BiGGAR Economics

SRUC

# Scotland's Natural Economy:
## Sustainable Growth Potential

A report to SRUC
July 2020

BiGGAR Economics

# Contents

# 1. Executive Summary

The natural economy, has the potential to be a driver of inclusive and sustainable growth for Scotland, increasing the resilience of the Scottish economy.

## 1.1 Natural Capital and the Natural Economy

The natural economy is an area of comparative advantage for Scotland, which can also be a critical plank of the national recovery and renewal strategy supported by the best of Scotland's universities and research institutes.

The natural economy has been defined as comprising six sub-sectors that either directly use, rely or contribute to conserving, natural resources: tourism, food and drink, fishing and aquaculture, agriculture, energy (including renewables) and forestry, logging and manufacture of wood.

These sectors broadly align with the range of capital services that are provided by nature, be they recreational, linked to the provisioning of ecosystem services or to their regulation and maintenance. The definition is built on standard industrial classifications and so is useful for policymakers and those interested in the natural economy, as it makes it possible to track its performance over time on a range of measures through publicly available statistics.

Natural capital accumulation and human wellbeing are intertwined aspects and advice on economy recovery highlights that assets of natural capital are vital for all aspects required for a wellbeing economy. A number of indicators and outcomes under each of the frameworks are more applicable to natural capital than others, with the common links being between communities, health, economy and life satisfaction. Increasing levels of human wellbeing both now and in the future are therefore grounded in the preservation and enhancement of natural capital.

## 1.2 Current Contribution of the Natural Economy

In 2018, the natural economy contributed to the Scottish economy £29.1 billion Gross Value Added (GVA), equivalent to more than a fifth of Scotland's GVA. In 2018 the sector employed 290,100 people, supporting 11% of employment across Scotland. If the energy sector is excluded from the definition, the natural economy generated £8.2 billion GVA and supported 223,100 jobs in Scotland.

Whereas most of the GVA generated by the natural economy is due to energy, employment is more distributed across industries as four sub-sectors – tourism, agriculture, energy and food and drink. Nature-related tourism makes the largest contribution with over 87,000 jobs.

The patterns in GVA and employment are reflected in the productivity of the sector, as defined in terms of its GVA per job. In 2018, the natural economy had a GVA per job of around £100,000, 90% higher than the average GVA per job in Scotland. This result was mostly driven by the inclusion of the energy sector (£299,000 GVA per job) and oil and gas, in particular.

If the energy sector is excluded from the definition, the GVA per job of the natural economy reduces to £37,000, 29% lower than the Scottish average. This is mostly driven by the impact of low GVA per job sectors, such as agriculture (£19,000 GVA per job) and tourism (£18,000 GVA per job), which have relatively high levels of employment in the natural economy.

While the GVA generated by the natural economy fell by 18% over the period 2008-2018, this was due to the decline in the value of the energy, which follows fluctuations in oil prices. Excluding the energy sector from the definition, the natural economy grew by 25% over the same period. This is because most of the sub-sectors of the natural economy saw an increase in their value, with for instance, the value of tourism increasing by 60% and that of agriculture by 39%.

Based on the share of employment by local authority area, the natural economy has a sizable presence in North Eastern Scotland, the Highlands and Islands and Southern Scotland. In North Eastern Scotland, the energy sector accounted for around 12% of jobs. Agriculture was the largest natural economy sub-sector in the Highlands and Islands and Southern Scotland.

## 1.3 Boosting Productivity of the Natural Economy

Over long periods of time, productivity is one of the main determinants of economic prosperity. This conviction underpins both the Scottish Government's ambition for Scotland to be among the most productive countries in the OECD and the strategies of individual sectors in the natural economy. In 2018, Scotland's productivity was mid-table compared to other OECD countries, with productivity growth over the period 2000-2018 having underperformed against the average across the EU and the OECD.

The scenario analysis showcased the benefits that could arise from increasing productivity in the natural economy. This was based on three different growth scenarios underpinned by different growth rates:

- scenario a – productivity in the natural economy averages 0.98% per year, equivalent to the rate of productivity growth over the whole Scottish economy between 2000 and 2018, which would increase GVA in the sector to £35.3 billion in 20 years (22% higher than 2018);
- scenario b – productivity in the natural economy averages 1.20% per year, the average productivity growth over the period 2000-2018 of the whole economy in Austria, the lowest ranked country in the top quartile of the OECD per productivity.

This would increase GVA in the sector to £36.9 billion in 20 years (27% higher than 2018);

- scenario c – productivity in the natural economy averages 2.10% per year, the average productivity growth rate required for the Scottish economy to match Austria's productivity in 20 years. This would increase GVA in the sector to £44.1 billion in 20 years (52% higher than 2018).

Accounting for the differences in the size and structure of the sector, depending on whether the energy sub-sector is included, the analysis was replicated for the natural economy without the energy sub-sector. In this way, it was estimated that after 20 years the GVA of the natural economy in Scotland would increase from its 2018 value of £8.3 billion GVA to:

- £10.1 billion GVA (22% higher than 2018) under scenario a;
- £10.5 billion GVA (27% higher than 2018) under scenario b; and
- £12.5 billion GVA (52% higher than 2018) under scenario c.

# 2. Introduction

This report prepared by BiGGAR Economics for SRUC quantifies the scale and potential of the natural economy.

## 2.1 Study Objectives

Scotland's Rural College (SRUC) has proposed that the natural economy can play a significant role in the recovery and renewal strategy.

SRUC commissioned BiGGAR Economics to define and quantify the natural economy. The objectives of the study were to:

- Develop and agree a definition of the natural economy;
- Prepare a baseline analysis of the natural economy's current contribution to the Scottish economy;
- Describe and quantify the potential of the natural economy to contribute to wider economic and well-being targets and outcomes;
- Describe how the natural economy can be a driver for the recovery from Covid-19;
- Describe and quantify the contribution that the natural economy can make to the longer-term transformation of the Scottish economy and to improving well-being.

## 2.2 Report Contents

This report is structured as follows:

- Chapter 3 defines natural capital and the natural economy and provides context on how the natural economy can contribute to the wellbeing economy;
- Chapter 4 quantifies the current scale of Scotland's natural economy; and
- Chapter 5 considers the economic benefits that could be realised by boosting productivity in the natural economy.

# 3. Natural Capital and the Natural Economy

This section defines natural capital and the natural economy and introduces the relationship between natural capital accumulation and increased levels of wellbeing in the economy.

The natural economy depends on all the elements produced by nature. These elements form sources of natural capital and the recognition of their importance and value has gained prominence particularly over the last decade. Ensuring the sustainability of sources of natural capital and a healthy and growing natural economy is fundamental to ensuring long term, sustainable economic growth and wellbeing for society.

The Advisory Group on Economic Recovery (AGER) report[1] states that Scotland's natural environment does this in three ways:

- provides natural products such as food and energy;
- provides natural defences such as flood protection and air which enable economic growth; and
- underpins many key sectors that provide employment, investment and tourism.

The AGER report recommendations include investment in natural capital and nature-based solutions.

The natural economy underpins all economic activity and provides the foundations for financial, human, social and manufacturing capital to exist. Sources of natural capital are fundamental for a wide range of employment in the Scottish economy with many of these jobs relying on a natural environment that is clean, healthy, safe and diverse.

## 3.1 Natural Capital

The term natural capital is not a new phenomenon but one which has gained increased prominence in recent years. It was first used by E.F. Schumacher in 1973 in his book 'Small is beautiful'[2] but it was not until 2005 that it was highlighted as a

[1] Advisory Group on Economic Recovery (2020) Towards a robust, resilient wellbeing economy for Scotland

[2] E.F. Schumacher (1973) Small Is Beautiful: A Study of Economics As If People Mattered

key aspect of enhancing human wellbeing[3]. Within the last decade, natural capital has been used to form national accounts and methods based specifically around the concept have emerged, such as the natural capital accounts for the UK and Scotland produced by the Office for National Statistics.

Aspects of natural capital impact all areas of life and provide a stream of ecosystem services that enable benefits at the individual, business and institutional level. There are sources of natural capital that are visible, including: food and raw materials; medicine; recreation and cultural sites; and habitats for wildlife and plants, and others that are not so easily recognised, such as: natural climate control; flood prevention; pollination; and soil formation.

Together nature's assets enable all types of human services to occur and have great value particularly for the sectors of agriculture, forestry and fishing, renewable energy, oil and gas, food and drink and tourism.

Not unlike financial capital, which can run up significant levels of debt, natural capital too can carry aspects of 'debt'. For natural capital, this debt can include overuse or exploitation of nature's assets and time and reparation is required to return them to a sustainable state. The historical lack of value attributed to natural capital has contributed to the depletion of nature's assets.

Without reparation measures to repay natural capital debt, there is the risk of scarce resources, displaced populations and difficulties of places self-sustaining. Natural capital debt can also have large financial liabilities for the economy with damage to forestry, crops and infrastructure estimated to cost the Scottish economy £200m each year[4].

Maintaining and preserving stocks of natural capital, such as livestock and fishing, have been the focus of much attention in the past, yet the full scale of contribution natural capital can make to economic growth and wellbeing provides an agenda for an extensive programme of research and development.

Of the four priorities (innovation, inclusive growth, internationalisation and investment) identified in the Scottish Government's Economic Strategy (2015)[5], natural capital investment has been identified as a key area of investment, as has resource efficiency.

Using natural capital resources efficiently requires preserving assets whilst simultaneously increasing the value gained from them in order to create sustainable economic growth. The 2015 strategy highlights the ability of resource efficiency to reduce emissions and energy demand and increase business productivity.

[3] Facciolo, M. and Blackstock, K. L. (2017). Review of UK Natural Capital Initiatives. James Hutton Institute.
[4] Scottish Forum on Natural Capital (2019) What is Natural Capital? http://naturalcapitalscotland.com/about/natural-capital/#.XusqERNKjVo
[5] Scottish Government (2015) Scotland's Economic Strategy

**"Protecting and enhancing our stock of natural capital is…fundamental to a healthy and resilient economy."**

***Scottish Government Economic Strategy (2015)***

## 3.2 Valuing Natural Capital

With heightened recognition of the importance of the natural economy to sustainable economic growth and wellbeing, work has been undertaken to calculate its value to the Scottish economy.

### 3.2.1 Scottish Natural Capital Accounts[6]

The Scottish Natural Capital Accounts are produced annually by the ONS to monetise the value generated in Scotland from the country's natural capital assets, with the most recent findings being released in March 2020. In the first release of these experimental statistics in March 2019, the Scottish Government's chief economist noted:

**"Nature provides the basic goods and services that make human life possible: the food we eat, the water we drink and the plant materials we use for fuel, building materials and medicine. The natural world also provides less visible services such as climate regulation, the natural flood defences provided by forests, removal of air pollutants by vegetation, and the pollination of crops by insects. Then there is the inspiration we take from wildlife and the natural environment."**

These experimental accounts were created in recognition that stocks of natural capital produce long-term sources of benefits and services to society whilst not generally having a market value attached to them. The ecosystem service accounts

[6] ONS (2020) Scottish natural capital accounts: 2020

strive to attach a monetary value to the benefits to society provided by natural capital.

The purpose of this valuation is to enable greater consideration of environmental effects in the planning and decision-making processes for policy makers and make the value of natural capital comparable to other economic indicators. The methodology is currently experimental and remains under development, with the value of cultural aspects such as aesthetic appreciation and heritage value currently not accounted for.

Aspects of natural capital included in the latest analysis are:

- agricultural biomass;
- fish capture;
- timber;
- water abstraction;
- mineral production;
- oil and gas production;
- renewable energy generation;
- carbon sequestration;
- air pollutant removal; and
- recreation.

The most recent analysis findings are that:

- the partial asset value of Scotland's natural capital in 2016 was £196 billion with, 46% of this value coming from fossil fuels and 21% from carbon sequestration;
- 37% of total asset value is from non-material benefits not directly accounted for in GDP;
- living in close proximity to green and blue spaces increased house prices in urban areas of Scotland by an average of £2,393;
- in 2018, the natural cooling effects of urban green spaces in Glasgow and Edinburgh prevented productivity losses of £3.15 million;
- renewable energy production increased from 18% in 2008 to 55% in 2018;
- timber production has doubled in the past 20 years;
- 1,549 years of life were saved from air pollution reduction methods in 2017; and
- in 2017 Scottish people spent over 1 billion hours on outdoor recreation activities.

As not everything included in the natural environment can be quantified, the above figures are likely to be an underestimate of the true value of national capital in Scotland.

## 3.3 Natural Capital and Wellbeing

The limitation of Gross Domestic Product (GDP) as a suitable measure of economic growth and performance has led to new ways of thinking about the economy. This has long been thought about but has gained prominence in recent years as many economic and social conditions continue to be negated as a factor in calculating

GDP. Environmental factors have been insufficiently accounted for, as has various stocks of capital that are required for the well-being of future generations.

This way of thinking has thus led to the creation of the wellbeing economy with new frameworks and measures developing to identify and monitor economic progress and social progress, with Scotland being a leader in developing this approach through the National Performance Framework.

### 3.3.1 Sustainable Development Goals

Of the 17 Sustainable Development Goals (SDG) produced by the United Nations, the following 9 can be attributed to the natural economy:

- no poverty;
- zero hunger;
- clean water and sanitation;
- affordable and clean energy;
- sustainable consumption and production;
- climate action;
- life below water;
- life on land; and
- partnerships for the goals.

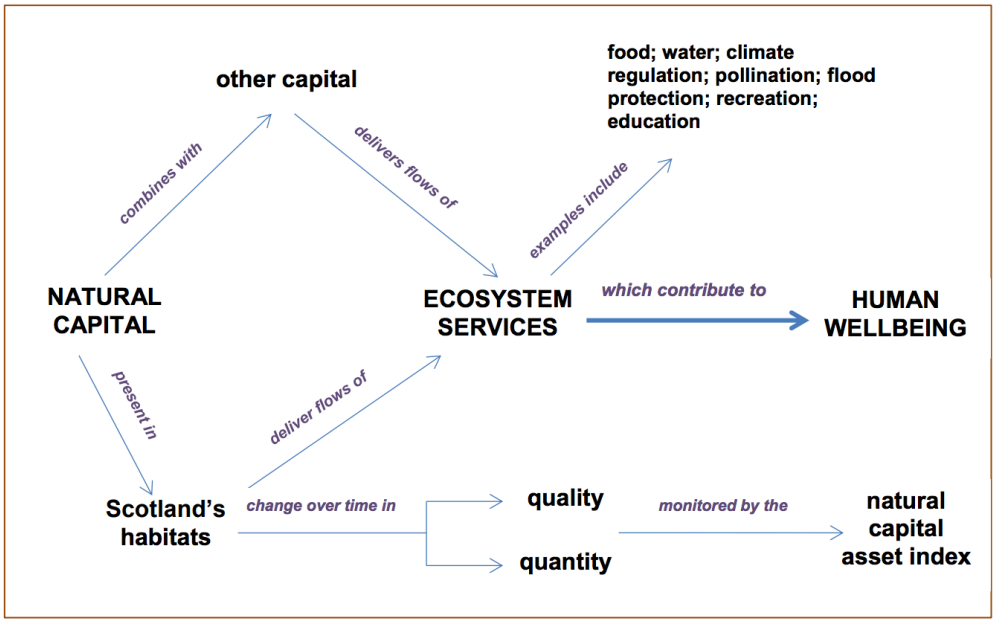
The SDG's listed above highlight the interlinked themes of: inclusive economic growth; climate change; and the management of on-and-off shore ecosystems, all of which are fundamentally rooted in the natural economy and rely on efficient stocks of natural capital. Achieving these goals ultimately provides a clear link between the accumulation of stocks of natural capital to increase the wellbeing of society.

### 3.3.2 Scottish Natural Capital Asset Index (NCAI)[7]

Scotland's Natural Capital Asset Index describes the changes in the quality and quantity of Scotland's ecosystems between 2000 and 2017, with the purpose of analysing the contribution that natural capital makes to human wellbeing (Figure 3-1)

[7] Scottish Natural Heritage (2019) Scotland's Natural Capital Asset Index 2019 Summary

**Figure 3-1 Link between Natural Capital and Human Wellbeing**




Source: Scotland's Natural Capital Asset Index – Information Note (2018)

The Index separates sources of natural capital into three categories:

- provisioning ecosystem services;
- regulation and maintenance ecosystem services; and
- cultural ecosystem services.

The NCAI use habitats as units of natural capital, with each habitat unit in Scotland rated on a scale of 1-5 of their ecosystem potential. This score, along with elements of expert judgement, public surveys and reviewed evidence, is then used to calculate the level of wellbeing generated in an area against the baseline year, 2000.

The habitats used for analysis are categorised as:

- woodland;
- inland surface waters;
- coastal;
- grasslands;
- mires, bogs and fens;
- heathland; and
- agriculture and cultivated.

They key messages from the most recent analysis were that:

- natural capital is a factor in economic growth in Scotland;
- natural capital asset stocks are increasing in Scotland, rising by 2% in the past 3 years and are currently at the highest level since the year 2000;

- all habitats considered as part of natural capital are improving and contributing to wellbeing; and
- climate change and non-native species provide great challenges to Scotland's natural capital and its contribution to human wellbeing.

At current time, analysis is focused only on land-based natural capital, with the methodology not being replicable for offshore environments due to lack of data.

## 3.4 National Performance Framework

Scotland's National Performance Framework (NPF) aims to:

- create a more successful country;
- give opportunities to all people living in Scotland;
- increase the wellbeing of people living in Scotland;
- create sustainable and inclusive growth; and
- reduce inequalities and give equal importance to economic, environmental and social progress.

The framework sets out 11 National Outcomes, underpinned by a set of 81 indicators, covering the following themes:

- children and young people;
- communities;
- culture;
- economy;
- education;
- fair work and business;
- health;
- human rights;
- international; and
- poverty.

Natural capital accumulation could ultimately be applied to each of the above outcomes since it yields benefits to everyday life at the individual, organisational and institutional level.

However, a review of the indicators for each outcome suggests that natural capital is most relevant to the outcomes that relate to communities, economy, environment, health, international and poverty.

### 3.4.1 Communities

The NPF identifies community indicators as close access to green and blue spaces and perceptions of the local area people live in.

Access to urban greenspace has been recognised as large contributor to human health and wellbeing as a result of their close reach to local populations. In terms of

natural capital, this can include cultural activities such as wildlife observation; fishing; education and unique species and sites.

The NCAI suggests that at current time, many urban greenspaces are neglected and therefore underutilised by people living nearby and negatively contributing to perceptions of neighbourhoods.

### 3.4.2 Economy

The relationship between the economy and wellbeing in relation to natural capital is captured mainly in the NCAI. The NCAI monitors the quantity and quality of terrestrial habitats and their production capacities both now and in the future. Additional impacts captured in the framework are the carbon footprint and greenhouse gas emissions present in the economy. Reducing both of these natural impacts is related to increasing the wellbeing of the people living in Scotland from reduced exposure to these aspects.

### 3.4.3 Environment

Underpinning the environment outcome of the NPF are the indicators of the percentage of visits to the outdoors, the condition of protected nature sites, energy from renewable sources and the sustainability of fish stocks, biodiversity and clean seas. Each of these indicators are formed from aspects of natural capital and the quality of their state.

According to the most recent analysis by the NCAI, the number of people in Scotland spending time outdoors weekly is currently at the highest rate in 20 years. Ensuring each of these indicators of natural capital are preserved and enhanced ensures the sustainability of the environment in the long-term and the wellbeing of future generations.

### 3.4.4 Health

Indicators of health relate to both the physical and mental wellbeing of individuals. Greater access to the outdoors and places and green spaces have a positive impact on both the physical and mental wellbeing of individuals. Physical activities such as hiking in the mountains are a part of natural capital which can be valued as a benefit to society and can positively impact healthy life expectancy and weight from increased outdoor exercise. Outdoor recreational trails such as cycle routes can reduce the number of journeys which are made by car and increase those taken by cycling.

### 3.4.5 International

The outcome of ‘International’ is indicated by Scotland’s reputation. Tourism is a large part of the Scottish economy and an attraction for many visitors is the landscapes and heritage sites born from Scotland’s natural capital. Preserving and enhancing the quality of this is linked to an increase in Scotland’s reputation as a place to live and visit, contributing to the wellbeing of residents and visitors.

### 3.4.6 Poverty

The indicators associated with the outcome of poverty relate to the cost of living, (including housing, fuel and food), in addition to the insecurities arising around the lack of resources for food.

Reverse causality is evident in the relationship between increased stock of natural capital and increased human wellbeing. Poverty leads to degradation of ecosystems because those who live in poverty rely more on natural sources of capital for their survival. In turn, degraded ecosystems result in higher levels of poverty as the overuse of natural capital results in depletion which creates higher costs for basic goods, e.g. food[8].

The United Nations (2016)[9] found that in order to reduce poverty, ecosystems and natural capital need to be well-placed in decision making and need to be sustainable provision sources for basic human necessities.

### 3.4.7 Summary

The aspects of natural capital are predominantly rooted in the NPF outcomes of: communities; economy; environment; health; international and poverty. It is within these outcomes that natural capital provides the most contribution to the wellbeing of the Scottish population. Whilst the identified outcomes are individual in their impacts, aspects of natural capital are inter-twined between these outcomes with increased quality of natural capital being directly associated with greater human wellbeing under one outcome but having a positive externality with another.

## 3.5 OECD Better Life Index

The OECD Better Life Index is based on 11 topics which the OECD has identified as essential to well-being in terms of material living conditions and quality of life. Each topic comprises two or three indicators which provide a measure of the wellbeing of people and progress of societies.

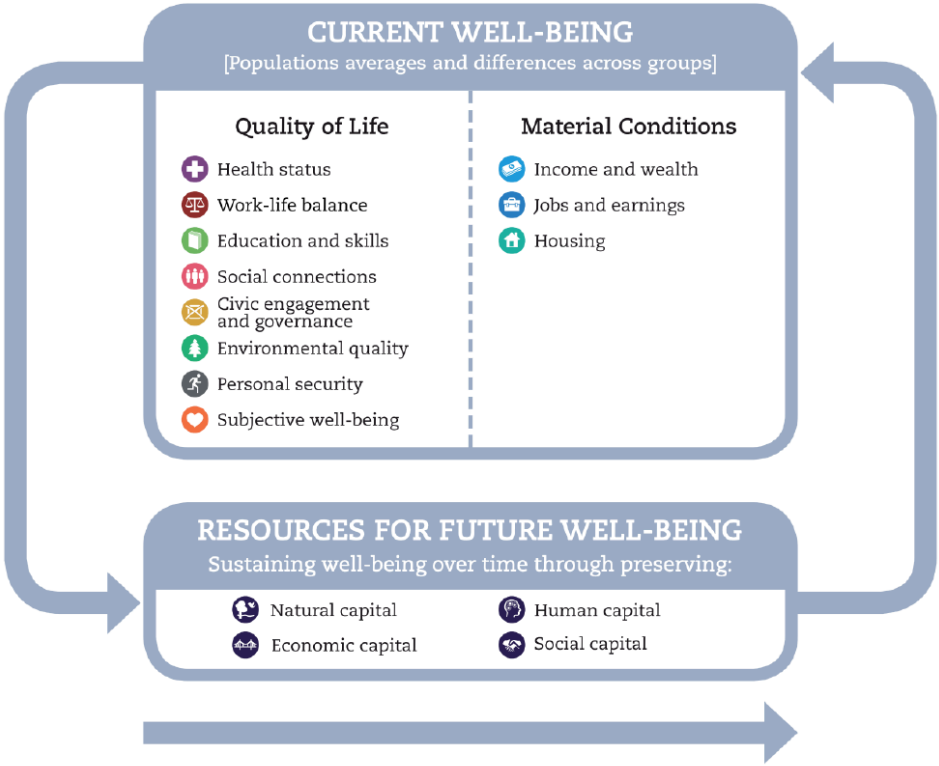
The wellbeing framework was developed to build upon research by Joseph Stiglitz, Amartya Sen and Jean-Paul Fitoussi on the measurement of economic performance and social progress[10]. According to the framework, prospects for future well-being can be assessed by considering the stock of different forms of capital that we have today and that will be passed on to future generations. As shown in Figure 3-2, preservation of stocks of natural capital is a key contributor to this.

[8] Millennium Ecosystem Assessment (2005), Natural Assets and Human Wellbeing

[9] United Nations (2016) Restoring Natural Capital Can Help Reduce Extreme Poverty: https://www.unenvironment.org/news-and-stories/story/restoring-natural-capital-can-help-reduce-extreme-poverty

[10] Report by the Commission on the Measurement of Economic Performance and Social Progress (2009), Stiglitz, Sen and Fitoussi

**Figure 3-2 OECD Framework for Measuring Well-Being and Progress**




Source: OECD (2017), How's Life? 2017: Measuring Well-being

Natural capital evidently has an impact on the wellbeing and quality of life of current and future generations. The areas in which this is most prominent are: environment, health and life satisfaction.

### 3.5.1 Environment

According to the framework, current and future wellbeing is affected by people's satisfaction with the quality of water in the area they live in, as well as the levels of air pollution.

### 3.5.2 Health

As identified in this section previously, there is a clear link between the physical and mental health of individuals and the state of the natural economy and people's access to it. Increased exposure to natural environments which are of a quality condition and well perceived can have positive impacts on the levels of health individuals report. Life expectancy can also expect to be improved as a result of an increase in health levels and the reduction of, for example, air pollution.

### 3.5.3 Life satisfaction

Related to natural capital's impacts on health is levels of life satisfaction. Life satisfaction is positively related to an increase in the perceptions of the areas people live in and the future state of the world they live in. Ensuring natural capital can

provide this level of comfort and security is therefore linked to the wellbeing of people now and for their families in the future.

## 3.6 The Four Pillars of Capital

The recent AGER report[11] to the Scottish Government recommended that Scotland should adopt the capitals approach of the OECD, focussing on Scotland's four pillars of capital (Figure 3-3), to create a robust and resilient economy in the long-term.

To inform the economic recovery strategy, these pillars were used to assess the Scottish economy pre COVID-19 and then to identify where the strengths and opportunities lie in each going forward. This form of analysis was used instead of a sector-by-sector approach to provide a complete picture of the Scottish economy and highlight the areas of priority to underpin the recommendations for recovery.

**Figure 3-3 The Four Pillars of the Redeveloped NPF**


Source: Advisory Group on Economic Recovery (2020)

[11] Report of the Advisory Group on Economic Recovery (2020). Towards a robust, resilient wellbeing economy for Scotland

### 3.6.1 People

The traditional notion of human capital in economics is the impact of the labour market on productivity and skills. However, this report seeks to widen this view to include human health and wellbeing in the definition. Addressing long-standing inequalities, unemployment and personal growth and wellbeing are key to the economic recovery of the people.

### 3.6.2 Business

Economic capital includes physical, intellectual and financial assets. To aid in the recovery of the economy, the focus needs to be on the long-term success of businesses despite the financial challenges of current times. It is recommended that this is enabled by close collaboration between businesses and Government.

### 3.6.3 Community

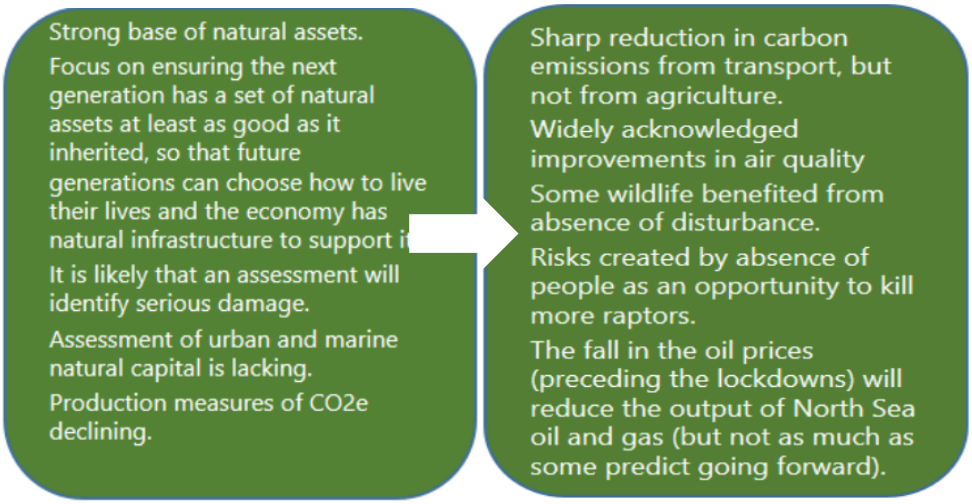
Social capital relates to the sense of belonging amongst groups of people and the features that arise from their interactions. The report splits the pillar into three main themes: bonds; bridges; and linkages. These themes represent the distance between groups of people across society. Preserving and enhancing aspects of community and the third sector is important to this form of capital.

### 3.6.4 Environment

Natural capital, as already defined earlier in this report, poses several questions for policy makers. One of these is the question of how to manage the stock of non-renewable sources of natural capital over a pro-longed time period, so that future generations are not left worse off by our consumption, particularly in relation to climate change. For renewable natural capital sources, there raises the question of how to use these in the most efficient and productive ways.

As shown in Figure 3-4, the current economic and health crisis has resulted in some positive effects on stocks of natural capital, however there are concerns these effects may be temporary. The lasting effects of the pandemic are yet to be established but it has been recognised that a ‘green recovery’ is essential to economic recovery and this is fundamentally grounded in Scotland’s natural capital. A move to a more circular economy is also important to economic recovery and is a key feature of SRUC’s new strategy.

**Figure 3-4 Environment Pre COVID-19 and After the Virus**




Source: Advisory Committee on Economic Recovery (2020)

## 3.7 Natural Economy

If broadly defined, the scope of what constitutes the natural economy could encompass all economic activity. This is because the climate and the range of ecosystem services provided by nature are a precondition of any economic activity taking place, as they make human life possible.

This section seeks to narrow down the definition of which industries are part of the natural economy. The aim is to build a definition that includes those sectors in the economy that:

- use natural resources;
- conserve/preserve natural resources; and
- rely on natural resources or on the natural environment.

To be of practical use, the definition is built using industrial categories at level 2, as defined in the Office for National Statistics' (ONS) 2007 Standard Industrial Classification (SIC)[12]. This choice is justified by the wide availability of economic statistics at this level of detail, which makes it possible to:

- monitor the performance of the natural economy;
- consider regional variation in the importance of the natural economy; and
- account for sectoral interdependencies.

To construct a definition of the natural economy, a series of sources were consulted, including:

[12] Office for National Statistics (ONS) (2009), UK Standard Industrial Classification of Economic Activities 2007 (SIC 2007).

- SRUC's initial submission to the Scottish Government Advisory Group on Economic Recovery[13];
- the 2016 Scottish Input-Output Tables[14];
- the 2018 Scottish Annual Business Statistics (SABS)[15];
- the economic report on Scottish Agriculture 2018[16] and the Total Income from Farming Estimates for Scotland, 2016-2018[17]; and
- the Scottish Government's Growth Sector Statistics[18].

The definition of the natural economy also drew on BIGGAR Economics' experience on the economics of the tourism, renewable energy and food and drink sectors.

## 3.8 The Definition

### 3.8.1 Sectors Included

By extracting and producing raw materials that are then processed by other industries, the primary sector directly relies on nature and its resources. For this reason, the first step in defining the natural economy was to identify those sectors which comprise the primary sector. The following sectors were identified:

- agriculture;
- forestry and logging (SIC 02);
- fishing and aquaculture (SIC 03);
- mining of coal and lignite (SIC 05);
- extraction of crude petroleum and natural gas (SIC 06);
- mining of metal ores (SIC 07);
- other mining and quarrying (SIC 08); and
- mining support service activities (SIC 09).

Since SABS, the main data source used to estimate the scale of the natural economy, does not consider large parts of the agricultural sector, it was preferred to rely on the data provided in the Economic Report on Scottish Agriculture[19] and on the Total Income from Farming Estimates for Scotland, 2016-2018[20]. These Scottish Government publications on the agricultural sector provide detailed data including on farm employment and economic output.

The next step in defining the natural economy was to include sectors that for their own viability are heavily reliant on natural resources. To establish to which sectors this condition applied, the analysis used the Scottish Government Input-Output

[13] SRUC (2010), Submission to the Advisory Group on Economic Recovery - Scotland's Natural Economy & its Role in the Recovery & Renewal Strategy.
[14] Scottish Government (2019), Supply, Use and Input-Output Tables, 1998-2016.
[15] Scottish Government (2020), Scottish Annual Business Statistics 2018.
[16] Scottish Government (2018), Economic Report on Scottish Agriculture 2018 edition.
[17] Scottish Government (2018), Total Income from Farming Estimates for Scotland, 2016-2018.
[18] Scottish Government (2020), Growth Sector Statistics.
[19] Scottish Government (2018), Economic Report on Scottish Agriculture 2018 edition.
[20] Scottish Government (2018), Total Income from Farming Estimates for Scotland, 2016-2018.

Tables' combined use table[21], which sets out how much inputs each economic sector uses from other sectors. By considering the share of primary product that is then consumed by other sectors, it was possible to identify three industries that are particularly reliant for their inputs on the primary sectors:

- manufacture of food products (SIC 10);
- manufacture of beverages (SIC 11); and
- manufacture of wood and of products of wood and cork except furniture manufacture of articles of straw and plaiting materials (SIC 16).

The last step in identifying the industries that are part of the natural economy was to include broader sectors that are not necessarily captured by a single industrial category. Two broader sectors fulfilling this condition were identified:

- tourism; and
- energy (including renewable).

These are two of the Scottish Government's Growth Sectors, those sectors of the economy where Scotland has a comparative advantage. As a result of their importance for policy, there are detailed statistics for these industries across a range of metrics similar to those included in the SABS. The sustainable tourism and energy (including renewables) sectors, as defined in the Growth Sectors Statistics, were then included as part of the natural economy.

The definition of the energy sector comprises some industries that were already identified as part of the primary sector. To avoid double-counting these sectors, they were excluded from the list of primary sectors and considered as activities supporting the energy (including renewables) industry.

To make a sub-sectoral analysis possible, the industrial sectors identified were then grouped into six sub-sectors:

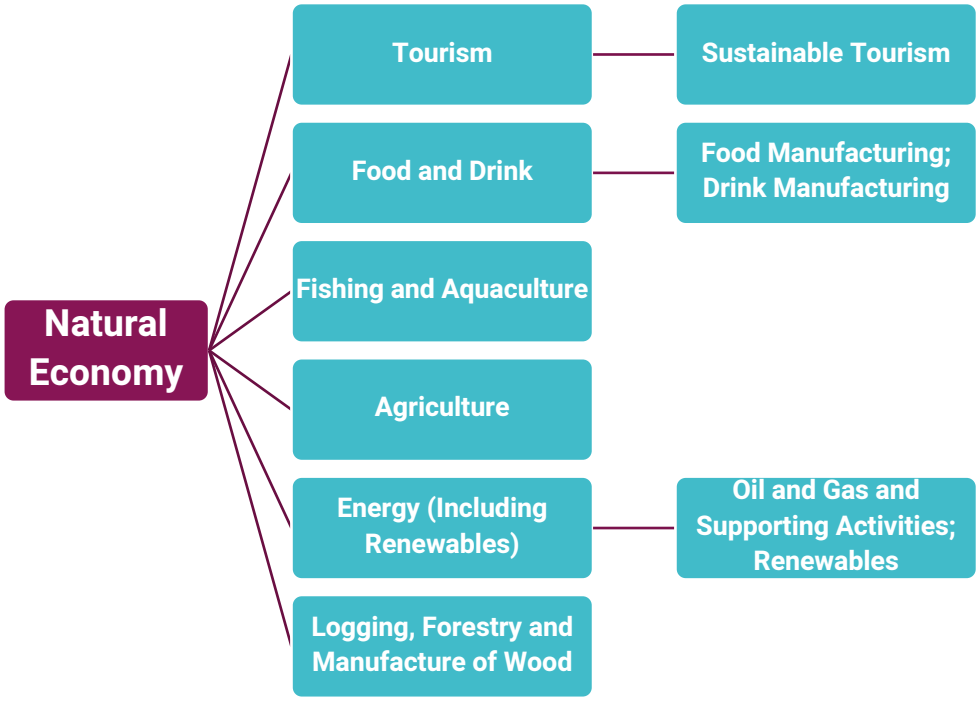
- tourism;
- food and drink;
- fishing and aquaculture;
- agriculture;
- energy (including renewables); and
- forestry, logging and manufacture of wood.

This broadly aligns with the sub-sectoral categories identified by SRUC as part of their submission to the Economic Recovery Group. The only difference is that here renewables were considered with other natural energy sources. This was because of data availability and the difficulty in defining the renewable energy sector without including businesses involved in its supply chain such as civil engineering, that would hardly fit in the definition of the natural economy.

[21] The mapping from the Input-Output tables into SIC-codes at level 2 is not exact as industrial categories slightly differ.

The split by sub-sector and details about what is included in each are set out in Figure 3-5. Additional detail, including all the SIC codes considered, is presented as appendix material.

**Figure 3-5 Defining the Natural Economy**




Source: BiGGAR Economics Analysis

### 3.8.2 Weighting

Having identified the sectors part of the natural economy, it was then necessary to consider whether any weighting was necessary. This would be required where some of the sectors identified were considered as relying on nature only to an extent. This adjustment was made because including them in their entirety would lead to overestimating the size of the natural economy sector.

Based on available evidence, this seemed to apply to tourism as it was acknowledged that tourism only in part depended on the landscapes that Scotland could offer to its visitors. Tourism to Scotland is, for instance, also partly driven by history and culture.

According to the Scottish Natural Heritage[22], nature-based tourism contributes around 40% of all tourism spend. This estimate goes in the same direction of evidence from the Scottish Visitor Survey 2015 & 2016[23], where 50% of the visitors interviewed mentioned scenery and landscape among the reasons for visiting

[22] Scottish Natural Heritage (2020), Sustainable Tourism, available at: https://www.nature.scot/professional-advice/planning-and-development/social-and-economic-benefits-nature/tourism

[23] Visit Scotland, Scottish Visitor Survey 2015 & 2016.

Scotland. Throughout the analysis it was assumed that 40% of the tourism sector relied on the natural economy.

## 3.9 Natural Economy and Natural Capital

The definition of the natural economy set out above is broadly aligned with the range of capital services provided by nature. In particular, the inclusion of the tourism sector captures a range of recreational natural services[24]:

- watching wildlife;
- recreational fishing;
- symbolic species and landscapes; and
- information for education.

The primary sectors and the businesses in the food and drink industry are linked to activities associated with the provisioning of ecosystem services, including:

- grass for livestock;
- dairy products;
- timber;
- soft fruits;
- wild salmon and venison; and
- freshwater for drinking.

The latter strand of services – regulation and maintenance of ecosystem services – is linked with activity that aims at the conservation of the natural environment. These activities are often carried out by farmers and land managers and are incentivised by initiatives such as the Agri-Environment Climate Scheme[25], a Scottish Government scheme which promotes land management practices. The regulation and maintenance ecosystem services include:

- climate regulation;
- natural flood protection;
- pollination; and
- soil formation.

## 3.10 Summary: Natural Capital and the Natural Economy

Natural capital accumulation and human wellbeing are intertwined aspects and advice on economic recovery highlights that assets of natural capital are vital for all

[24] Scottish Natural Heritage (2018), Scotland's Natural Capital Asset Index – Information Note Updated 2018.
[25] Scottish Government (2020), Rural Payments and Services – Agri-Environment Climate Scheme, available at: https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/

aspects required for a wellbeing economy. A number of indicators and outcomes under each of the frameworks are more applicable to natural capital than others, with the common links being between communities, health, economy and life satisfaction. Increasing levels of human wellbeing both now and in the future are therefore grounded in the preservation and enhancement of natural capital.

The natural economy has been defined as comprising six sub-sectors that either directly use, rely or contribute to conserving, natural resources. These include:

- tourism;
- food and drink;
- fishing and aquaculture;
- agriculture;
- energy (including renewables); and
- forestry, logging and manufacture of wood.

These sectors broadly align with the range of capital services that are provided by nature, be they recreational, linked to the provisioning of ecosystem services or to their regulation and maintenance.

The definition sought to follow, where possible, existing sectoral groupings and was built relying on standard industrial classifications. This makes it a useful tool for policymakers and those interested in the natural economy, as it makes it possible to track its performance over time on a range of measures through publicly available statistics.

# 4. Natural Economy Baseline

This section quantifies the contribution that the natural economy is currently making to the Scottish economy.

The economic baseline of the natural economy and its development over time in Scotland were estimated based on the definition set out in the previous chapter and data from:

- Scottish Annual Business Statistics (SABS)[26] 2018;
- Scottish Government Growth Sector Statistics[27];
- Economic Report on Scottish Agriculture 2018[28] and the Total Income from Farming Estimates for Scotland, 2016-2018[29]; and
- Business Register and Employment Survey (BRES) 2018[30].

Data for the mining sector refers to 2016, since the SABS did not provide data for the sector for both 2017 and 2018 as these were considered as containing disclosive data.

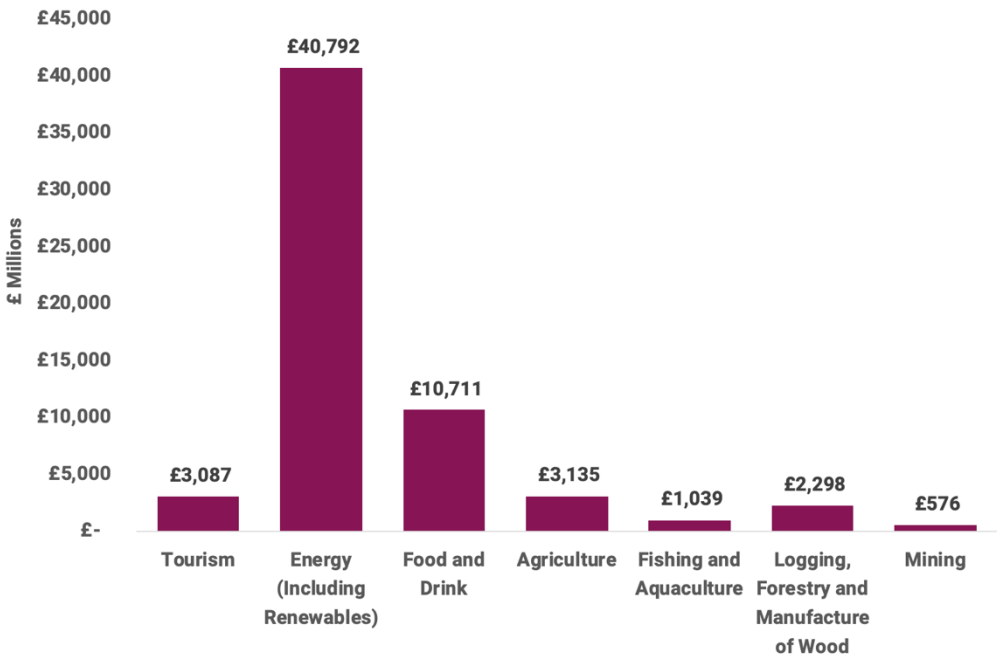
## 4.1 Turnover

It was estimated that in 2018, the natural economy had a turnover of £62 billion. The turnover of the natural economy excluding the energy sector was £21 billion.

Over £40.8 billion was generated by the energy sector including renewables (Figure 4-1). Food and drink was the second largest sector with respect to turnover and generated around £10.7 billion. Agriculture and tourism combined generated around 10% of the turnover of the natural economy and over 30% if energy was not included.

[26] Scottish Government (2020), Scottish Annual Business Statistics 2018.
[27] Scottish Government (2020), Growth Sector Statistics.
[28] Scottish Government (2018), Economic Report on Scottish Agriculture 2018.
[29] Scottish Government (2018), Total Income from Farming Estimates for Scotland, 2016-2018.
[30] ONS (2018), Business Register and Employment Survey 2018.

**Figure 4-1 Turnover by Natural Economy Sub-Sector, 2018***




Source: Scottish Government (2020, Scottish Annual Business Statistics 2018; Scottish Government (2020), Growth Sector Statistics; and Scottish Government (2018), Total Income from Farming Estimates for Scotland, 2016-2018.* mining turnover, not available for 2018, was estimated by applying the turnover per job ratio of the sector in 2013 to 2016 employment.

## 4.2 Gross Value Added

Gross Value Added (GVA) is a commonly used measure of economic activity, which considers the value of production minus the value of those inputs used in the production process.

Applying the definition of the natural economy set out above and excluding subsidies going to the agriculture sector, it was estimated that in 2018 the Scottish natural economy generated £29.1 billion GVA, more than a fifth of total Scottish GVA[31]. The natural economy excluding energy contributed £8.3 billion GVA, 6% of total Scottish GVA.

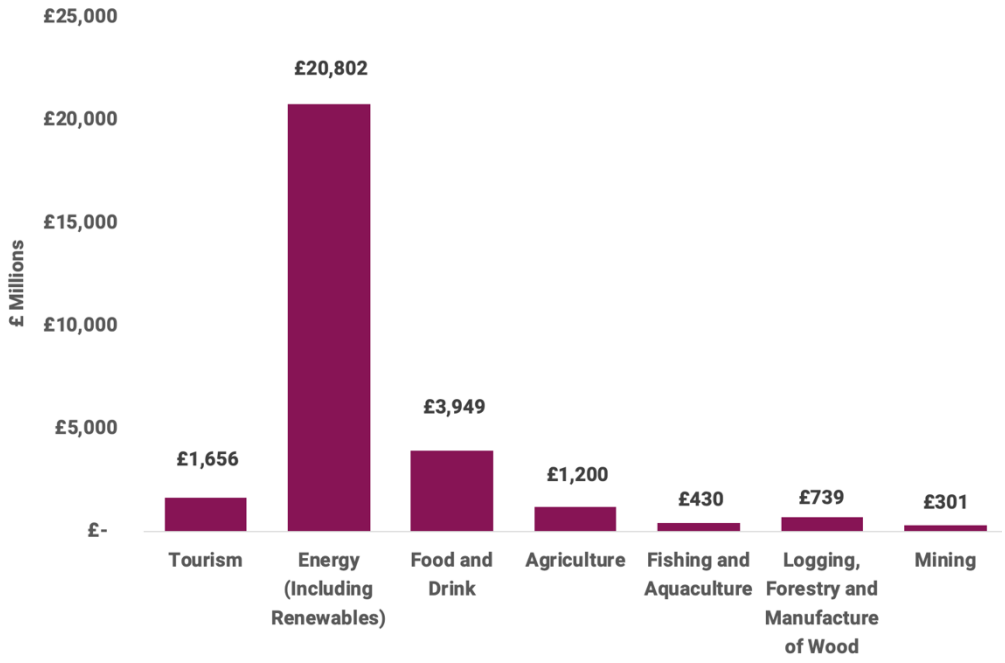
The contribution made by each sub-sector of the natural economy is shown in Figure 4-2. The largest GVA contribution was made by energy (including renewables) which generated £20.8 billion GVA in 2018.

Around 14% (48%, if energy was excluded) of the GVA generated by the natural economy was attributable to the food and drink sector. It was also estimated that nature-inspired tourism added a further £1.7 billion GVA. Agriculture (4%), fishing and aquaculture (1%), mining (1%) and logging, forestry and wood manufacture (3%)

[31] Total GVA in Scotland was sourced from: ONS (2019), Regional Gross Value Added (balanced) by industry: all NUTS level region.

accounted for the remaining 9% of the natural economy's GVA. These four sub-sectors accounted for a third of the sector, if energy was not included.

**Figure 4-2 GVA by Natural Economy Sub-Sector, 2018**




Source: Scottish Government (2020), Scottish Annual Business Statistics 2018; Scottish Government (2020), Growth Sector Statistics and Scottish Government (2018); and Scottish Government (2018), Total Income from Farming Estimates for Scotland, 2016-2018.

## 4.3 Employment

In 2018 the natural economy employed 290,100 people, or about 11% of employment across Scotland[32]. The difference in the share of employment and GVA of the natural economy with respect to Scotland is likely to be affected by the presence of capital-intensive sectors such as energy, mining and food and drink manufacturing.

If the energy sector was not included, the natural economy supported 223,100 jobs, or 9% of employment in Scotland. Once energy is excluded, the relative contribution of the sector in terms of employment to the Scottish economy is larger than the one made to GVA, as labour-intensive activities such as tourism become relatively more important in the index.

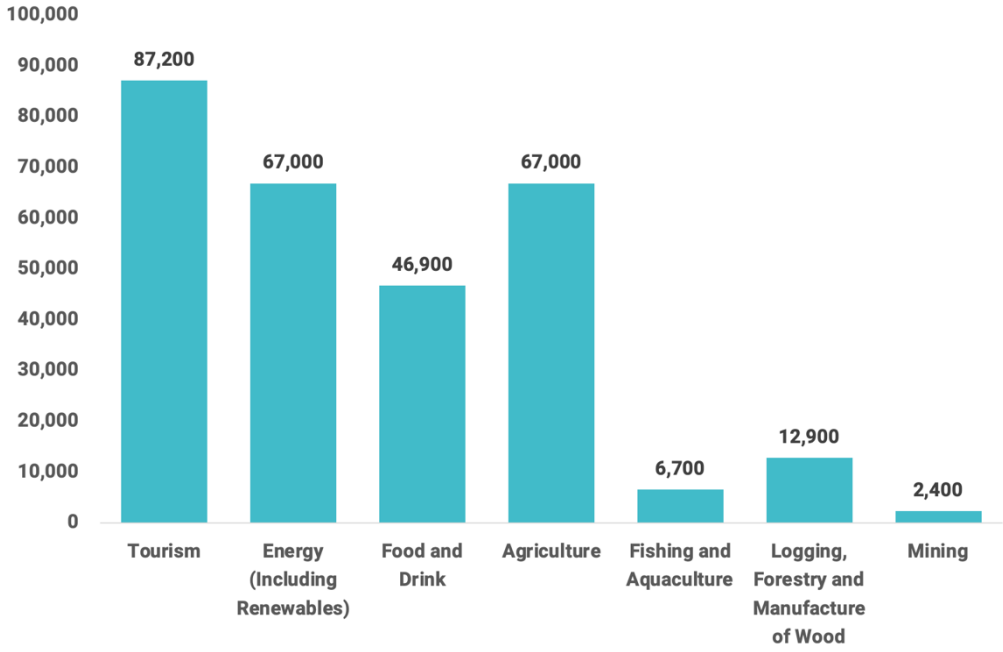
Tourism made the largest employment contribution by supporting 87,200 jobs (Figure 4-3) and it made a considerably larger contribution to sectoral employment than to GVA. This is explained by different work patterns in the sector, seasonality and a larger share of part-time employment.

Employment in the energy sector, food and drink manufacture and agriculture was sizable contributing 67,000, 46,900 and 67,000 jobs respectively. The remaining sub-

[32] ONS (2018), Business Register and Employment Survey 2018.

sectors jointly contributed 22,000 jobs or around 7% of employment in the natural economy, up to 10% if energy was not included.

**Figure 4-3 Employment by Natural Economy Sub-Sector, 2018**




Source: Scottish Government (2020), Scottish Annual Business Statistics 2018; Scottish Government (2020), Growth Sector Statistics; and Scottish Government (2018); and Scottish Government (2018), Total Income from Farming Estimates for Scotland, 2016-2018

## 4.4 GVA per Job

The literature on economic productivity considers two commonly used measures: GVA per job and GVA per hour worked[33]. Due to data availability, this section considers the productivity of the natural economy based on GVA per job.

It was estimated that in 2018 the Scottish natural economy had a GVA per job of £100,000. Among those sectors that comprise the natural economy, energy had the largest GVA per job at around £299,000. This is likely driven by the GVA per job in the oil and gas industry, as research by BiGGAR Economics on the supply chain of the renewable energy sector estimated a GVA per job for the sector of around £89,000. GVA per job in the natural economy is around 90% larger than the GVA per job of the sectors included in the SABS, which in 2018 stood at nearly £53,000 per job.

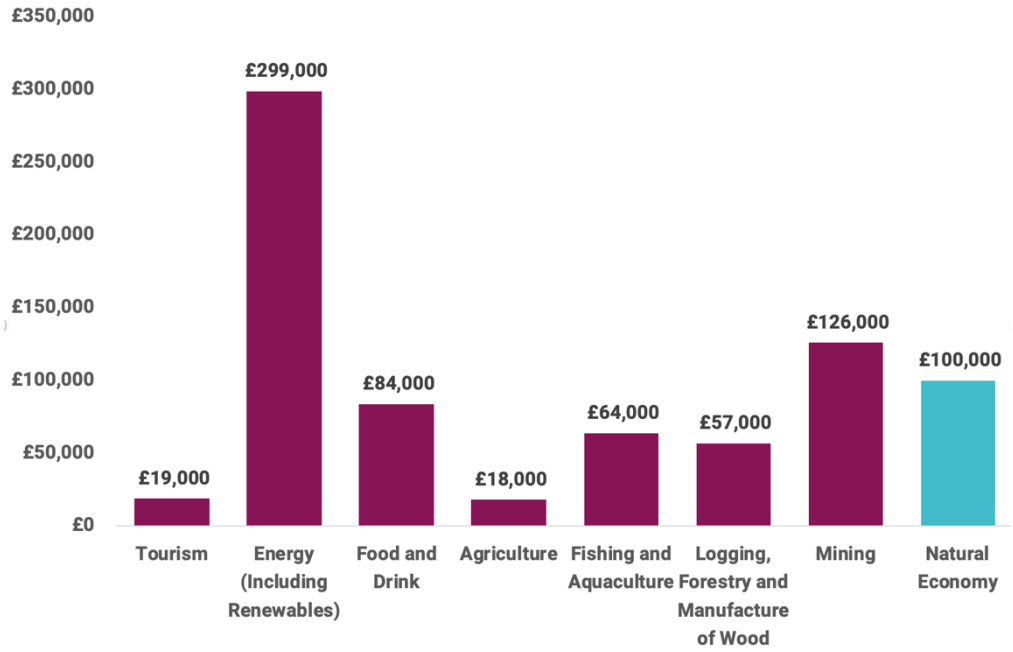
Agriculture and tourism had a relatively low GVA per job of between £18,000 and £19,000.

If the energy sector is excluded from the definition, the GVA per job of the natural economy in 2018 would be £37,000, 29% lower than the Scottish average. This is

[33] ONS (2018), Regional and sub-regional productivity in the UK: February 2018, available at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/articles/regionalandsubregionalproductivityintheuk/february2018

because of the impact of low GVA per job sectors such as tourism and agriculture which have relatively high levels of employment in the natural economy.

**Figure 4-4 GVA per Job by Natural Economy Sub-Sector**




Source: Scottish Government (2020), Scottish Annual Business Statistics 2018; Scottish Government (2020), Growth Sector Statistics; and Scottish Government (2018), Total Income from Farming Estimates for Scotland, 2016-2018.

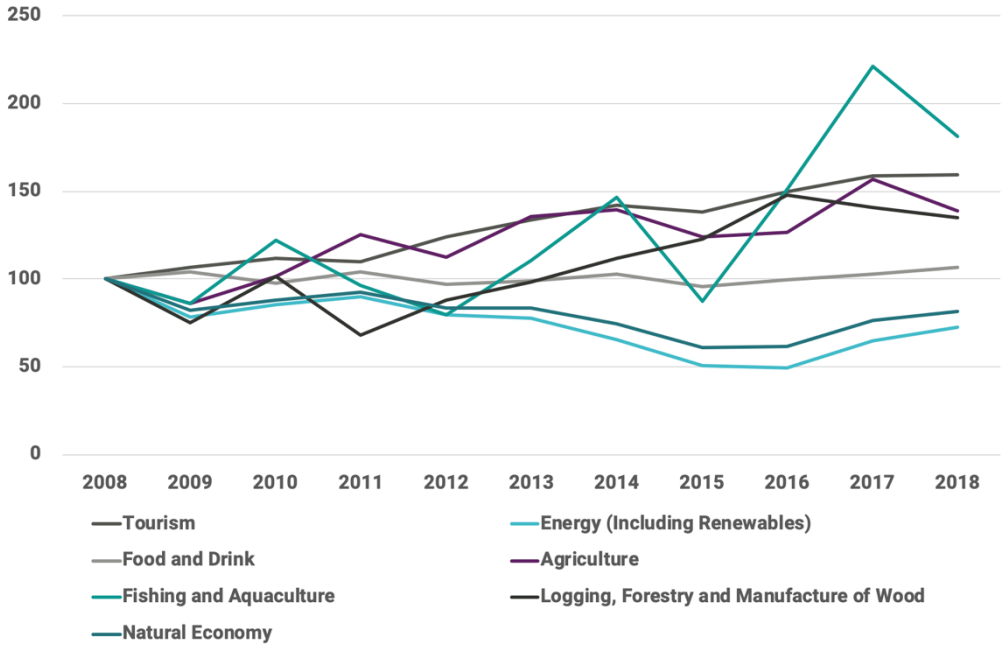
## 4.5 Trends over Time

Through the data sources used, it was also possible to consider how the GVA generated by the natural economy has evolved over the period 2008-2018.

The graph below shows changes in the GVA generated by the natural economy, where GVA was indexed on its 2008 value. Between 2008 and 2018, the size of the natural economy shrunk by 18%. This was mostly driven by a decline in the GVA generated by the energy sector.

Aside from the value generated by the food and drink sector, which remained relatively constant across the period, the other sectors comprising the natural economy experienced growth. For instance, the value of tourism increased by 60% over the period and that of agriculture by 39%.

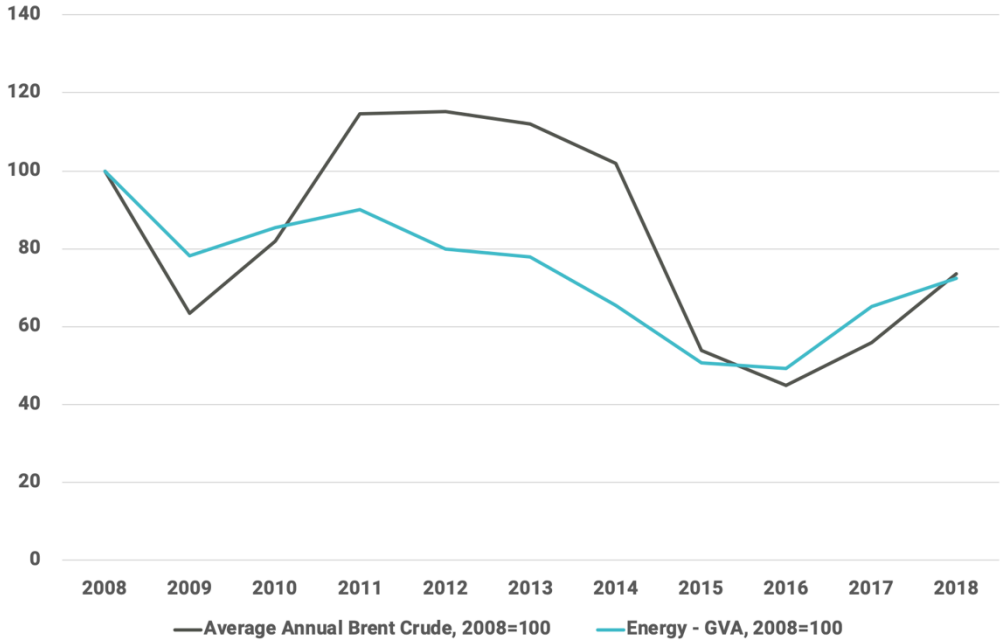
## Figure 4-5 Natural Economy Growth by Sub-Sector, 2008-2018*




Source: Scottish Government (2020) Scottish Annual Business Statistics 2018, Scottish Government (2020), Growth Sector Statistics and Scottish Government (2018), Total Income from Farming Estimates for Scotland, 2016-2018 and Scottish Government (2018), Economic Report on Scottish Agriculture 2018; *excludes mining for which data over the whole time period were not available.

Trends over time in the natural economy are mostly driven by the inclusion of energy in the index. The GVA in this sector tends to experience fluctuations that are partly explained by changes in oil and energy prices. This is shown in Figure 4-6, where changes in the USD$ price per barrel of Brent crude oil are plotted against changes in the GVA of the energy sector. While fluctuations in GVA are less marked than those in Brent crude oil prices, the two lines follow the same trend.

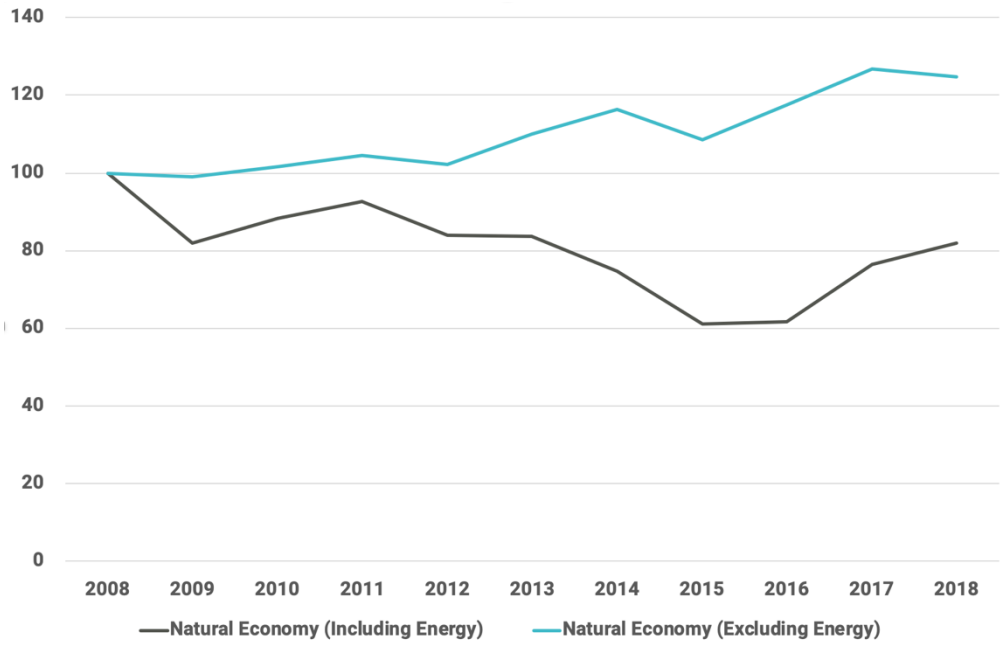
## Figure 4-6 Energy GVA and Crude Brent Prices, 2008-2018




Source: Scottish Government (2020), Scottish Annual Business Statistics 2018 and Statista (2020), Average Annual Brent Crude Oil Price from 1976 to 2020

Once changes in the energy sector are excluded, the overall trend for the natural economy is one of growth in value (+25%) over the period 2008-2018, as shown in Figure 4-7.

## Figure 4-7 Natural Economy GVA Growth 2008-2018 - Including and Excluding Energy



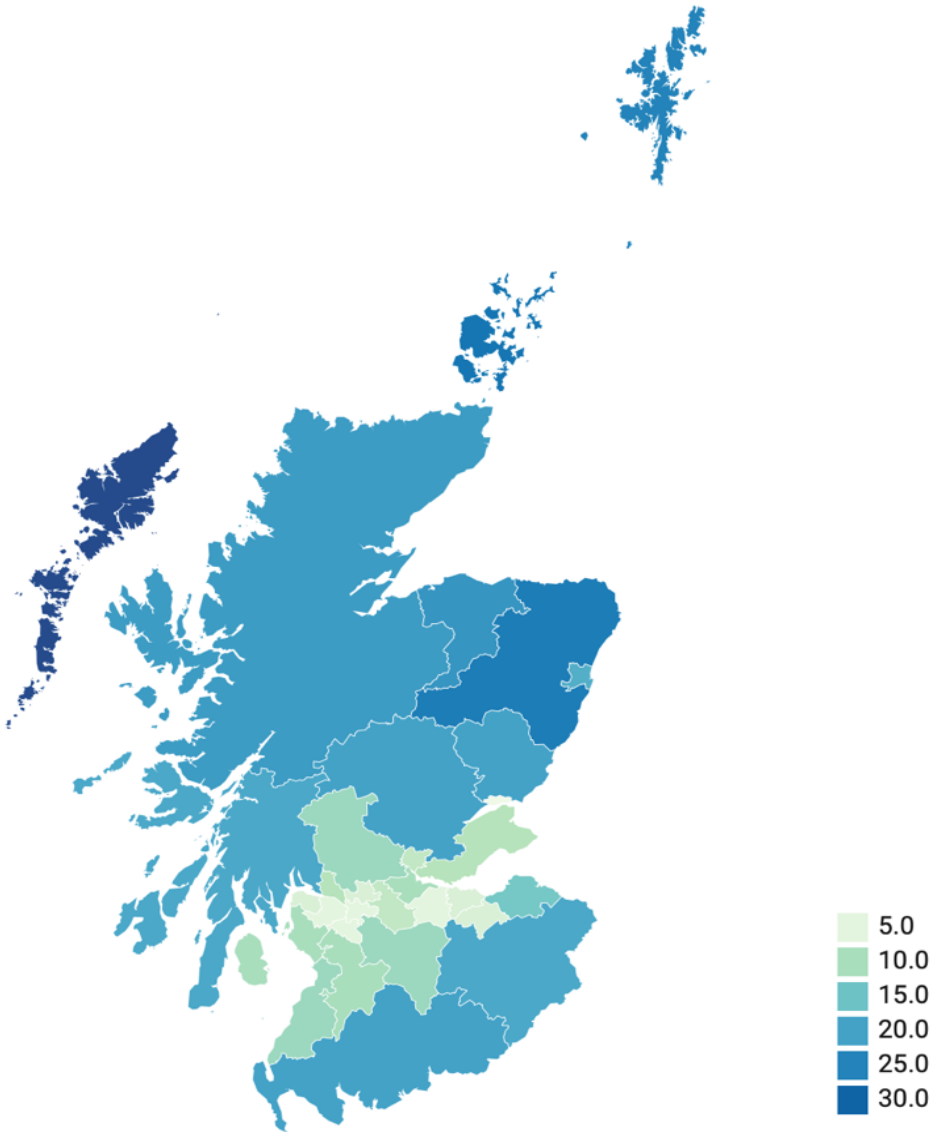

Source: Scottish Government (2020) Scottish Annual Business Statistics 2018, Scottish Government (2020), Growth Sector Statistics and Scottish Government (2018), Total Income from Farming Estimates for Scotland, 2016-2018 and Scottish Government (2018), Economic Report on Scottish Agriculture 2018.

## 4.6 Regional Distribution of Employment

The relative importance of the natural economy across Scotland varies by local authority area, with rural areas more directly dependent on the sector.

The map below uses data from BRES[34] to show the relative importance of the natural economy as an employer across Scotland. Largest shares of employment in the natural economy with respect to other sectors (in darker blue shades) are found in the Highlands and Islands, the North East of Scotland and the South of Scotland.

**Figure 4-8 Share of Employment in the Natural Economy by Local Authority, 2018**




Source: ONS (2018), BRES; Scottish Government (2020) Growth Sectors Statistics.

[34] ONS (2018), Business Register and Employment Survey (BRES) 2018.

The table below provides total employment by subsector across the five NUTS2[35] economic areas defining the Scottish economy. Around 12% of the 2018 workforce employed in North Eastern Scotland were working in the energy sector. In the Highland and Islands employment in agriculture accounted for around 9% of total employment. In Southern Scotland around 5% of employment was in agriculture and the natural economy contributed at least 14% (12% excluding energy) of employment. West Central Scotland and Eastern Scotland relied the least on the natural economy, as 5% and 8% of their employment was supported by the sector in 2018.

**Table 4-1 Employment in the Natural Economy by Sub-Sector and Region, 2018**

| | North Eastern Scotland | Highlands and Islands | Eastern Scotland | Southern Scotland | West Central Scotland |
|---|---|---|---|---|---|
| Agriculture | 9,300 | 23,500 | 17,900 | 18,500 | 1,900 |
| Energy | 35,000 | 4,700 | 12,500 | 5,800 | 8,300 |
| Fishing and Aquaculture | 2,300 | 4,000 | 500 | 200 | 100 |
| Food and Drink | 6,100 | 7,700 | 12,100 | 9,200 | 10,800 |
| Forestry and Manufacture of Wood | 1,400 | 2,800 | 4,600 | 3,100 | 1,100 |
| Mining | 500 | 800 | 400 | 400 | 300 |
| Tourism | 7,600 | 11,700 | 33,900 | 13,000 | 21,500 |
| **Employment in the Natural Economy** | **62,200** | **55,200** | **81,900** | **50,200** | **44,000** |
| **Total Employment** | **289,000** | **248,000** | **951,000** | **370,000** | **754,000** |

Source: ONS (2018), BRES 2018; Scottish Government (2020) Growth Sector Statistics. *Totals may not add up due to rounding

## 4.7 Summary of Natural Economy Baseline

In 2018, the natural economy contributed to the Scottish economy £29.1 billion GVA, equivalent to more than a fifth of Scotland's total GVA. In 2018 the sector employed 290,100 people, supporting 11% of employment across Scotland. If the energy sector is excluded from the definition, the natural economy generated £8.2 billion GVA and supported 223,100 jobs. The labour-intensive sub-sectors of the natural economy,

[35] A division of which local authorities are included in each NUT3 geographic area is set out in: EUR-Lex (2018), REGULATION (EC) No 1059/2003 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 May 2003 on the establishment of a common classification of territorial units for statistics (NUTS), available at: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:02003R1059-20180118&qid=1519136585935

under a similar definition, received relatively more weight and the sector made a larger contribution to employment in Scotland (9%) than to GVA (6%).

Whereas most of the GVA generated by the natural economy is due to energy, employment is more distributed across industries as four sub-sectors – tourism, agriculture, energy and food and drink. Nature-related tourism made the largest contribution with over 87,000 jobs.

The patterns in GVA and employment are reflected in the productivity of the sector, as defined in terms of its GVA per job. In 2018, the natural economy had a GVA per job of around £100,000, or 90% higher than average GVA per job in Scotland. This result was mostly driven by the inclusion of the energy sector (£299,000 GVA per job) and oil and gas, in particular.

If the energy sector is excluded from the definition, the GVA per job of the natural economy would be £37,000, or 29% lower than the Scottish average. This is mostly driven by the impact of low GVA per job sectors with relatively high levels of employment in the natural economy, such as agriculture and tourism, which have a GVA per job of £19,000 and £18,000 respectively.

While the GVA generated by the natural economy fell by 18% over the period 2008-2018, this was due to the decline in the value of the energy, which follows fluctuations in oil prices. Once the energy sector is excluded from the definition, the natural economy grew by 25% over the same period. This is because most of the sub-sectors part of the natural economy saw an increase in their value, with for instance, the value of tourism increasing by 60% and that of agriculture by 39%.

Based on the share of employment by local authority area, the natural economy has a sizable presence in North Eastern Scotland, the Highlands and Islands and Southern Scotland. In North Eastern Scotland, energy accounted for around 12% of jobs. Agriculture was the largest natural economy sub-sector in the Highlands and Islands and Southern Scotland.

# 5. Fostering Productivity in the Natural Economy

This section introduces productivity and economic prosperity, considers levels and growth in productivity in Scotland and assesses the potential impact of higher productivity in the natural economy.

## 5.1 Productivity in Scotland

Productivity is widely considered by economists as the main driver of changes in economic performance and in the long-term prosperity of a country. For this reason, increasing productivity has long been high on policymakers' agenda and a core objective of successive Scottish Government economic strategies. For instance, boosting productivity figured as part of the Scottish Government 2015 Economic Strategy, which set the target for Scotland of reaching "the top quartile of OECD countries in terms of productivity"[36].

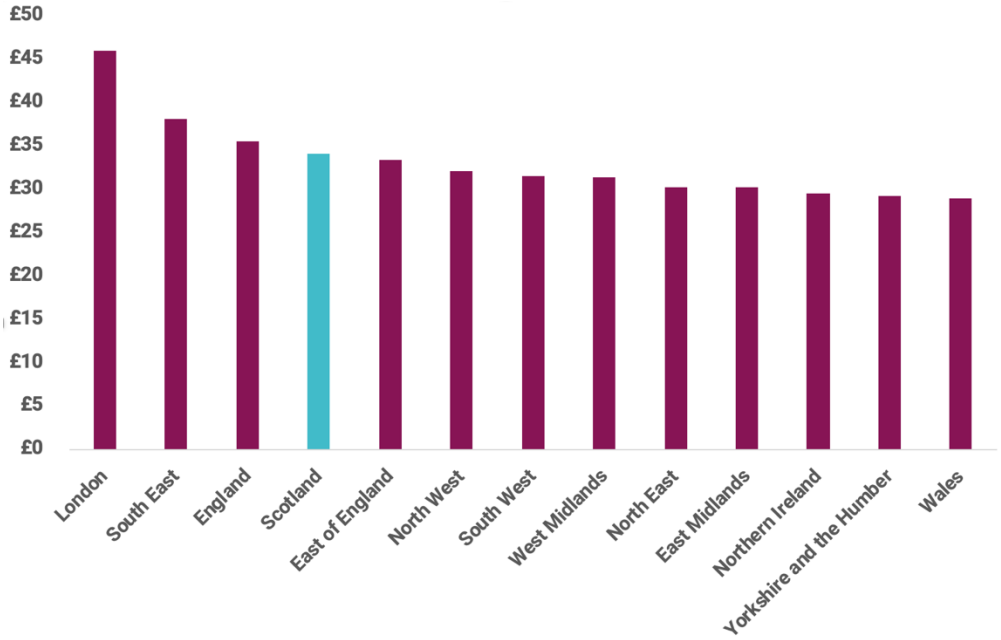
A focus on productivity and productivity growth has also characterised the sectoral strategies of some of the industries forming the natural economy. For instance, Ambition 2030[37], the strategy for the Scottish food and drink sector points to a series of initiatives, such as the strengthening of supply chains and innovation as being instrumental to increase productivity in the sector.

### 5.1.1 The Level of Productivity in Scotland

Scotland compares positively in terms of its productivity performance (defined as the output produced per hour of work) relative to most other regions of the UK with the exclusion of London and the South East. In 2018 labour productivity in Scotland was 97.6% of the UK average[38].

[36] Scottish Government (2015), Scotland's Economic Strategy 2015, p.11.
[37] The Scotland Food and Drink Partnership (2017), Ambition 2030, Scotland a Land of Food and Drink, available at: https://foodanddrink.scot/media/1465/ambition-2030.pdf
[38] ONS (2020), Regional labour productivity, including industry by region, UK 2018, available at: https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/bulletins/regionallabourproductivityincludingindustrybyregionuk/2018

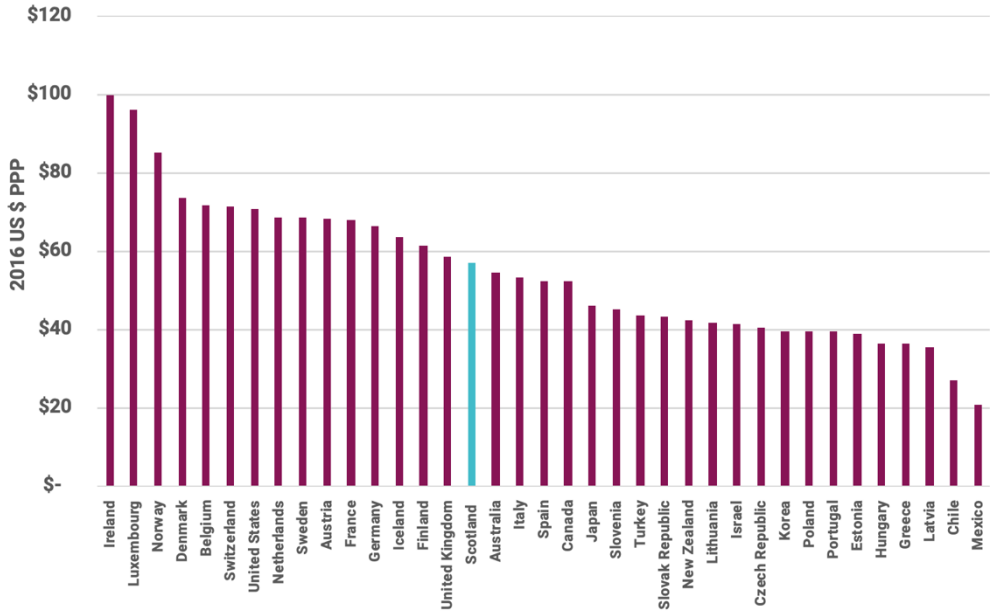
### Figure 5-1 Labour Productivity Across the UK, 2018




Source: ONS (2020), Regional labour productivity, including industry by region, UK: 2018

Scotland's level of productivity made it the 16th economy among OECD countries in 2018. Productivity in Scotland was 16.3% smaller than the 75th percentile (US$PPP 68.01), the ambition set out in the Scottish Government's 2015 Economic Strategy.

### Figure 5-2 GDP per Hour Worked in the OECD in 2018, 2015 US$PPP




Source: OECD (2020), Level of GDP per Capita and Productivity – GDP per hour worked, USD constant prices 2015 PPPs. and ONS (2020), Regional Labour Productivity, Including Industry by Region, UK 2018.

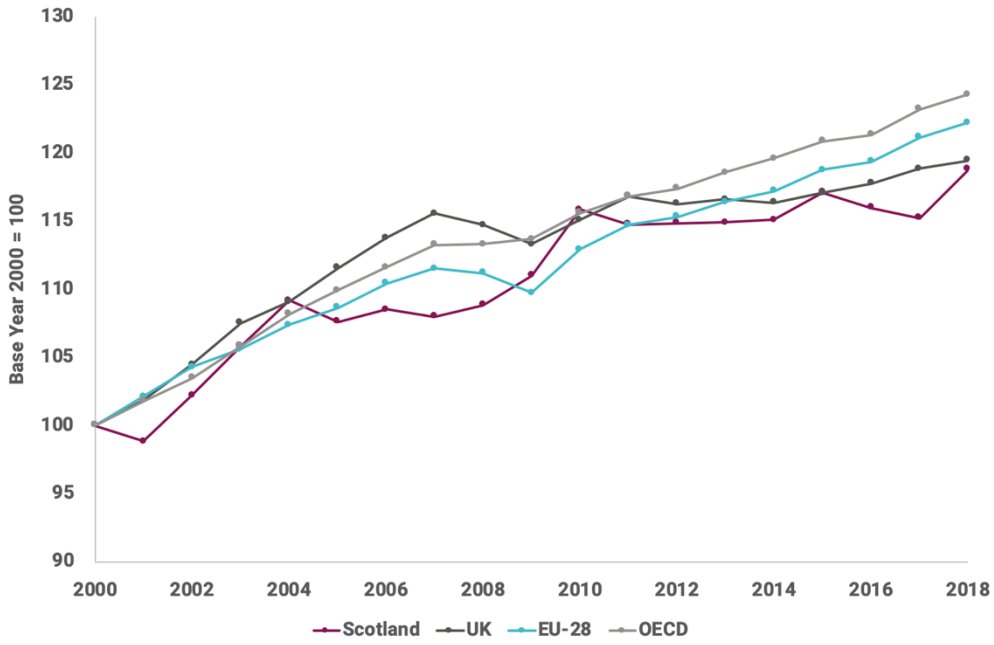
Evidence on output per hour worked over the period between 1998 and 2017 suggests that productivity in the Scottish economy, after having grown until 2004, kept increasing until 2008, though following trends in hours worked. While

productivity did not fall during the financial crisis as the number of hours worked fell, it has barely increased since[39].

### 5.1.2 Productivity Growth

Evidence from the Scottish Government's Productivity Scotland Statistics[40] suggests that over the period between 2000 and 2018, labour productivity in Scotland has grown at a similar rate as in the UK as a whole. However, both the UK and Scotland have lagged behind the EU-28 and the OECD, a group of advanced economies.

**Figure 5-3 Labour Productivity Growth Scotland Vs Other Economies, 2000-2018**




Source: Scottish Government (2020), Labour Productivity Statistics: 2019 Q3.

Low productivity rates have increasingly become a feature across advanced economies. Recent research[41] found that the main reason accounting for this trend was a lack of competition across firms. Slow institutional adaptation, slow technology adoption by businesses and workers, the emergence of complementarity investments, as well as the difficulty of national accounts in capturing changes in the structure of production also interact in explaining the productivity slowdown.

### 5.1.3 The Reasons behind Scotland's Productivity Performance

The value of production over an hour of work is determined by a series of factors. For instance, workers that have higher educational levels are able to add relatively more value to production, other things being equal. Similarly, employees' access to capital makes a difference to production processes.

[39] University of Strathclyde, Fraser of Allander Institute (2019), Scottish productivity statistics – latest updates and longer-term trends, available at: https://fraserofallander.org/scottish-economy/productivity/scottish-productivity-statistics-latest-update-and-longer-term-trends/

[40] Scottish Government (2020), Labour Productivity Statistics: 2019 Q3.

[41] Oxford Martin School Programme on Technological and Economic change (2019), The Productivity Paradox, reconciling rapid technological change and stagnating productivity.

To increase Scotland's productivity performance, it is therefore important to understand where differences in productivity emerge compared to peer economies. Recent work[42] does so by considering the productivity contribution and performance of Scotland across the following dimensions:

- capital stock – the amount of equipment, machinery and infrastructure available per employee;
- workforce skill – the level of education of the workforce;
- terms of trade – price differences between imports and exports; and
- total factor productivity – a variable that captures the difference in productivity unaccounted by these other factors, including institutional and organisational factors.

The study found that the main differences in productivity between Scotland and other economies arose with respect to total factor productivity and capital stock.

### 5.1.4 Productivity in the Natural Economy

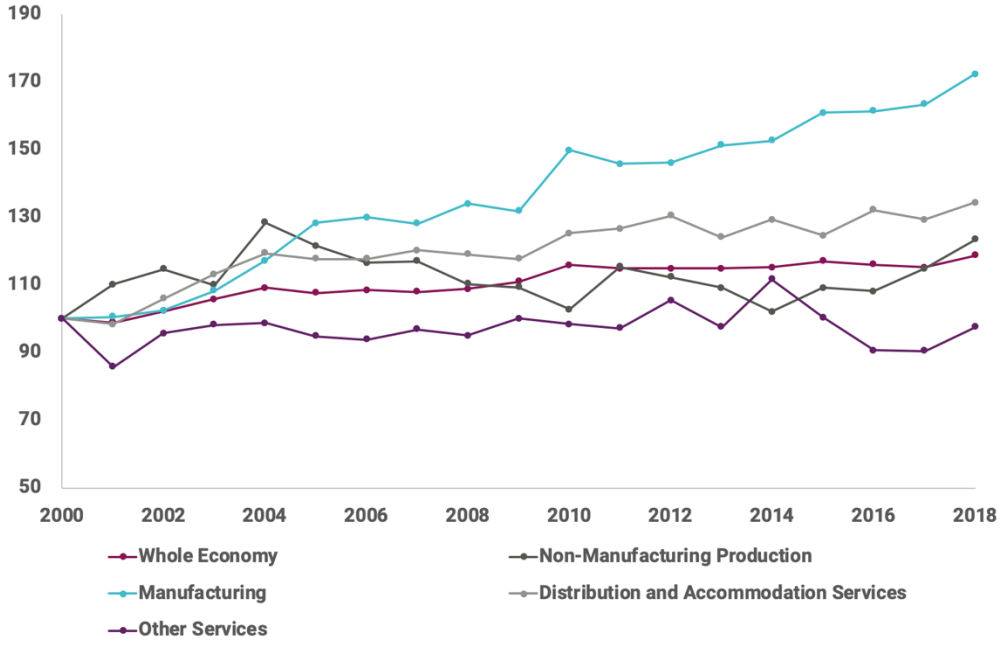
As shown in the baseline of the natural economy in the previous chapter, the sector, driven by energy, has a higher GVA per job than the Scottish average.

Within the natural economy, there exist also sub-sectoral differences with regards to productivity growth. These are captured in Figure 5-4, which considers those broad industrial sectors that have industrial codes included in the definition of the natural economy.

Most of the growth in productivity (output per hour worked) in Scotland has resulted from increases in the productivity of manufacturing activities. Sectors associated with tourism have either performed worse (other services activities) or similarly (distribution and accommodation) to the average productivity growth for Scotland.

[42] David Hume Institute (2018), Wealth of the Nation, Scotland's Productivity Challenge, available at: https://static1.squarespace.com/static/59b82ed532601e01a494df34/t/5b90c890c2241b85ea99ace7/1536215190323/Wealth%2Bof%2Bthe%2BNation%2B060918.pdf

**Figure 5-4 Productivity Growth by Sector in Scotland, 2000-2018**




Source: Scottish Government (2020), Labour Productivity Statistics: 2019 Q3.

## 5.2 Boosting Productivity in the Natural Economy: Future Scenarios

This section considers the long-term impact of changes in productivity in the natural economy. The analytical exercise relies on a series of scenarios where different rates of productivity growth in the sector are assumed.

The time period considered across the analysis is 20 years and assumptions on productivity growth were based on the productivity growth performance of Scotland and other economies between 2000 and 2018.

The scenarios are based on productivity growth rates estimated at the level of the whole economy. While being an approximation, as the natural economy may be more or less productive than the average sector in the economy, the assumption allowed to model changes in productivity based on the productivity performance of other economies. As such, it should be interpreted as an illustration of the scale of the potential benefits from different rates of productivity growth making an economic impact over time.

**5.2.1 Scenario A – Productivity Growth Follows the 2000-2018 Trend in Scotland**

The first scenario considered is a baseline scenario, where it is assumed that productivity in the natural economy will grow at the same rate as productivity in Scotland did over the period between 2000 and 2018.

As a result, it was assumed that average annual productivity growth in the natural economy would be 0.98%.

### 5.2.2 Scenario B – Growth Matches Austria, a Higher Productivity OECD Peer

This scenario was based on the analysis of GDP per hour worked across the OECD from above. It sets a situation where Scotland stops falling further behind the top quartile of the OECD in terms of productivity. This aligns with the Scottish Government's ambition to see Scotland among the top quartile of OECD countries per productivity.

Under this scenario, it was assumed that productivity growth in the natural economy would be equivalent to that over the period 2000-2018 of the whole economy in Austria, which is at the 75$^{th}$ percentile in terms of productivity per hour worked. As a result, it is assumed that the natural economy would grow at a rate of 1.20%, where productivity growth was estimated based on OECD data[43].

### 5.2.3 Scenario C – Scotland in the Top Quartile for Productivity After 20 Years

Under this scenario, it was assumed that productivity in the natural economy would be such that Scotland would be able by the end of the period to match the productivity of Austria, the country whose average productivity is at the 75$^{th}$ percentile.

To estimate the growth rate required, it was assumed that Austria would keep growing along the same growth rate it had over the period 2000-2018. For Scotland to reach the same productivity per hour worked after 20 years (USD$PPP 86.38), an average annual growth rate of 2.10%, would be required.

## 5.3 Boosting Productivity in the Natural Economy: Findings

Applying the following growth rates to the natural economy, it was estimated that after 20 years the natural economy could account for:

- £35.3 billion GVA under scenario a;
- £36.9 billion GVA under scenario b; and
- £44.1 billion GVA under scenario c.

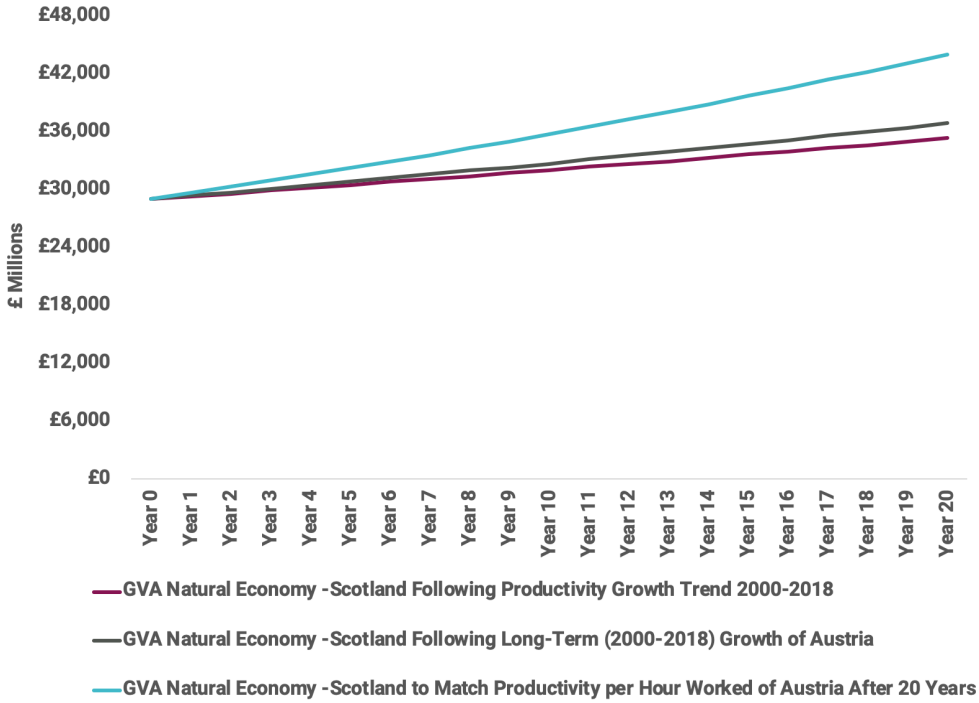
This would be equivalent to an increase compared to the 2018 level of GVA of:

- 22% under scenario a;
- 27% under scenario b; and
- 52% under scenario c.

The figure below shows changes in the GVA of the natural economy over the period considered.

[43] OECD (2020), Annual Growth in GDP per hour Worked.

**Figure 5-5 Growth of the Natural Economy - Scenario Modelling**




Source: BiGGAR Economics Analysis

## 5.4 Boosting Productivity in the Natural Economy, Excluding Energy: Findings

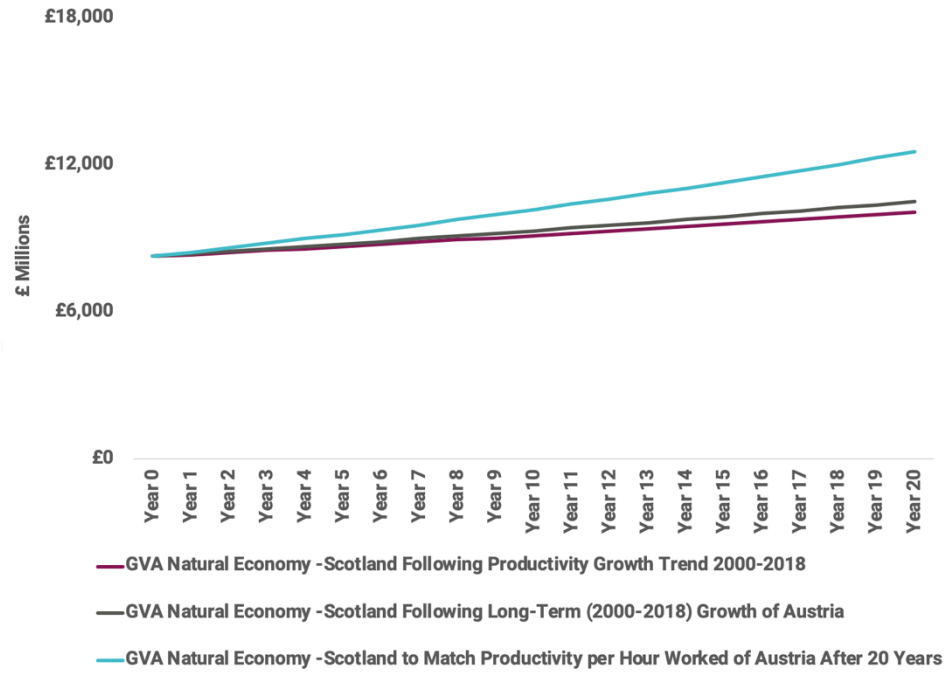
Given the differences between a definition of the natural economy including and excluding the energy sub-sector emerged from the economic baseline, the scenario analysis was replicated excluding the energy sector.

Applying the same productivity growth rates and assumptions from above, it was estimated that after 20 years the natural economy without the energy sub-sector could account for:

- £10.1 billion GVA under scenario a;
- £10.5 billion GVA under scenario b; and
- £12.5 billion GVA under scenario c.

Changes in the GVA of the natural economy excluding energy over the period considered are shown in Figure 5-6.

**Figure 5-6 Growth of the Natural Economy Excluding Energy – Scenario Modelling**




Source: BiGGAR Economics Analysis.

## 5.5 Summary of Productivity Growth Scenarios

Over long periods of time, productivity is one of the main determinants of economic prosperity. This conviction underpins both the Scottish Government's ambition for Scotland to be among the most productive countries in the OECD and the strategies of individual sectors in the natural economy.

In 2018, Scotland's productivity was mid-table compared to other OECD countries, with productivity growth over the period 2000-2018 having underperformed against the average across the EU and the OECD.

The scenario analysis showcased the benefits that could arise from increasing productivity in the natural economy. This was based on three different growth scenarios underpinned by different growth rates:

- scenario a – productivity in the natural economy averages 0.98% per year, equivalent to the rate of productivity growth over the whole Scottish economy between 2000 and 2018, which would increase GVA in the sector to £35.3 billion in 20 years (22% higher than 2018);
- scenario b – productivity in the natural economy averages 1.20% per year, the average productivity growth over the period 2000-2018 of the whole economy in Austria, the lowest ranked country in the top quartile of the OECD per productivity. This would increase GVA in the sector to £36.9 billion in 20 years (27% higher than 2018);
- scenario c – productivity in the natural economy averages 2.10% per year, the average productivity growth rate required for the Scottish economy to match

Austria's productivity in 20 years. This would increase GVA in the sector to £44.1 billion in 20 years (52% higher than 2018).

Accounting for the differences in the size and structure of the sector depending on whether the energy sub-sector is included, the analysis was replicated for the natural economy without the energy sub-sector. In this way, it was estimated that after 20 years the GVA of the natural economy would increase from its 2018 value of £8.3 billion GVA to:

- £10.1 billion GVA (22% higher than 2018) under scenario a;
- £10.5 billion GVA (27% higher than 2018) under scenario b; and
- £12.5 billion GVA (52% higher than 2018) under scenario c.

# 6. Appendix

This section provides a breakdown of the definition of the natural Economy by SIC industrial code.

**Table 6-1 The Natural Economy - Definition**

| | |
|---|---|
| SIC 02 Forestry and logging | |
| SIC 03 Fishing and Aquaculture | |
| SIC 07 Mining of Metal Ores | |
| SIC 08 Other Mining and Quarrying | |
| SIC 10 Manufacture of Food Products | |
| SIC 11 Manufacture of Beverages | |
| SIC 16 Manufacture of Wood Products | |
| Sustainable Tourism | SIC 55.1: Hotels and similar accommodation,<br>SIC 55.2: Holiday and other short-stay accommodation,<br>SIC 55.3: Camping grounds, recreational vehicle parks and trailer parks,<br>SIC 56.1: Restaurants and mobile food service activities,<br>SIC 56.3: Beverage serving activities,<br>SIC 79.12: Tour operator activities,<br>SIC 79.9: Other reservation service and related activities,<br>SIC 91.02: Museum activities,<br>SIC 91.03: Operation of historical sites and buildings and similar visitor attractions,<br>SIC 91.04: Botanical and zoological gardens and nature reserve activities,<br>SIC 93.11: Operation of sports facilities,<br>SIC 93.199: Other sports activities (not including activities of racehorse owners) nec,<br>SIC 93.21 Activities of amusement parks and theme parks, |

| | |
|---|---|
| | SIC 93.29: Other amusement and recreation activities. |
| Energy (including Renewables) | SIC 05: Mining of coal and lignite;<br>SIC 06: Extraction of crude petroleum and natural gas,<br>SIC 09: Mining support service activities,<br>SIC 19: Manufacture of coke and refined petroleum products,<br>SIC 20.14: Manufacture of other organic based chemicals,<br>SIC 35: Electricity, gas, steam and air conditioning supply,<br>SIC 36: Water collection, treatment and supply,<br>SIC 38.22: Treatment and disposal of hazardous waste,<br>SIC 71.12/2 Engineering related scientific and technical consulting activities,<br>SIC 74.90/1 Environmental consulting activities |
| Agriculture | |

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