BiGGAR Economics

Strategic Economic Impact of Top 6 Global Agri-Food University in Scotland

A report to

SRUC

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1 EXECUTIVE SUMMARY

There is a compelling strategic economic case for creating a globally-competitive agri-food university in Scotland. Scotland's rural economy does not compare well with other economies; in common with the rest of the UK, it has suffered from low levels of investment in R&D in the primary sector; and current global trends and challenges require action to be taken to prevent a further widening of the performance gap.

The agri-food sector is facing major global trends that create an on-going need for innovative solutions. The global population is expanding, there are increasing pressures to manage and protect environmental and ecological resources while addressing the health and nutrition needs of the world's population and meeting the challenges presented by climate change.

Scotland faces an additional suite of challenges. As well as the uncertain future presented by Brexit, on average, farms in Scotland are loss-making businesses that require subsidies in order to return a profit.

In other comparative economies such as the Netherlands, New Zealand, Sweden and Norway, universities play a central role in creating value and stimulating the performance of the agri-food sector. These institutions have a several features in common:

- they are organisations of scale and breadth with long histories of growth and adaptability;
- although they have a global outlook they are firmly rooted in the domestic rural economy and,
- crucially, they work in close partnership with industry and national governments to identify and address education and research needs.

This model can be replicated in Scotland and has the potential to deliver a substantial return on investment. To create most value, the university model should reflect an integrated, collaborative approach between industry, centres of knowledge excellence and government. Built in order to reflect the different drivers of each partner, this innovation and skills system has been shown to work best in the comparator countries and is the most effective vehicle through which to generate and diffuse new knowledge.

For the agri-food sector in Scotland to be sustainable, competitive and resilient there is a need for system change, a new skills and innovation system based on lessons that can be learned from comparator countries, allied to Scotland's unique position. Matching productivity of the leading comparator nations will require an increase in annual investment in this system of £276 million and a strategic approach to the development of the sector.

If Scotland is able to rise to the challenge, and match the top performing comparator countries, the prize that can be won is substantial. There are both economic and environmental benefits including an additional £4.5 billion gross value added in the primary sectors, meeting the targets for growth in food and drink and leading the world in reducing agricultural emissions.

2 INTRODUCTION

This report sets out the strategic economic case for creating a globally competitive agri-food university in Scotland. It shows that there is a need for change. There is a need for change because:

- Scotland does not compare well with other successful advanced economies across a range of measures for the rural economy; and
- the trends and challenges facing the rural economy, the wider economy and society more generally mean that continuing to do the same things is not a viable proposition.

The report considers where this change will come from and the economies which have been successful in creating world leading agri-food sector. In particular, it highlights:

- the innovation and skills systems in comparator countries, including the role of universities;
- how these institutions create value; and
- that a similar model could be built in Scotland, based on existing institutions.

Finally, this report estimates the scale of the strategic economic benefits that could result from the creation of a new agricultural university being created: the size of the prize means that investment will deliver a substantial return.

2.1 SRUC

2.1.1 Origins

Scotland's Rural College (SRUC) was created in 2012 when the Scottish Agricultural College merged with three regional land-based colleges: Barony (in Dumfries), Elmwood (in Fife) and Oatridge (in West Lothian). Together they combine more than a century of research, education and rural business consultancy. The integration of these three complementary areas of activity is at the heart of SRUC's operations and is a distinctive strength of the College.

It exists to deliver comprehensive skills, education and business support to Scotland's land-based industries. It is founded on world class and sector-leading research, education and consultancy which extends to more than 50 countries world-wide.

SRUC is spread throughout Scotland with campuses, consultancy offices, veterinary disease surveillance centres and research farms covering the length and breadth of the country.

The organisation is at the leading edge of a new educational model for Scotland in amalgamating further and higher education, resulting in a vertically integrated range of qualifications from access level right up to PhD.

2.1.2 Scale

In 2017, the SRUC had a total income from all sources of £77 million. It employed around 1,500 staff and had a student population of 2,800 full-time, part-time and distance learning students.

2.1.3 SAC Consulting

SAC Consulting is a major strength of the SRUC's offering, providing a crucial direct link between the organisation and the agri-food business community to ensure that research and skills are translated into practice. With a team of more than 375 consultants, vets and specialists stationed across 26 offices in Scotland and the North of England, SAC Consulting offers a wealth of local knowledge and expertise across a wide geographical area to farmers, rural businesses, food processing firms and supplier markets.

It's portfolio of services ranges from analytical services to bespoke individual consultancy contracts, covering all aspects of rural enterprise from agronomy, livestock and dairy services to disease surveillance, farm animal diagnostics and environmental consultancy. It also offers a dedicated UKAS-accredited analytical facility which provides a seamless service from field to lab.

A recent customer satisfaction survey carried out by SAC Consulting showed that it has achieved a 67% penetration rate in the farming industry and that customers view SAC as a key source of quality specialist consultancy advice. It also demonstrated that 96% of SAC farming clients feel they get value for money from the services delivered by the organisation.

2.1.4 Transformation Plan

The first phase of SRUC's university transformation plan was announced publicly in September 2018 when proposals were published for a new £35 million facility in Dumfries & Galloway at the Barony Campus[1].

The first stage in the transformation will result in SRUC moving to a faculty-based model with three vibrant new faculties located across Scotland:

- North (Faculty of Agri-Food and Business);
- Central (Faculty of Rural Science and Policy); and
- South & West (Faculty of pasture-based agriculture, forestry and biorefining).

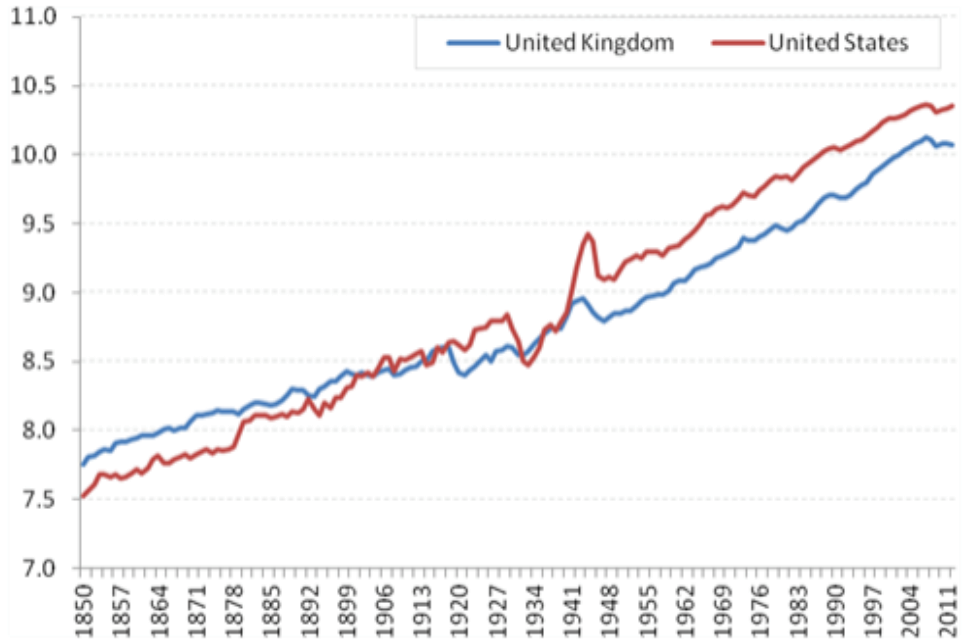
2.2 Historic Precedent

The United States of America is currently the richest and most powerful country in the world, but this has not always been the case. In the late 19th Century the US established Land Grant Universities. Initially, these Land Grant Universities had a strong focus on increasing the knowledge base and skill set within the agricultural sectors. A study of the growth of the US economy has found that the establishment of these institutions was hugely important to the emergence of the USA as the dominant global economy, replacing the UK, and making it the global economic superpower[2]. The Figure 3-1 shows that Real GDP per capita growth in the US lagged behind that of the UK until the 1890's and since then the long term growth trend has been higher than that of the UK.

[1] Source: *First phase of university transformation plan announced*, SRUC press release, 20th September 2018

[2] IZA Institute of Labor Economics (June 2018) What accounts for the US Ascendancy to Economic Superpower by the Early 20th Century: The Morrill Act – Human Capital Hypothesis

Figure 2-1: US & UK Long-term Real GDP per capita, 1870 - 2012



Source: IZA Institute of Labour Economics

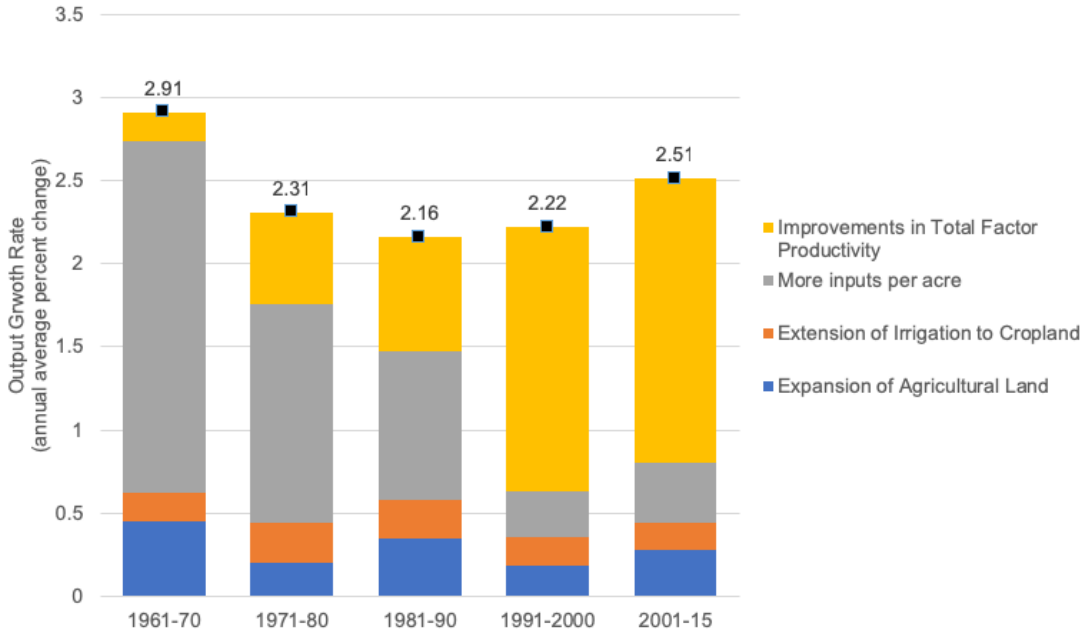
Many different things happened in this period in the USA, such as the reconstruction after the civil war, the development of the railways and the revolution in high school education. However, the IZA considered statewide analysis of the economic growth of the USA and found that the 'Land Grant Universities' created by the Morrill Act in 1862 and 1890 were associated with a step change in economic growth. This is because these universities enabled the creation of human capital as an engine of endogenous economic growth. The states which were the first to have these Land Grant Universities established were the first to benefit from this economic growth and increased productivity. The public investment in these institutions also stimulated additional investment from the private sector.

While the Scottish rural economy and the issues that we face into the 2020s are different from the US in the 1870s, it is interesting to note that the idea that universities can be a driver for economic driver is not a new one.

The role of productivity growth in the agricultural sector is of growing importance. Data from the US Department of Agriculture[3] gives an insight on how the growth drivers have changed over time. In the 1960s up until the 1980s, global agricultural output growth was mainly driven by more inputs being used per acre of agricultural land. However, from the 1990s onwards growth came from a different source and was mainly driven by increases in total factor productivity.

[3] United States Department of Agriculture (2018) Economic Research Service – International Productivity Data Product

Figure 2-2: Sources of Growth in Global Agricultural Output, 1961 – 2015



Source: US Department of Agriculture

As the agri-food sector in Scotland moves forward it will need to focus on productivity improvements, to contribute to the growing global demand for food. As with the US in the late 19th Century, the role of the education sector in providing necessary skills and knowledge, will be an important driver of this productivity growth.

3 THE RURAL ECONOMY: BENCHMARKING SCOTLAND

3.1 Comparator Countries

The contribution of agriculture and the rural economy to employment and prosperity has been declining (in relative terms) since the agricultural revolution. However, declining importance is not inevitable and many of the global challenges that we are facing can be addressed by the rural economy. For example, the major challenge facing the global agri-food industry is how to double world food production to feed a rapidly expanding global population with diminishing resources while also protecting the environment and addressing the challenges posed by climate change.

There are other small advanced economies that can offer lessons for Scotland. These are countries where the rural economy is an important part of a prosperous economy and society and helps to drive economic growth. Each one has a globally competitive agri-food university. These are illustrated below.

Figure 3-1: Comparator Countries

Source: BiGGAR Economics

No comparator country will be exactly the same as Scotland as a consequence of differences in the history and structure of their agriculture, varied regulatory and support arrangements, a different mix of products and comparative advantages, different arrangements for market access etc.

However, lessons can be learned from comparator countries, where the rural economy (including agriculture and food & drink) has contributed to economic prosperity and growth, in the overall context of a high performing economy.

The reasons for choosing each comparator are:

- Netherlands – a small, densely populated country employing innovation to become the 2nd largest food exporter in the world;
- New Zealand – the largest dairy and sheep meat exporter globally, with export-based national branding;

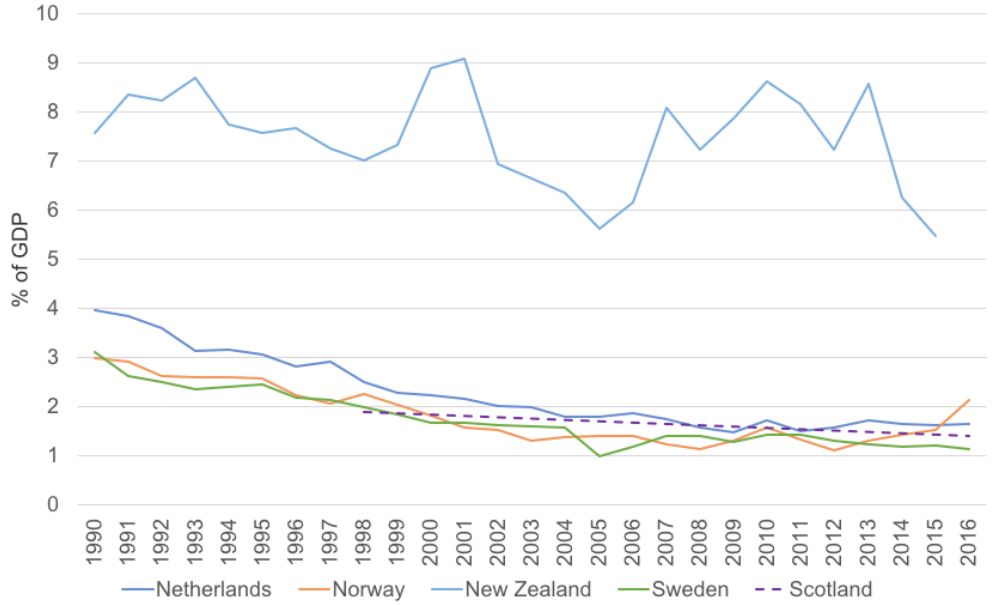
- Norway – a non-EU European state, competing outside the Common Agricultural Policy; and
- Sweden – a country which has had to react to changes in export markets, notably sanctions on Russia.

The common factor to all is that they have a well-functioning innovation system, with a globally competitive agri-food university at its centre.

3.2 Primary Sector Comparison

As a share of the economy in 2016 the 'Primary Sector'[4] accounted for 1.4% of GDP in Scotland[5], which is a typical share of the majority of the comparator countries. Of these countries, New Zealand stands out, with the Primary Sector accounting for more than 5% of GDP[6]. All economies have seen a decline in the relative scale of the Primary Sector and Scotland is no different, as the proportion of GDP from the Primary Sectors decreased from 1.9% in 1998 to 1.4% in 2016.

Figure 3-2: Primary Sector as a % of the Economy (GDP), 1990 - 2016



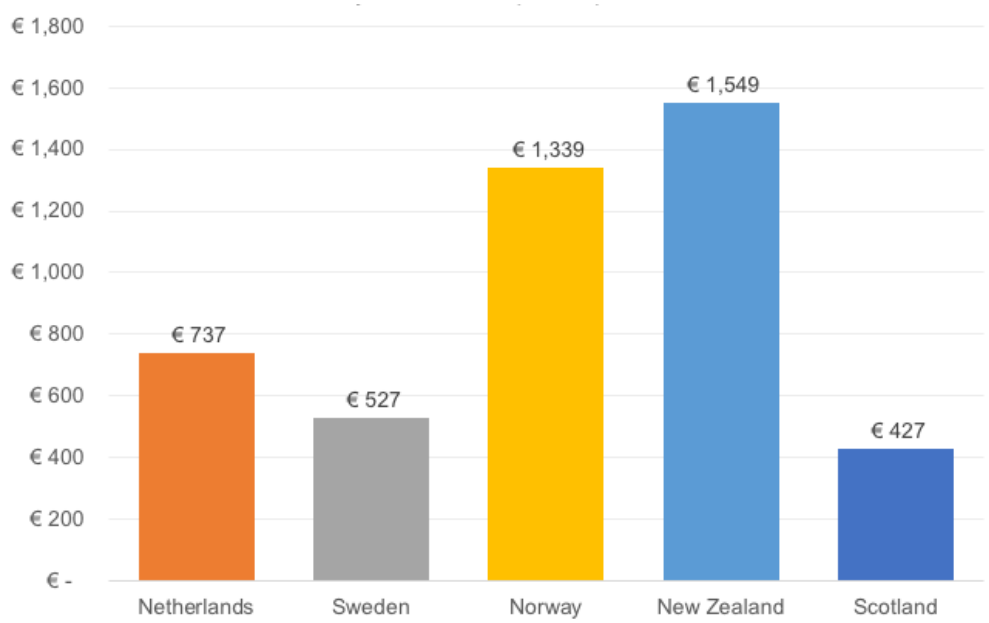
Source: World Bank – World Development Indicators, Scottish Parliament

However, many of these comparator economies have a higher GDP per capita than Scotland. Therefore, looking at the Primary Sector as a share of the economy can be misleading.

If, instead, the countries are compared by GDP per capita from the Primary Sector, we find that Scotland's is lower. In 2016, the Primary Sector generated €427 GVA per person in Scotland, compared to €1,549 GVA in New Zealand and €737 GVA in the Netherlands.

[4] This report uses the term 'Primary Sector' to cover agriculture, forestry, fishing and other sectors which are grouped together in specific datasets.
[5] Scottish Parliament Information Centre (Feb 2018), A Guide to Gross Value Added (GVA) in Scotland
[6] World Bank (2018) World Development Indicators NV.AGR.TOTL.ZS

Figure 3-3: Primary Sector GVA per Capita, 2016



Source: Eurostat[7], National Accounts of New Zealand[8], Scottish Parliament

In the case of New Zealand, this is what would be expected, given that the Primary Sector accounts for a much larger share of the economy. However, for the other comparator countries, the obvious conclusion would be that the Primary Sector shares the relative under performance of the economy as a whole.

3.2.1 Productivity Comparison

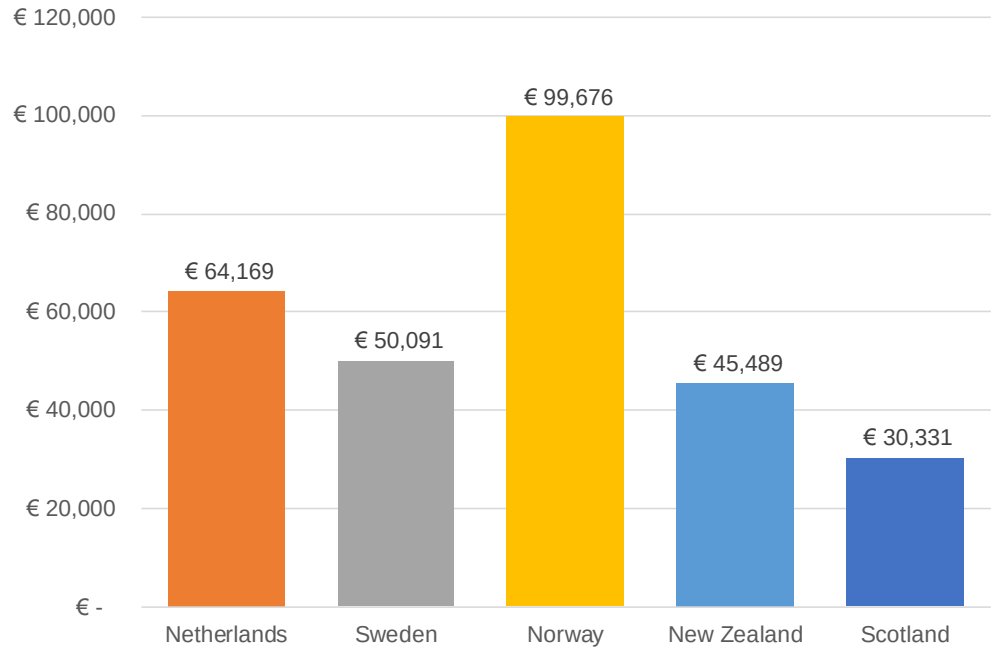
Part of the explanation could be the productivity of the sector. Productivity is a measure of the outputs produced from a given level of inputs. Rising productivity is important for economic growth and increasing living standards.

Measured as Gross Value Added (GVA) per Job, that is output per job, the productivity of the Primary Sector in Scotland is significantly less than the comparator countries:

- Two-thirds of the level in New Zealand;
- 60% of the level in Sweden;
- Less than half the level in the Netherlands; and
- 30% of the level in Norway.

[7] Eurostat (2018) Structural Business Statistics Database
[8] Stat NZ (2018) National Accounts (Industry Production and Investment): Year ended March 2016

Figure 3-4: Primary Sector GVA per Job, 2016



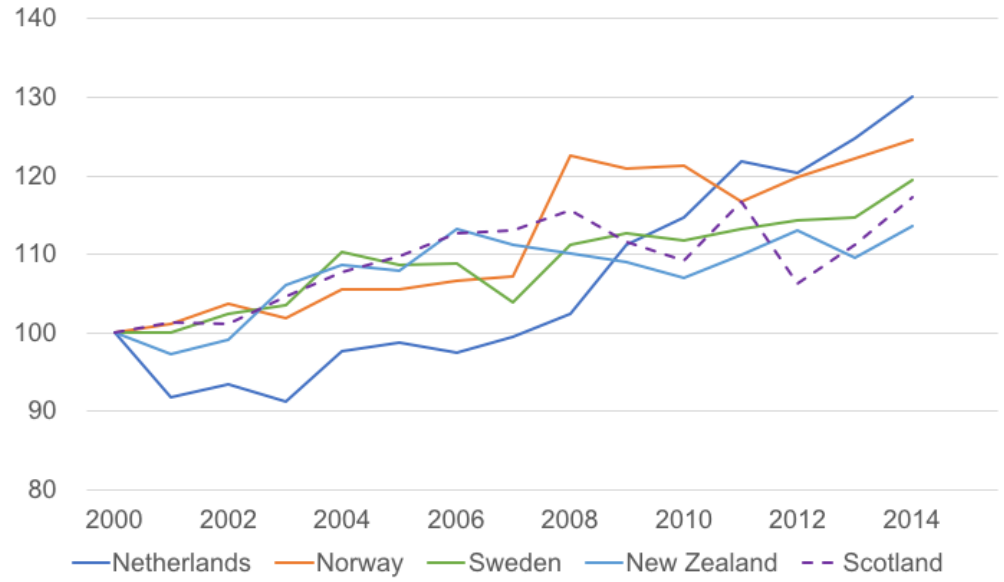
Source: OECD, Scottish Parliament

3.2.2 Productivity Trends

When we look at trends in total factor productivity (TFP) in agriculture, we find that the growth in the agricultural sector (so a narrower measure than the GVA per job, was for the Primary Sector) in Scotland has been the lowest of the comparator countries.

In 2014, TFP was 1.17 greater than in 2000 in Scotland. In the Netherlands it was 1.30. Therefore, average annual TFP growth rate was 1.1% in Scotland and 1.9% in the Netherlands. This means that the gap between Scotland and the comparator countries is getting wider and that Scotland is falling further behind.

Figure 3-5: Total Factor Productivity in Agriculture (2000 = 100)



Source: USDA Economic Research Service, Scottish Government

This is important for three main reasons:

- more productive countries will be more competitive in domestic markets (compared to imports) and in export markets;
- in advanced economies, the main source of economic growth is productivity growth and so slower productivity growth in agriculture means a lower contribution to economic growth compared to other countries; and
- generating more economic value (whether in the form of wages or profits) for those in the agricultural sector will be dependent on productivity growth.

3.3 Skills and Knowledge Creation

3.3.1 Investment in Agricultural R&D

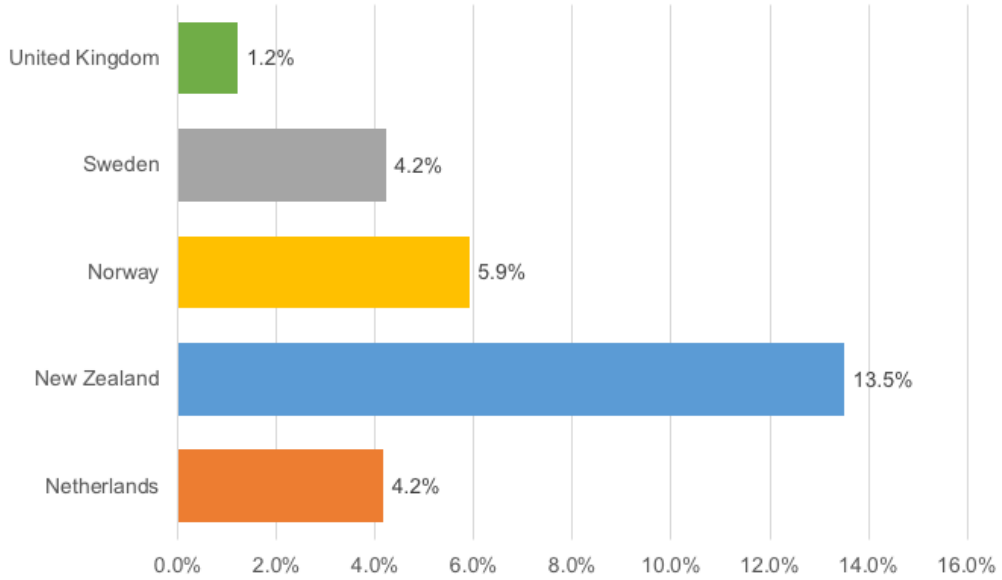
The UK has one of the lowest levels of investment in R&D of the advanced economies and Scotland is behind the UK average. Across the UK, total R&D investment was £29.4 billion, equivalent to 1.67% of GDP[9]. Of this, £2.3 billion, 7% of the total, was in Scotland and this is equivalent to 1.54% of GDP in Scotland. Across the EU, the investment in R&D is equivalent to 1.94% of GDP.

As the UK already lags behind other EU economies in terms of overall R&D investment, it should be particularly worrying that, within this proportion, the agriculture sector receives only 1.2% of UK national government and business R&D investment. The OECD provides data on the sum of Business Expenditure in R&D (BERD)[10] for the Primary Sector and the Government Budget Allocations for R&D for Socio-economic outcomes related to agriculture (GBARD). This shows

[9] ONS (2018) Gross domestic expenditure on research and development, UK: 2016
[10] OECD (2018) Joint OECD-Eurostat international data collection on resources devoted to R&D

that in 2016 New Zealand had the greatest proportion of R&D devoted to agriculture within the comparator countries.

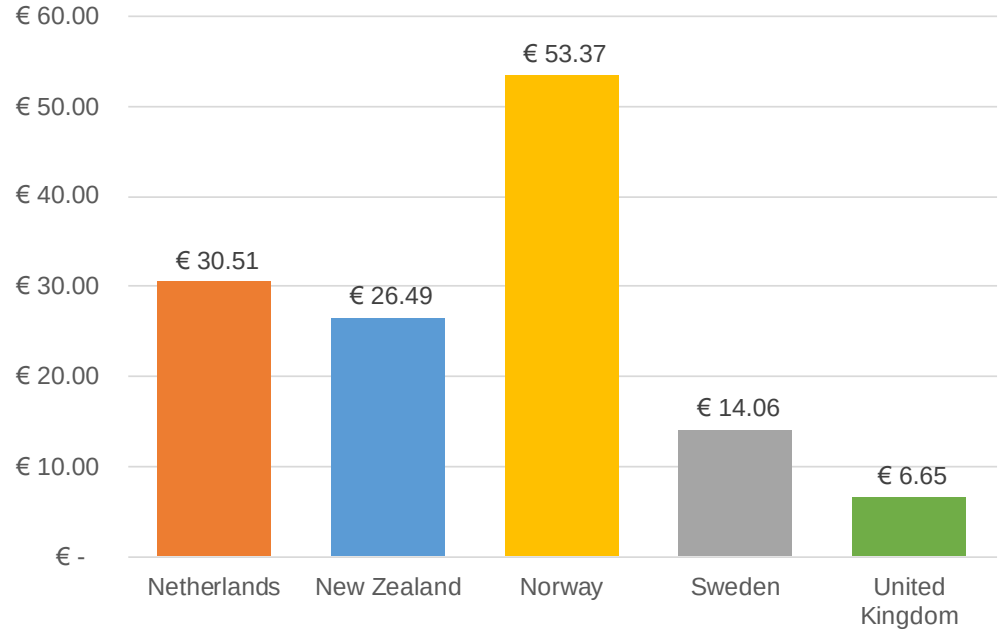
Figure 3-6: Agricultural Share of R&D Investment, 2016



Source: OECD, includes BERD and GBARD data for latest available year

Looking at the Primary Sector more broadly, OECD data on the latest business and government investment in R&D shows that UK R&D investment per capita is significantly less than in comparable countries. In 2015 this was equivalent to €6.65 per person in the United Kingdom, compared to €53.57 in Norway and €30.51 in the Netherlands.

Figure 3-7: Agricultural Share of R&D Investment per Capita, 2015



Source: OECD

This presents a challenge for future productivity growth as without R&D investment, where are the new ideas that will transform the sector and deliver the widest range of economic, social and environmental benefits.

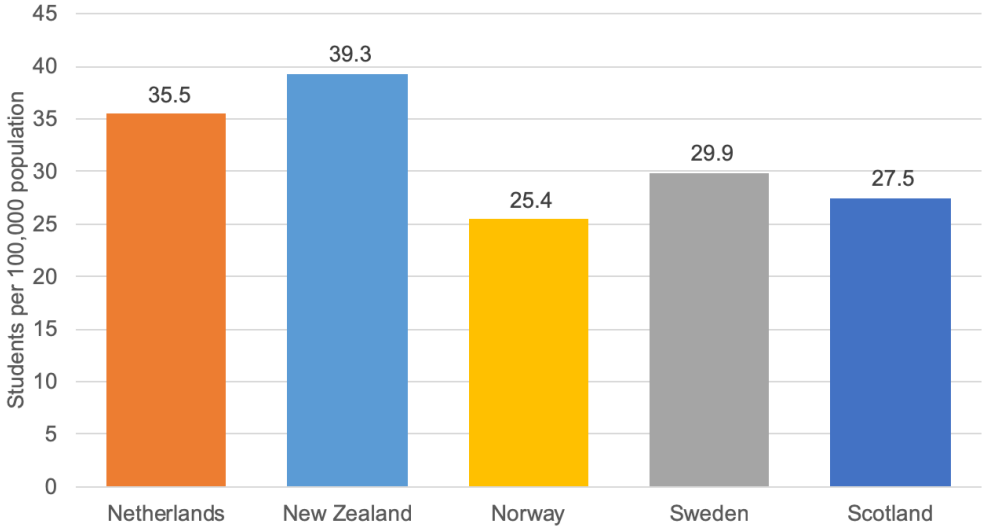
3.3.2 Primary Sector Skills

Advances in knowledge in the Primary Sector, generated through investment in research and development, are of little use to a sector if there is not a skilled workforce available to translate the new knowledge into practice and thus increase productivity. This absorptive capacity, the ability of firms to incorporate external knowledge and advances, is crucial for the growth of the Primary Sector.

The educational attainment of a workforce is considered to be a proxy for the skills available within the sector. Higher education in particular is important to improving the absorptive capacity of a sector and, as shown in Figure 3-1, Scotland has one of the lowest concentrations of Primary Sector students studying at University of all the comparator countries[11]. In New Zealand there are 39.3 Primary Sector students for every 100,000 people in the population and in the Netherland there are 35.5[12].

This would suggest that the Primary Sector in these countries is more likely to have the skills available to translate future advances in knowledge into practice.

Figure 3-1 - Primary Sector Higher Education Students per 100,000 population



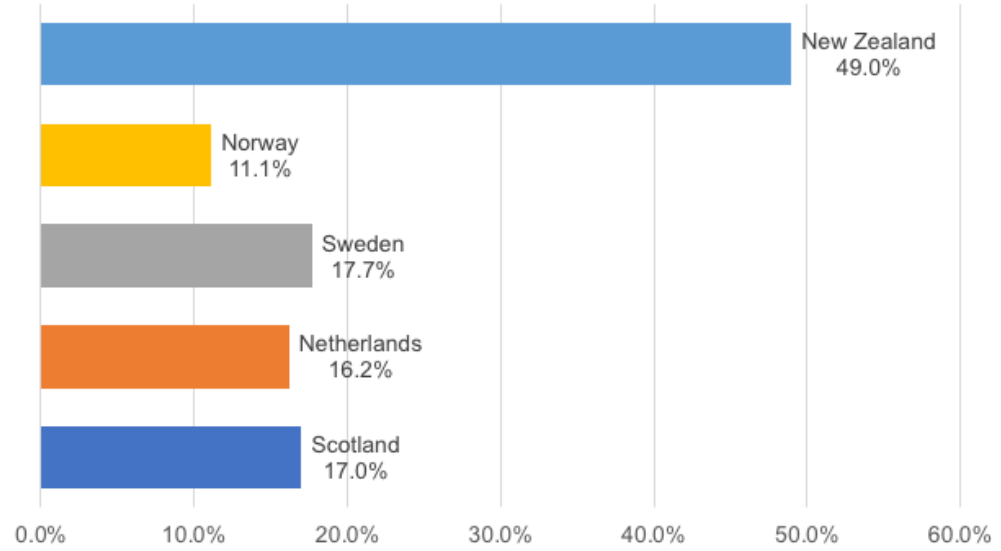
Source: OECD, Higher Education Statistics Agency (HESA)

3.3.3 Agricultural Emissions

There are other important measures beyond economic output and productivity. Given the challenges of climate change, the emissions of greenhouse gases (GHG) is another important issue to be considered. The proportion of greenhouse gas emissions that come from agriculture in Scotland are not particularly high[13] relative to the comparators (and a lot lower than in New Zealand[14]).

[11] Higher Education Statistics Agency (2018) Higher Education Student Statistics: UK, 2016/17
[12] OECD (2018) Education at a Glance 2016
[13] National Atmospheric Emissions Inventory (2018) Devolved Administrations GHG Inventory 1990 - 2016
[14] Government of New Zealand Ministry for the Environment (2018) New Zealand's Greenhouse Gas Inventory 1990 - 2016

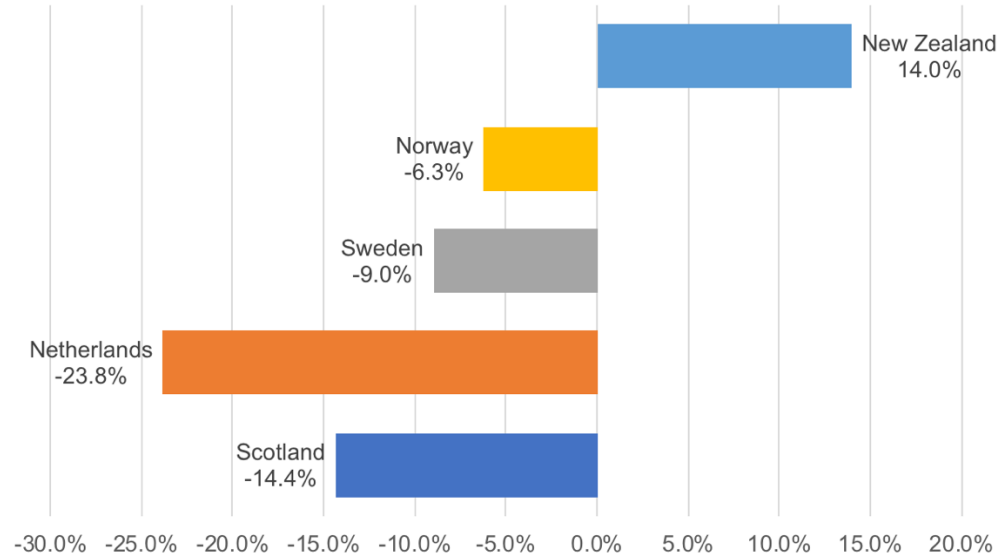
Figure 3-8: Proportion of Greenhouse Gas Emissions from Agriculture, 2015



Source: European Environment Agency[15], UK National Atmospheric Emissions Agency, New Zealand Ministry for the Environment

All countries have struggled to reduce emissions from agriculture as much as they have from other sectors. The Netherlands has seen the greatest level of reduction in emissions, although it still has the highest level of emissions intensive in terms of emissions per hectare of agricultural land. New Zealand has seen a significant increase in the number of ruminant animals, resulting in an increase of emissions over time.

Figure 3-9: Change in Emissions from Agriculture, 1990-2015



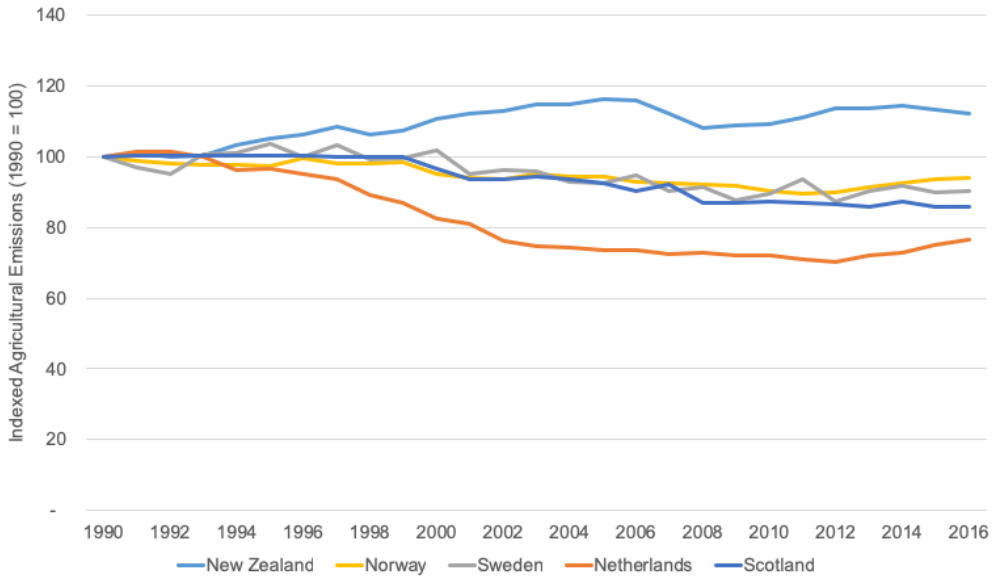
Source: European Environment Agency, UK National Atmospheric Emissions Agency, New Zealand Ministry for the Environment

All comparator countries have seen recent stagnation in the reduction of agricultural emissions. Scotland is doing comparatively well, but most reductions were

[15] European Environment Agency (2018) Annual European Union greenhouse gas inventory 1990–2016 and inventory report 2018

achieved before 2008 and change has been relatively modest since then. As this picture is replicated across most advanced economies, this suggests that the 'easy wins' in agricultural emissions have been achieved and that making further reductions, beyond what has already been achieved, will require further investment and advances in knowledge.

Figure 3-10: Agricultural Emissions Reductions per Year, 1990 to 2016



Source: OECD, UK National Atmospheric Gas Emissions by Source

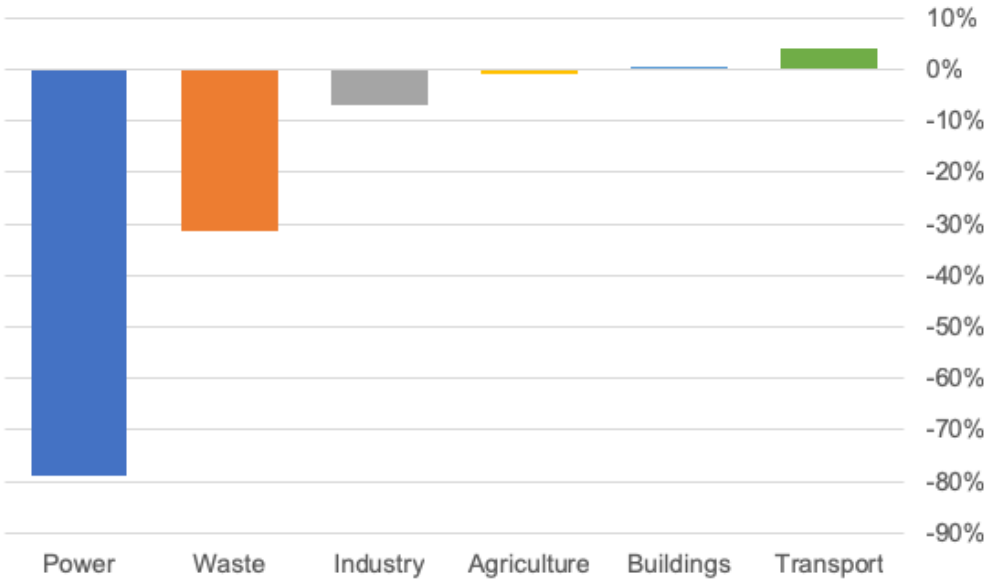
However, when this is set in the context of the bigger picture of emissions reduction, agriculture is barely contributing to the overall emissions reductions' targets. This trend is similar across the advanced economies, with countries such as Norway and the Netherlands actually seeing an increase in emissions in recent years.

A recent report from the Committee on Climate Change[16] to the Scottish Parliament concluded that Scotland is performing well on reducing greenhouse gas emissions compared to the rest of the UK, and that it has met its annual legislated target for 2016.

Overall, Scottish emissions are now 49% below the 1990 levels, and Scotland is on course to outperform the interim emissions reduction target for at least a 56% reduction in actual emissions by 2020.

[16] Committee on Climate Change (2018) Reducing emissions in Scotland: 2018 Progress Report

Figure 3-11: Change in Emissions from Scotland by Source, 2011 to 2016



Source: Committee on Climate Change (Sep 18) from National Atmospheric Emissions Inventory (NAEI)

The decarbonisation of the power sector and reductions in emissions from waste in Scotland have helped to drive down emissions. However, these mask a lack of progress in other areas.

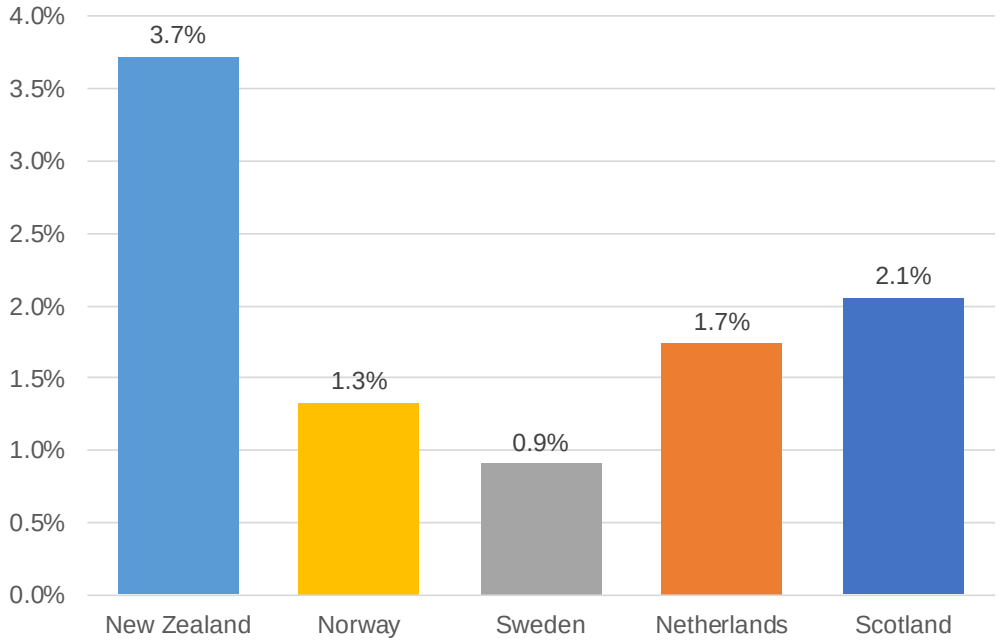
Scotland's ambitious emissions targets will only be achieved if effective policy extends beyond waste and power into sectors that have not yet seen significant reductions.

3.4 Food and Drink Sector

Food and drink manufacturing accounts for a larger proportion of the economy in Scotland[17] than all other comparator countries apart from New Zealand[18]. In Scotland, the GVA of the food and drink manufacturing sector was equivalent to 2.1% of the total Scottish GDP. The whisky industry was a significant proportion of this GVA and overall, the majority of this GVA is from the manufacture of drink.

[17] Scottish Government (2018) Scottish Annual Business Statistics
[18] Stats.nz

Figure 3-12: Food and Drink Manufacturing GVA as % of GDP

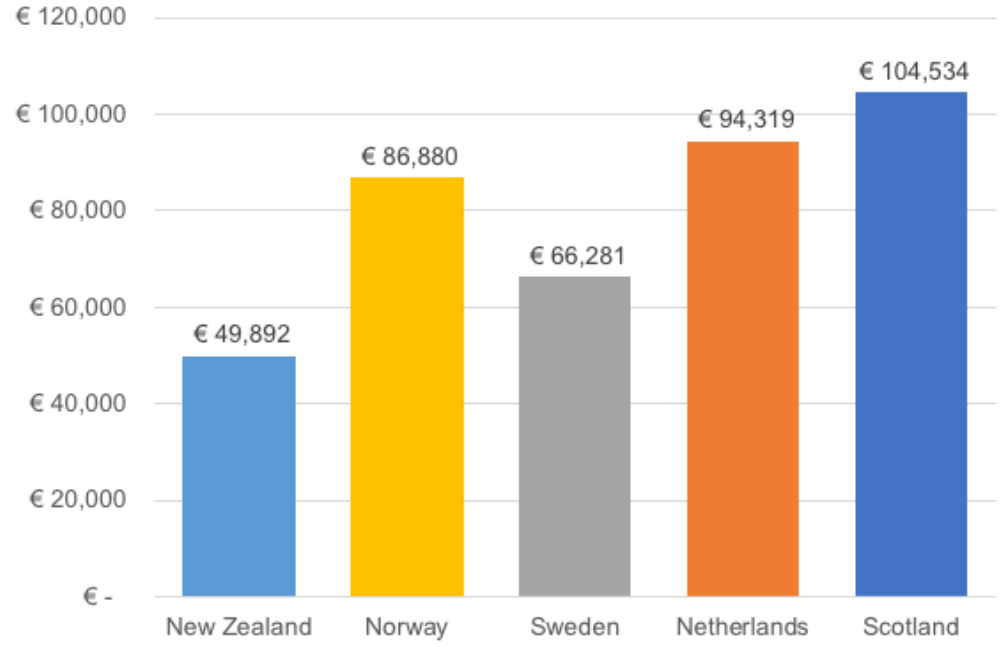


Source: Eurostat, Scottish Annual Business Statistics and Stats.nz

3.4.1 Food and Drink Productivity

Productivity, measured in GVA per job, of the Scottish food and drink manufacturing sector is higher than the comparator countries, at €104,534. This is strongly influenced by the impact of the whisky industry.

Figure 3-13: Food and Drink Manufacturing GVA per Job, 2016/17

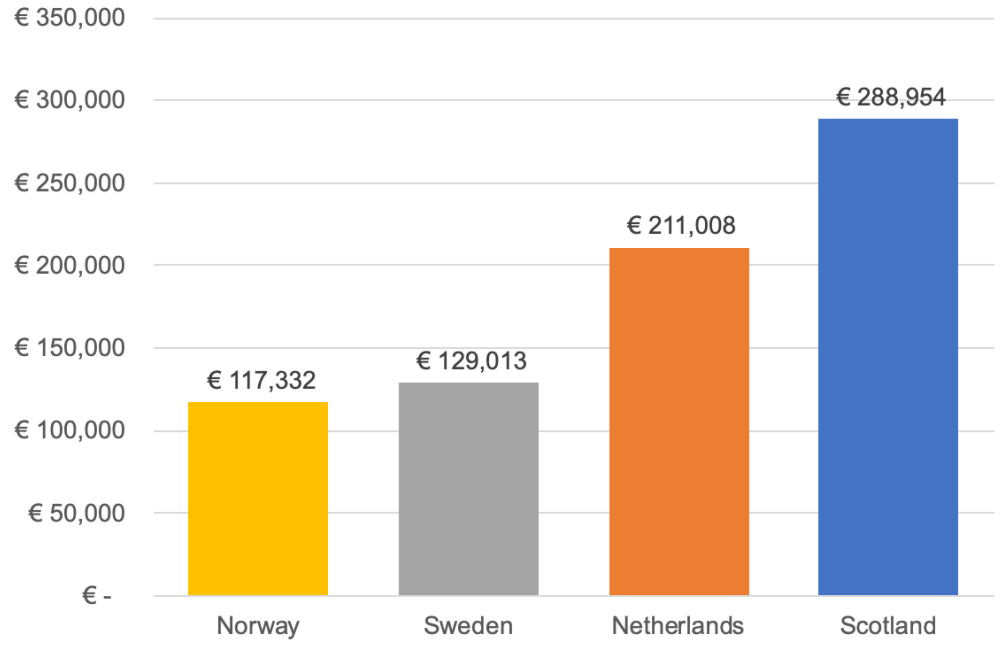


Source: Eurostat, Scottish Annual Business Statistics and Stats.nz

Much of the GVA from the whisky industry does not remain in the Scottish economy since a large proportion of the sector is owned by multinational companies based outside Scotland. If the manufacture of drink is considered separately, the GVA per

job in Scotland is almost €290,000. Excluding this effect from the statistics, it may not be correct to conclude that Scotland has a highly productive food and drink manufacturing sector.

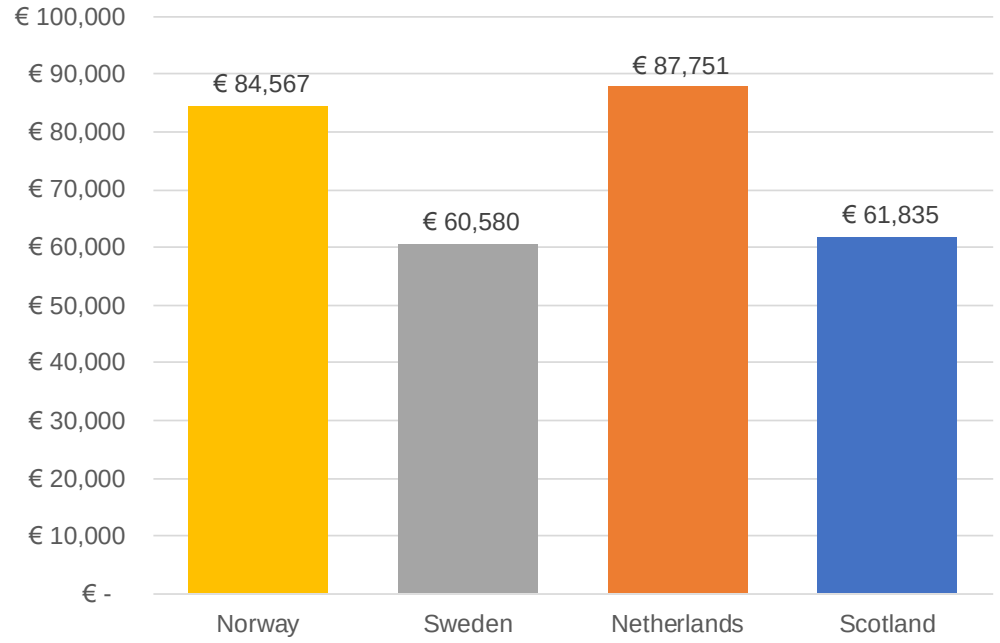
Figure 3-14: Drink Manufacturing GVA per Job, 2016/17



Source: Eurostat, Scottish Annual Business Statistics

The GVA per job in the food manufacturing sector is one of the lowest of the comparator countries. The GVA per job in this sector is greatest in the Netherlands at €87,751 and lowest in Sweden at €60,580.

Figure 3-15: Food Manufacturing GVA per Job, 2016/17



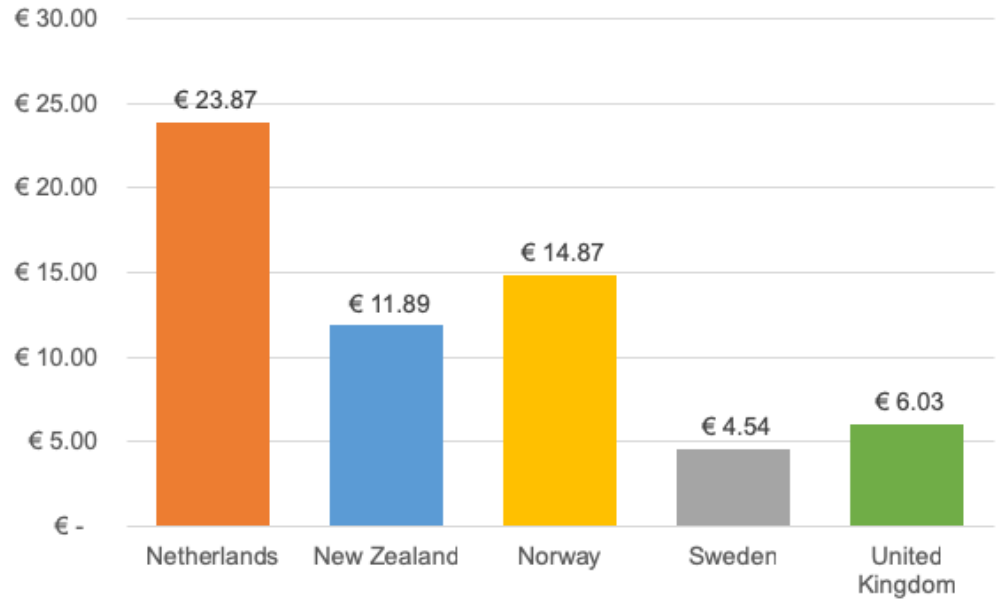
Source: Eurostat, Scottish Annual Business Statistics

Although productivity in the food and drink manufacturing sector is higher in Scotland than elsewhere, this hides considerable variation within the sector. In order toachieve sectoral resilience, there is a need to work on improving productivity in the parts of food & drink manufacturing which are not performing as well.

3.4.2 Food and Drink Investment in R&D

The level of investment in research and development in the food and drink sector is also lower per capita in the UK than in most other countries. Data is not available for Government expenditure in this area, however data on the business investment in R&D shows that in the UK the investment per capita is equivalent to €6.03 in the UK, which is the lowest of all the comparator countries except from Sweden.

Figure 3-16: Business R&D Investment in Food and Drink per Capita, 2013-2015



Source: OECD, BERD

3.5 Benchmarking Summary

Benchmarking the agri-food sector in Scotland against the comparators countries highlights both areas of success and areas of concern. In particular this shows that:

- the Primary Sector share of GDP (1.4%) is typical for a small advanced economy (apart from New Zealand);
- but, when adjusted for the scale of each economy, output of the Primary Sector is much lower than in the comparator countries;
- there is a large productivity gap for the Primary Sector as GVA per job is less than half of that in the Netherlands;
- comparative performance on emissions benchmarks well, but there is an opportunity to be a global leader in the reduction of agricultural emissions, which have plateaued across the developed world;
- there is a huge gap in R&D investment; and
- food and drink output and productivity benchmarks well, although the performance is strongly skewed by the impact of the whisky industry.

4 TRENDS AND CHALLENGES

Drawing on the findings from the benchmarking exercise, there is a clear need to address some of the major challenges faced by the agri-food industry. At a global level there are challenges presented by:

- population growth;
- increasing food production to meet the demand from a larger population with increasing aspirations and expectations;
- climate change;
- environmental management and ecological systems;
- addressing health and nutrition challenges;
- the circular economy; and
- the quality of life, both rural and urban.

All of these features build and strengthen the case for a change in approach. They require innovative solutions that need to be translated into practice in education and knowledge exchange.

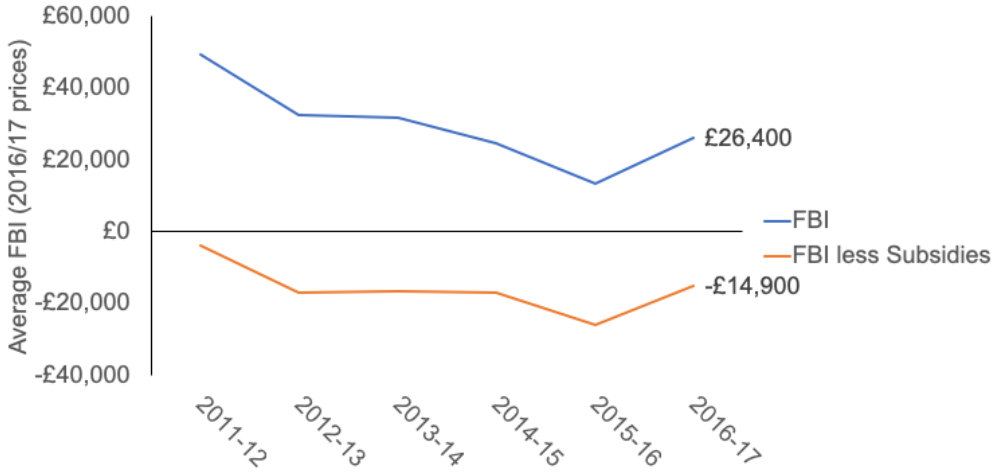
In addition to these global challenges, the agri-food sector in Scotland is facing particular challenges regarding the markets in which it operates and the support mechanisms currently in place

4.1 Agricultural Incomes and Subsidies

The business model for agriculture does not seem financially or economically sustainable. On average, farms make a loss from agriculture. Only non-agricultural activity, such as tourism and subsidies, deliver an income which is often modest.

On average, farm businesses make a loss of £21,300 (excluding income from non-agricultural activity). With subsidies of £41,300 per farm this turns the loss into a net income of around £26,400. This is a long term trend, which has seen farm business income on a downward trend between 2011/12 and 2016/17.

Figure 4-1: Farm Business Income in Scotland 2011 - 2017



Source: Scottish Government, RESAS, Farm Business Survey, 2016-17

The growth in non-farming income, from activities such as tourism and energy, has helped some farmers. However these opportunities may not be available to all agricultural businesses and may have increased competition from other businesses in their area.

4.2 Post Brexit Environment

The lack of profitability in the agricultural sector and the productivity issues described in Section 3 will make the sector less resilient to significant economic and market shocks. In addition to these issues, Scotland will leave the European Union in March 2019, including the Common Agricultural Policy (CAP), which is its main source of subsidy, and the EU Single Market, which is its main export market.

The implications for the agri-food sector as a result of this are likely to be many and varied. Predicting the impact on the sector prior to the conclusion of any agreement on future relationships with the EU is likely to generate a range of possible outcomes, reflecting the uncertainty of this process. However, it is likely that the issues that the sector will need to address will include:

- agricultural subsidies, in their current form, are to be phased out in the 2020s;
- labour supply may be a challenge with a different immigration policy; and
- market access arrangements are uncertain and new trade deals could introduce new sources of import competition.

5 AGRI-FOOD UNIVERSIES IN COMPARATOR COUNTRIES

It is worth considering what the comparator countries do differently to support their agri-food sectors through higher education. Each country has a globally competitive agri-food university that sits at the centre of an innovation and skills eco-system.

Four organisations in particular provide relevant and insightful examples:

- Netherlands – Wageningen University and Research;
- New Zealand – Lincoln University;
- Norway – Norwegian University of Life Sciences; and
- Sweden – Swedish University of Agricultural Sciences.

5.1 Wageningen University and Research (WUR)

- Officially launched in 1998
- WUR celebrated its100th year in higher education in 2018
- Combines Wageningen University and Wageningen Research
- Frequently and consistently ranked in top positions by several global sources (1st in World for Agriculture and Forestry: QS 2018)
- In 2017 it had an income equivalent to £569 million, 4,900 staff and 12,000 students
- Currently offers 19 Bachelor's programmes and 29 Master's programmes and produces around 4,800 scientific publications per year
- In the 4 years to 2017/18, it educated more students (enrolments up by 25%) with relatively static inputs (income + 3%; staffing - 5%)

WUR is a large and highly reputable agricultural university in the Netherlands. It is particularly strong in greenhouse horticulture and exports this technology around the world, adapting the technology for different growing environments. It has strong links with industry, facilitating rapid technology exchange with the wider agri-food industry. This translation, or 'extension', activity has been a fundamental element of the Dutch transformation into a global leader in agricultural innovation[19].

One of the ways in which is does this is through its links with the Foodvalley organisation.

5.1.1 Wageningen and Food Valley NL

Food Valley NL was Established in 2004 and is the main knowledge-intensive agri-food ecosystem in the Netherlands. It has over 140 members representing aspects of the

[19] LEI Wageningen UR (2008) Economic assessment of Dutch agricultural research

agriculture, food and drink sectors from growers, ingredient and feed manufacturers to engineering companies, to research companies and recruitment organisations. Its aim is to speed up the links between innovation in the agri-food sector and market introduction. It regularly hosts events and networking opportunities and also showcases innovative solutions.

The key lesson from the Food Valley NL example is that success comes from intensive co-operation between companies, knowledge institutions and government.

5.2 Lincoln University

- Established in 1878, Lincoln University as the first agricultural college in Southern Hemisphere
- Became a university in 1990
- Ranked 12th in the world for small universities by QS in 2017
- In 2017, the University had an income equivalent to £59 million, a staff complement of 650 people and a student population of 2,700
- Has a number of subsidiary companies and joint ventures which focus on commercialisation activity

It has a strong connection with the land and primary industries which contribute significantly to the New Zealand economy. Its work is aimed at helping to solve some of the biggest global challenges.

Lincoln University has a role to play in leading the understanding of how agriculture, the environment and tourism - the three pillars of prosperity for New Zealand - can exist together for the benefit of all. It offers a range of diploma courses as well as Bachelors', Masters' and PhD courses.

5.3 Swedish University of Agricultural Sciences

- Founded in 1977 through merger of 3 colleges that specialised in agriculture, forestry and veterinary subjects
- Regularly and consistently ranked in top positions by several global sources (4th in World for Agriculture & Forestry: QS 2018)
- In 2017, it had an income equivalent to £288 million; a staff complement of 2,800 people and around 3,700 students
- It offers 23 undergraduate and 21 Master's programmes
- It produces 1,600 research papers each year with at least one SLU author
- It is organized into 'future' platforms: Future Forests, Future Food, Urban Future, Future Animals and Health

SLU is a research-intensive university engaged in education, research and environmental monitoring and assessment. Around 70% of the University's turnover is dedicated to research and doctoral programmes.

5.4 Norwegian University of Life Sciences

- Founded in 1859 as an Agricultural Postgraduate College
- Awarded university status in 2005
- Previously known as the Norwegian College of Agriculture
- Merged with Norwegian School of Veterinary Science in 2014
- In 2017 the University had 1,700 staff and 5,200 students
- It offers 64 programmes (many taught in English) from 2 campuses
- Four priority areas: interdisciplinarity, digital society, lifelong learning, a unified university

NMBU's mission is to contribute to the well-being of the planet. Their interdisciplinary research and study programmes generate innovations in food, health, environmental protection, climate and sustainable use of natural resources.

All seven university faculties will be located on one campus from 2019 with the completion of a new teaching and research building for veterinary science.

Two other major institutions are also co-located with NMBU at Campus Ås: they are the Norwegian Institute of Food, Fisheries and Aquaculture Research (Nofima) and the Norwegian Institute of Bioeconomy Research (NIBIO).

5.5 Lessons from the Comparators

The comparator institutions described in this section all have an impact on the agri-food sectors within their national economies and provide lessons on the best way forward, for the Scottish sector. In particular these organisations have shown that they can benefit from:

- being institutions of scale and breadth;
- having long histories of growth, change and merger;
- demonstrating that the education they deliver is informed by their research;
- their research being translated into practice via skills and industry engagement;
- industry playing a role in identifying challenges and educational needs;
- a system of education, research and industry working together;
- having a global outlook and being rooted in the domestic rural economy; and
- focusing on excellence.

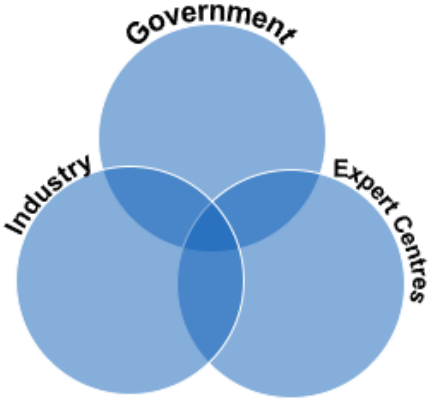
6 VALUE CREATION MODEL

This chapter describes how value can be created for the agri-food sector and how this would work for Scotland.

6.1 Value Creation Model

The elements that successfully drive value creation, innovation and growth in the agricultural sector are the same as those in any other sector of the economy. As with all sectors, innovation is best driven by an integrated collaborative approach between industry, centres of knowledge excellence and government.

Figure 6-1: Components of the Value Creation Model



Source: BiGGAR Economics

This model is replicated in the agriculture sector across comparator countries. The presence of the elements themselves does not result in value being created. The most successful examples of this are where the elements have collaborated to take a strategic approach to value creation and have established the systems required to nurture this approach. Within each of the comparator countries, the universities play a crucial role in ensuring that the elements and systems are creating value most effectively.

These elements will also be required in the value creation model for agri-food in Scotland, however the constituent parts of this 'triple helix' are more complicated in agri-food than in other sectors. Therefore, the need for a 'big picture' view is increasingly important.

6.1.1 Government

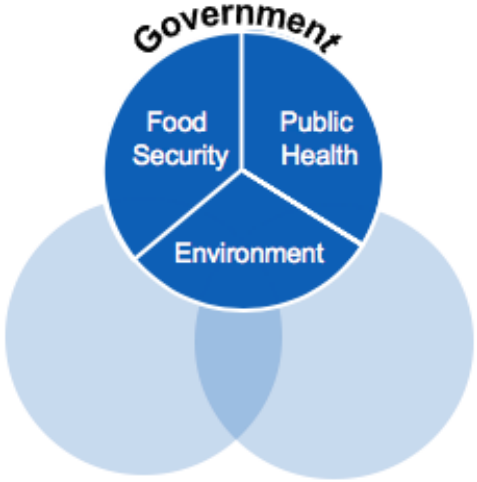
The government has multiple objectives and interests in contributing to innovation and growth in the agri-food sector.

Food and public health are closely related, and particularly important issues in Scotland, which has high levels of obesity and alcohol consumption. This has subsequent impacts on the NHS and also on economic production. The Scottish Government has the objective of improving the public health of Scotland through the food and drink that is consumed. So, increasing economic growth achieved through low value alcohol and processed food production is unlikely to sit well with that objective; the quality of growth will also be important.

The Scottish Government is also responsible for environmental issues. The primary sectors are the guardians of the vast majority of the Scottish environment and the Scottish Government has an interest in growing the economic value in this sector in an environmentally sustainable way.

Similarly, Governments, both UK and Scottish, are concerned with the security of food supply. Therefore, they are interested in the overall output of the agri-food sector in addition to the value generated and jobs supported.

Figure 6-2: Value Creation: Government Interest

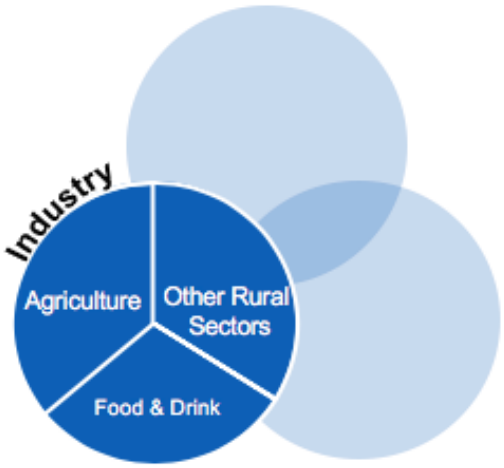


Source: BiGGAR Economics

6.1.2 Industry

The agricultural sector is vitally important for other industries such as food and drink and other rural sectors.

Figure 6-3: Value Creation: Industry Interest



Source: BiGGAR Economics

The agri-food sector includes multiple industries which are directly involved and others which have a significant vested interest in the success of the agri-food sector.

Other rural sectors, including tourism, forestry and utilities are interested in maintaining a healthy and vibrant rural economy, which can encourage workers into the rural economy and improve the standard of living in these areas.

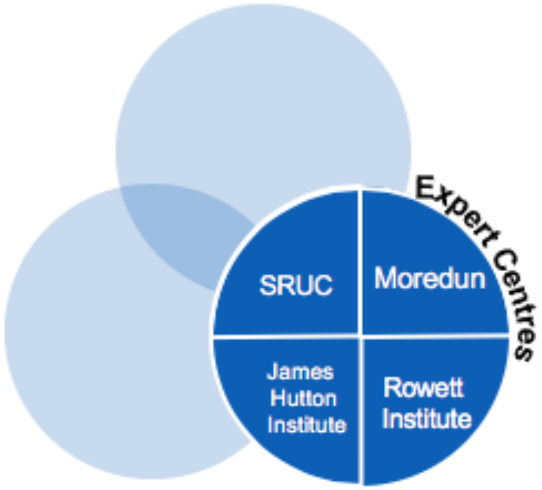
6.1.3 Expert Centres

There are multiple universities, colleges and research centres that work to support value creation in Scotland.

These 'Expert Centres' include those supported by the Scottish Government as the Main Research Providers (MRPs) as part of the Environment, Climate Change and Land Reform (ECCLR) and Rural Economy and Communities (REC) portfolios, namely:

- SRUC;
- The Moredun Institute;
- The James Hutton Institute; and
- The Rowett Institute.

Figure 6-4: Value Creation: Expert Centres



Source: BiGGAR Economics

In some areas, expertise overlaps and in others there are particular areas of strength. There is no unifying organisation which provides a 'big picture' view.

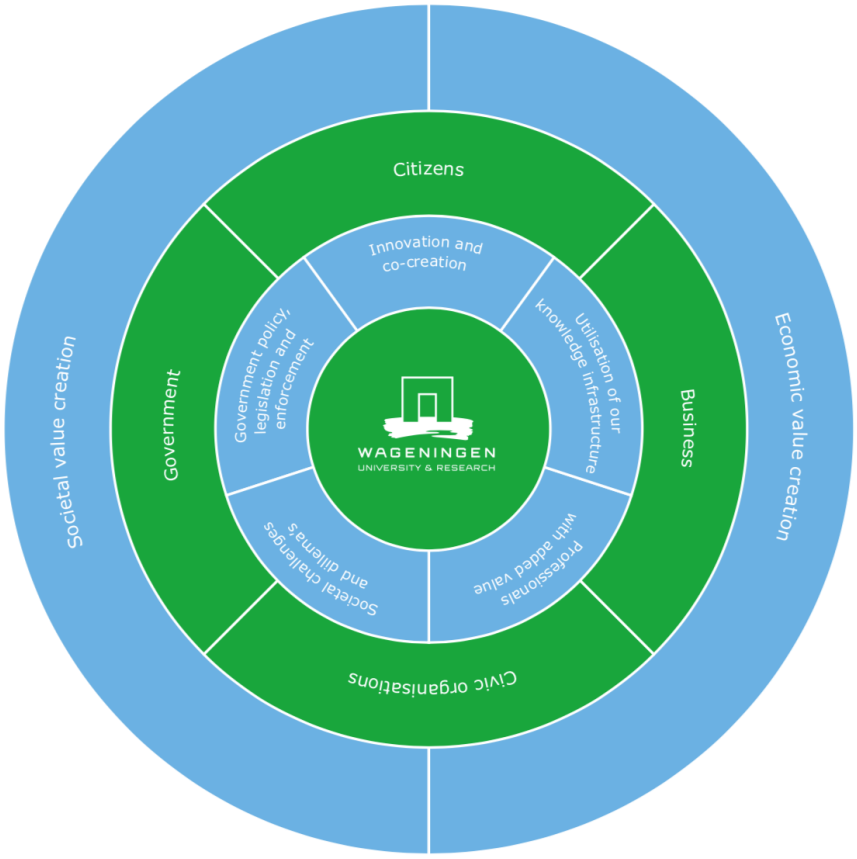
In addition to these, other universities in Scotland have areas of expertise which contribute to this (such as the Institute of Aquaculture at the University of Stirling, the Scottish Centre for Production Animal Health and Food Safety at the University of Glasgow and the Roslin Institute at the University of Edinburgh).

6.1.4 Value Creation WUR Example

There is an opportunity to learn from the comparator institutions and countries and their approach to creating systems of value creation within agri-food. Wageningen University & Research (WUR) provides an inspirational example of how a university or research institution creates value.

The system of value creation in the Dutch agri-food sector is outlined in Figure 6-5, with the WUR at its heart. This reflects the strategic role that the WUR has in providing the vision, guidance, knowledge and skills required to achieve economic growth through the agri-food sector. This includes consideration for both economic and social value creation and the mechanisms and stakeholders required to achieve this.

Figure 6-5: Value Creation by WUR



Source: WUR

6.2 Circular Economy

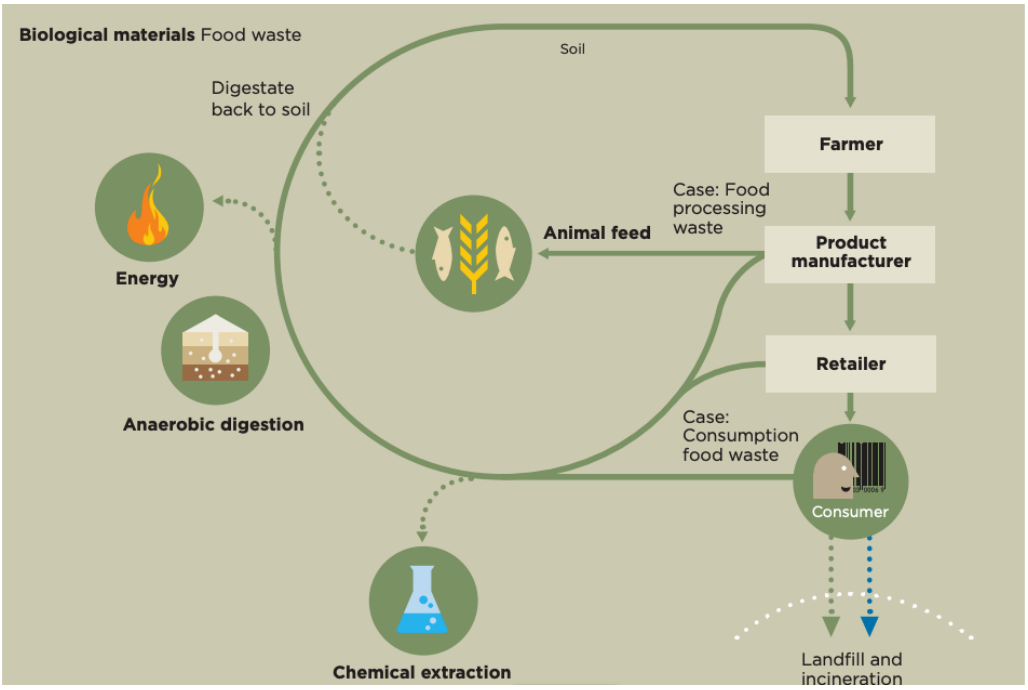
A further, wider aspect of the value created by the agri-food sector is its role in supporting the circular economy. The traditional value chain in the agri-food sector sees production move from the farmer to the food manufacturer, the wholesaler/ retailer and to the consumer. Any waste would typically go to landfill and/ or incineration.

The circular economy concept highlights that further value can be created, and environmental impacts reduced by reusing, recycling and repairing products at each stage of the chain.

In agri-food some of the opportunities highlighted are in energy, chemical extraction, anaerobic digestion and animal feed. The Ellen MacArthur Foundation

estimated that this approach in the food and beverage value chains could generate £1.2 billion additional value for the UK economy.

Figure 6-6: Circular Economy



Source: Ellen MacArthur Foundation

The circular economy is also an area of interest for the comparator institutions, including the Wageningen University & Research, who are investing heavily in research and translation in this area.

6.3 Value Creation Summary

Value is created through generating:

- new knowledge; and
- diffusing that knowledge.

It is formed through the interaction of research, education, industry, government and society.

The routes to value creation are:

- new knowledge from research;
- transfer of knowledge via IPR;
- transfer of knowledge via collaborative working;
- further and higher education; and
- continuing education.

7 A MODEL FOR SCOTLAND

Scotland already has the building blocks of what is required to generate value creation for the agri-food sector, but it has not yet established an innovation and skills system like other comparator countries.

7.1 Foundations

In 2017, the combined income of SRUC and the three agri-food research centres in Scotland was around £140 million. This includes income associated with education and skills, research and other services.

Figure 7-1 - Income of MRP members

Organisation	Income
SRUC (Group)	£77.1 million
James Hutton Institute	£38.0 million
Moredun Research Institute	£12.9 million
Rowett Research Institute	£11.8 million*
Total	£139.8 million

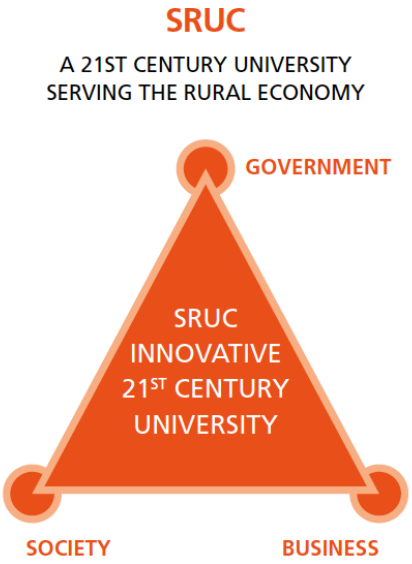
Sources: SRUC, James Hutton and Moredun the source is their individual audited accounts submitted to Companies House. The Rowett became part of the University of Aberdeen in 2008 and this data has been sourced directly from the University for the year ending 31 July 2016*

7.2 Potential Model

Scotland would not be starting from scratch in this and a Top 6 Global Agri-Food University can be built on strengths that already exist within Scotland.

SRUC has proposals for a new model, building on these strengths. The scope of SRUC covers all areas of activity that would need to be addressed, including both further and higher education, research and applying that research into practice. The research, innovations and skills flow between SRUC and industry through its consulting activity, other industry engagement and the improved productivity of their graduates within the sector.

Figure 7-1: Potential Model



Source: SRUC

This model would aim to follow the Fraunhofer model approach whereby activity and funding activities were split into three, with one third of income as long-term funding from the public sector, one third from competitive public contracts and the remaining third from commercialisation and industrial income. The Fraunhofer institutes are German research institutes active in commercialisation and technology development. They are widely credited with making a major contribution to productivity in the German economy.

In this model, SRUC is:

- the core driver of the rural economy and the competitiveness of Scotland's Food and Drink industry;
- leading on innovation and sustainable development in Scotland's rural sectors;
- providing world-class research, education, training and consulting;
- shaping economic, skills and training strategies; and
- committed to excellence and innovation in the advancement, communication and translation of knowledge throughout the rural economy.

8 STRATEGIC ECONOMIC CASE

This section outlines the strategic economic case for development of a top 6 agri-food university in Scotland. In particular it considers why the agri-food sector in Scotland is worthy of investment and the economic size of the prize of achieving its potential.

8.1 Why Agri-Food?

8.1.1 Comparative Advantage

A sector has comparative advantage when the opportunity cost of using the resources for any other sector is lower. The primary resource in agri-food is land, which Scotland has in abundance. There are minimal other demands for agricultural land from other sectors, unlike in England, for example, where the greater population density means that a higher proportion of this land is valued highly by other sectors.

Scotland has a strong reputation for agri-food quality at an international level, which the Scottish Government is looking to enhance through initiatives led by Scottish Development International and others.

This analysis has shown that there is a significant productivity gap that can and should be closed. For such an important sector in the Scottish economy, it is concerning that this gap currently exists but the agri-food universities in these comparator countries give an indication as to how this gap can be closed.

8.1.2 Sustainability

There is a need for all aspects of the economy to be managed and grown in an environmentally, economically and socially sustainable way. Agri-food has a particularly important role to play in this considering it is responsible for the majority of the land in Scotland and the success or otherwise of this sector has such a significant impact on the social and economic sustainability of large numbers of rural communities within Scotland.

The growth in interest in the 'circular economy' is driven by a need to make the economy more sustainable. Significant opportunities have been identified within the agri-food sector to extract greater value and reduce environmental impacts.

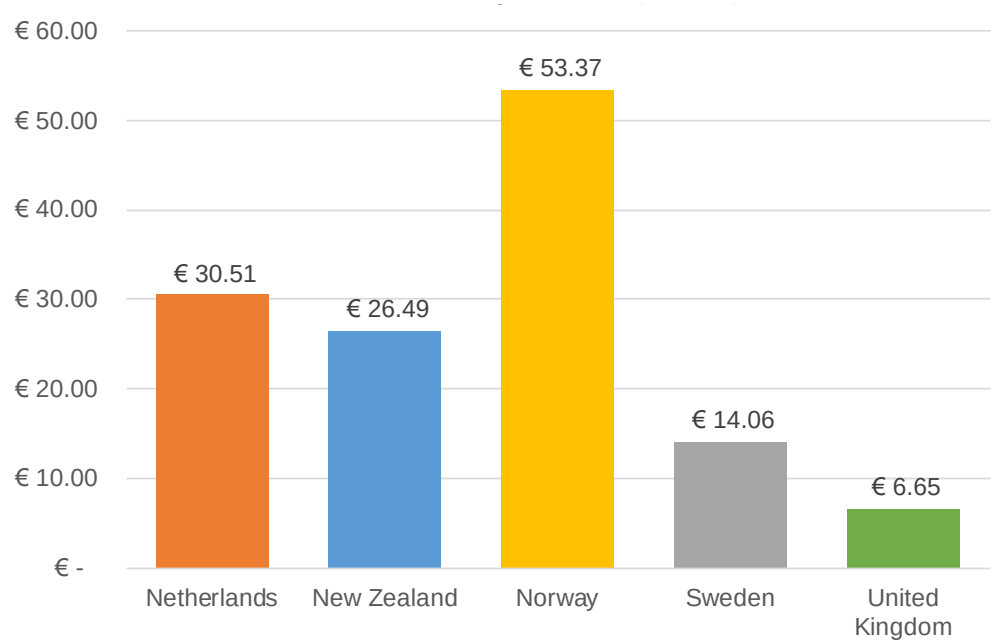
8.2 Size of the Prize

The economic potential of the agri-food sector in Scotland is significant and achieving this could result in improved outcomes for the economy and for the environment.

8.2.1 Primary Sector R&D investment in the UK is relatively low

Across the Netherlands, New Zealand, Sweden and Norway the average level of R&D investment in the Primary Sector per head is €31.11. This is much greater than the €6.65 average in the UK. This reflects a lower overall level of investment in R&D in the UK.

Figure 8-1: R&D Investment in Primary Sectors per Capita, 2015



Source: OECD

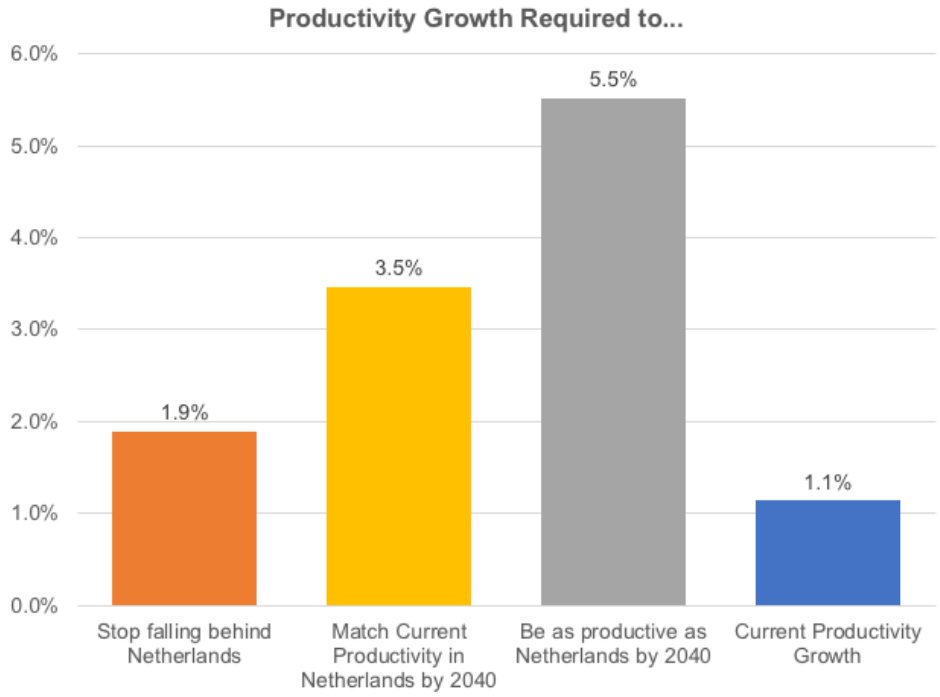
8.2.2 Economic Prize

All other things remaining equal, there will need to be a significant increase in the productivity growth rate for Scotland to match the productivity of the best performing comparator country, the Netherlands. The level of GVA per job in the Netherlands is currently over double that in Scotland and the gap between the two countries is growing each year as the higher TFP growth rate in the Netherlands means that it is pulling away from Scotland.

A number of different scenarios have been analysed:

- to stop the gap growing between Scotland and the Netherlands, Scotland will need to increase its productivity growth rate from 1.1% to 1.9% per year;
- for Scotland to be as productive as the Netherlands is now by 2040, it will need to grow at 3.5% per annum; and
- for Scotland to be as productive as the Netherlands is on track to be in 2040 an annual growth rate in TFP of 5.5% will be required.

Figure 8-2: Primary Sector Productivity Growth Scenarios…



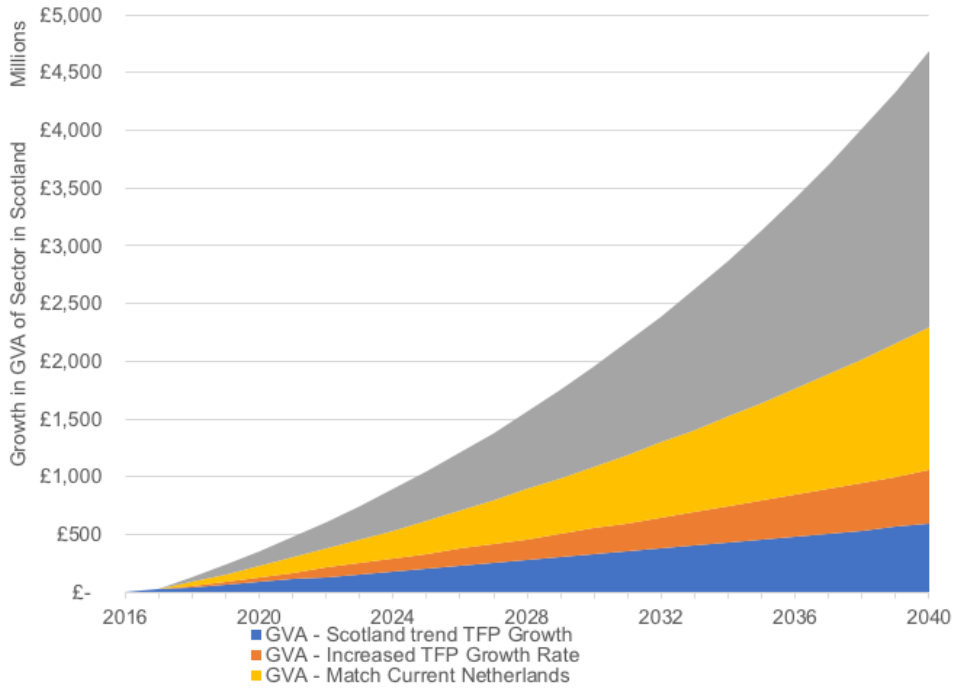
Source: BiGGAR Economics Analysis

Over the long term, achieving these growth rates would result in differing levels of economic activity in the agri-food sector in Scotland.

The GVA of the Primary Sector in Scotland in 2016 was £1.9 billion. (Scottish Parliament – GVA in Scotland). We have modelled the impact on GVA of the different growth rates illustrated in the previous figure.

- If Scotland increased its productivity (TFP) growth rate in line with the Netherlands (from 1.1% to 1.9%) There would be significant economic gains. All things remaining equal, the sector would contribute an additional £460 million GVA by 2040: an increase in productivity of one-third.
- If Scotland increased its productivity (TFP) to catch up with the current GVA/Job in these sectors in the Netherlands by 2040 (€64k per job), there would be even greater economic gains. All things remaining equal, the sector would grow by an additional £2.2 billion GVA by 2040: more than double its current level.
- Matching the Netherlands productivity levels by 2040 would add over £4.5 billion GVA to the economy.
- The primary Sector would be worth the equivalent of 3.7% of the Scottish economy in 2016, up from 1.4% at present.

Figure 8-3: Primary Sector GVA in Scotland in different Growth Scenarios



Source: BiGGAR Economics Analysis

These are ambitious targets and would require that substantial, significant changes are made, however the potential impact on the economy is very large.

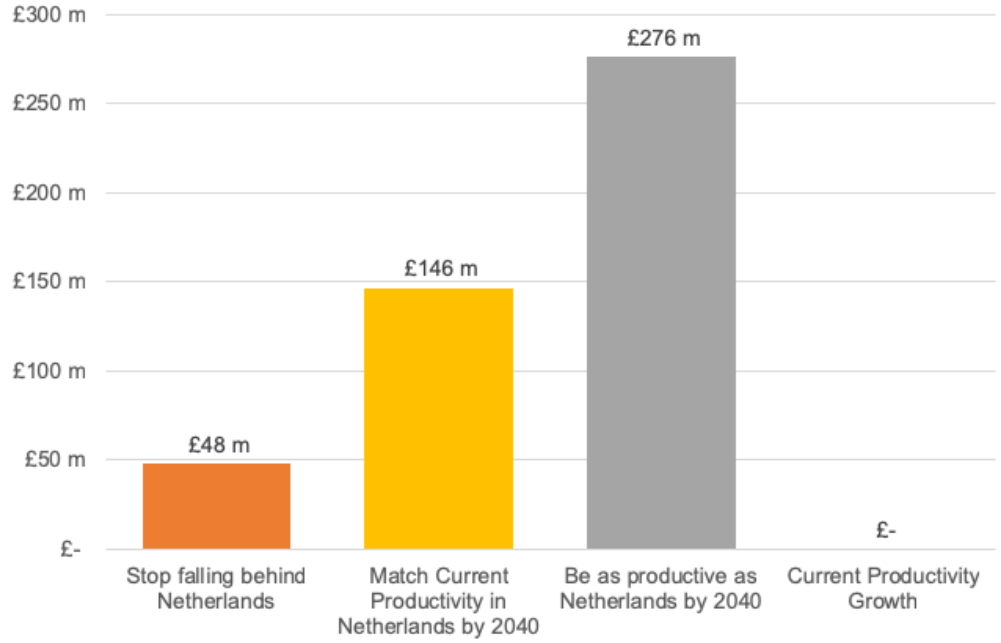
The returns to investment in agricultural R&D and skills development are significant and positive. For example, analysis of R&D investments by Instepp[20] found that the Median Internal Rate of Return (IRR) was 37.5% and ranged from 52% in Asia & Pacific to 30.3% globally.

This investment will need to be maintained and to grow;

- the initial annual investment of £48m each year to stop falling behind the Netherlands, will need to grow by 2.9%;
- the initial annual investment of £146m each year to match current productivity in the Netherlands, will need to grow by 4.3%;
- the initial annual investment of £276m each year to be as productive as the Netherlands by 2040, will need to grow by 6.3%; and
- this is not just about the value of the R&D investment but also the systems in which it is invested.

[20] The International Science & Technology Practice & Policy (August 2016) 'Returns to Food and Agricultural R&D Investments Worldwide, 1958 – 2015

Figure 8-4: Implications for Additional R&D Investment Required



Source: BiGGAR Economics Analysis

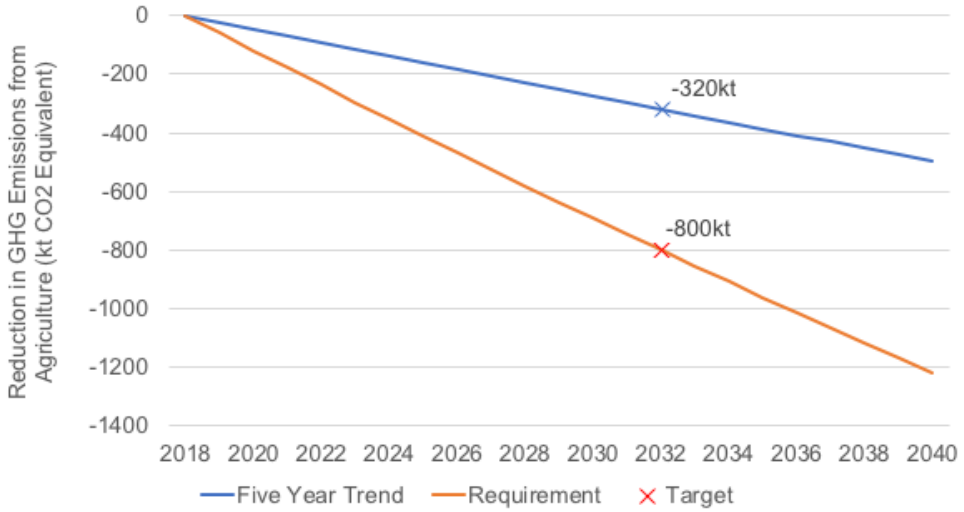
8.2.3 Climate Change Prize

Scotland is currently on track to miss the target of GHG emissions reductions that it has set itself for agriculture. If the current trend is maintained, Scotland will miss this target by more than half.

The reductions in agricultural emissions have been minimal in recent years, averaging 0.3% per annum reduction over the past five years. The target is to reduce agricultural emissions by 9% or 800 kilotons of CO_2 Equivalent between 2018 and 2032. On current trends, Scotland will reduce this by 320 kiloton of CO_2 equivalent by 2032, which is 580 kilotons short of this target.

Across Europe and other comparator countries, the low-lying fruits of reductions in agricultural emissions have been picked and progress has stalled. The challenges now require a greater level of innovation to meet the continued need for emissions reduction. Scotland has the opportunity to lead in this area which is a challenge for all developed economies.

Figure 8-5: Climate Change



Source: Committee on Climate Change; BiGGAR Economics Analysis

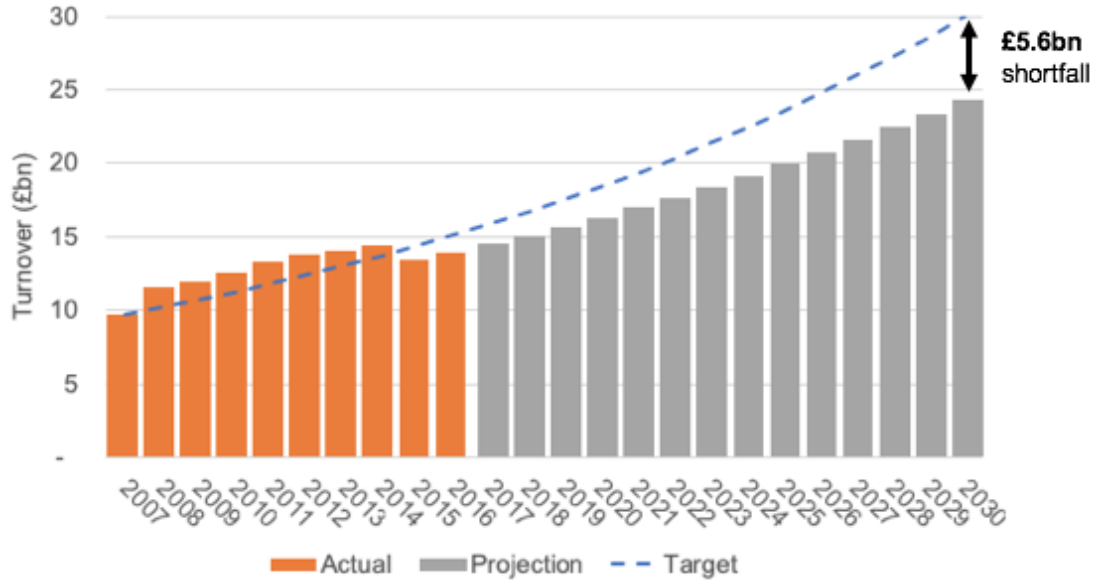
8.2.4 Food and Drink Prize

Scotland Food and Drink has a current ambition to achieve turnover of £30 billion in the food and drink sector by 2030[21]. This would require an annual growth rate of 5.0% from 2007 onwards[22].

The actual average growth rate has been 4.1% and therefore Scotland is currently below target. Until 2014 it had exceeded target but a number of factors, including reduction in global food prices, have meant that the sector turnover has decreased then since then. Continuing on this growth trend will result in Scotland missing its target by £5.6 billion in 2030 and the interim target of £16.5 billion turnover by 2017 will also be missed.

[21] Ambition 2030 Strategy Document, Scotland Food and Drink
[22] The figures quoted are in current prices and *include* general inflation. If inflation assumed to be 2.5% over the period, the actual growth figure required will be 2.5%.

Figure 8-6: Food and Drink Sector Growth Projections, 2007 - 2030



Source: Scottish Government Growth Sector Database, Scotland Food and Drink Strategy: Ambition 2030, projections based on BiGGAR Economics calculation

8.3 Summary of Strategic Economic Case

There is potential to generate significant economic benefits for Scotland if the productivity gains of comparator countries are matched. This will require additional investment in skills, R&D and a coherent system of innovation Additional drive is also needed to meet emissions targets for agriculture and the value of the Food and Drink sector in general.

9 CONCLUSION

The agri-food sector in Scotland has the potential to contribute a lot more to the economy, society and environment of Scotland than it currently does. Benchmarking Scotland against key comparator nations has shown what can be achieved in places where the agri-food sector is innovative, attractive and prioritised.

At the centre of each of these successful comparator agri-food economies is an agri-food university that is the focal point for a system of innovation. These universities contribute to the gap that currently exists between Scotland and these countries in the level of investment in R&D, the skills and the overall productivity of the agri-food sector. They support a strategic approach to the development of the agri-food sector, ensuring that the outputs of R&D are translated into practice and the workforce has the skills required to push this process forward.

The 'business as usual' approach for the agri-food sector is no longer an option as the sector will need to operate in a rapidly changing environment of massive global trends. This includes an increasing demand for quality food globally and a need to mitigate the environmental impact of producing this food. In addition to this, the UK's exit from the European Union will also represent a significant market shock and have significant implications for an agricultural sector which currently makes a loss from farming activity.

If Scotland is able to rise to the challenge and match the top performing comparator countries, the prize that can be won is substantial. These are both economic and environmental benefits including:

- an additional £4.5 billion GVA in the Primary Sector,
- meeting the targets for growth in food and drink; and
- leading the world in reducing agricultural emissions

In order to achieve this, there will need to be a change in culture and a focused expansion of how the sector innovates, invest and educates. The lessons from the comparator countries have shown that an agri-food university, at the centre of an innovation and skills system, is an essential ingredient in driving this change.