'growth sectors' is not specific enough, and indeed in some places a more devolved approach would be helpful
- A stable and cohesive plan, and policies around things like R&D should help to give businesses the certainty they need to invest in R&D in Scotland, and to identify where Scotland needs to focus on developing vocational skills
- Stronger connections with the rest of the UK will also help Scotland to leverage the financial muscle of London, the Golden triangle's ability to draw international capital, and research relationships
- The last decade has been a muted one for Scottish productivity – with a clear strategy and plan for Bottom Up and Top Down innovation, the next one need not be

About the Authors



The authors of this report have their own experiences as innovators.

Sometimes innovation is about unexpected new products or services. Will Sutton, before moving to offshore energy, worked in an industrial research laboratory on new corrosion-resistant alloys but also helped develop a process for forming decorative colour films on stainless steel. To everyone's surprise this was enthusiastically adopted in Japan for applications from bathtubs to a huge new black and gold Buddhist Temple in Tokyo. You never know!

Sometimes it's about getting existing processes to work. Chris Bond joined Scotland's nascent offshore oil industry in 1979 as a chemical engineer and found himself problem-solving and adapting unproven technology. One of many examples was understanding the physics, and then modifying the discharge water clean-up equipment to achieve regulatory standards. Another was getting the gas compression system to work to minimise flaring.

Sometimes you swing and you miss. Jamie Gollings led a team of his fellow physics students in a spin-out biotechnology company, seeking to commercialise an idea developed during an entrepreneurship module on their Master's. They secured some funding, claimed a place in a lab, but unfortunately the 'personal lactose filter' proved uneconomical. However, as a taste of the innovation process for a group of 22 year olds, it proved invaluable.

Introduction

This paper is about how to improve innovation in Scotland. It considers first “How Innovative is Scotland today?” and notes the economic impacts of low and falling growth which results from poor innovation and productivity. **It argues that Scotland has “All the Ingredients, No Recipe”.**

Then it introduces the concept of “A Supply Chain of Ideas” to argue that demand for innovation is as important as the supply of ideas. It considers two different but complementary approaches to stimulating innovation: “A Bottom Up Approach” focused on ‘left-behind towns and places’ where innovation can help community wealth-building and “A Top Down Approach” looking at how national/ regional strategies for innovation can be improved. In both of these cases, we see the power of networks when creating and sharing ideas within localities, across the UK and beyond. “Conclusions” complete the paper.



How Innovative is Scotland Today?

Whatever form innovation takes, it acts to boost productivity and create economic growth. This can be through improved processes in existing firms, with the creation of sprightly new businesses, or even advanced new industries. Higher productivity means higher wages and living standards. This is something that Scotland and the rest of the UK are desperate for.

We can't delve into innovation policy in Scotland without first celebrating its proud history. This is the country that has given the world the telephone, television and penicillin. James Watt's improvements to the steam engine, developed whilst an instrument maker at Glasgow University, spurred the industrial revolution.

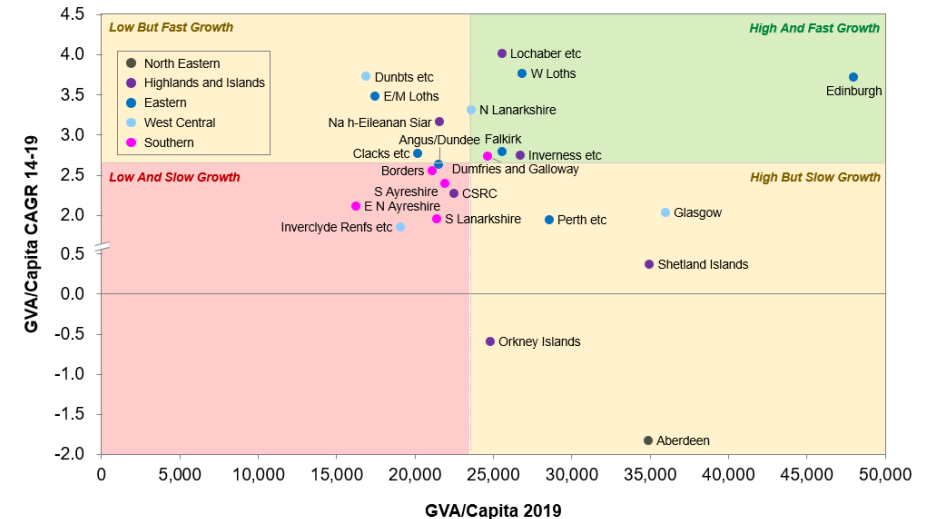
The bad news is that Scotland is not performing as well on innovation as it could be. It remains the third most productive nation or region of the UK, after London and South East England. However, it is being caught up. Productivity per head grew at 2.2% a year between 2014 and 2019. In much of the rest of the UK growth was over 3%, including 3.4% in Wales, 3.7% in Northern Ireland and 3.4% in the North West and East of England. If Scotland had maintained its 'productivity premium' compared to the North West from 2014-19, output per head would be £1,600 (6%) higher.¹

The European comparisons are also unflattering. When compared to states of similar size, Flanders and Denmark, a recent NIESR Report found Flanders was 40% more productive than Scotland and Denmark 20%.²

Scotland is not a hotbed of start-up activity. It has fewer new businesses being created each year relative to its population than every region of England except the North East³. It lacks high growth firms, with only 1.5 per 10,000 people, compared to 3 per 10,000 in London or 2 per 10,000 in the South East; again, it only beats the North East out of the English regions³. Glasgow was also found to underperform in recent analysis by the Centre for Cities, having fewer firms in innovative sectors per head than Birmingham, Manchester, Leeds and many other comparable cities⁴. Patenting activity is also middling, ranking 6th out of 12 in terms of patents filed per capita in 2020⁵.

This problem is felt unevenly across the country and different industries. The chart below illustrates the differing levels of productivity and growth in productivity across Scottish sub-regions. Edinburgh is a clear outlier, boasting both the highest GVA/capita in the country and one of the highest rates of productivity growth. Meanwhile, Aberdeen suffered a sharp hit to its productivity between 2014 and 2019, although some of that may have reversed in the last year given the jumps in energy prices. Most of Southern Scotland falls in or near the 'Low And Slow Growth' segment, whilst for other parts of the country there is more variability in the performance of sub-regions.

Gross Value Added (GVA) per Capita and Annual Growth by Scottish Sub-Region

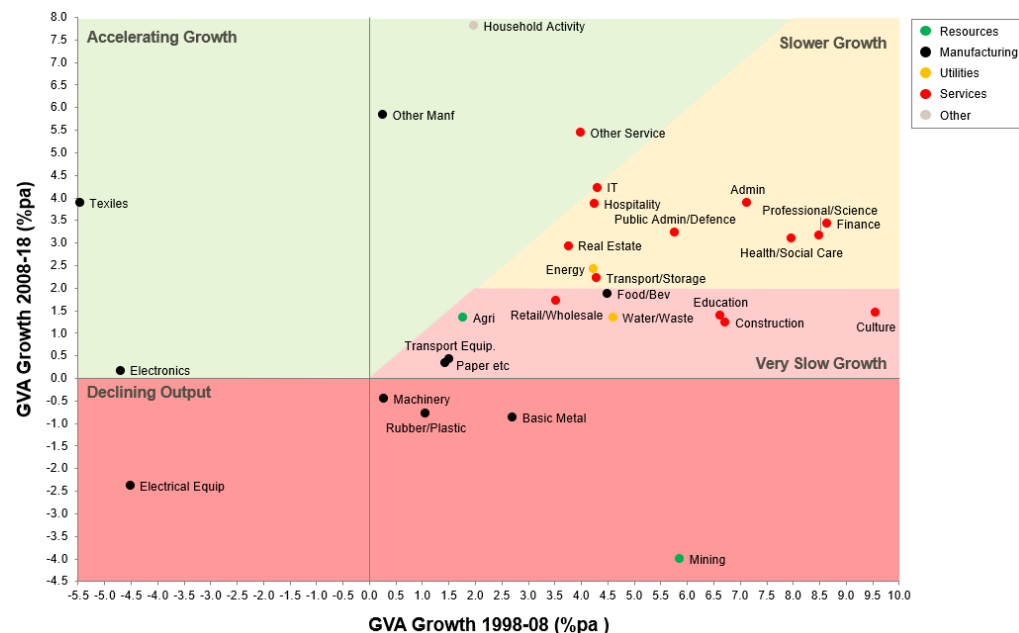


Source: ¹ ONS, *Regional gross value added (balanced) per head and income components, 2022*. OSF Analysis

The efforts of policymakers can't just be about the most dynamic regions. If those in the 'Low But Fast Growth' segment carried on at their pace of growth and reached the median GVA/capita, that would be worth £4bn of extra Gross Value Added, or £3.5k/capita. Closing just half of the gap between those of the 'Low and Slow Growth' group and the median would add a further £3bn at £2k/capita⁶. We're talking about an extra £7bn for the Scottish economy by focusing on driving innovation and productivity in those communities who are currently lagging behind. That would represent 5% of growth in the economy. Some of this would ultimately pass through to earnings, boosting living standards in these areas. The slowing rate of productivity growth in Scotland, however, points to these goals currently being far off unless things change.

There are, similarly, industries which are falling behind. Across the economy, most sectors have seen a decline in growth in the last decade. The chart below shows how this has fallen especially hard on all manufacturing except food and drink. Education, cultural activities and construction have also seen a sharp decline in output growth.

Comparing GVA Growth in 1998-08 and 2008-18



Source: ¹ ONS, Regional gross value added (balanced) per head and income components, 2022. OSF Analysis

Scotland, then, isn't quite living up to its past. As we will see in the next section, this isn't for a lack of the raw inputs that make a country innovative. There is something else holding Scotland back.



Whatever form innovation takes, it acts to boost productivity and create economic growth. Higher productivity means higher wages and living standards. This is something that Scotland and the rest of the UK are desperate for.












All the Ingredients, No Recipe



Scotland has a veritable bounty of the inputs required to make innovation work in an economy. With its high class universities, generous levels of public sector R&D and skilled workforce, its bag of ingredients is a promising one.

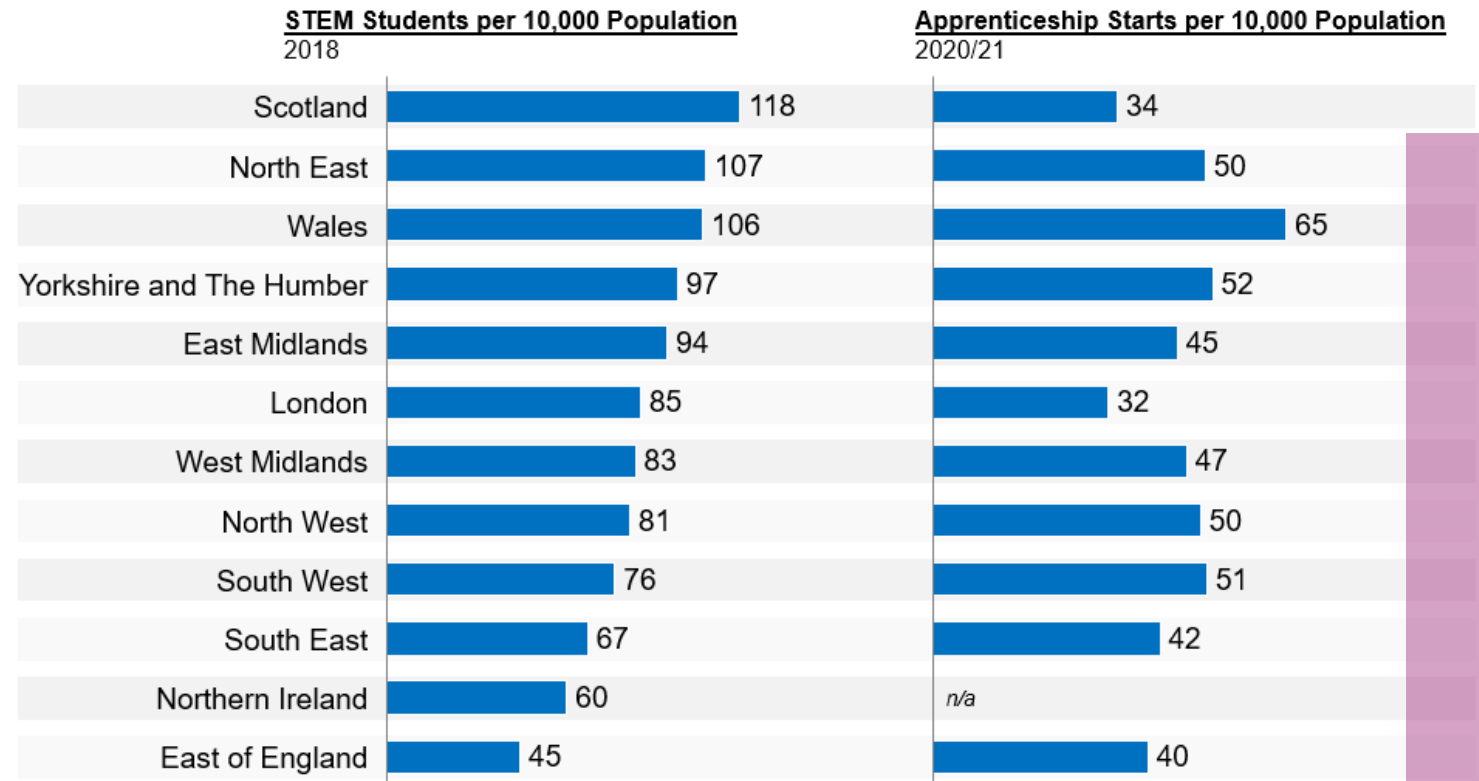
One of the jewels in the crown of 90s and 00s daytime television was 'Ready, Steady, Cook!'. Contestants would be faced with making the best meal they could from a hidden grab bag of vegetables, meat and carbs. Fortunate contestants would be offered tomatoes, prawns and saffron. Those less lucky might receive a swede, some walnuts and a pork chop.

Textbooks will tell you that innovation takes a combination of factors: R&D spend, a well-educated workforce, a market to demand better/cheaper things, government support, research institutions, availability of capital, an entrepreneurial culture. Scotland has a veritable bounty of the inputs required to make innovation work in an economy. With its high class universities, generous levels of public sector R&D and skilled workforce, its bag of ingredients is a promising one, as we shall see.

Innovation Driver	Scotland Rating	Commentary
 Effective Government Support	Yellow	<ul style="list-style-type: none"> High level of economic development spend GDP and productivity growth have been lacklustre indicating support is not working
 Robust IP System	Green	<ul style="list-style-type: none"> Scotland and England/Wales IP systems very similar UK's overall rated as 2nd best in the world after the US
 Access to Capital	Yellow	<ul style="list-style-type: none"> (Distant) 2nd to London on venture capital offices 2nd highest level of 'in region' investor investee pairings
 High R&D Spend	Yellow	<ul style="list-style-type: none"> Highest rate of higher education sector R&D ...but towards bottom of the pack for private sector R&D
 Strong Universities	Green	<ul style="list-style-type: none"> 8 in top 500 global universities (3rd to London and SE) Edinburgh is 16th in the world
 Skilled Workforce	Yellow	<ul style="list-style-type: none"> Largest population of graduates outside of London Highest rate of STEM graduates Modest rate of apprentices, trainees, technicians. Relative lack of skilled vacancies
 Innovative Culture	Red	<ul style="list-style-type: none"> 3rd lower proportion of people who've thought about starting their own business Among lowest for businesses willing to take out financing



Scotland benefits from many other excellent universities and colleges, which play a key role in stimulating innovation in the everyday economy in their local and sometimes neglected areas.



Source: England 2021 Local Authorities averaged over regions⁸; Wales 2021⁹; Scotland 2018¹; ^{11 12 13 1} OSF Analysis

Edinburgh University is rated as being the 16th best in the world according to the QS World University Rankings 2023. 7 Scottish universities feature in its top 500, which is third to only London (9) and the South East (9) across parts of the UK. No other region or country has more than 3 in the top 500⁷. Scotland benefits from many other excellent universities and colleges, which play a key role in stimulating innovation in the everyday economy in their local and sometimes neglected areas.

These institutions can be the fulcrum around which innovation occurs. They generate and disperse new ideas from their own and international academia, they collaborate with businesses and other actors to help them solve their problems, and they create talent and spin-out companies. Out of these high quality institutions, Scotland generates far more STEM graduates per head than elsewhere⁸ – these are the lifeblood of high-tech industry, and innovation across the economy. The share of the population qualified to at least level 4 is higher in Scotland than everywhere except London^{9 10 11}.



However, in a recent study of Scotland's productivity NIESR noted that the proportion of graduates (both STEM and non-STEM) was high relative to the UK and OECD but the proportion of skilled but non-graduate workers was not. As the figure shows, Scotland has fewer apprenticeship starts than almost every other nation or region^{12 13 14}. Also, there are fewer skilled jobs available in Scotland. Highly skilled occupations represent nearly 27 per cent of all vacancies in Scotland, compared with 32 per cent in England². This imbalance of supply and demand of skilled workers means that not all of them can fully contribute their skills to the economy.

Germany has always taken very seriously getting the mix right between numbers of graduates and non-graduates in STEM disciplines and trying to ensure there is a balancing demand for these skilled people. The same principles should apply, of course, to non-technology sectors such as the creative arts, economics, psychology and sociology – all crucial in a modern society.

Although it is a distant second to London, Scotland is an important financial hub. This means that agents of innovation in Scotland should be able to benefit from access to nearby services. There are 9 offices of Venture Capital firms (largely in Edinburgh), which is less than London (60+) but higher than elsewhere (there are 4 in Yorkshire and The Humber and the North West)¹⁵. It also comes second in banks and building societies per capita, the number of equity investors per capita, and the volume of equity deals per head.

These deals are, however, smaller in value than average. Scotland is more mid-tier when it comes to Angel investment, and usage of the EIS and SEIS schemes. Despite this, our interviews with those involved in the innovation economy suggest that Scottish start-ups fare well at the Angel investment stage, but struggle after that.¹⁶

We can see the impact of Scotland's strength as a financial centre on investment. The British Business Bank found that 80% of investor-investee pairings for Scottish organisations are with Scotland-based investors. For London, this is over 90%, but for the third placed region (the North East) this is around two thirds¹⁵. Capital is vital to support R&D, acquire new technologies and scale changed processes, so Scotland's well established pool of financial services providers should be a boon to innovation.

The state, too, is a generous supporter of R&D. Indeed, 0.7% of Scottish GDP is from the R&D carried out in Scotland's higher education sector, far higher than even Cambridge's East of England, where it makes up 0.5%. As the figure below shows, though, this is not matched by correspondingly high private sector R&D activity; the academics' activity is not proving catalytic among businesses, and Scotland is a clear outlier here.¹⁷

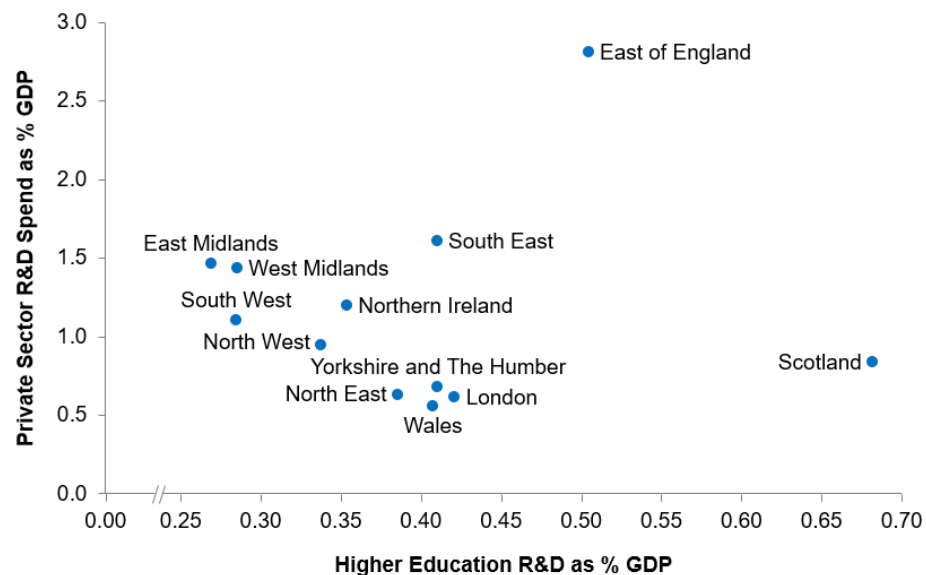
Other reviews have noted the relative lack of private sector R&D activity in Scotland^{18 19}. It may be argued that private sector R&D is more focused than public sector R&D on impact, objectives and innovations of value to the business. This

is not to argue one is better than the other but that a better balance might be helpful.

Why there is a relative lack of private R&D may be associated with the small number of large companies which are head quartered in Scotland and able to direct private sector R&D to Scotland.

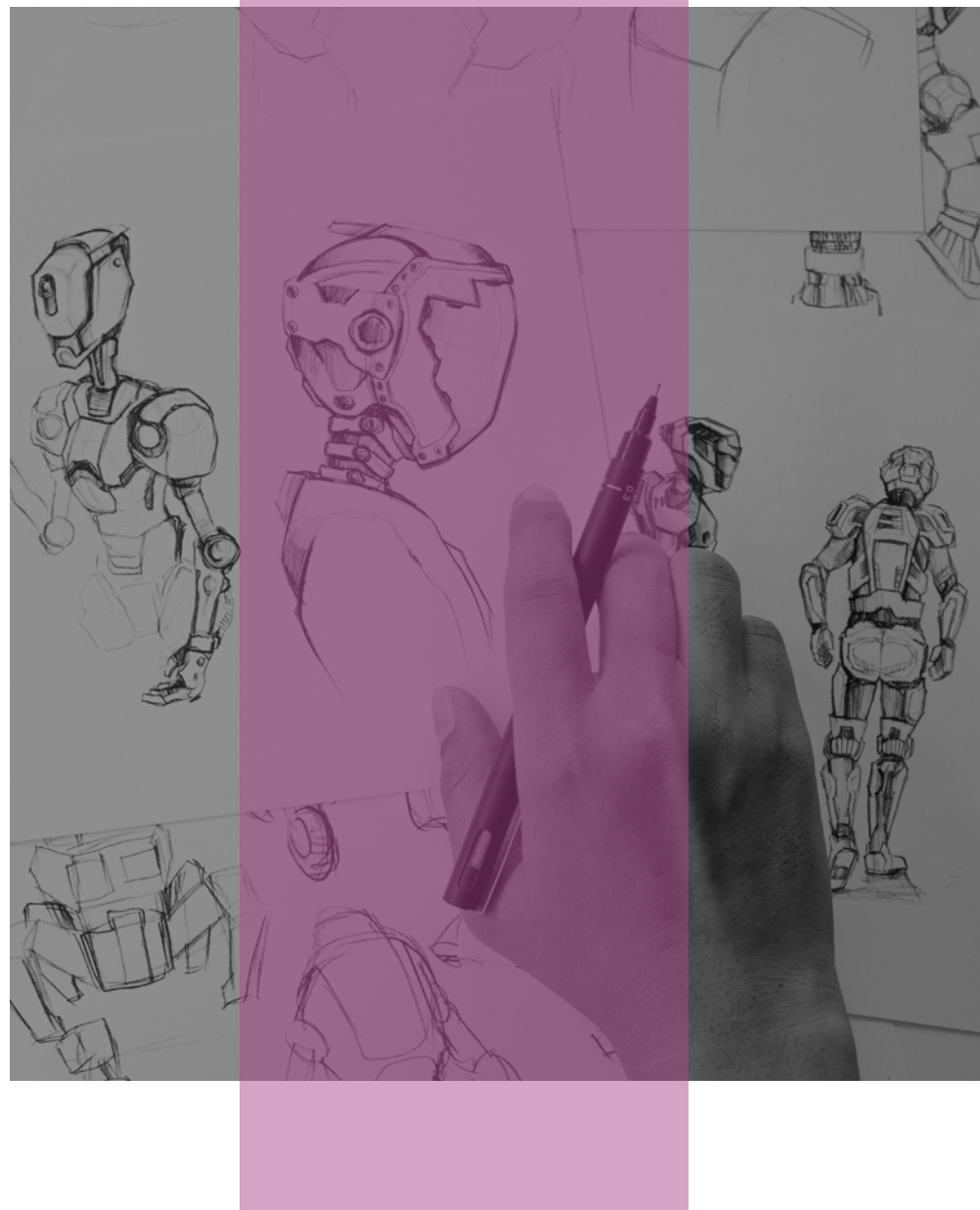
It seems that FDI into Scotland is healthy and facilitated by the financial centre of Edinburgh². However, perhaps more of this FDI could be encouraged into private sector Research, Development and Innovation. The UK has the world's second strongest IP system according to the International IP Index of the US Chamber of Commerce²⁰. Scotland's system is very similar to that in England and Wales, so would also expect to be highly rated. This should help to amplify the appeal of Scotland as an R&D centre.

R&D Spend by Higher Education vs Private Sector (2019)

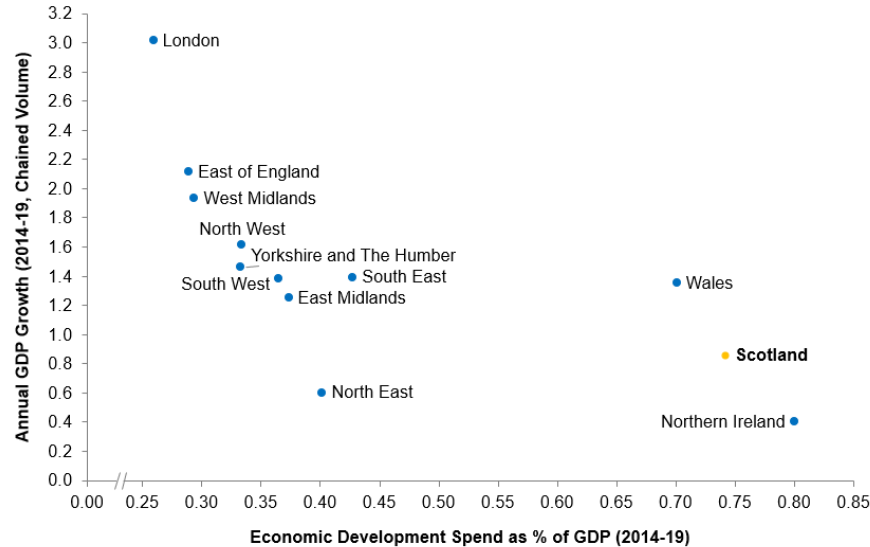


Source:¹⁶ House of Commons Library, 'Research and development spending,' Research Briefing, 2021. OSF Analysis

As well as on R&D, the Scottish state is a big spender on economic development. The institutions funded, like Scottish Enterprise, HIE and the SNIB are devices through which the state can stimulate and direct innovation. It invested 0.7% of GDP between 2014 and 2019, but experienced not even 1%pa economic growth. As the next figure demonstrates, Scotland spends more than almost any other part of the UK on stimulating the economy, but sees less for it.



Economic Development Spend vs Growth 2014-19



Source: ²¹ ONS, *Regional gross domestic product: all ITL regions, 2022* and ²² HM Treasury, *Country and regional analysis, 2021*. OSF Analysis

Another area of concern is entrepreneurialism, or attitude to risk. Clearly firms like Skyscanner, Amphista Therapeutics and Fanduel demonstrate that Scotland can foster and launch new businesses in tech, life sciences and more. Even so, we've seen that the business birth rate in Scotland is lower than elsewhere. Part of this may be related to attitudes. Only 41% of Scots have thought about starting their own business. This is lower than every country and region in the UK except Northern Ireland²³. Just 30% of SMEs are willing to use finance to grow, which ranks 9th out of the 12 parts of the UK¹⁵.

Scotland has one of the strongest sets of innovation enablers of UK nations and regions. There are some question marks over entrepreneurialism and private sector R&D levels, but otherwise, Scotland would be expected to be a real leader in driving innovation in the UK. What's going wrong? The ingredients are there, but the meal is disappointing. Perhaps the answer is the lack of a good recipe.

Over the following sections this report will firstly describe the Supply Chain of Ideas. Bill Gates has highlighted the need to demand innovations as well as to supply novel ideas and inventions²⁴. Invention without application and innovation is not enough.

The report will also explore what policy and structural changes might be made to simulate innovation from the Bottom Up and the Top Down.

In brief, Bottom Up innovation focuses on the percolation, diffusion and adoption usually of existing good practices and innovations into local, often 'left-behind' towns and rural areas. It is closely linked with community wealth building.

Top Down innovation depends on the effective national/regional analysis of opportunities coupled with appropriate direction and support.



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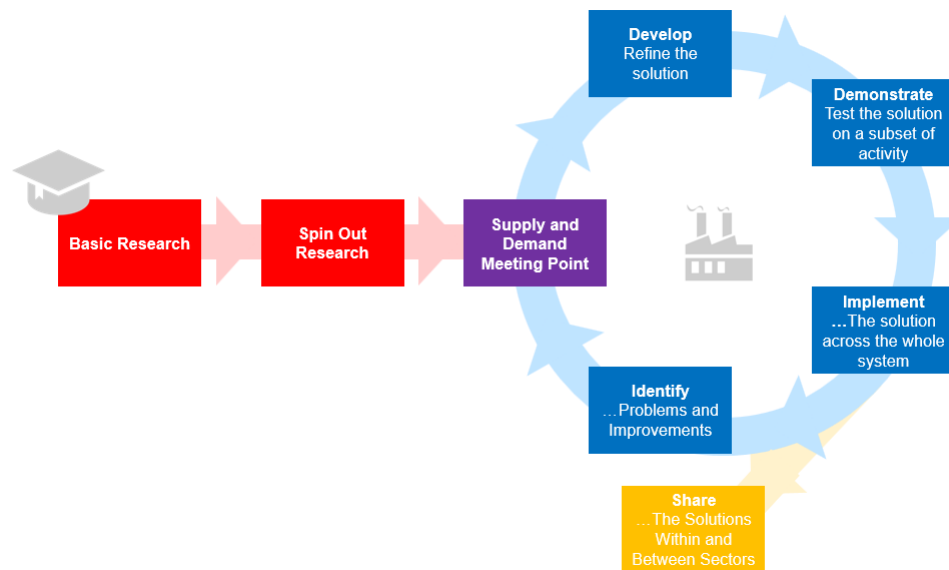
The Supply Chain of Ideas



The big question is around the appetite of Scottish organisations and entrepreneurs to identify, solve, implement and share innovations.

Dan Breznitz, an innovation academic and practitioner, notes that it is important to distinguish between invention and innovation. “Invention is the process of coming up with a truly novel idea, while innovation is the process of using ideas (not necessarily novel) to offer new or improved products or services.”²⁵ Bill Gates has suggested that a modern prosperous economy has to be underpinned by a “supply chain of ideas” in which the demand for ideas is broadly balanced by supply. Here, we are talking about innovation, not just invention – this is the lifeblood of economic growth. His principle has been expanded upon and illustrated below.

Supply Chain of Ideas



For the cycle to keep spinning, there needs to be sufficient demand from within the organisation, as making innovation work takes time and money. It also takes effort and engagement to spot problems and think ‘is this something that needs improving?’. Even for big problems, it can sometimes be easier for an organisation (or staff or management) to stick with the status quo rather than seek to resolve it and improve the situation.

On the supply side we are looking for a plentiful supply of ideas, inventions and solutions which meet the demand side needs of the innovating organisations. The supply side can be academic or research institutes, public or private R&D centres or knowledge exchange hubs. The demand side can be any sort of organisation seeking to improve its products, services or performance.

As we’ve seen, Scotland has a very strong university sector, and high levels of higher education investment in R&D. The supply of ideas and inventions from that source is not the issue here. However, private sector R&D in Scotland is relatively low. This issue, along with how government policy can influence it, will be explored in the ‘Top Down’ section.

The big question here is around the appetite of Scottish organisations and entrepreneurs to identify, solve, implement and share innovations. The data on entrepreneurialism and willingness to borrow to invest were both weak in Scotland compared to elsewhere in the UK. In the next section, we look at ways of supporting that demand, as well as how to make sure that the supply of innovation meets it.

Bottom Up Innovation

To make an economy truly hum with innovation, there needs to be a groundswell of improvements and ideas coming at the level of smaller firms and local organisations, in all kinds of localities across Scotland. Each locality will have its special character and will benefit from focused support and facilitation. Innovation takes many different forms, applied not just to business or technology but also to social enterprises and creative projects.

Bottom Up innovation is especially crucial for the parts of the country and industries which do not capture the imagination of policy makers in Edinburgh. Raising the productivity of the least productive could be worth at least £7bn to the economy, as we saw earlier.

The Scottish Government recently published its community wealth building strategy (CWB)^{26 27}. It incorporates many ideas and initiatives taken from earlier work, such as the Preston Model and the framework developed by CLES (Centre for Local Economic Strategy)²⁸. The overall approach in the CWB is a welcome one. At the heart of any bottom up innovation strategy needs to be the collaboration of local anchor institutions, which should include local businesses, the local university and colleges, third sector organisations, the Local Authority, business/industry groups and Trade Unions.

Although (if implemented) this strategy would be a step in the right direction, there is more that can be done to buttress support for innovation at the grass roots level.

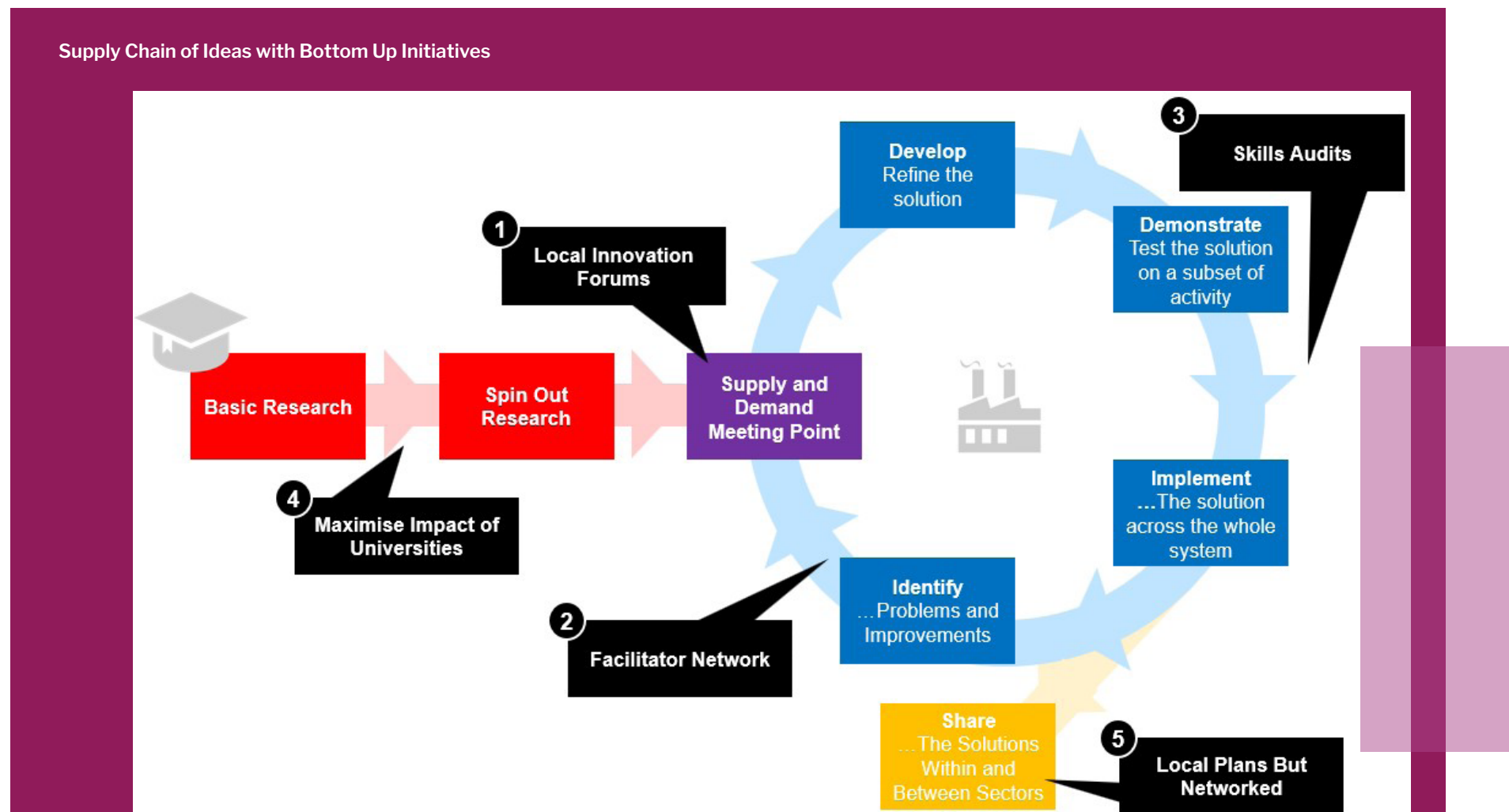
In the last section, we introduced the 'Supply Chain of Ideas'. When it functions well, the benefits are clear. An example can be found in the Orkney fishing industry. Fisheries innovation has been led by Orkney Sustainable Fisheries, a not-for-profit cooperative of active fishermen, supported by Heriot Watt University. One project has



been focused on Brown Crab, a valuable segment of Orkney’s shellfish export industry. The counter-intuitive innovation has been to increase catch mesh size, reducing total catch in the short term but leading to a sustainable catch of larger crabs for the premium markets of M&S Orkney Brand Crab and European customers. The ability of Heriot Watt scientists to model harvest strategies and the willingness of fishermen to try the new strategy has been crucial and led to similar improvement projects in all the six Inshore Fishery Management Groups around Scotland.²⁹

Scotland needs more such stories. Like the fishermen of Orkney, a combination of an ability to spot problems, forge networks with collaborators and implement solutions can help to boost productivity across the foundational economy.

There are suggestions below for how Scottish organisations can get better at spinning through the cycle of innovation, and building the networks that support it.



1. Establish Local Innovation Forums

Magical things can happen when you get the right people in the room, when the right business with a problem meets the right academic with a spare PhD student. There are parts of the country that are already doing this well (as we saw in Orkney). However, these opportunities need to be available in every corner of Scotland.

Local Innovation Forums (LIFs) would bring together the anchor institutions of a community and tighten local networks. Their purpose is to actively boost the local demand for ideas to solve problems and improve processes, and then stimulate the supply to meet those challenges. Not every business or charity leader has the time or space to wrestle with the innovation process. These LIFs are proposed to manage and energise the meeting point where the demand side and the supply side arrive at ideas most favourable to the region or city's combination of natural and human resource.

They would gather representatives from all local businesses at a granular level so that there is real knowledge of the need and grasp of what is most likely to work for their particular circumstance.

The first aim of the Innovation Forums is to flush out the demand for ideas by asking questions:

- How could your business or organisation be improved?
- Are there specific problems which innovation could resolve?
- What does it cost?
- Are there human skills gaps?
- Does it require new technology or automation?
- What are the priorities?

Once successful projects are identified, funding of the initial phases should be from levelling up or shared prosperity funds. The LIFs and the Facilitators network should then aim to source project-specific funding to help it scale.

2. Locally-Based Facilitator Network

To support the Local Innovation Forums we need people trained as Facilitators for this process with soft skills, business acumen and an appreciation of what sort of locally-based innovation actually works. They are the agents of

innovation, working with local anchor institutions and other businesses and organisations to identify the problems holding back better performance, identifying potential solutions and assisting the innovation process. They would also be linked by regional and national networks to help best practice ripple across the economy.

3. Local Skills Framework

Skills shortages are major impediments to growth. Following the recommendations of the RSA (Royal Society of Arts), localities should consider carrying out a formal skills audit amongst the local anchor institutions, leading into a skills development plan.

Fabian Wallace Stephens of the RSA outlined the relevant processes in 'Local skills frameworks, levelling up and the future of work'. The key activities are to take stock of the skills available in an area and compare them with the future needs for soft, technical and digital skills.³⁰

The RSA is exploring the value of this approach at the local level to support Levelling Up and has carried out a pilot project centred on Southampton. The project has set out to identify the skills needed to meet the city's growth ambitions for the maritime, digital and creative sectors while ensuring all residents have the core skills to thrive in the future world of work. The project combines an analysis of online job adverts to identify the most in-demand skills and used the ESCO framework (European Skills Competencies and Occupations) to organise the data. For the three key growth sectors, separate skills mapping was carried out in conjunction with sector experts.³¹

The RSA believe that this mixed-method approach to skills fore-sighting is a step forward from traditional labour market intelligence and can provide a richer and more immediate perspective. However, it is still somewhat rooted in the business requirements of today rather than the possibilities for the future.

What strikes the present authors is that approaching a local town or area to try to stimulate innovation and demand for ideas fits well alongside conversations about future skills needs. In fact, you can't really have one without the other, and local organisations will reap the benefits of both.

Once the skills needs are properly understood, at that point something can be done about it. As examples, this could be through training schemes developed through a joint venture, or by building better networks with a college that is a source of such skills.

4. Maximise Impact of Universities

Scottish universities have a role powering innovation both at the local level, Bottom Up, and at the national level, Top Down. This might range from top-flight R&D in City/Regions to supporting more modest but locally-important innovation. Government and universities should discuss how to strengthen the links. Some possible areas might include:

- The 'Impact' section of the REF system should recognise this so that all forms of effective engagement with the university's local economies are rewarded.
- Another potential area of university engagement could be discussion with local employers on mapping a skills framework and then facilitating provision of appropriate courses in HE/FE institutions locally.
- Also universities should be encouraged with government funding to set up a Community Liaison Team to seek out local engagement opportunities.
- On spin-outs, a recent report by the University of Cambridge suggests that policy needs to look beyond just the equity stakes taken by universities, and look at the quality of support given, the networks they are plugged in to and the other financial/IP arrangements in place.³²

Sellafield Case Study

An excellent example of universities working effectively with local businesses can be found in Cumbria. The University of Cumbria is working with Sellafield Ltd to set up a virtual Project Academy for the people engaged in Sellafield's nuclear storage and decommissioning projects. The Academy benefits from UoC's expertise in education and training to develop and deliver project management courses, professional qualifications and degree programmes for all employees. Since 2016 the Project Academy has registered 4,500 attendances on short courses and professional qualifications with over 450 registrations for higher education programmes³¹. The economic and social impact in this rather isolated area is hugely important in sustaining high quality work opportunities in local communities.



5. Local Plans but Networked

Every locality is unique but some common threads link them. For example, islands share common problems and the Islands Forum set up by the UK Government to aid levelling up may prove useful. Similar forums might link other groups of disadvantaged localities, such as remote communities, rural communities, and post-industrial areas. If the Scottish Government really wants to understand how to get these things working better, it could set up several pilot areas to test some of these suggestions.

The levelling Up White Paper proposed a £100m budget to set up innovation Hubs in Greater Manchester, West Midlands and Glasgow³³. However, their precise roles were not defined. We believe the role of these regional Innovation Hubs should be two-fold. As well as assisting Top Down innovation they should network all Bottom Up LIFs to share good practice and spot any useful synergies between Regional and Local opportunities (e.g. innovation in, say, the installation of Solar PV panels is both Top Down and Bottom Up).

Making these kinds of systemic improvements to how innovation works can lead to change across all sectors of the economy, including those which are more foundational and not high-tech. These are the bedrock of employment in many of the underperforming towns and rural areas of Scotland. Getting innovation to work better across these places and sectors will help to lift employment, productivity and wages in these sectors. It will increase both pride in place and support living standards.





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Scotland needs a state which is specific about what it wants to achieve, and unafraid to be bold.

Top-Down

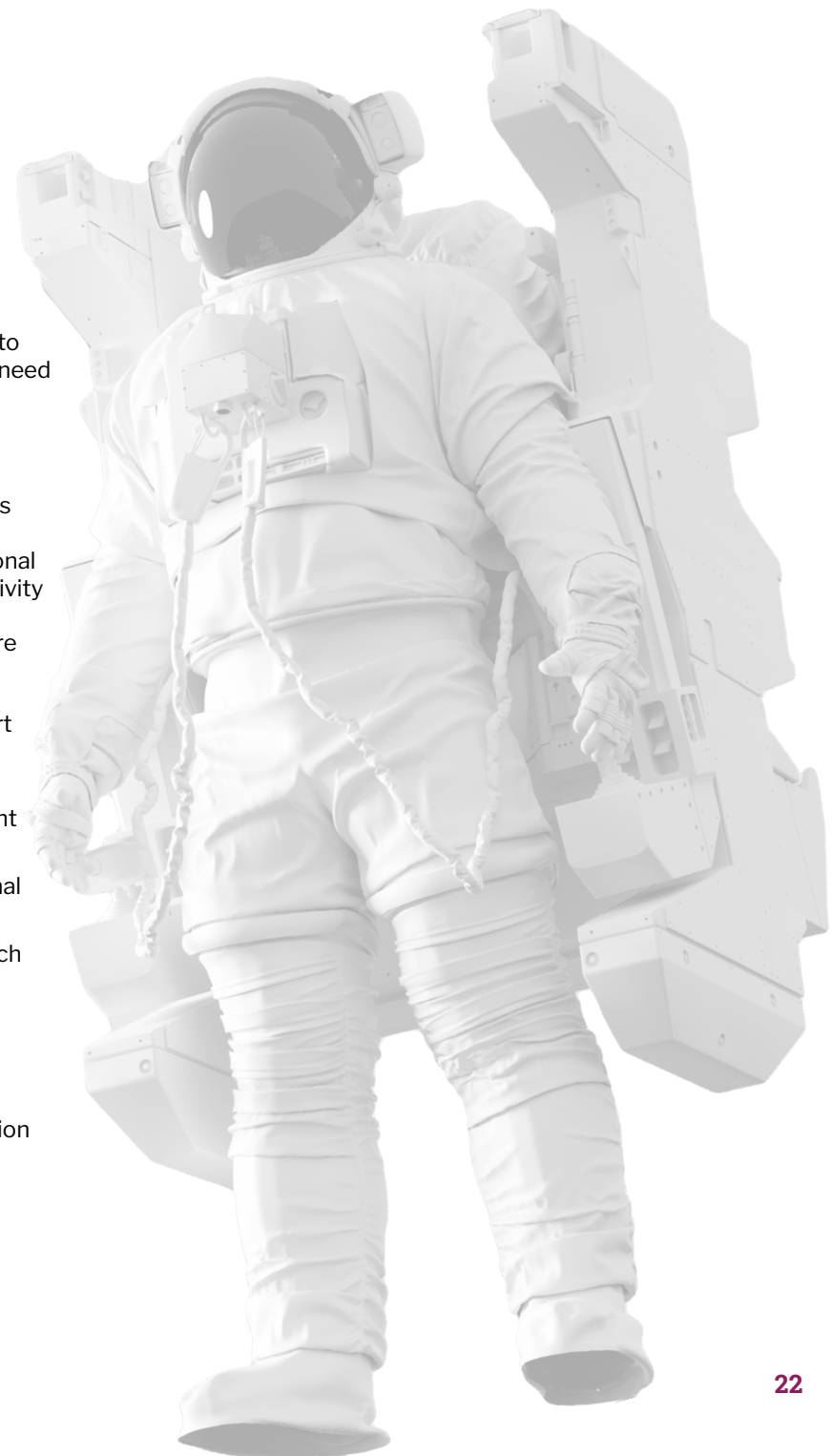
Our Scottish Future is a clear advocate for devolution, and innovation policy is no different. That's why we've highlighted the importance of a Bottom Up innovation policy. However, there are some things that must be tackled at national or regional level. Questions about which sectors and industries Scotland should focus on as being crucial for the national interest, and how to apply budgets and tax policy at scale to attract and influence the investment decisions of businesses and investors – these are all challenges that need to be led from the Top Down. And this will demand more leadership, expertise and decisiveness than seen previously from Scottish Government and Scottish regions.

Earlier in the report, we reflected on the state of Scotland's innovation drivers. We found a largely positive picture, but that doesn't mean there isn't room for improvement. The Scottish Government has had 3 years to act on two influential reports to which the present authors are indebted for data and ideas. One is from Professor Muscatelli, asked by the Scottish Government to tackle 'Driving Innovation in Scotland – A National Mission'¹⁷. The second is from Professor John Tsoukalas and the Productivity Institute 'Scotland's Productivity Challenge'¹⁸. Both emphasise the crucial importance of improving productivity, both examine the possible strengths and weaknesses of the Scottish institutions in driving growth and both identify the need for more effective government leadership and a national mission to improve productivity.








Our takeaway from these reports is to suggest several principles of stronger effective government support as parts of a cohesive national strategy:

- Develop a set of networked and inter-connected economic, industrial, enterprise and education and training strategies which identify key growth sectors that Scotland could excel in to deliver employment and export growth.
- Reward universities through funding streams to recognise their contribution to key national and regional growth sectors but also their engagement with Local Innovation Forums in local communities.
- Build a national interest in innovation, recognising that innovation covers a wide spectrum from research through to fully functioning operation and followed by continuous improvement.
- Use the weight of the state to direct bold strategic outcomes and investment in growth sectors. For example, use government procurement to aid the commercialisation process of proven prototype innovations and use SNIB to leverage enhanced inward investment to Scotland.

These principles have inspired a range of policy recommendations. These are mapped against the innovation drivers identified earlier in the report in the diagram on the next page.



Initiatives Mapped to Innovation Drivers

Innovation Driver	Scotland Rating	Initiative
 Effective Government Support	Yellow	<ol style="list-style-type: none"> 1 A clearer plan 2 Devolution Where Possible 3 A Braver State
 Robust IP System	Grey	
 Access to Capital	Yellow	<ol style="list-style-type: none"> 4 A More Focused SNIB 5 Link Scotland to VC/Corporate Funding Across the UK
 High R&D Spend	Yellow	<ol style="list-style-type: none"> 6 Consistency in Funding 7 Simplify Funding Streams
 Strong Universities	Grey	
 Skilled Workforce	Green	<ol style="list-style-type: none"> 8 A Revolving Door Between Business and Academia
 Innovative Culture	Red	<ol style="list-style-type: none"> 9 Interdisciplinary Projects in Schools 10 Innovation Modules in Every Degree

Effective Government Support

It takes time to foster a new industry, to bring together the right set of talents, the right infrastructure and the right capital to develop or hone successful products or services. It takes time to drive investment in a sector or area. These things require stability of support, and clarity of strategy.

It is often interesting to compare Scotland with similar nations, such as Denmark, identified in the Muscatelli Report as a good exemplar.

Denmark Case Study

Like Scotland, innovation in Denmark is dominated by the public sector and today, the public sector invests more than 1% of GDP in research and innovation [17]. This has helped Danish innovation and R&D (RDI) achieve very high effectiveness and international recognition.

Denmark regularly reviews and updates its strategies for RDI and has built institutions and networks to activate these them. There is a constancy of purpose notably missing in Scotland and the UK, preoccupied with short termism.

Danish GTS Institutes (Approved Technology Service Institutes) play a key role in Denmark's innovation system. They work closely with private-sector partners to identify and solve technological challenges. They tend to avoid ambitious, long term, large scale R&D themselves but encourage the application of existing technologies in pragmatic and effective ways. They have been credited with upgrading the Danish innovation system.

The evidence for such initiatives is strong, with studies showing that such government-backed Innovation Networks can boost labour productivity by 7% and total factor productivity by 13% for those who participate in them. It would be interesting to compare the roles of UK Catapults with Danish GTS Institutes in a further study.

Additionally, Danish universities play a strong role in fostering entrepreneurship, with facilities in Research Parks on campus supported by services such as training, counselling matchmaking and funding networks. All Danish universities have established technology transfer offices (TTOs) tasked with scouting, funding and commercialisation activities. They also promote this spirit in their student body through their courses, competitions and events.

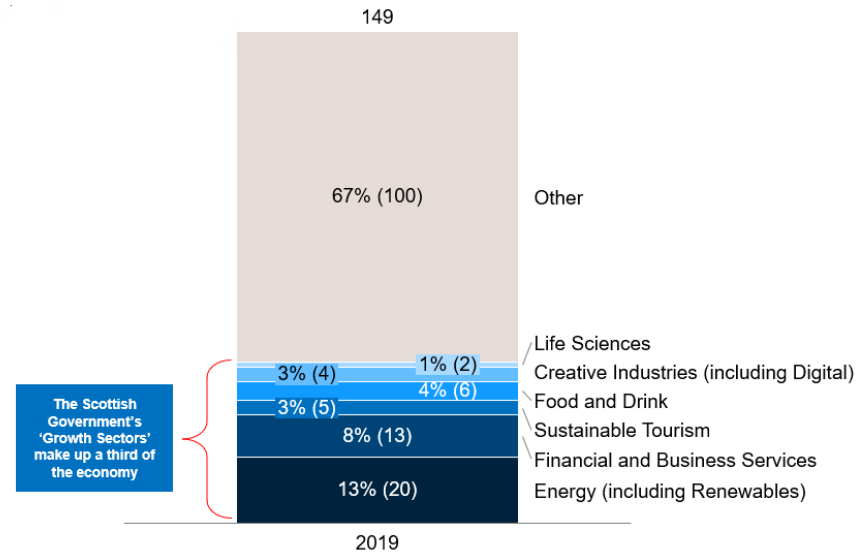


Scotland can be that country too. But to get there, it needs a state which is specific about what it wants to achieve, and unafraid to be bold. We make a series of suggestions below about how Scotland can better stimulate innovation from the top down, and make the most out of government's powers of convening, investing and leading.

1. A Clearer Plan

The economic policy landscape is currently confused. It doesn't lack for strategies – indeed there are arguably too many. They overlap, and contradict, crossing boundaries of innovation policy, national economic transformation, welfare economics and more.

Scottish GVA by Sector, 2019 (% , £m)^[1]



Source: ³⁴ Scottish Government, *Growth Sector Statistics, 2019* and ³⁵ ONS, *Regional gross domestic product: all ITL regions, 2022*. OSF Analysis

Industries covering a third of the Scottish economy are classified as growth sectors by the Scottish Government. It should make much firmer and more focused choices about which industries Scotland and its regions should be prioritising, and what the country's role in these sectors should be. The authors' view is that renewable energy and energy systems is the right primary area of focus, and with a special effort on helping those with O&G skills to transition sectors.

¹ Financial and Business Services GVA data incomplete. We have estimated this based upon the GVA/head of those subsectors it is available for, and applied this to the FTE numbers for the remaining subsectors.

A simple methodology has been developed to demonstrate how promising subsectors could be identified. We have looked at subsectors within the Scottish Government's Growth Sectors, and compared them based upon metrics like productivity, their R&D spend and employment growth. They were scored based upon what quartile they were in on each measure (Max result scores 4, rest of top quartile 3, 2nd quartile 2 etc). The top 10 of the 84 subsectors are listed below. These point to especially promising subsectors: wind, tidal, hydro and renewable heat within energy; pharma and R&D in life sciences; the advanced manufacturing of anything from beverages to medical equipment; finance, legal and consulting in business services. Together, these top 10 make up 12% of the Scottish economy, or 5% excluding O&G – a much more focused set of activities. This is just a starting point – the methodology could be developed further – but this illustrates the level of prioritisation that the SG should be doing.

Top 10 Priority Subsectors in Scottish Economy ^[2]

Subsector	Sector	GVA/Cap (£k)	GVA/Cap Growth	FTEs	FTE Growth	Median Weekly Wage (£)	RoW Exports as % Revenue	rUK Exports as % Revenue	BERD £/FTE	% of Jobs in Top 5 LAs	Score
		2019	2014-19	2019	2015-19	2021	2019	2019	2019	2019	
Basic Life Science Manf.	Life Science	213	13%	4,000	7%	689	43%	10%	1,540	46%	25
Biotech R&D	Life Science	249	38%	900	6%	689	43%	10%	1,540	46%	24
O&G Extraction	Energy	1,262	6%	10,000	-2%	800	12%	27%	541	66%	24
Offshore Wind	Energy	377	23%	1,600	52%	800	12%	27%	541	66%	24
Renewable Heat	Energy	206	8%	900	73%	800	12%	27%	541	66%	24
Beverage Manufacture	F&D	208	2%	11,000	0%	576	47%	28%	15	38%	23
Legal Activities	Biz. Services	67	4%	23,000	5%	609	21%	59%	73	66%	23
Other Biz. Support	Biz. Services	66	8%	18,000	8%	609	21%	59%	73	66%	23
Hydropower	Energy	701	5%	700	9%	800	12%	27%	541	66%	23
Fishing/Aquaculture	F&D	71	3%	7,000	12%	576	47%	28%	15	38%	22

Legend: Max Result Top Quartile 2nd Quartile 3rd Quartile Bottom Quartile

Source: ³⁴ Scottish Government, Growth Sector Statistics, 2019. ³⁶ ONS, Low Carbon and Renewable Energy Economy (LCREE) survey estimates, UK, 2014 to 2020. OSF Analysis

Once a decision has been taken on where to place Scotland's focus, then the right investments and policy prescriptions can be made. The SNIB, Scottish Enterprise, HIE and others can be given a much clearer remit which will amplify their impact.

The UK Government also needs a clearer plan for the economy, for industry and for innovation. A consistent vision would again aid progress, especially if it attained buy-in from governments both side of the border.

² 84 subsectors have been identified from the Scottish Government's Growth Sector Statistics and the ONS's Low Carbon and Renewable Energy Economy (LCREE) survey. Where possible, subsector level data has been used (GVA/Capita, GVA/Capita growth, FTEs, FTE growth), otherwise sector level data is used. The lack of complete data means that these results are indicative. Points are assigned based upon the highest value receiving 4 points, everything else in the top quartile 3 points, 2 points for the 2nd quartile and 1 for the 3rd.

2. Devolution Where Possible

Several public sector budgets impact upon Scotland's innovation system such as adult skills, R&D incentives and university funding. Scotland's innovation related budgets are held predominantly at the SG level. In England, such responsibilities are moving from Whitehall to Combined Authorities, where those exist. Local authorities typically manage funds for some but not all 16-19 and adult skills provision.³⁷

It is our belief that decision making on Top Down economic development spending is best made at the 'city region' or 'sub region' level in many cases. We echo the Centre for Cities in calling for Glasgow, in particular, to gain more powers over public sector R&D, skills and transport policy.³⁸ These are large enough territories to benefit from economies of scale and analysis of how economic actors operate, but small enough that the comparative advantages and wishes of the community and geography can be taken into account. Some major strategic decisions, e.g. defence spending or major infrastructure projects need to be taken cooperatively at government level. Conversely, there should always be funding devolved right down to local areas for Bottom Up innovation and community wealth building. City/Region planning and funding can incorporate both Top Down strategic investments together with Bottom Up initiatives for the 'foundational economy' as it is termed in the Glasgow City Region Plan^{39 40}. The SG should move to devolve more of this spending down to such groupings, and encourage Scottish Enterprise to mirror this approach.



Bristol Case Study

Regional growth stimulation is patchy across Scotland and UK. In some areas Local Enterprise Partnerships (LEPs) are very successful. For example, the West of England Combined Authority (WECA) promotes the region's strength in Aerospace and Advanced Materials. WECA leads a cluster of aerospace companies together with local universities and R&D Centres of Excellence and, with the Department of International Trade has launched a High Potential Opportunity to stimulate inward investment. They have also set up a Global Centre of Innovation to spread innovation expertise across the region's other industries. One way of doing this is to encourage the transfer and secondment of people through 'revolving doors' between academia, industry and research centres and Catapults

These initiatives, and similar projects such as the West Midlands Regional Economic Development Institute, seek to emulate the strengths of the London/Oxford/Cambridge Golden Triangle in attracting investment for innovation. They emphasise the importance of customising interventions to fit the local context.

3. A Braver State

In some cases, the full might of the Scottish Government is needed to crack open a new opportunity. This might be because the necessary scale of an industry is national, or multiregional, or involves assets controlled by the state. The example of the ScotWind auction shows what happens when a government fails to load the dice in Scotland's favour – a chance to accelerate the domestic renewables manufacturing industry, and the innovation that would bring, missed.

In ScotWind and other cases where the SG has a direct role in managing Scottish assets, a more strategic approach should be taken to ensure Scottish firms form the heart of any supply chain, as the case study illustrates. The SG should also be thinking not just about the physical assets involved – the ScotWind project will generate masses of operational data that will prove invaluable for the foreign owners of the winning projects in refining and developing new methods. This type of information is the lifeblood of innovation, and the SG should have safeguarded access to it as part of the ScotWind scheme.

The state can also help by aggregating demand, and then directing it to support a nascent industry, to help it get on its feet. NHS Scotland, for example, wields a huge budget that can be directed to support the most promising innovations in Scottish life sciences. Similarly, things which are currently purchased individually by local authorities or schools could be jointly purchased, even across the UK to massively amplify its impact. The Net Zero transition in particular will necessitate new infrastructure across the country – aggregating this demand at the UK level could help stimulate domestic innovators. Laying out explicitly these needs, how and where they could be manufactured/ serviced and the government's role in supporting them would drive private investment alongside the state's.

ScotWind Case Study

A recent example of Scotland getting this wrong is with the ScotWind auction in January 2022. The country boasts a large Exclusive Economic Zone, covering 6 times the land's footprint⁴¹. It is one of the richest sources of potential wind power on the continent, and represents a substantial economic opportunity. There are the jobs and industrial capacity to be gained from building, installing and maintaining the fleet of wind turbines, as well as the profits that will be generated from their energy. The ScotWind auction let Scotland down on both counts.

The Crown Estate Scotland sold off plots of seabed equal to 8,600 km, which could generate up to 25GW of offshore wind. 17 projects were selected, all of which are led by overseas companies.⁴² This is a tragedy – why couldn't a Scottish state-backed company have taken some of the plots, retaining the profits from exploiting the country's resources within Scotland rather than being sent overseas?

The SG set a price cap originally of £10,000 per km², but raised this to £100,000 per km² following a similar auction in England which demonstrated a higher price tolerance in the market. This brought in £700m⁴³. However, what was sold of the licenses were sold right at the cap, suggesting that the market value would have been higher. In New York, a recent auction generated over £3bn for just 7GW of power.⁴⁴

Scotland may also be missing a chance to use these license sales to help kick-start the country's offshore renewables manufacturing industry. In their submissions, bidders had to commit to keeping 25% of the supply chain for the wind farms in Scotland. This very modest target allows developers to achieve it simply by maintaining the installed wind farms – it does not require them to manufacture or even install the turbines. In practice, it is also hard to enforce, and judged through self-assessment by the firms.

Scottish industry would have had a better chance of meeting this opportunity if the ScotWind auction was carried out more gradually. As we see from the New York example, auctions for smaller areas are commonplace. They have the benefit of staggering when new turbines will be manufactured and installed. The current Scottish wind turbine industry has no chance of manufacturing 25GW in one go, but it could have scaled up gradually to meet that demand if ScotWind were instead sold at 5GW a year over 5 years. Instead, the foreign companies running the wind projects will be relying, once more, mostly on foreign companies to make the turbines.

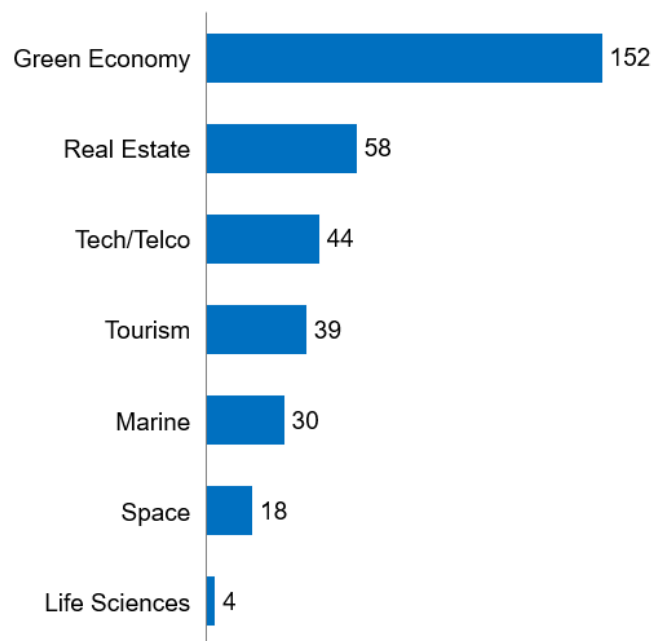
4. A More Focused SNIB

The Scottish National Investment Bank is a welcome addition to the country's economic development landscape. It has so far invested £350.7m, and will eventually be capitalised to £2bn. It is already supporting some exciting organisations, such as Sunamp with their heat batteries, or Nova Innovation's underwater tidal turbines. These kinds of investments in the riskier parts of the green economy make sense – things that have the potential to catalyse whole new, innovative industries.⁴⁵

There are some investments in the portfolio, however, that seem like a distraction for a national institution that is focused on driving economic growth and innovation. £43m has so far been invested in real estate related projects, and £39m in tourism. As we've mentioned, the need for innovation in these sectors is also there, but the specific projects seem to fall short of that goal. The second biggest investment by the SNIB, at £40m, is with PFP Capital for a Mid-Market Rent Fund, to help provide affordable rental accommodation. A laudable goal, but is that really what the SNIB was set up to achieve? On the tourism side, £7m is being spent on decorating 4 hotels in the Highlands. Why could this not be funded by the HIE, or a more local funding source, rather than the nation's newly instituted driver of innovation?

It may be that the missions set for the SNIB are too broad, if they include such a wide array of projects and sectors. Being clearer on whether the SNIB's mission is to foster high growth sectors, or stimulate incremental improvements in existing ones would help it to do either of these roles more effectively, and better use its capital.

Investments by SNIB by Category, £m



Source: ⁴⁴Scottish National Investment Bank, 'Portfolio,' 2022. OSF Analysis

5. Link Scotland to VC/Corporate Funding Across the UK

In Q2 of 2022, £325m of Venture Capital (VC) funding landed in Scotland, of the £7.2bn coming to the UK. The vast majority heads to London^{46 47}. Again, with Foreign Direct Investment (FDI), London takes 42%, the South East 13% and Scotland has 5.5%. How to claim a greater share?

A clearer story about Scotland's sectoral specialisms would help, as we've outlined elsewhere – for example by making Scotland the go-to destination for any VC coming from America with an interest in net zero tech, or similar. Scotland's substantial financial services industry should also prove a useful source of private, patient capital to Scotland's scale-ups, and the SNIB is continuing to drive efforts to unlock this. Tightening relationships between Scottish and Golden Triangle universities, through shared investor fairs, university courses, spinout investments and academic partnerships could also help to refract some VC attention north of the border.

High R&D Spend

6. Consistency in Funding

The UK Government commitment for £20bn/yr of UK-wide government investment in R&D by 2024/5 is to be welcomed⁴⁸. However, as noted in the previous section we need to encourage business investment in R&D and recent tinkering with the Tax Credit rules for SMEs is unhelpful. The scheme offers SMEs (below 500 employees and £100m revenue) a tax credit of 130% of qualifying expenditure⁴⁹. Apparently, the scheme has been misused fraudulently so the UK Government has chosen to change the system rather than address the fraud. SMEs have complained that the changes proposed reduce the support they need and have planned for. The changes should be reviewed and revised to support and encourage SME-led R&D.

7. Simplify Funding Streams

There is considerable overlap of funding streams for RDI in Scotland and the UK. Much 'Top Down' funding comes from BEIS with 'Bottom Up' funding coming from 'Levelling Up' funds. Clarifying the map would be useful to encourage more FE and HE institutions to participate together with local communities.

Skilled Workforce

8. A Revolving Door Between Business and Academia

Part of tying together the fundamental research of academia with the practical problem solving of business is about creating more of a free flow of staff between the two realms. Perhaps one reason why healthcare/life sciences is proving highly innovative and successful in the UK is the ease with which people move around between academia, other research centres, the NHS, and pharmaceutical companies. The rapid development of a Covid vaccine and then Covid treatments is a clear example where people not only moved through revolving doors but wore two hats, filling more than one role in more than one organisation.

Even in more normal times it is commonplace for an individual to be both in an academic post and a practising clinician in the associated teaching hospital. So, the demand for innovation in medicines and treatments is rapidly passed on to the research teams. And progress in the application of new treatments is immediately available to both clinicians and researchers.

The approach seen in healthcare should be encouraged across all sectors. **Universities could be incentivised to lead the way on this front through the REF, or by making this an intrinsic part of research council grants.**



The cult of the lone genius does a disservice to what has often been a shared practice. In Scotland, we've got no shortage of intellect or creativity, and no lack of opportunities and problems to apply this to. Scotland can live up to its potential as a nation of innovation once more.

Innovative Culture

9. Interdisciplinary Projects in Schools

These days innovation generally requires an understanding of complex systems – not just the moment of inventive genius but the whole series of steps to implementation, such as design, testing, environmental and societal impact assessment. This requires a multi-discipline approach bringing STEM and humanities thinking together to understand how the system of people – information – tools works as a whole. Then to explore the opportunities and possible risks of the intended innovation. Cross-subject projects which enable young people to see how knowledge from one area can be applied to another could provide a good grounding in this kind of thinking.

Business and innovation schemes such as Young Enterprise Scotland should also be supported. They have a range of programmes that can be carried out in schools, including ones that bring teams of young people together to explore ideas and essentially found a start-up. These can be used to test multidisciplinary thinking outside of the classroom, and in a business context.

10. Innovation Modules in Every Degree

Universities are making increasing efforts to make their graduates ready for the world of work. Part of that can come through the curriculum. In Imperial College London, degrees contain “obligatory modules in disciplines outside their undergraduate degree”⁵⁰. All students should be exposed to the entrepreneurial process, and have practice in how to identify problems that could be solved in anything from a business process to society at large. This is especially true for STEM subjects, where technology transfer modules could be impactful. During one of the authors' time at Imperial College, there was a module that grouped together students and challenged them to work through how to turn a scientific idea into a successful business, including exploring the rules around IP.

Conclusion

In this paper we have:

- Explored how Scotland is performing currently when it comes to innovation
- Set out a model for how innovation operates
- Demonstrated how we could improve innovation performance both at the local and national level

Many of our solutions come down to connections. Connecting businesses with new ideas. Introducing academics to the people who can tell them how to make their research more applicable. Tying together similar communities who can understand each other's problems. Connecting the innovators of Scotland with capital elsewhere.

The archetypal brainwave innovator is the one propped wistfully against an apple tree, or bashing frantic code in a basement apartment. But, for the innovation this paper is all about, we only need a few of the truly brilliant.

What we definitely do need is a nation of people wanting to do their work better: more quickly, more cheaply, with less resource and with better outcomes for customers and workers. And that's a culture, an attitude of mind which can and should be encouraged to develop through all levels of education and public communication from leaders and politicians. A culture that recognises that innovation is a shared, collaborative practice.

In Scotland, we've got no shortage of intellect or creativity, and no lack of opportunities and problems to apply this to. By making clear choices, directing the state's help more effectively, and creating the forums for these meetings to take place, Scotland can live up to its potential as a nation of innovation once more.



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Our Scottish Future believes that good government in Scotland and across the United Kingdom has to be based on the values of cooperation, empathy, solidarity and reciprocity.

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