Scottish Government
Riaghaltas na h-Alba

Assessing the cumulative and cross-sector economic benefits of investment in natural capital in Scotland

AGRICULTURE, ENVIRONMENT AND MARINE

social research

Contents

Glossary & Abbreviations

Term	Explanation
Component activity	Activities underlying natural capital interventions, e.g., silviculture, support services to forestry and hunting, classified according to ONS SIC codes.
Employment effect	The impact on jobs attributed to just the direct financial expenditure of the intervention (measured by multiplying financial cost by the Type 1 Employment effect).
Employment effect (Direct + indirect)	The impact on jobs attributed to the Output effect of the intervention (measured by multiplying output effect by the Type 1 Employment effect).
Input-Output (I-O) Model	Input-output analysis is an empirical tool designed to analyse sector interdependencies. The input-output table describes the flows of goods and services through an economy in monetary units for a given time period, usually a year. The input-output modelling approach can be used to estimate the effects on employment resulting from an increase in final demand for the product or service in a given industry. I-O models can estimate the economy-wide employment results from a given level of spending.
Job Leakage	The loss of job creation from one area to another area. This may be from region to region or from country to country.
Location Quotient	A measure to quantify how concentrated a particular industry, cluster or occupation is in a region in relation to the wider nation. A value above 1 indicates that the concentration of a particular industry, cluster or occupation in a region is greater than that of the wider nation.
Multipliers	The ripple effects of spending on natural capital related activities can be estimated using multipliers. Multipliers are measures of the way in which an increase in activity by one firm will lead to an increase in activity by other related firms. Multipliers are estimated by indirect means, using input-output tables. They are calculated by using the estimates for direct, indirect and induced effects, which are also estimated from I-O tables. 1. Direct effect – defined as an increase in demand for the goods produced by any sector leading to an increase in the output of goods from that sector. 2. Indirect effect – as producers increase their outputs in any sector, their suppliers will also have an increase in the demand for their goods, and so on. The shock of the increase in final demand for that good then ripples through the supply chain. 3. Induced effect - as a result of these supply chain effects, the level of income in the economy will increase, and a portion of this income will be spent on other goods and services leading to further increases in demand. This is termed an induced income effect.

Term	Explanation
Nature-related activity	A nature-related activity is a detailed type or category of spending under each of the seven broad GFI nature outcomes used in the GFI model.
Nature-related outcome	Nature-related outcomes (henceforth referred to as 'GFI outcomes') in the GFI model are based on public policies like the Defra's 25 Year Environment Plan in England and equivalent policies for the Devolved Administrations. The seven GFI model "nature-related outcomes" were used to identify the scale and size of the finance gap for nature across Scotland.
Natural capital intervention	Interventions featured in the environment-economy model that investments flow into, e.g. woodland creation, peatland creation.
Output effect	The direct and indirect impact of any expenditure in the local economy (measured by multiplying financial cost of the intervention by the Type 1 output multiplier).
Standard Industrial Classification (SIC)	The UK Standard Industrial Classification of economic activities, abbreviated as UK SIC, is a five-digit classification providing the framework for collecting and presenting a large range of statistical data according to economic activity.

Executive Summary

Scotland has set a strong precedent for taking action to support responsible investment in natural capital as part of a just transition to a net zero and nature-positive economy. The Scottish Government's National Strategy for Economic Transformation (NSET) includes a commitment to developing a values-led, high-integrity market for responsible investment in natural capital. This builds on existing market mechanisms such as the Woodland Carbon and Peatland Codes, which aim to help mobilise private investment into nature-based projects.

This report builds on a project that WSP undertook for Scottish Government in 2021/22 on Understanding the local economic impacts of natural capital investment. Together with eftec, WSP looked at the economic benefits of committed, planned and investment gap spending (*the Green Finance Institute (GFI) Finance Gap for UK Nature* report (2021)) to secure nature-related outcomes in Scotland by 2030.

The approach mapped the GFI outcome categories (e.g. clean water, protect and / or restore biodiversity, reduce flood risk) across different types of natural capital interventions (e.g. woodland creation and management, peatland restoration, regenerative agriculture) through desktop research and stakeholder engagement. These natural capital interventions allowed us to link environmental-economic activities, using Input-Output models and Standard Industrial Classification (SIC) codes identified in the previous study, to GFI outcome categories.

The study estimated that public and private investment forthcoming to address the GFI nature finance gap for Scotland (over the period 2022-2032) could be **£12.5bn**. Deploying this capital on nature restoration activities would generate an estimated output effect of **£17bn** into the Scottish economy, meaning every £1 invested in nature recovery would generate £1.35 for the economy.

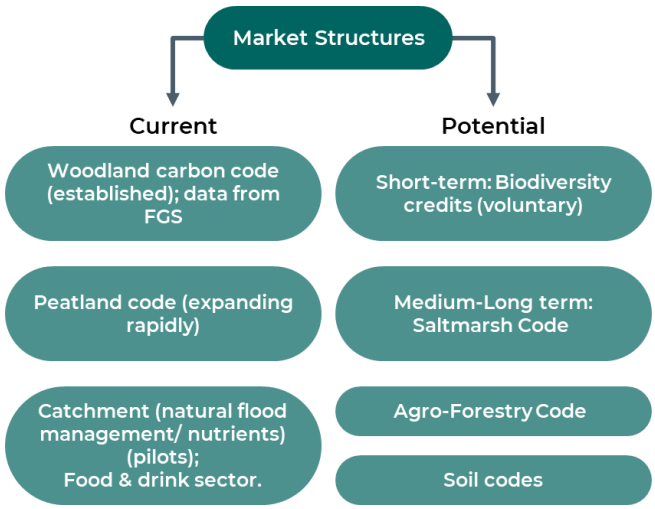
In terms of jobs created, the potential economic impact of closing the £12.5bn nature finance gap investment could be **around 146,000 direct and 197,000 direct and indirect jobs**. The study also provided an indication of how these economic impacts could be distributed over time, based on the maturity of current, planned and future drivers and market enabling mechanisms.

The largest output effect was observed in **silviculture** and the **provision of other forestry services**, yielding an **output effect of £4.4 billion and 66,990 direct and indirect jobs** created. Significant output effects may also be seen in sectors concerning: (i) the renting and leasing of agricultural machinery and equipment; and (ii) in the provision of support services to forestry.

Mapping natural capital interventions to the GFI outcome categories

	GFI outcome category						
Natural Capital Interventions	**Protect and/or restore biodiversity**	**Clean water**	**Reduce flood risk**	**Improve bio-resource efficiency**	**Improve access and engagement with natural environment**	**Climate adaptation through bio-carbon**	**Biosecurity**
Woodland Creation & Management	✓	✓	✓			✓	
Peatland Restoration	✓	✓	✓			✓	
Overall Regenerative Agriculture	✓						✓
Coastal Restoration	✓					✓	
Woodland Management	✓	✓			✓		✓
Peatland Management	✓	✓			✓		✓
Regen Agriculture Management	✓						
Coastal Management	✓				✓		
Catchment-based approach to clean water	✓	✓					
River re-naturalisation & NFM	✓		✓				
Regenerative Agriculture - Soil Health	✓			✓			
Access creation					✓		

Of the 197,380 direct and indirect jobs created, 190 jobs may be leaked outside of Scotland. Although this is a small percentage of the total jobs created as part of the investment, investment in appropriate local training and skills provision could better position Scotland to retain these jobs.

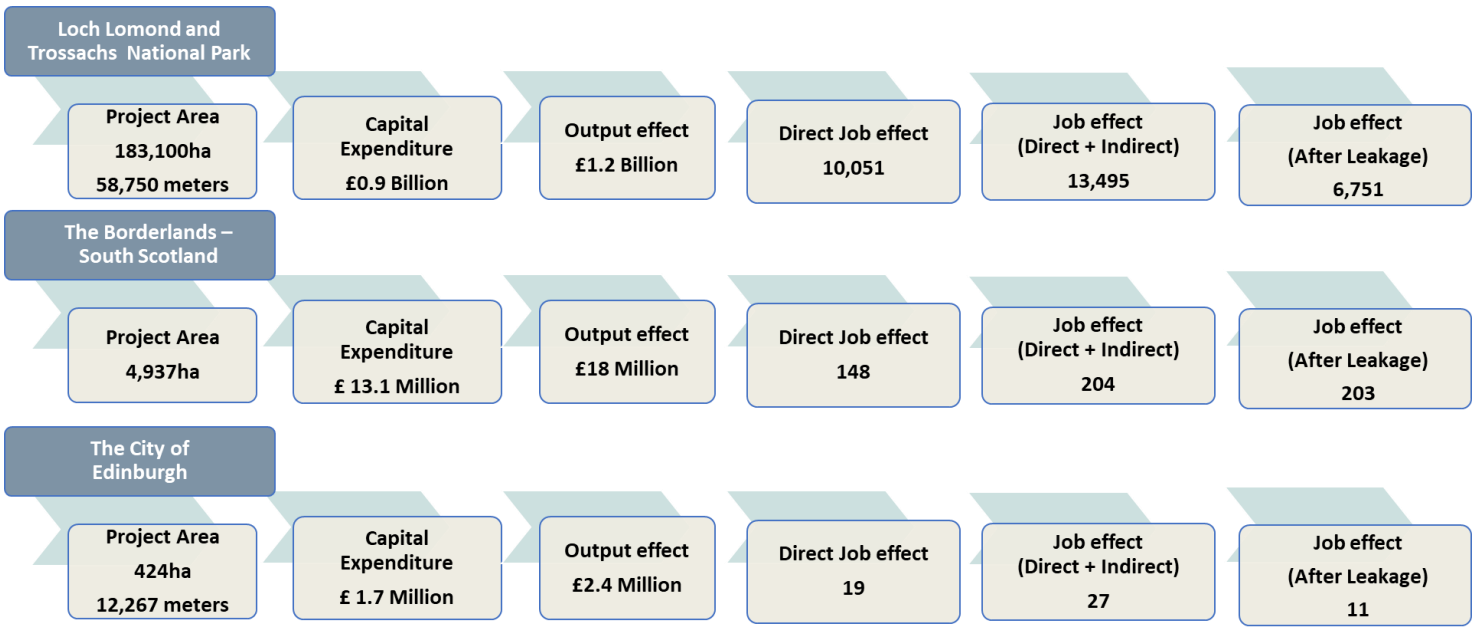


Finally, to ensure that the GFI and environment-economy models are fit for purpose, and to demonstrate their capabilities, the models were applied to three case studies in Scotland selected after stakeholder consultations (see below). These case studies capture different scales and type of natural capital interventions, funding sources and market / policy drivers (see figure above). Stakeholder responses suggest that private sector investment is motivated by clear policies, strategies, plans, regulations in addition to market drivers such as the various natural capital codes (e.g. woodland, peatland – see figure above).

Details of natural capital investment case studies considered in the research

	Natural capital interventions	Funding sources	Main drivers
Loch Lomond and The Trossachs National Park	Woodland and peatland	Peatland ACTION and Place programme, Community funding trusts, Countryside Trust	Woodland and Peatland code; Scotland's Forestry Strategy (2019-2029), Trees & Woodland Strategy (2019-2039)
The Borderlands Natural Capital Innovation Programme, South of Scotland	Coastal restoration and regenerative agriculture	Borderlands Natural Capital Programme, Forestry Grants Scheme, private finance, Woodland Trust, National Lottery Heritage Fund	Woodland and Peatland code, and Biodiversity credits, Solway Tweed River Basin Management Plan, flood risk and biodiversity action plans
City of Edinburgh	River re-naturalisation and natural flood and clean water	FIRNS, the Woodland Trust, Greenspace Scotland, the Future Parks Accelerator	Edinburgh Adapts, Climate Ready Edinburgh, Edinburgh Biodiversity Action Plan, and Thriving Green Spaces Strategy

Investment in natural capital across the three case studies ranges from between £1.7 million and £0.9 billion, covering an area between 424ha and 183,100ha. The natural capital investment generates an output effect ranging between £2.3 million and £1.1 billion, between 19 and 10,051 direct jobs generated, and between 27 and 13,495 direct and indirect jobs created. This is detailed in full on the figure below.



The model findings show high value for money from investment in natural capital interventions. There are differing natural capital interventions in each of the case study areas resulting in differing output effects. Edinburgh creates the highest investment-output ratio at 1.41, where for every £1 invested £1.41 could be generated in the local economy. This is followed by South Scotland at 1.38, and Loch Lomond and The Trossachs National Park at 1.35. This is predominately due to the natural capital interventions in which the investment is focused, with access creation having a greater investment-output ratio than others. The net jobs created across all three case studies is comparatively high with approximately 16 jobs created per £1 million invested.

Value for money of investment by case study

Case study	Investment	Output-Investment ratio	Jobs-investment ratio (per £1 million invested)
Loch Lomond and The Trossachs National Park	£0.9 Billion	1.35	15.7
Soum of Scotland	£13 Million	1.38	15.6
City of Edinburgh	£1.7 Million	1.41	16.1

By comparison, investment in the transport and storage sector, electricity and gas sector, chemicals sectors or construction sector would return an output-investment ratio of 1.34, 1.64, 1.27 and 1.53 respectively. Investing £1 million into these sectors would generate and support approximately 14, 6, 5 and 19 direct and indirect jobs, respectively. Compared to these industries the natural capital case studies offer a mid-range output-investment return and on the larger side of the employment-investment ratio, likely due to the labour intensity required.

Potential areas of skill shortage or gaps were analysed to find likely areas of job leakage, and potential regions in Scotland and outside of Scotland to which these jobs could be leaked. Given the type of natural capital interventions in the Borderlands, the leakage effect is negligible, with most jobs likely to be absorbed in the region. All three case studies require substantial labour inputs, which is a good indicator that they will support local jobs. However, some of the jobs are desk based and can be provided in any location.

Input expenditure breakdown by case study

Case study	Labour	Transportation/machinery	Materials	Products
Loch Lomond and The Trossachs National Park	62%	27%	11%	0%
South of Scotland	61%	3%	36%	15%
City of Edinburgh	77%	6%	17%	0%

The modelling framework developed in this study has strong implications for project and programme design and delivery. Stakeholders indicated that the model can be used for prioritising investments and also in partnering with various development partners and funding entities.

The time horizon of this study is 10 years (between 2022-2032), which is in line with the time horizon of the finance gap estimations in the GFI study. Using the adapted GFI model, the project team estimated the required scale of investment in nature objectives for Scotland by linking the nature-related activities, drivers and enabling mechanisms, to different funding categories and their assumed time horizons. This being said, different market-related mechanisms have different rates of maturity and/or expected rates of development. With overlaps, scale and timing assumptions, the project team was able to model the expected future financial investment into nature recovery along the following lines:

- **Mechanisms that are ready to operate and scale up are assumed to increase within five years:** Example mechanisms within this category are the Woodland Carbon and Peatland Codes which are already in use across the UK (the former being more mature). These codes are voluntary quality assurance and certification standards which are already operational and issue verifiable carbon credits for new woodland creation and peatland restoration projects, respectively, in Scotland and the rest of the UK;
- **Mechanisms that are in development but still several years from being ready due to further R&D being required:** These are assumed to increase spending during the middle of the 10-year period. Example mechanisms include voluntary biodiversity credits, which are currently in the early development stages in Scotland; and

- **Mechanisms with unclear development pathways:** These will primarily increase beyond Year 10. The precise form of these mechanisms still has uncertainties, and so they only stimulate increased spending towards the end of the 10-year period at best.

Going forward, it is crucial to ensure that economic benefits in the nature-based sector can be captured in local and regional economies by ensuring strong enabling frameworks and skills programmes. There is also the opportunity cost and risk of delaying investments (e.g. in terms of missing climate change targets, loss of first-mover advantage etc). Further, complementing the economic impacts with community benefits and wider social value can create stronger drivers for scaling up investments in natural capital. Strong partnership models are required as nature-based solutions can have multiple impacts and require a range of capabilities. Finally, the study and the newly developed models therein can be used to test the delivery and planning frameworks mentioned in Scotland's latest Biodiversity Strategy.

Introduction & Context

The Scottish Government (SG) commissioned WSP and Economics for the Environment Consultancy (eftec) to assess the cumulative, cross-sector economic benefits of private investment in natural capital on regional and national markets in Scotland**.** The project commenced in October 2022 and was completed in April 2023. This document is the Final Research Report for the project and provides guidance on how to use the Green Finance Institute (GFI) nature finance gap model (the "GFI model") adapted for Scotland, and the supporting economic model generated for the analysis of economic impacts. This report is best read in conjunction with the model, which has been published alongside the report.

This project is a progression from the local economic impacts project that WSP undertook for Scottish Government in 2021/22 on Understanding the local economic impacts of natural capital investment. One of the key differences between the previous and this study is the greater focus on the **regional economy** in Scotland in this report**.**

Aims and objectives for the project

The aim of the project was to assess the potential cumulative and cross-sector economic benefits of investment in natural capital in Scotland. To achieve this, the project objectives were to:

- Provide a comprehensive understanding of the potential and predicted impacts of national and regional natural capital market development and drivers, in relation to core and wider economic benefits;
- Link to current policy development work on scaling up private investment; and
- Help understand the implications of SG intervention and scenarios around different market factors like regional economic partnerships, international opportunities and beyond.

Context for the project

Scotland's National Strategy for Economic Transformation (NSET) emphasises the role of a natural capital approach in supporting a just transition to a net zero, nature-positive economy with the overall vision that by 2032 Scotland will be a wellbeing economy thriving across social, economic and environmental dimensions[1]. Driven by the need to achieve net zero, meet ambitious targets for woodland creation and peatland restoration, promote biodiversity, and to understand and maximise the vast array of physical, economic and social benefits of natural capital, Scotland has committed to create a values-led, high-integrity market for responsible private investment in natural capital as part of the NSET. This market will be supported by a national project pipeline for nature-based solutions.

As an early action to support the delivery of this NSET commitment, Scottish Government published a set of Interim Principles for Responsible Investment in Natural Capital[2]. The Interim Principles set out the Scottish Government's ambitions and expectations for a values-led, high-integrity market for responsible private investment in natural capital to communities, investors, land managers, land owners, public bodies and other market stakeholders.

Scotland has been at the forefront of work to create viable markets for nature, for example by supporting the development of the Woodland Carbon Code and the more recent Peatland Code, to name just two prominent examples. At the same time, Scotland has been leading work to ensure that new markets are inclusive and equitable, including via land reform policy and just transition policy and planning. In Scotland, a range of current natural capital market development efforts like the Scottish Wildlife Trust's (SWT) Riverwoods programme or recent Landscape Enterprise Networks reflect these principles of integrated land management and equitable distribution of benefits within blended finance initiatives. Scotland is also increasing public investment in nature, with the £65 million Nature Restoration Fund (NRF) that was secured through the cooperation agreement between the Scottish Greens and the Scottish Government.

[1] Scotland's National Strategy for Economic Transformation - gov.scot (www.gov.scot)

[2] Interim Principles for Responsible Investment in Natural Capital - gov.scot (www.gov.scot)

These efforts are timely and likely increasingly urgent. At COP26 (2021) hosted in Glasgow, the burgeoning world of climate finance was a central theme. As many world leaders declared, up to half of climate finance needs to be linked to climate adaptation, making the impacts and market potential of nature capital benefits like flood prevention, air quality improvements, drought and heat protection even more urgent to understand. At COP26, the First Minister endorsed the Leaders' Pledge for Nature, an international commitment to reverse biodiversity loss and create a "nature-positive" world by 2030. The Scottish Environment Strategy sets out the framework for this transition with emphasis on supporting responsible private investment in nature-based solutions. At COP26, the newly created Glasgow Finance Alliance for Net Zero (GFANZ), a coalition of private sector investors, committed trillions of dollars to fight the climate emergency to 2030 – just one sign of how quickly the demand for high quality natural capital and climate solution investment vehicles may grow. In this context, Scotland has a huge opportunity to become a world leader in the development of natural capital markets.

At the UN Biodiversity Conference (COP 15) in Montreal December 2022, the most important contribution Scotland made to the talks was the Edinburgh process, which Scottish Government led on behalf of the Convention for Biological Diversity. It saw over 300 regions, cities and local authorities around the world sign the Edinburgh Declaration, which commits to transformative action to protect biodiversity and calls for an ambitious global deal for nature. Scottish Government also launched its Biodiversity Strategy at COP15. This biodiversity strategy sets out a clear ambition for Scotland to be Nature Positive by 2030, and to have restored and regenerated biodiversity across the country by 2045. It commits Scotland to statutory nature restoration targets that future governments can be held accountable for, the restoration of vital habitats like Scotland's rainforest and peatlands at scale, and taking new steps to promote nature-friendly farming, fishing and forestry.

The Green Finance Institute (GFI) Finance Gap for UK Nature Report[3] revealed that the finance gap to secure nature-related outcomes in Scotland, as defined in the GFI report[4], is between 15 and 27 Billion pounds for the current decade (2022-2032). In addition, there is interest in understanding the types and numbers of jobs likely to be created by increasing natural capital investment, in line with the natural capital approach adopted in the NSET. Given the pace and scale of investment required to restore nature in Scotland, and the Scottish Government's commitment to a just and fair economy, there is a clear need to better understand the business case for investment and the potential economic benefits for local and regional economies.

[3] GFI Finance Gap for UK Nature Report – Press Release: https://www.greenfinanceinstitute.co.uk/wp-content/uploads/2021/10/Press-Release.pdf

[4] Note that the finance gap estimated in the GFI study was determined for nature-related outcomes defined based on Defra's 25 Environment Plan rather than those specified in the Scottish Government policy packages. Nevertheless, the value of each nature-related outcome for Scotland estimated in the GFI study was based on the Scottish evidence whenever it was available, including spending commitments announced by the Scottish Government. The GFI

Contents of the final research report

The report is structured as follows:

This **introduction** chapter sets out the aims and objectives of the research and explains the purpose of this report and its structure; as well as the context for the research including an outline of the policy context for natural capital investment.

Project approach and analytical framework explains the concepts and methodology used to conduct the overall study.

Investment in nature objectives provides a typology for analysing natural capital markets and flows of private investment into natural capital markets. This includes a description of the GFI model, how it links to nature-related activities, and the drivers and enabling mechanisms for private investment.

Scale and size of investment presents the funding categories, time horizons and assumptions that underpin the adaptation of the GFI model for natural capital in Scotland.

The chapter on the **economic impact of nature related markets and investments** provides an overview of the environment-economy model and its linkages with the GFI model. In this chapter, the model is used to conceptually estimate the impact of the total investment in the different GFI categories.

Applying the model to regional case studies presents case study results from applying the Input-Output models to real-world scenarios across three different regions in Scotland; and helps analyse the international opportunities and barriers for natural capital markets in Scotland.

The chapter on **using the model to show current progress in natural capital funding across Scotland** provides a user template for how to input data into the environment-economy model.

Conclusions summarize the main findings from the overall project, and provide recommendations for further research.

study therefore provides useful (broad) estimated ranges for the nature finance gap in Scotland. These can be refined through further more detailed and Scotland specific studies.

Project approach and analytical framework

Project approach

A summary of the approach is provided in Figure 1. The project comprises four key elements focusing on: (1) natural capital markets and private sector; (2) scale and size of investment; (3) economic benefits; and (4) geographic impacts. Further detail of each of the following phases is provided below in Figure 1**.**

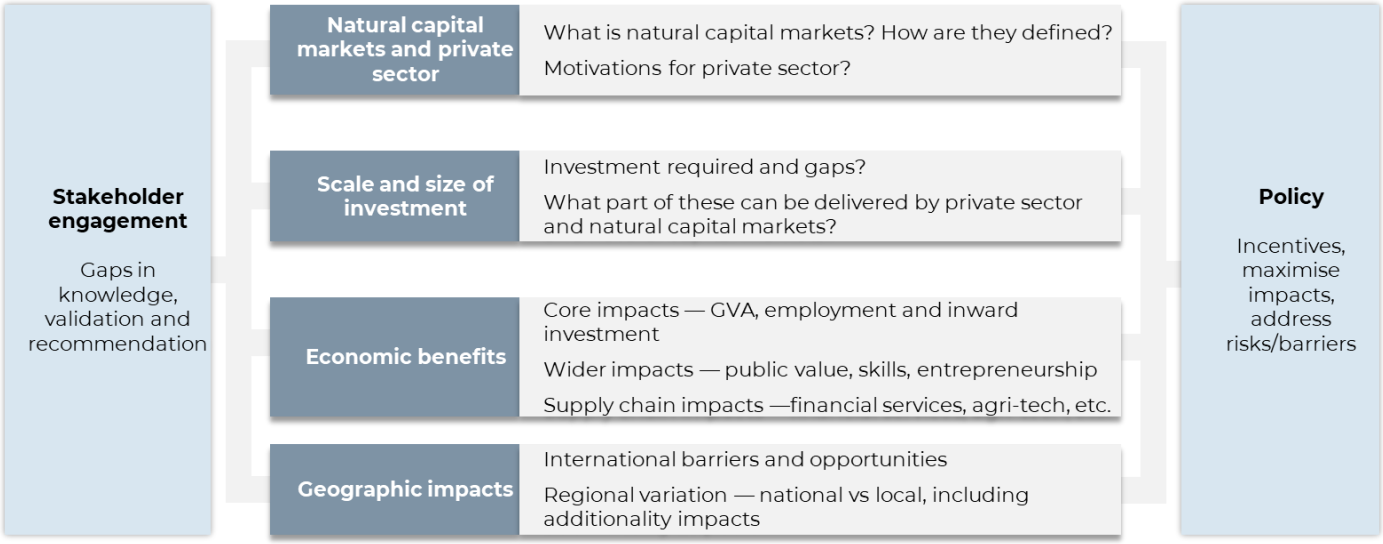


Figure 1: Overview of the project approach

Natural capital markets and private sector

The project needed to define a working typology of natural capital markets and private sector investment. This relied on the definition of the finance gap for natural capital investment from the 'The Finance Gap for UK Nature' report commissioned by the Green Finance Institute (GFI) (the 'GFI report' henceforth). The GFI report estimated the finance gap to achieve seven "nature-related outcomes" (henceforth referred to as 'GFI outcomes'), based on public policies like the Defra's 25 Year Environment Plan in England and equivalent policies for the Devolved Administrations[5]. Private investment, along with public and third sector funding initiatives, is considered key for closing the finance gap. Private sector motivations for investing in natural capital were also analysed in this stage of the project.

[5] See the GFI report (2021) for more information on the complete list of sources used to derive spending requirements per nature-related outcome. Where possible, Scotland specific figures were derived. For certain nature-related outcomes, UK-wide or England-specific estimates were extrapolated to derive the spending requirements for each DA. This is an area where future research could improve the estimates.

Scale and size of investment

The “GFI model” refers to the nature finance gap model developed to estimate the current and required spending on nature across the UK. The GFI model analysis in this current study focuses only on Scotland-specific estimates. The seven GFI model “nature-related outcomes” were used to identify the scale and size of the finance gap for nature across Scotland.

A desktop review of existing public, private and blended funding mechanisms was conducted in order to assess the committed and required investment in natural capital (and hence to refine the finance gap estimates from the 2021 report for Scotland).

Consultations with Scottish Government and wider stakeholders were undertaken in order to define a natural capital markets typology and validate the three main nature spending results – committed spend, required spend and the finance gap (the difference between the two) – for Scotland. The workshop resulted in:

- Agreeing modelling assumptions for the GFI model adapted for Scotland, in relation to: natural capital funding, funding gaps, categorisation of different funds, classification of timescales for funds mobilisation (short, medium and long term), and information on new funds being allocated;
- Discussing public sector and private sector expenditure data being used for the GFI model for Scotland, including where there are overlaps between public funding initiatives, e.g. Peatland ACTION, Forestry Grants Scheme (FGS), and the Nature Recovery Fund (NRF);
- Soliciting views on the scale of demand in natural capital markets; and
- Discussing potential regional case studies to be applied to economic model.

Economic benefits

Building on the identification of the funding gap and market drivers for natural capital investment in Scotland, an assessment of the quantitative economic impacts of natural capital investment in various activities and markets was conducted. This stage of the project required drawing on the environment-economy model developed in the previous study for Scottish Government ‘Understanding the local economic impacts of natural capital investment’ and understanding how the nature-based activities in the previous environment-economy model (what are henceforth in this report referred to as natural capital interventions) are associated with GFI outcomes. An assessment was carried out as to how investment in natural capital interventions spill over to other sectors, through input-output analysis and multiplier effects. The GFI outcomes were mapped onto natural capital interventions (e.g. woodland creation, peatland creation) and these in turn are underpinned by a set of component activities that take place (e.g. silviculture, support services to forestry and hunting). Component activities are classified according to ONS SIC codes and go beyond labour and capital, e.g. activities further up the value chain that are office-based.

Geographic impacts

The key outputs of this stage were to summarise regional impacts, where possible outlining risks and caveats of expressing the economic impacts at different geographical levels; and testing the environment-economy model by applying it to regional case studies in close consultation with the Scottish Government.

To achieve this, a combination of regional case studies and regional SIC data linked to natural capital activity was used to better understand the regional impact of investing in natural capital projects, in that region. Where possible, the regional case studies included a qualitative description of supply chain impacts and wider economic impacts and potential barriers relating to skills gaps, skills development, and land use diversification.

Judgement on leakage factors was applied to account for jobs that could leak out and be created beyond the area studied into another region or even beyond Scotland. Location quotients compare the concentration of an industry within a region in Scotland, compared to that of the whole and Scotland and/or England. The use of location quotients gave an indication as to where particular specialisms and high concentrations of labour supply, and therefore skillsets, existed within the different regions of Scotland. Conversely, low location quotients revealed skills gaps in regions and gave insights into geographic locations where leakage outside a region may occur, indicating where these skills gaps may be met, whether that be another region in Scotland or a neighbouring country (i.e. England).

This analysis was developed further through the regional case studies where a wide range of economic benefits for the local regional were predicted including:

- The core economic indicators of GVA, employment and inward investment
- The value added to public sector spend;
- Current skills gaps; and
- The associated local supply chain impacts of investing in natural capital across all relevant sectors.

Finally, this stage involved exploring international market opportunities and barriers in relation to Scotland's natural capital and where Scotland's natural capital has a competitive international advantage; and providing a high-level description of the trends and status of international natural capital markets.

It is hoped that, where supply chains and labour market development occur as a result of natural capital investment in regions or across Scotland, it will also create opportunities to market these services internationally. This is expected to be linked to the required innovation needed to drive this development, such as in nature fintech and remote sensing. By reviewing the current availability of technical expertise and the locations of labour supply, this also helped to understand the potential aspects of natural capital supply chains in Scotland that could be marketed internationally.

Analytical framework

The analytical framework adopted for this study is shown in Figure 2 below. The framework comprises four pillars: 1) financing sources; 2) drivers and enabling mechanisms to stimulate investment in natural capital; 3) natural capital interventions funded by natural capital investment; and 4) economic impacts derived from natural capital interventions (through analysis of component activities).

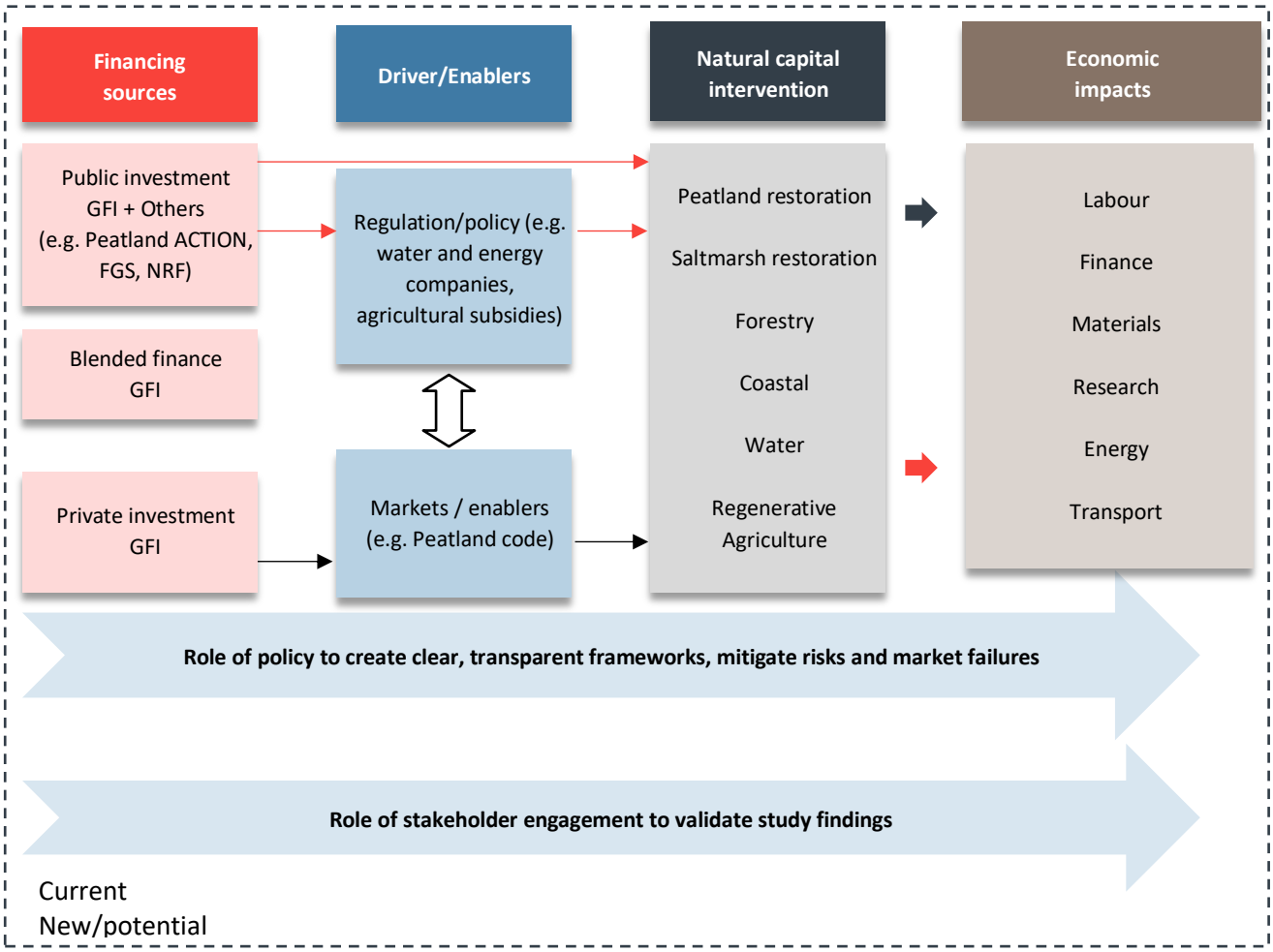


Figure 2: Analytical framework

The analytical framework and ensuing model is agnostic of the source of finance. The framework can be viewed as sequential, such that when natural capital investment is resourced, there are market drivers and enabling mechanisms that facilitate the flow of investment through to natural capital interventions such as peatland restoration, woodland creation and management, regenerative agriculture, and so on. When finance (private, public or blended) is mobilised to enable these natural capital interventions to take place, this generates economic impacts through labour, materials, research activities, energy, transport, further finance, and so on.

The framework captures current as well as new or potential natural capital markets. The framework highlights the role of policy in creating clear, transparent frameworks, as well as stakeholder engagement. Policies influencing and supporting financing can be at the national level, for example at the level of the Department of Environment, Food & Rural Affairs (DEFRA), Scottish Forestry, or Scottish Environment Protection Agency (SEPA); by contrast, policy and support related to economic impacts can include those implemented by Scottish Enterprise, or local authorities.

Crucial to the analytical framework for this project is the role of stakeholder consultations, from developing a typology of natural capital markets with corresponding time horizons for market development and maturity, through to assessing the economic impacts of natural capital interventions at the regional level.

Investment in nature objectives

The first phase of the project involved scoping and determining nature objectives for Scotland and the required scale of investment in those objectives (including already committed and additional spend needed to meet the nature objectives). This section provides an overview of nature objectives, natural capital markets and investment requirements, both public and private. It is based on the Green Finance Institute (GFI) model on finance gaps for nature-positive outcomes, with additional analysis of the drivers and enabling mechanisms to propel private investment for nature objectives in Scotland.

Nature objectives, natural capital markets and investments

The Scottish Government's commitment to net zero and a nature positive economy reflected in its National Strategy for Economic Transformation (NSET) recognises the key role that natural capital markets can play in achieving them. Scotland benefits from a wide range of ecosystem services provided by its natural capital, such as provision of clean water and biodiversity that underpins food security.

As described in the previous section, an ambitious increase in scale of overall investment in nature, including private funding, is required to close the finance gap. Scotland has been leading work to develop viable natural capital markets across the wide range of nature-related outcomes. For example, it has supported the development of the Woodland Carbon and Peatland Codes aimed at financing projects leading to woodland creation and peatland restoration respectively. It also recognises the need to continue developing new markets to address the finance gap for other nature-related outcomes. Many of these financing drivers and enabling factors have not been introduced yet but the efforts to implement them are ongoing (e.g. biodiversity, water quality).

This and the following section outline the key Scottish nature-related outcomes (and activities) and link them with the relevant natural capital markets and investments which, if implemented, could support the Scottish Government's efforts to address the nature finance gap.

Introduction to the GFI model

The Finance Gap for UK Nature report (2021) was commissioned by the Green Finance Institute (GFI) and produced by eftec with the support of Rayment Consulting Services. This serves as the primary reference for undertaking analysis of nature objectives, natural capital markets and investments for Scotland for this study. The overall purpose of the GFI report was to "*identify the finance gap across the UK to achieve nature-positive outcomes in order to assess the potential need for private investment*." The GFI project steering committee was comprised of a range of public, private and third sector and country-specific experts, including public bodies from across the UK and Scotland such as Joint Nature Conservation Committee, Environment Agency, Defra, NatureScot and Scottish Forestry.

In this report, the "GFI model" refers to the nature finance gap model developed to estimate the current and required spending on nature across the UK which was summarised in the GFI report. The GFI model covers six geographic boundaries: United Kingdom (UK-wide), England, Wales, Scotland, Northern Ireland and Overseas Territories. In this current report, only Scotland-specific estimates were used. Given the high uncertainty around the long-term market developments and public commitments aimed at addressing the nature objectives, this study looked only at the 2022-2032 GFI figures (i.e. the short-term, 10-year horizon)[6].

Investment requirements were estimated for each of the four UK countries, which provided the data for Scotland used in this work. The GFI model is composed of seven "nature-related outcomes". In the absence of sufficiently well-defined nature-related outcomes for England and each of the three UK Devolved Administrations (DAs), the investment targets analysed in the GFI model were adapted from seven of the ten environmental outcomes outlined in Defra's *25 Year Environment Plan* for England as shown in Table 1, as well as drawing on input from the project steering committee (including experts from Scottish public sector organisations).

For the purposes of this study, no further change to the nature-related outcomes in the GFI model was made. Given the scope and resources of this study, the GFI model adequately covered key nature-related outcomes in the Scottish context and produced relevant finance gap estimates across the outcomes.

Table 1: 25 Year Environment Plan environmental outcomes and corresponding GFI nature-related outcomes

25YP Environmental outcomes	Included or excluded in GFI model
Clean and plentiful water	Included – Clean water
Thriving plants and wildlife	Included – Protect and/or restore biodiversity
A reduced risk of harm from environmental hazards such as flooding and drought	Included – Reduce flood risk
Using resources from nature more sustainably and efficiently	Included – Improve bio-resource efficiency
Enhanced beauty, heritage, and engagement with the natural environment	Included – Improve access and engagement with natural environment
Mitigating and adapting to climate change	Included – Climate mitigation through bio-carbon
Enhancing biosecurity	Included – Enhance biosecurity
Clean air	Excluded
Minimising waste	Excluded
Managing exposure to chemicals	Excluded

[6] The original GFI model covers three time periods: 2022-2032 (10-year horizon), 2022-2042 (20-year horizon) and 2022-2052 (30-year horizon).

The GFI model distinguishes three main nature spending results: (i) committed; (ii) required; and (iii) finance gap. Committed spending is public spending that has formally been committed (and in some instances invested) to date (within the 2022-2032 assessment period); required spending indicates the funding needed to achieve the targets defined by the nature outcomes. The finance gap therefore shows the difference between the required and committed spending. The GFI model primarily implies anticipated spending from the private sector as the existing public commitments are often found to be insufficient to address the finance gap[7]. The finance gap for Scotland as estimated by the GFI model serves as an appropriate starting point for assessing the value and scale of private investment that may be required to achieve stated nature outcomes for Scotland, as well as the potential economic impacts of this investment estimated in subsequent sections of this report.

Description of GFI outcomes and nature-related activities for Scotland

The GFI model consists of seven nature-related outcomes (listed and defined in Table 2). While each outcome is unique and the model produces a specific finance gap for each outcome, the outcomes are not always mutually exclusive – there may be instances where spending may contribute to more than one outcome. For instance, increasing plant species abundance as part of biodiversity and nature restoration may help to reduce flood risk through natural flood management measures or reduce carbon emissions, both of which would contribute to other nature-related outcomes. The model produced both unadjusted and overlap-adjusted finance gap figures to present the gross and net spending required to achieve each nature-related outcome.

Table 2: Definitions of GFI nature-related outcomes

GFI outcomes		Definition
	Clean water	To prevent further deterioration of, maintain or enhance the quality of water in the environment
	Protect and/or restore biodiversity	To extend coverage of protected areas, managing pressures on habitats and species, increasing species' abundance and reversing losses covering both terrestrial and marine biodiversity
	Reduce flood risk	Reduce risk of flooding by investing into natural flood management (NFM) measures, which are a part of the broader programme of investment into Flood and Coastal Erosion Risk Management (FCERM)

[7] Note that the exact source of funding needed to address the finance gap for nature is not explicitly determined in the GFI study. Nevertheless, the existence of a finance gap under current public spending commitments suggests that further private funding needs to be levered. Given pressures on wider public spending it is unlikely that current and future public commitments can meet the funding requirements for nature, so finance from the private sector will be needed.

GFI outcomes		Definition
	Improve bio-resource efficiency	To improve the services provided by natural assets in the UK by reducing the pressures on terrestrial and marine environments, through sustainable management of: (i) commercial fish and shellfish; and (ii) soil health
	Improve access and engagement with natural environment	Improve access to and condition of green spaces, blue spaces and areas with specific landscape features
GHG	Climate mitigation through bio-carbon	Invest in land use to reduce greenhouse gas emissions and increase carbon sequestration as part of the UK's Net Zero commitment by 2050
	Enhance biosecurity	To protect native animals, and plants in the UK by preventing, managing and/or eradicating the spread of invasive species, animal disease and plant disease. Long-term risks may increase due to the impacts of climate change – resulting in more rapid spread of invasive species and/or disease(s).

Source: GFI, eftec and Rayment Consulting (2021)

In the GFI model, each outcome has at least one associated "nature-related output" (or "nature-related activity" as referred to in this report). A nature-related activity is a detailed type or category of spending under each of the seven broad nature outcomes. Some outcomes such as "clean water" are not broken down into more detailed activities, whereas other outcomes such as "enhance biosecurity" consist of multiple activities. Table 3 outlines and defines each nature-related activity across the seven nature outcomes using the definitions from the GFI model.

Table 4 then presents a breakdown of the estimated finance gap for Scotland for the period 2022 to 2032. Where a value is not presented (i.e. a blank cell), the GFI model did not determine a figure for the committed spending, required spending or finance gap for that particular nature-related activity. The finance gap was assessed as £0 for only one outcome ("Reduce flood risk") as the committed spending exceeded the required spending for the ten-year period[8]. The finance gap was indeterminate for one outcome ("Enhance biosecurity") due to data gaps. For each of the other five outcomes, the finance gap across any of the nature-related activities is aggregated at **£20.4 billion** and shown in the "overall gap" column.

The Scottish Government Nature Restoration Fund (NRF) is a multi-year £65 million fund that grants awards to projects focusing on wildlife and habitat restoration and / or addressing biodiversity loss and climate change. In an update to the GFI model, this study treats £65 million as additional committed spending under "Protect and / or restore biodiversity." The last two rows of Table 4 show totals across required spending, committed spending, finance gap and overall gap for both the 2021 GFI model estimates (GFI figures only) and the updated model (with GFI adjusted for additional NRF committed spend).

[8] For this outcome, the committed spend exceeded the estimated required spend. To avoid having a negative finance gap, it was replaced with £0.

Table 3: GFI nature-related outcomes and associated nature-related activities

GFI outcomes		Nature-related activities	Definition of nature-related activities
	Clean water	**No specific nature-related activities distinguished for this outcome**	
	Protect and/or restore biodiversity	**Increase and restore protected freshwater and terrestrial sites to favorable condition**	**Extend coverage of protected areas, restore protected sites to favorable condition and address pressures on species in the wider terrestrial environment**
		Create/restore priority habitats outside protected sites	Create and restore wildlife-rich habitats outside protected sites, with a focus on priority habits. Habitats include woodland, grassland, wetland, heathland, montane, inland rock and coastal habitats
		Protect endangered species	Protect endangered species through targeted site management of species' habitats
		Increase species abundance	Agri-environment measures to increase species abundance in addition to investments into priority habitats
		Woodland creation and management	Support planting of trees to increase and restore forest cover as well as manage existing woodlands to maintain their overall productive potential
		Peatland restoration	Bring all peatland into good (near natural) condition by restoring the degraded peatlands and managing the restored peat by 2040
		Increase the proportion of protected and well-managed seas	Manage pressures on the marine environment and limit damage by maintaining the network of marine protected areas (MPAs) across the UK, thereby tackling pressures such as over-exploitation, pollution and climate change
		Ensure populations of key marine species are sustainable*	Management of marine species – including cetaceans, seals, birds and fish
		Ensure seafloor habitats are healthy and sustainable	Restore deteriorated benthic (seafloor) habitats in the marine and coastal environments in order to increase carbon sequestration and enhance biodiversity
		Achieve Biodiversity Net Gain*	Spending to achieve net gains in biodiversity for land use and infrastructure investments

GFI outcomes		Nature-related activities	Definition of nature-related activities
	Reduce flood risk	**No specific nature-related activities distinguished for this outcome**	
	Improve bio-resource efficiency	Increase sustainability of fish stocks	Improve the sustainability of fishing practices and aquaculture in order to reduce their impact on the marine environment, and implement and enforce robust management measures to protect fish and shellfish stocks
		Sustainable soil management	Improve the sustainability of agriculture in order to improve the quality of degraded agricultural soil and prevent further deterioration
	Improve access and engagement with natural environment	Provide accessible green and blue space	Improve access and management of green and blue spaces, where maintaining and/or improving the quality of the natural asset is the primary outcome
		Safeguard and enhance landscape features	Improve condition of landscape features, including Areas of Outstanding Natural Beauty (AONB), field margins (on farmlands) and maintenance of historic sites
GHG	Climate mitigation through bio-carbon	**No specific additional nature-related activities distinguished for this outcome (key actions, e.g., woodland creation, peatland restoration, are covered under other outcomes)**	
	Enhance biosecurity	Reduce risks of invasive species*	Reduce the risk of entry and spread of invasive species in the UK. At least 49 such species are identified as priority for the UK.
		Reduce risks of animal disease	Reduce the spread and risks of animal disease and related costs
		Reduce risks of plant disease*	Reduce the spread and risks of plant disease and related costs

Source: GFI, eftec and Rayment Consulting (2021)

Notes:
(1) Nature-related activities for which no finance gap, required spending and/or committed spending was given for Scotland in the GFI model are indicated with a single asterisk (*).
(2) Nature finance gaps estimated in the GFI model can be divided into two types: a “specific” finance gap and an “overall” finance gap. The specific finance gap for a given nature-related outcome is derived by taking the difference between the assessed required spending and the committed spending for that outcome. The overall finance gap is an aggregate of all nature-related outcomes for a selected region (e.g., Scotland) and time period, with adjustment for overlaps between outcomes.

Table 4: GFI – Finance Gap for Nature Targets, Scotland (£m, 2022-2032)

GFI outcomes		Nature-related activities	By output/outcome (£m, 2022-2032)			Overall gap (£m, 2022-2032)
			Required spending	Committed spending	Finance gap	
	Clean water	**All clean water**	3,533	354	3,179	3,179
	Protect and/or restore biodiversity	Increase and restore protected freshwater and terrestrial sites to favourable condition	1,484			
		Create/restore priority habitats outside protected sites	1,352			
		Protect endangered species	323			
		Increase species abundance	772			
		Woodland creation and management	1,306	566		
		Peatland restoration	534	250	284	
		Increase the proportion of protected and well-managed seas	896	840	56	
		Ensure populations of key marine species are sustainable				
		Ensure seafloor habitats are healthy and sustainable	4,210		4,210	
		Achieve Biodiversity Net Gain				
		All biodiversity	10,877	2,005	8,230	6,542
	Reduce flood risk	Reduce risk of flooding through natural flood management	38	143	0	0

GFI outcomes		Nature-related activities	By output/outcome (£m, 2022-2032)			Overall gap (£m, 2022-2032)
			Required spending	Committed spending	Finance gap	
	Improve bio-resource efficiency	Increase sustainability of fish stocks	166	10	156	
		Sustainable soil management	400	80	320	
		All bio-resource	566	90	476	476
	Improve access and engagement with natural environment	Provide accessible green and blue space	939	1,099		
		Safeguard and enhance landscape features	1,352	36	1,316	
		All access and engagement with landscape	2,291	1,135	1,316	1,236
	Climate mitigation	Climate mitigation through bio-carbon	9,390	520	8,870	8,870
	Enhance biosecurity	Reduce risks from invasive species				
		Reduce risks of animal disease	400			
		Reduce risks of plant disease				
		All biosecurity				
		Total – GFI only	27,095	4,247	22,071	20,368
		Total – GFI and NRF	27,095	4,312	22,006	20,238

Note: For outcomes with multiple nature-related activities, the overall gap is a sum of finance gaps across the activities within that outcome. For some outcomes, the overall gap is adjusted for any overlap across the activities and outcomes to avoid double counting, e.g. safeguarding landscape features might simultaneously help protect biodiversity. For "Clean water" and "Reduce flood risk," the overall gap is a repeat of the finance gap shown for the single, aggregated nature-related activity. An overall gap is missing for "Enhance biosecurity" due to data gaps. The last two rows of Table 4 show totals across required spending, committed spending, finance gap and overall gap for both the GFI model (GFI figures only) and the updated model (with GFI adjusted for additional committed spend from the Nature Restoration Fund (NRF) which was not considered in the scope of the GFI study). For more information about the assumptions used in the GFI analysis please refer to the GFI Finance Gap for UK Nature Report: https://www.greenfinanceinstitute.co.uk/wp-content/uploads/2021/10/The-Finance-Gap-for-UK-Nature-13102021.pdf

At the outcome level, Table 4 shows that “Climate mitigation through bio-carbon” (approximately £8,870 million) and “Protect and / or restore biodiversity” (approximately £6,542 million) constitute the outcomes with the largest finance gaps in Scotland from 2022 to 2032.

Further details on GFI study data and extrapolation methods for Scotland can be found in the Appendix.

Description of drivers / enabling mechanisms for Scotland

The total finance requirements identified in Table 4 represent substantial potential spending. It is unrealistic to expect such an increase in finance to happen in a single year. Therefore, to understand the expected size and timing of spending to address the finance gap for nature, it was necessary to consider what might stimulate the relevant spending. This study developed a typology of Scotland-specific drivers and enabling mechanisms needed to foster private (and in some cases also public) investment into nature outcomes and activities.

Table 5 presents definitions of selected drivers and mechanisms identified as relevant to Scotland.

Table 5: Definitions of drivers and enabling mechanisms for Scotland

Drivers/enabling mechanisms	Definition
Rewilding	Comprehensive conservation effort focused on restoring sustainable biodiversity and ecosystem health by protecting core wild/wilderness areas, providing connectivity between such areas, and protecting or reintroducing apex predators and highly interactive species (David Foreman and The Rewilding Institute, n.d.)
Voluntary biodiversity credits	An economic instrument used to finance activities that deliver net positive biodiversity gains. Unlike carbon or biodiversity offsets, which are payments made by a business to compensate for its damaging impacts on location-specific ecosystems, biodiversity credits allow companies to support nature-positive action, funding long-term conservation and restoration of nature (World Economic Forum, 2022)
Peatland Code	The voluntary certification standard for UK peatland projects providing assurances to voluntary carbon market buyers that the climate benefits being sold are real, quantifiable, additional and permanent (IUCN UK Peatland Programme, n.d.)
Woodland Carbon Code	The quality assurance standard for UK woodland creation projects that generates high integrity, independently verified carbon units (Woodland Carbon Code, n.d.)
Catchments	Catchment management initiatives aimed at sustainable use of a catchment’s water resources, including flood management, water pollution and river engineering (NatureScot, 2023)
Product Certification	The provision by an independent body of written assurance (a certificate) that the product in question meets specific requirements (International Organization for Standardization, n.d.)

Drivers/enabling mechanisms	Definition
	For instance, a move towards product certification in the fisheries sector would indirectly reduce the finance gap by crowding in investment and other forms of spend towards sustainable fishing.
Natural flood management	Restoring a catchment's wetlands, floodplains and woodlands to slow the flow of water and store water, thereby increasing the natural capacity to deal with floods to help manage flood risk (NatureScot, 2023)
Nature Restoration Fund (NRF)	A competitive £65 million fund launched by the Scottish Government in 2021 encouraging applicants with projects that restore wildlife and habitats on land and sea and address the twin crises of biodiversity loss and climate change (NatureScot, 2023)

Sources: (1) David Foreman and The Rewilding Institute, What is Rewilding? (n.d.). (2) World Economic Forum, How biodiversity credits can deliver benefits for business, nature and local communities (2022). (3) IUCN UK Peatland Programme, Introduction to the Peatland Code (n.d.). (4) Woodland Carbon Code, UK Woodland Carbon Code (n.d.). (5) NatureScot, Catchment management (2023). (6) (International Organization for Standardization, Certification (n.d.). (7) NatureScot, Flood management (2023). (8) NatureScot, Scottish Government Nature Restoration Fund (NRF) (2023).

Figure 3 presents a classification of natural capital markets and mechanisms from non-public sector entities for Scotland. In this study, market structures are broken down into "current" and "potential". Current market structures are those that are presently implemented and functioning whereas potential market structures are those that are still in concept or development stages. Regulated sectors are those that are subject to some form of regulatory oversight. Finally, other private sector investment covers investment from private sources that are not part of a formal market structure. Note that the figure presents a subset of drivers and enabling mechanisms, which also include policy and other mechanisms.

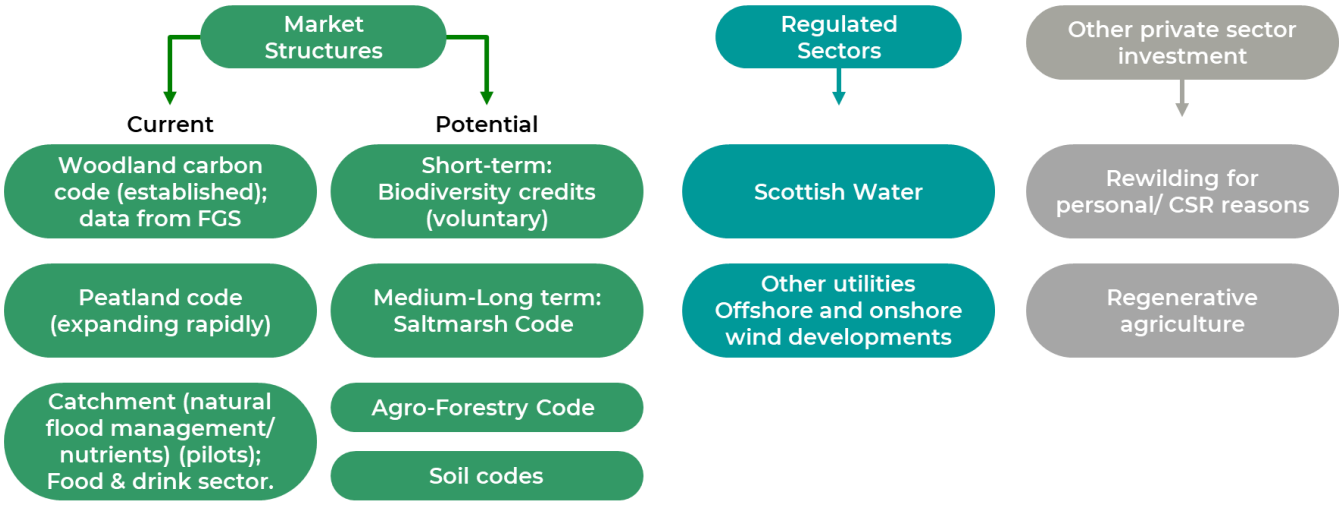


Figure 3: Outline of natural capital markets and mechanisms in Scotland

Table 6 pertains to drivers and mechanisms across the GFI outcomes and associated activities that are relevant to Scotland. By and large, these tend to support multiple outcomes. For instance, voluntary biodiversity credits can be used towards multiple nature-related activities in the biodiversity outcome, but may also be relevant to the "Provide accessible green and blue space" activity which falls under the nature-related outcome "Improve access and engagement with natural environment." Similarly, Woodland Carbon and Peatland Codes can contribute to all nature-related activities, barring any marine-specific ones, across the seven outcomes. This is because many of the nature-related outcomes are interrelated at a high level (i.e. spending may contribute to multiple outcomes).

Table 6: GFI outcomes and associated nature-related activities and drivers and enabling mechanisms

GFI outcomes		Nature-related activities	Drivers/enabling mechanisms
	Clean water	All clean water	Regulated sector / catchments
	Protect and/or restore biodiversity	Create/restore priority habitats outside protected sites	Rewilding/ voluntary biodiversity credits
		Protected endangered species	Rewilding/ voluntary biodiversity credits
		Increase species abundance	Voluntary biodiversity credits
		Woodland creation and management	Woodland Carbon Code / Rewilding/ voluntary biodiversity credits
		Peatland restoration	Peatland Code / rewilding
		Increase the proportion of protected and well-managed seas	Rewilding/ voluntary biodiversity credits
		Ensure populations of key marine species are sustainable	Voluntary biodiversity credits
		Ensure seafloor habitats are healthy and sustainable	Rewilding/ voluntary biodiversity credits
		Achieve biodiversity net gain	Voluntary biodiversity credits
	Reduce flood risk	Reduce risk of flooding through natural flood management	Catchment/ NFM/ Regulated Sector
	Improve bio-resource efficiency	Increase sustainability of fish stocks	Product certification. Possibly voluntary biodiversity credits
		Sustainable soil management	Agri policy/ regulations TBC. Possible carbon code.

GFI outcomes		Nature-related activities	Drivers/enabling mechanisms
	Improve access and engagement with natural environment	Provide accessible green and blue space	Possible overlap with biodiversity credits
	Climate mitigation through bio-carbon	Climate mitigation through bio-carbon	Peatland Code / Woodland Carbon Code / other codes in development

Notes: (1) This is a subset of drivers and enabling mechanisms, which also include policy, regulatory and other mechanisms. (2) The table provides the list of drivers and enabling mechanisms only for the outcomes/ nature-related activities for which the finance gap was estimated in the GFI model. (3) “Enhance biosecurity” is not shown in this table as it is the only outcome with one aggregate indicator. No drivers and enabling mechanisms were identified for this outcome due to data gaps in the GFI model.

Scale & Size of Investment

Using the adapted GFI model, the project team estimated the required scale of investment in nature objectives for Scotland by linking the nature-related activities, drivers and enabling mechanisms, from the previous section, to different funding categories and their assumed time horizons.

The overall confidence rating for estimations of scale and size of investment in this section is 'moderate' due to assumptions, data gaps and other uncertainties or risks (e.g., rapidly expanding markets). This implies that the results presented in the section should be interpreted with caution. Specific assumptions made in the model for this project are explained below, whenever appropriate to the discussion.

Modelling funding categories and time horizons

The time horizon of this study is 10 years (between 2022-2032), which is in line with the time horizon of the finance gap in the 2021 GFI study. Nevertheless, the GFI study estimated only the value of investment required to achieve the core nature outcomes; it did not determine how and at which point in time the finance gap would start to be actively decreased through private market investments (i.e. beyond the public committed spending identified at the time). As a result, for the purpose of this study, the GFI finance gap per activity had to be adjusted to reflect the anticipated current and future market developments (i.e. such as through the public and private drivers / enabling mechanisms identified in the previous chapter).

To achieve this, the size and timing of spending to close the finance gap over the next 10 years was estimated for each nature-related activity. The timing category assigned aimed to reflect the maturity of the relevant drivers and enabling mechanisms in Scotland. Where possible, areas of spend were mapped onto and across specific time periods – this detailed mapping was based on the collective knowledge of the project team and expert stakeholders who provided input on modelling assumptions for the GFI model adapted for Scotland during the February 2023 workshop.

The range of different timings and assumptions for the drivers and enabling mechanisms applied in the study for Scotland covered:

- Mechanisms that are ready to operate and scale up, and are assumed to increase within five years. Example mechanisms within this category are the Woodland Carbon Code and Peatland Code which are already in existence across the UK. These codes are voluntary quality assurance and certification standards which are already operational and issue verifiable carbon credits for new woodland creation and peatland restoration projects, respectively, in Scotland and the rest of the UK.

- Mechanisms that are in development but still several years from being ready due to further R&D being required. These are assumed to increase spending during the middle of the 10-year period. Example mechanisms include voluntary biodiversity credits, which are currently in the early development stages in Scotland[9].
- Mechanisms with unclear development pathways that will primarily increase beyond Year 10. The precise form of these mechanisms still has uncertainties, and so they only stimulate increased spending towards the end of the 10-year period at best.

Appendix A, Table A.1 shows detailed timing assumptions for each nature-related activity across all outcomes. These detailed assumptions account for granularity in assumed timing of spending. For instance, the project team determined that the nature-related activity "Sustainable soil management" is expected to increase in Year 3, which falls within the first timing assumption category (increase within five years).

Modelling and funding assumptions

Different market-related mechanisms have different rates of maturity and / or expected rate of development. With overlaps, scale and timing assumptions, the project team was able to model the expected future financial investment into nature recovery.

Final assumptions used to estimate the total anticipated reduction in the finance gap per nature-related activity are shown in Table 7. Participant input from the workshop in February 2023 helped to refine these timing assumptions and to identify and match nature-related activities with the appropriate drivers and enabling mechanisms for Scotland.

In Table 7, the last column reports the reduction in the finance gap that is expected to be addressed until 2032 through the drivers and enabling mechanisms identified for each activity. The potential predicted reduction totals **£11.7 billion** and covers 58% of the overall finance gap for Scotland[10]. This leaves an estimated outstanding finance gap for the period 2022-2032 of **£14.6 billion**[11].

[9] Overview of CivTech 8 challenge on designing biodiversity credits and enabling investment in Scotland's nature found here.

[10] Adjusted for NRF funding.

[11] The £14.6bn figure is derived by subtracting the modelled **investment to address the finance gap** over the period 2022-2032 (committed spend in Table 4 + the anticipated reduction in the finance gap via drivers and enabling mechanisms in Table 7) from the **total required spending** to achieve nature outcomes (GFI upper estimate of £27bn in Table 4). The total **finance gap investment** considered in this study is £12.5bn (which excludes £3.4bn reduction in the finance gap for marine and coastal activities as these are not covered in the economic model outlined in the next chapter).

Note that as some of the drivers and enabling mechanisms are assumed not to be ready to be implemented with an immediate effect, they can only help address the nature-related activity finance gaps shown in Table 4 during part of the 10-year timescale[12]. Hence, despite the assumption that the annual maximum reduction in the finance gap per outcome can be equal to a tenth of the total finance gap estimate for this outcome (i.e. each year the gap can be reduced by an equal amount (in real terms) across the 10-year period[13]), the annual reduction can start occurring at a different point in time depending on each outcome. For instance, the finance gap for "All clean water" is £3,179 million from 2022-2032 for Scotland in the GFI model, but the estimated reduction in the finance gap expected through the drivers and enabling mechanisms listed for that activity is £954 million (as the market mechanisms and other drivers for this outcome will not be ready before Year 6 over the 10-year time span, see "Timing assumed" in Table 7). Similarly, the finance gap for "Sustainable soil management" is £320 million, but the estimated reduction in the finance gap expected is £256 million (as the drivers and enabling factors are not ready to be implemented with an immediate effect).

For some spending, new / updated commitments have been made since the GFI model was developed. For example, the Scottish Government Nature Restoration Fund (NRF) has committed £65 million over a ten-year period[14]. As this spending is already committed, it reduces the finance gap estimated in the GFI model for Scotland from 2022-2032.

Certain nature-related activities show a finance gap of "Unknown" because the GFI model was not able to produce a finance gap based on a missing required and/or committed spending figure for that nature-related activity. There was one nature-related activity ("Reduce risk of flooding through natural flood management") for which the finance gap is £0 as the committed spend exceeds the assessed required spend.

The modelling and funding assumptions and final finance gap estimates outlined in Table 7 are used in the subsequent sections to model the expected socio-economic impacts of anticipated investment in nature in Scotland.

[12] Note that the 10-year assessment period starts in 2022 and ends in 2032. Hence, at the time of this report's publication, the remaining time to realise the outstanding 48% of the overall finance gap is 8.5, rather than full 10 years.

[13] Note that it is also assumed that the reduction in the finance gap cannot exceed the annual market capacity per outcome, meaning that the outstanding finance gap cannot be addressed retrospectively. For example, if the drivers and enabling mechanisms for a given outcome can only be implemented in Year 3, this means that approximately 80% of the finance gap can be feasibly reduced (i.e. the potential finance gap reductions in Year 1 and Year 2 are bygone and cannot be compensated for in the future).

[14] The model accounts for £10 million in funding in Year 1 followed by £13.5 million each year over the following four years. In the model it is assumed that funding for the Nature Restoration Fund will continue beyond the initial five-year period to Year 10.

Table 7: Timing assumption and finance gap by nature-related activity and driver and enabling mechanism

Status of mechanism	Timing assumed	Nature-related activities	Drivers/enabling mechanisms	Reduction in finance gap (£m, 10 yrs)
Ready to operate/ scale up	**Increase within 5 years**	Create/restore priority habitats outside protected sites	Rewilding/ voluntary biodiversity credits	*Unknown*
		Woodland creation and management	Woodland Carbon Code / Rewilding/ voluntary biodiversity credits	£740
		Peatland restoration	Peatland Code / rewilding	£284
		Ensure seafloor habitats are healthy and sustainable	Rewilding/ voluntary biodiversity credits	£3,368
		Sustainable soil management	Agri policy/ regulations TBC. Possible carbon code.	£256
		Climate mitigation through bio-carbon*	Woodland Carbon Code, Peatland Code, Saltmarsh, Hedgerow & Agro-forestry Codes	£5,026
		Increase the proportion of protected and well-managed seas	Rewilding/ voluntary biodiversity credits	*Unknown*
In development but several years until ready	**Increase in Years 6-10**	Protect endangered species	Rewilding/ voluntary biodiversity credits	*Unknown*
		Increase species abundance	Voluntary biodiversity credits	*Unknown*
		Ensure populations of key marine species are sustainable	Voluntary biodiversity credits	*Unknown*
		Achieve biodiversity net gain	Voluntary biodiversity credits	*Unknown*
		All clean water	Regulated sector / catchments	£954
		Reduce risk of flooding through natural flood management	Catchment/ NFM/ Regulated Sector	£0
		Increase sustainability of fish stocks	Product certification. Possibly voluntary biodiversity credits	£47

Status of mechanism	Timing assumed	Nature-related activities	Drivers/enabling mechanisms	Reduction in finance gap (£m, 10 yrs)
		Climate mitigation through bio-carbon*	Soil Code	£887
Development pathway unclear	**Increase mainly beyond Year 10**	Safeguard and enhance landscape features	*Unknown*	£132

Notes:
(1) Some nature-related activities are excluded from this table as the timing assumption was indeterminate.
(2) The nature-related activity "climate mitigation through bio-carbon", indicated with a single asterisk (*), was broken down into two timing assumptions in this table as the status and timing of the various drivers and enabling mechanisms within the activity vary.
(3) The last column on reduction in finance gap shows estimates of figures that are not discounted.

Economic impact of nature related markets and investments

The environment-economy model

The environment-economy model was generated in Microsoft Excel using the results of the natural capital market review, stakeholder engagement and desktop review. The model uses input data (amount of investment in pounds or area in hectares) on the different natural capital interventions to estimate the economic benefit from the proposed investment in a given region or portfolio. The economic impacts of the natural capital investment portfolio are then reported by the natural capital interventions and summarised accordingly to the different SIC codes and by GFI outcomes.

The environment-economy model process is show in Figure 4 below.

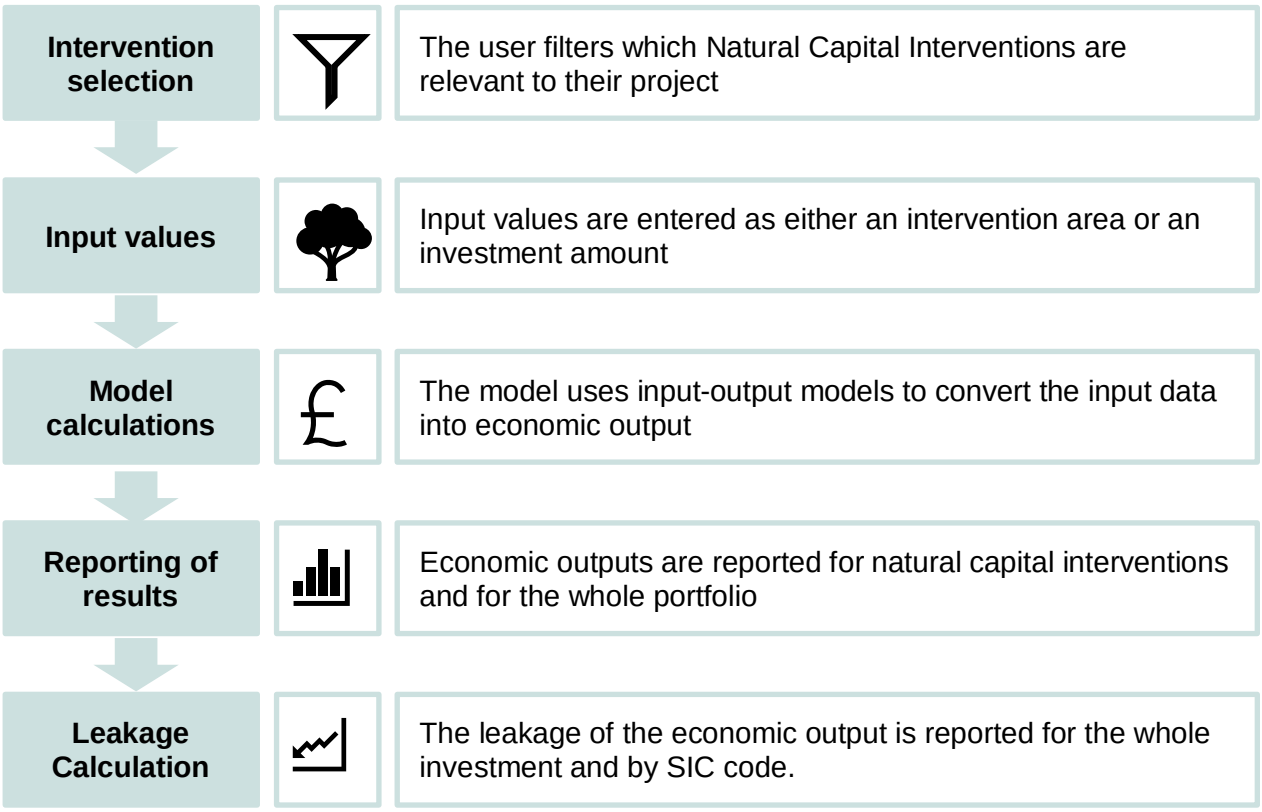


Figure 4: Environment-Economy model diagram

The environment-economy model in this project built on the work undertaken as part of the previous Scottish Government project on "Understanding the local economic impacts of natural capital investment" (2022)[15] by using the input-output models developed in the 2022 project to link the quantity of investment in natural capital to economic impacts.

The previous input-output models provide a comprehensive list of potential component activities within each natural capital activity (what is termed a natural capital intervention in this report) and assigned an expected cost, dependent on the intervention characteristics. Using a fixed set of assumptions, the environment-economy model used the outputs provided in the input–output models to estimate the economic impact from a user-defined set of natural capital interventions and then summarises the results to demonstrate where there is overlap between investment-specific activities across the different natural capital interventions and GFI outcomes. In addition, likely job leakage was reported for each component activity included in the model.

Environment economy model guide

For this project, one overarching environment-economy model has been developed and should be used in the same manner. However, the results produced will be unique depending on the input values (area in hectares, investment in £) and the cost values entered into the reference sheets.

The model contains 19 separate sheets shown below in Table 8:

Table 8: Model Contents

Sheet Number	Model Name
01	Readme' instruction sheet;
02	Data input sheet;
03	Summary sheets;
04	An Overall results summary sheet;
05	A detailed summary Sheet;
06	A GFI Investment Category Breakdown;
07	Natural Capital Intervention sheets;
08	Woodland creation and management sheet;
09	Peatland restoration sheet;
10	Overall Regenerative Agriculture;
11	Coastal Restoration;

[15] Scottish Government, 2022, Understanding the local economic impacts of natural capital investment report: https://www.gov.scot/publications/understanding-local-economic-impacts-natural-capital-investment /

Sheet Number	Model Name
12	Woodland Management Peatland Management;
13	Regenerative Agriculture Management;
14	Coastal Management;
15	Catchment-based approach to clean water;
16	River re-naturalisation & NFM;
17	Regenerative Agriculture - Soil Health;
18	Access creation; and
19	The reference data.

Further information on the different elements of the model and how to interpret them is provided in Appendix B. Screenshots from the model have been included for illustrative purposes. However, this part of the report is best read in conjunction with the models themselves, which are available as standalone supporting documents to this Final Research Report.

Mapping GFI outcomes to the environment-economy model

The relationship between the GFI outcome categories and the different types of natural capital interventions was established through desktop review and expert opinion. The outcomes of the analysis and the GFI categories that each natural capital intervention contributes to are shown in Table 9**Error! Reference source not found.**. This matrix means that the model can summarise economic outputs by each GFI outcome.

Table 9: Natural Capital Interventions and the GFI categories

Natural Capital Interventions	GFI outcome category						
	Protect and / or restore biodiversity	Clean water	Reduce flood risk	Improve bio-resource efficiency	Improve access and engagement with natural environment	Climate adaptation through bio-carbon	Biosecurity
Woodland Creation & Management	✓	✓	✓			✓	
Peatland Restoration	✓	✓	✓			✓	
Overall Regenerative Agriculture	✓						✓
Coastal Restoration	✓					✓	

Natural Capital Interventions	GFI outcome category						
	Protect and / or restore biodiversity	Clean water	Reduce flood risk	Improve bio-resource efficiency	Improve access and engagement with natural environment	Climate adaptation through bio-carbon	Biosecurity
Woodland Management	✓	✓			✓		✓
Peatland Management	✓	✓			✓		✓
Regen Agriculture Management	✓						
Coastal Management	✓				✓		
Catchment-based approach to clean water	✓	✓					
River re-naturalisation & NFM	✓		✓				
Regenerative Agriculture - Soil Health	✓			✓			
Access creation					✓		

As part of the project, an analysis was run to estimate the potential economic impacts of a hypothetical portfolio of natural capital investment that could address the full GFI nature finance gap for Scotland until 2032 (the 'finance gap investment' as per the previous chapter). This was to provide an illustrative example of model functionality. The assessment used the required spend values identified in Chapter 2 as input for the models (i.e. £ of investment). To estimate the potential economic output of the total investment in the different GFI categories in the model, the total investment amount for each GFI outcome was apportioned across all relevant natural capital interventions equally. The total investment amount combines committed public investment and the additional investment that would be required to address the finance gap. Committed public investment (see Table 4) assumes public investment is certain and therefore can be modelled. The reduction in the finance gap is measured by the GFI finance gap figures over 10 years (see Table 7)[16] to give a total value. The input values used in the model are shown in Table 10. The area / distance created values were generated from the investment amount using the predetermined ratios in the references data.

[16] It should be noted that the figure for the reduction in the finance gap covers a ten-year period. Due to the introduction of the timing assumptions reflecting the fact that some NC markets (or drivers / enabling factors) will not be implemented instantly (i.e. in year 1), it is realistic to

Table 10: Input values used to model the economic benefits of investment to address the full GFI finance gap for Scotland 2022-2032

Natural Capital Intervention[17]	Investment Amount (£bn)			Area / distance created (Ha/m)
	Short-term	Medium-term	Long-term	
Woodland Creation & Management	£0.93	£1.37	£0.43	544,128
Peatland Restoration	£0.93	£1.37	£0.43	354,562
Overall Regenerative Agriculture	£0.12	£0.13	£0.03	126,479
Coastal Restoration	£0.87	£1.20	£0.35	486,155
Woodland Management	£0.26	£0.42	£0.18	413,221
Peatland Management	£0.26	£0.42	£0.18	1,988,849
Regenerative Agriculture Management	£0.11	£0.13	£0.03	458,621
Coastal Management	£0.22	£0.26	£0.11	166,724
Catchment-based approach to clean water	£0.14	£0.29	£0.10	1,114,418
River re-naturalisation & NFM	£0.14	£0.15	£0.04	36,467
Regenerative Agriculture - Soil Health	£0.23	£0.28	£0.12	197,019
Access creation	£0.03	£0.05	£0.24	10,558,333
Total[18]	**£4.20**	**£6.07**	**£2.22**	**N/A**

assume that only a portion of the finance gap per activity will be reduced within the next 10 years.

[17] Short, medium and long term assumed to be years 1 to 5, years 6-9 and years 10/onwards, aligned with previous funding assumptions. GFI outcome funding is then accordingly mapped onto natural capital interventions.

[18] May not sum up to exactly the same total amount due to rounding issues.

Results from the modelling show that the public and private investment required to address the GFI nature finance gap for Scotland of **£12.5bn** would generate an estimated output effect of £17 billion into the Scottish economy, meaning that every £1 invested would generate £1.35 for the economy. In terms of jobs, the potential economic impact could be 146,020 direct and 197,380 direct and indirect jobs created or existing jobs sustained. These jobs are likely to be in industries such as silviculture, renting and leasing of agricultural machinery and equipment, and support services to forestry and hunting. These economic benefits are, of course, additional to the many wider social and environmental benefits that would accrue from such a significant investment in nature restoration. These wider benefits would be reflected over time in measures within the Scottish Natural Capital Accounts[19] (NCA) and the Natural Capital Asset Index[20] (NCAI).

Table 11 shows the capital expenditure, jobs and output effect broken down by SIC industry codes. The largest output effect was within the SIC category 2.1: 'Silviculture and other forestry services' with a value of £4.4 billion and 66,990 direct and indirect jobs created or existing jobs sustained. The other major SIC categories were 'Renting and leasing of agricultural machinery and equipment' and 'Support services to forestry'.

Table 11: Capital expenditure, jobs and output effect broken down by SIC industry codes

SIC Industry	Capital Expenditure (£bn)	Jobs (Direct & Indirect)	Output Effect (£bn)
Environmental consulting activities	£0.16	3,269	£0.21
Renting and leasing of agricultural machinery and equipment	£2.46	39,257	£2.98
Support services to forestry	£2.48	34,674	£3.40
Wholesale of agricultural machinery, equipment and supplies	£1.24	17,797	£1.65
Construction of other civil engineering projects	£0.39	7,865	£0.60
Silviculture and Other	£4.40	66,990	£6.00
Hunting, trapping and related service activities	£0.63	12,531	£0.95
Logging	£0.14	2,864	£0.24
Other professional, scientific and technical activities (not environmental consultancy)	£0.05	1,080	£0.07
Support activities for crop production	£0.50	9,959	£0.76

[19] Scottish Natural Capital Accounts 2022 - gov.scot (www.gov.scot)

[20] Natural Capital Asset Index | NatureScot

SIC Industry	Capital Expenditure (£bn)	Jobs (Direct & Indirect)	Output Effect (£bn)
Construction of water projects	£0.05	1,094	£0.08
Total[21]	**£12.53**	**197,380**	**£16.95**

Of the 197,380 direct and indirect jobs, 190 jobs may be leaked outside of Scotland. Although this is a small percentage of the total jobs created as part of the investment, investment in appropriate local training and skills provision could better position the region or Scotland to better retain these jobs within Scotland. However, leakage of jobs following natural capital investment in regional economies in Scotland is likely to be much more significant, as explained in the next chapter. Table 12 shows the output effect arising from the natural capital intervention phased over the short, medium and long term.

Table 12: Natural capital interventions by output effect and time horizon

Natural capital intervention	GFI		
	Output Effect (£bn)		
	Short	Medium	Long
Woodland Creation & Management	£1.29	£1.90	£0.59
Peatland Restoration	£1.20	£1.77	£0.55
Overall Regenerative Agriculture	£0.16	£0.17	£0.04
Coastal Restoration	£1.16	£1.61	£0.47
Woodland Management	£0.38	£0.62	£0.26
Peatland Management	£0.33	£0.54	£0.23
Regenerative Agriculture Management	£0.17	£0.20	£0.05
Coastal Management	£0.30	£0.36	£0.15
Catchment-based approach to clean water	£0.19	£0.38	£0.13
River re-naturalisation & NFM	£0.18	£0.19	£0.05
Regenerative Agriculture - Soil Health	£0.31	£0.38	£0.16
Access creation	£0.04	£0.08	£0.37
Total[22]	**£5.71**	**£8.19**	**£3.01**

[21] May not sum up to exactly the same total amount due to rounding issues.

[22] May not sum up to exactly the same total amount due to rounding issues.

Table 13 shows the jobs effect arising from the natural capital intervention phased over the short, medium and long term.

Table 13: Natural capital interventions by overall job effect and time horizon

Natural capital intervention	GFI		
	Jobs (Direct + Indirect)		
	Short	Medium	Long
Woodland Creation & Management	13,935	20,551	6,364
Peatland Restoration	14,617	21,557	6,675
Overall Regenerative Agriculture	1,870	1,989	497
Coastal Restoration	13,524	18,731	5,471
Woodland Management	4,555	7,374	3,096
Peatland Management	3,890	6,297	2,644
Regenerative Agriculture Management	2,168	2,584	646
Coastal Management	3,318	4,019	1,690
Catchment-based approach to clean water	2,156	4,333	1,524
River re-naturalisation & NFM	2,173	2,310	578
Regenerative Agriculture - Soil Health	3,642	4,411	1,855
Access creation	516	1,033	4,789
Total[23]	**66,363**	**95,189**	**35,829**

The following table provides a breakdown of the cost per hectare (or meters, in the case of access creation) for each natural capital intervention. The table shows that the highest cost per hectare is for river re-naturalisation and natural flood management (£8,858 per hectare), followed by peatland restoration (£7,697 per hectare), while the cost is lowest for access creation (£30 per meter).

Table 14: Cost per hectare by natural capital intervention

Natural capital intervention	Investment per Ha/meters
Woodland creation & management	£5,015
Woodland management	£2,066
Peatland restoration	£7,697
Peatland management	£429
Coastal restoration	£4,977
Regenerative agriculture management	£600
Regenerative agriculture – soil health	£3,154

[23] May not sum up to exactly the same total amount due to rounding issues.

Natural capital intervention	Investment per Ha/meters
Overall regenerative agriculture	£2,177
Coastal management	£3,551
River re-naturalisation and natural flood management	£8,858
Catchment approach to clean water	£482
Access creation	£30

Note: The costs for each natural capital intervention are based on previous calculations undertaken for the report Understanding the local economic impacts of natural capital investment. No further investigations into the cost per hectare were undertaken for this study.

Model interpretation, accuracy and assumptions

In summary, the environment-economy model converts either the total investment (£) or area of land (ha) inputted in by the user for a range of natural capital interventions into economic impacts (jobs and output metrics).

The expected investment (£) to intervention area (ha) ratio used to generate these relationships was taken from the input-output models generated as part of the previous Scottish Government project "Understanding the local economic impacts of natural capital investment" (2022) and are therefore reliant on their accuracy.

The model converts the expenditure on natural capital interventions into the economic impacts within a particular region or the whole of Scotland (as shown in the example) including the output effect, which is defined as the ripple effect of the expenditure through the supply chain. This ripple effect is measured by multipliers used within the Input-Output tables. Multipliers are measures of the way in which an increase in activity by one firm will lead to an increase in activity by other related firms. For example, the contractor who installs deer fencing buys timber, the timber merchant buys new tyres for their trucks, all the firms' workers spend their wages on food or consumer goods, and so forth. Hence, the output effect captures the direct and indirect impact of any investment in the economy. Direct and indirect jobs are calculated by multiplying the employment effect multiplier with investment and output effect respectively.

It should be noted that the model treats investment as a one-off injection of capital rather than a profile of investment over time, so as the economic impacts are timebound, many of the jobs estimated within the model may be temporary / relatively short-term during the creation or restoration of the habitat in question. The model does allow for the investment to be in the short, medium or long term future in line with the GFI assumptions. A proportion of jobs will, however, be permanent and these are often captured within the maintenance and management activities listed within each intervention.

The environment-economy model was developed using the best available information and standard cost rates for each individual activity required as part of each overall natural capital intervention. This was done using an average value for the whole of Scotland using data from stakeholder engagement and literature reviews. The values within the model represent an average of the cost for each activity across a variety of factors including the scale of the intervention, the geographical location and socio-economic context.

The environment-economy model allows the user to replace or supplement the existing cost data and job types with regional-level information which would modify the relationship between the site characteristics and the magnitude of each activity. This will enable users to ensure the model is appropriate to the scenario they wish to assess. However, justification should be provided whenever elements of the reference data sheet are edited.

As part of this project the economic environment linkages for the marine GFI outcomes within the different natural capital interventions have been excluded from the overall environment-economy model. This exclusion was required due to the lack of detailed input-output models for marine natural capital interventions such as were available for the terrestrial natural capital activities. This lack of information was due to the special nature and greater uncertainty within the marine environment. In addition, the marine environment was not included within the previous Scottish Government project “Understanding the local economic impacts of natural capital investment” (2022). It was therefore beyond the scope of this project to generate primary values for the economic environment linkages within the marine environment for use in the overall environment-economy model.

The inclusion of the marine environment provides a suitable avenue for further research and development to build on the work done as part of this project. Further work could be undertaken to develop input-output models for the marine activities mentioned in the GFI outcomes, such as “Ensure seafloor habitats are healthy and sustainable”.

The model is anticipated to support early-stage business cases and provide an initial estimate of the investment, output effect and number of jobs created by natural capital investment. However, it should not be used to support full business case analysis of local level projects without additional information.

Applying the model to regional case studies

To ensure that the GFI and environment-economy models are fit for purpose, and to demonstrate their capabilities, the models were applied to three case studies in Scotland.

The three case studies cover different combinations of natural capital interventions and with different scales of capital investment involved. They were identified through collaboration with the project steering group and desk review of a longer list of potential case studies. A brief description of the three case studies is provided in the next section and the main economic findings (quantitative) are given below.

Depending on data availability within each region, the environment-economy model has been applied to an entire region for some case studies, and to a selection of projects in others. For example, the model has been applied regionally to the Loch Lomond and the Trossachs National Park (LLTNP), whereas, for the South of Scotland and the City of Edinburgh, it was applied to a selection of projects only. It was important to ensure representation of both rural and urban contexts across case studies, hence the application of the model to rural (LLTNP and South of Scotland) and urban (City of Edinburgh) contexts.

Figure 5 below provides a summary of the economic impact results for each case study. The output effect is always greater than capital expenditure and represents the indirect impact of any capital expenditure on natural capital projects in the regional economy. The potential number of jobs created by the capital expenditure and the output effect is shown as the direct jobs and direct plus indirect jobs, respectively.

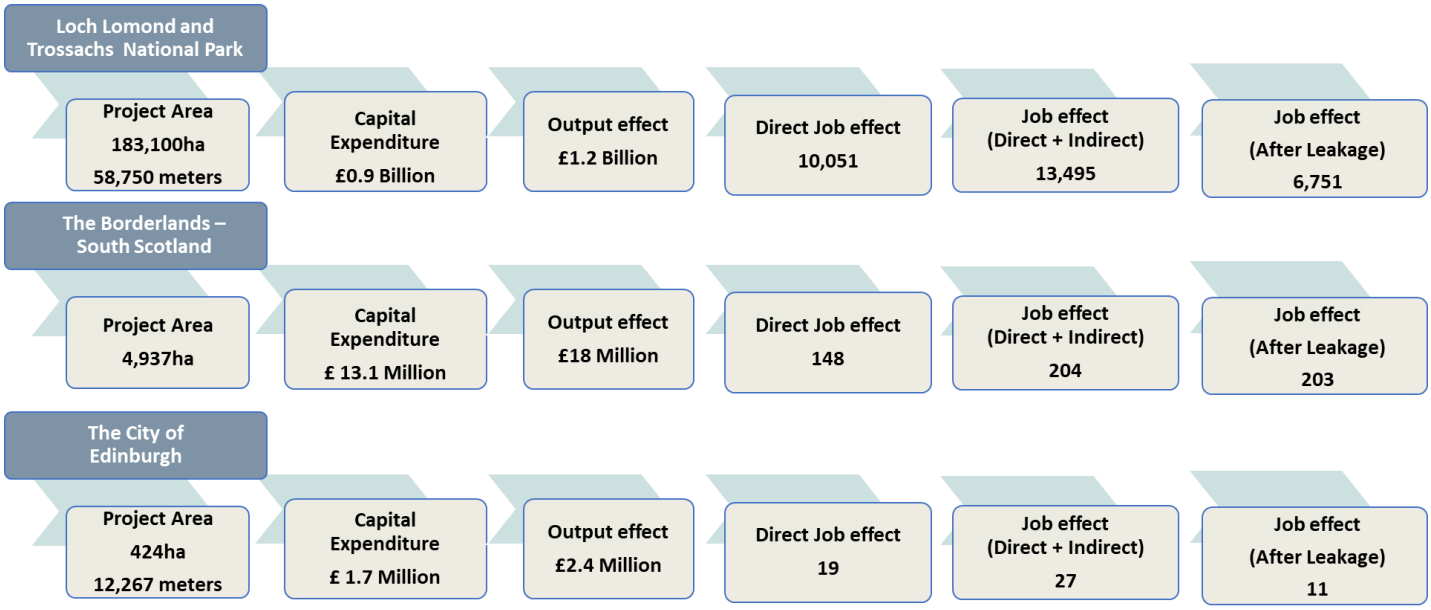


Figure 5: Summary of application of environment-economy model to case study regions

There are differing natural capital interventions in each of the case studies resulting in differing output effects. Edinburgh creates the highest investment-output ratio at 1.41, where for every £1 invested £1.41 could be generated in the local economy. This is followed by South Scotland at 1.38, and Loch Lomond and The Trossachs National Park at 1.35. This is predominately due to the natural capital interventions in which the investment is focussed, with access creation having a greater investment-output ratio than others due to the component activities such as construction having a higher output effect.

The net jobs created across all three case studies is comparatively high with approximately 16 jobs created per £1 million invested. Some of the jobs created will be temporary but a proportion will be permanent. Jobs related to maintenance and management are the most likely to be permanent.

Table 15: Value for money of investment by case study

Case study	Investment	Output-Investment ratio	Jobs-investment ratio (per £1 million invested)
Loch Lomond and The Trossachs National Park	£900 Million	1.35	15.7
South of Scotland	£13 Million	1.38	15.6
City of Edinburgh	£1.7 Million	1.41	16.1

Investment in natural capital across the three case studies ranges from between £1.7 million and £0.9 billion, covering an area between 424ha and 183,100ha (the greatest investment in £ and area is in the LLTNP case). The natural capital investment generates an output effect ranging between £2.3 million and £1.1 billion, between 19 and 10,051 direct jobs generated, and between 27 to 13,495 direct and indirect jobs created.

The City of Edinburgh has the highest output-investment ratio as a result of a greater proportion of their investment spend in higher output multiplier related SIC codes. For example 22% of investment falls within the construction of other civil engineering projects, which has one of the highest associated output multipliers.

Potential areas of skills shortage or gaps were analysed to find likely areas of job leakage, and potential regions in Scotland and outside of Scotland to which these jobs could be leaked. The following electoral regions were used to evaluate job leakages: Central Scotland, Glasgow, Highlands and Islands, Lothian, Mid Scotland and Fife, North East Scotland, South Scotland and West Scotland. The case studies encompass the regions West Scotland, South Scotland and Lothian[24].

[24] Source of data: Business Register and Employment Survey (2021)

Given the type of natural capital interventions in the Borderlands, the leakage effect is negligible with most jobs likely to be absorbed in the region. However, Loch Lomond and the City of Edinburgh are more likely to experience leakage to surrounding regions, given their lack of relevant specialisms in the types of natural capital interventions required. Loch Lomond and the City of Edinburgh are likely to experience leakage to other regions of 59% and 50% of direct and indirect jobs, respectively.

All three case studies require substantial labour inputs, which is a good indicator that they will support local jobs. However, some of the jobs are desk based and can be provided in any location.

Table 16: Input expenditure breakdown by case study

Case study	Labour	Transportation / machinery	Materials	Products
Loch Lomond and the Trossachs National Park	62%	27%	11%	0%
South of Scotland	61%	3%	36%	15%
City of Edinburgh	77%	6%	17%	0%

Table 17 presents the natural capital interventions disaggregated by investment amount and time horizons for each case study. Approximately 11.6%, 52.7% and 100% of the total investment for Loch Lomond, South of Scotland and Edinburgh respectively is likely to happen in the short term. The majority of investment in Loch Lomond is assumed to be in the medium-to-long term given the physical scale of the Park and corresponding time to achieve natural capital goals. All investment timelines (South of Scotland and Edinburgh) or hectarage goals (Loch Lomond) were obtained through stakeholder engagement. A more detailed breakdown of these goals can be found in the footnotes.

Table 17: Natural capital interventions by investment and time horizon

Natural capital intervention	Loch Lomond[25]			South of Scotland[26]			City of Edinburgh[27]		
	Investment			Investment			Investment		
	Short	Medium	Long	Short	Medium	Long	Short	Medium	Long
Woodland creation & management	£19 million	£16 million	£271 million	£3.5 million	£1.4 million	-	£1.1 million	-	-
Woodland management	£37 million	£37 million	£37 million	-	-	-	-	-	-
Peatland restoration	£41 million	£38 million	£400 million	-	-	-	-	-	-
Peatland management	£1.6 million	£1.6 million	£1.6 million	-	-	-	-	-	-
Coastal restoration	-	-	-	£2 million	-	-	-	-	-
Regenerative agriculture management	-	-	-	£0.6 million	-	-	-	-	-
Overall regenerative agriculture	-	-	-	£0.7 million	£4.8 million	-	-	-	-

[25] Woodland and peatland management and footpath creation assumed to be split equally across time horizon. Woodland creation assumed to start at 400ha/year and increase to 800ha/year, then remain at this level. Peatland restoration assumed to start at 800ha/year and increase to 1250ha/year (target scenarios provided by the Loch Lomond and the Trossachs National Park Authority).

[26] Overall regenerative agriculture interventions are assumed to occur in the short and medium term. Regenerative management projects are assumed to be completed within 5 years. Woodland creation and management projects are phased over a 7-year period. Coastal restoration interventions are assumed to occur in the short-term.

[27] Projects are assumed to be undertaken in the short-term.

Natural capital intervention	Loch Lomond[25]			South of Scotland[26]			City of Edinburgh[27]		
	Investment			Investment			Investment		
	Short	Medium	Long	Short	Medium	Long	Short	Medium	Long
River re-naturalisation and natural flood management	-	-	-	-	-	-	£0.1 million	-	-
Catchment approach to clean water	-	-	-	-	-	-	£89,000	-	-
Access creation	£0.6 million	£0.6 million	£0.6 million	-	-	-	£0.4 million	-	-
Total[28]	**£100 million**	**£94 million**	**£0.7 billion**	**£6.9 million**	**£6.2 million**	**-**	**£1.7 million**	**-**	**-**

Table 18 presents the natural capital interventions disaggregated by output effect and time horizons for each case study. Approximately 12%, 53% and 100% of the total output effect for Loch Lomond, South of Scotland and Edinburgh respectively is likely to happen in the short term.

Table 18: Natural capital interventions by output effect and time horizon

Natural capital intervention	Loch Lomond			South of Scotland			City of Edinburgh		
	Output Effect			Output Effect			Output Effect		
	Short	Medium	Long	Short	Medium	Long	Short	Medium	Long
Woodland creation & management	£26 Million	£22 Million	£374 Million	£4.8 Million	£1.9 Million	-	£1.6 Million	-	-
Woodland management	£55 Million	£55 Million	£55 Million	-	-	-	-	-	-
Peatland restoration	£53 Million	£50 Million	£458 Million	-	-	-	-	-	-
Peatland management	£2.1 Million	£2.1 Million	£2.1 Million	-	-	-	-	-	-
Coastal restoration	-	-	-	£2.7 Million	-	-	-	-	-
Regenerative agriculture management	-	-	-	£0.9 Million	-	-	-	-	-

[28] Totals may not sum up due to rounding issues.

Natural capital intervention	Loch Lomond			South of Scotland			City of Edinburgh		
	Output Effect			Output Effect			Output Effect		
	Short	Medium	Long	Short	Medium	Long	Short	Medium	Long
Regenerative agriculture – soil health	-	-	-	-	-	-	-	-	-
Overall regenerative agriculture	-	-	-	£1 Million	£6.6 Million	-	-	-	-
Coastal management	-	-	-	-	-	-	-	-	-
River re-naturalisation and natural flood management	-	-	-	-	-	-	£0.1 Million	-	-
Catchment approach to clean water	-	-	-	-	-	-	£0.1 Million	-	-
Access creation	£0.9 Million	£0.9 Million	£0.9 Million	-	-	-	£0.6 Million	-	-
Total[29]	**£137 Million**	**£130 Million**	**£891 Million**	**£9.5 Million**	**£8.5 Million**	**-**	**£2.4 Million**	**-**	**-**

[29] Totals may not sum up due to rounding issues.

Table 19 presents the natural capital interventions disaggregated by jobs effect and time horizons for each case study. Approximately 12%, 53% and 100% of the total jobs for Loch Lomond, South of Scotland and Edinburgh respectively is likely to happen in the short term.

Table 19: Natural capital interventions by overall job effect and time horizon

Natural capital intervention	Loch Lomond			South of Scotland			City of Edinburgh		
	Jobs (Direct + Indirect)			Jobs (Direct + Indirect)			Jobs (Direct + Indirect)		
	Short	Medium	Long	Short	Medium	Long	Short	Medium	Long
Woodland creation & management	285	240	4,054	52	21	-	17	-	-
Woodland management	656	656	656	-	-	-	-	-	-
Peatland restoration	645	604	5,590	-	-	-	-	-	-
Peatland management	25	25	25	-	-	-	-	-	-
Coastal restoration	-	-	-	32	-	-	-	-	-
Regenerative agriculture management	-	-	-	12	-	-	-	-	-
Regenerative agriculture – soil health	-	-	-	-	-	-	-	-	-
Overall regenerative agriculture	-	-	-	12	76	-	-	-	-
Coastal management	-	-	-	-	-	-	-	-	-
River re-naturalisation and natural flood management	-	-	-	-	-	-	2	-	-
Catchment approach to clean water	-	-	-	-	-	-	1	-	-
Access creation	12	12	12	-	-	-	7	-	-
Total[30]	**1,623**	**1,537**	**10,337**	**108**	**97**	-	**27**	-	-

[30] Totals may not sum up due to rounding issues.

Qualitative overview of the case studies

The three case studies, Loch Lomond and The Trossachs National Park, the Borderlands Natural Capital Innovation Programme in the South of Scotland, and the City of Edinburgh comprise projects that capture a range of natural capital interventions: woodland creation and management, peatland restoration and management, regenerative agriculture overall, regenerative agriculture management (covering the management of existing regenerative practises and not the conversion from traditional methods), coastal restoration, catchment approach to clean water, river re-naturalisation and natural flood management and footpath creation. The Borderlands in the South of Scotland and the City of Edinburgh case studies look at the impact of select projects, while the Loch Lomond and The Trossachs National Park case study accounts for a significant programme of nature restoration for the whole National Park.

Case study interviews were conducted with relevant stakeholders for each region, covering the following:

- Linking projects within each region to natural capital interventions in the model;
- Linking natural capital interventions in the region to the GFI outcomes;
- Project size in terms of geographic scale / extent in area (hectares) or investment value (£);
- Information on main habitats and management measures;
- Information on drivers and enabling mechanisms in relation to regulations and markets; and
- Information on the extent of private, public and blended financing initiatives.

Table 20 provides a key relating to graphics found in Table 21, Table 24 and Table 27.

Table 20: GFI outcome symbols used throughout case study analysis

Symbol	GFI outcome
	Clean water
	Protect and/or restore biodiversity
	Reduce flood risk
	Improve bio-resource efficiency
	Improve access and engagement with natural environment
	Climate mitigation through bio-carbon

Case study 1: Loch Lomond and The Trossachs National Park

This case study focuses on Loch Lomond and The Trossachs National Park (LLTNP). The natural capital interventions that are key to the Park include woodland creation and management, and peatland restoration activities, followed by investment into visitor infrastructure to help enable sustainable access. The potential for natural capital investment in Loch Lomond and The Trossachs National Park covers nature activities such as 61,000ha of woodland creation and management, 54,100ha of woodland management, 56,600ha of peatland restoration, and 11,400ha of peatland management. The interventions listed in Table 21 were provided by the National Park Authority and, in consultation with them, mapped against natural capital interventions in the environment-economy model, and to GFI outcome categories.

Table 21: Projects within the case study area – Loch Lomond and The Trossachs National Park

Projects within the case study area	GFI outcome category
1. Management of existing woodland in the national park	
2. 'Preferred areas' for woodland expansion	
3. 'Potential areas' for woodland expansion	
4. Peatland in 'stable condition'	
5. Peatland targeted for Peatland ACTION funding	
6. Outside of Peatland ACTION scope (alternative landscape scale needed)	
7. Delivering sustainable access to and around the National Park	
8. Place programme investment into visitor infrastructure - development 1	
9. Place programme investment into visitor infrastructure - development 2	

Economic impacts of investment

The investment required for this total area of 183,100 hectares is £859,993,790, with a further £1,762,500 for footpath creation, the latter of which equates to 58,750 meters of track[31]. Table 22 below provides a breakdown of capital expenditure, jobs and output effect by SIC industry code.

[31] Hectare values provided by Loch Lomond and the Trossachs National Park Authority were converted into capital investment (£) using conversion factors in the model.

Table 22: Capital expenditure, jobs and output effect broken down by SIC industry codes – Loch Lomond and The Trossachs National Park

SIC Industry	Capital Expenditure	Jobs (Direct & Indirect)	Output Effect
Environmental consulting activities	£5.5 Million	112	£7.3 Million
Renting and leasing of agricultural machinery and equipment	£229.2 Million	3,656	£277.4 Million
Support services to forestry	£232.4 Million	3,255	£319.1 Million
Wholesale of agricultural machinery, equipment and supplies	£4.2 Million	60	£5.6 Million
Construction of other civil engineering projects	£13.2 Million	263	£20.3 Million
Silviculture and Other	£281.7 Million	4,276	£382.7 Million
Hunting, trapping and related service activities	£74.9 Million	1,498	£114.1 Million
Logging	£18.9 Million	375	£31.2 Million
Total[32]	**£859.9 Million**	**13,495**	**£1.16 Billion**

Table 23 examines the economic impacts of the natural capital interventions associated with the case study.

Table 23: Economic Impact of Natural Capital Interventions

Economic Impact Type	Impact
Output effect	The portfolio of investment in the LLTNP case would generate an output effect of £1.16 billion into the local economy, equating to every £1 invested generating £1.35 into the local economy. Most of the output effect is captured by Silviculture activities, Support Services to Forestry, and Renting and leasing of agricultural machinery and equipment. Approximately 62% of investment will go into labour-related activities, followed by 27% into transportation / machinery[1 2]. Appendix D provides a further breakdown.
Jobs impact	In terms of jobs created, the potential economic impact could be the creation of 10,051 direct and 13,495 direct and indirect jobs. These jobs are expected to occur over the entire life-cycle of natural capital investment in the Park, with 12% of these occurring in the short-term, 11% in the medium term, but the vast majority being created in the long-term (77%). The total area considered for natural capital intervention is 183,100 ha. due to the large size, the majority of jobs are created in the long-term in line with timelines to achieve intervention goals. Some of these jobs created may also be temporary so will be phased over the 10-year period. These jobs may be created in the industries of silviculture and other, renting and leasing of agricultural machinery and equipment, and support services to forestry and hunting. Of the 13,495 direct and indirect jobs created, 6,818 jobs may be leaked to other regions in Scotland, while 74 jobs may be leaked outside of Scotland, which is a significant leakage effect. To reduce the leakage from the region and to boost economic outcomes locally, Loch Lomond and The Trossachs National Park could focus on building and upskilling a labour force capable of silviculture activities such as tree

[32] May not sum up due to rounding issues.

Economic Impact Type	Impact
	planting and planting of new sphagnum moss colonies to support their forestry and peatland activities.
Skills impact	Of the 74 jobs that could be leaked outside of Scotland, these are all environmental consulting related, which could leak to the North-East of England due to their ability to be completed remotely. Addressing local training and education attainment could better position the region to retain these jobs within Scotland.

Financing the investment

Discussion with Park stakeholders provided more information on the sources of funding and the various policy and market drivers generating investment for these natural capital interventions.

Finance sources - Funding from national government, Peatland ACTION and Place programme. Other funding sources included community funding trusts, Countryside Trust and funding from forestry agencies such as RSPB, Forest and Land Scotland, Woodland Trust, National Park Authority**.**

Drivers and enabling mechanisms – the Woodland and Peatland code have been the main market enabling drivers for private sector funding. Our responses also suggested that private sector investment are motivated by clear policies, strategies, plans, regulations. In this case study, these specifically refer to Scotland's Forestry Strategy (2019-2029) and then the LLTNPA Trees & Woodland Strategy ((2019-2039), Draft National Park Partnership Plan (2024-2029) and Future Nature Route Map**.**

Case study 2: Borderlands Natural Capital Innovation Programme, South of Scotland

This case study focuses on the Borderlands Natural Capital Innovation Programme taking place in the South of Scotland (comprising Dumfries & Galloway and the Scottish Borders). The natural capital interventions that are key to the programme include woodland creation and management, peatland restoration, overall regenerative agriculture, regenerative agricultural management, and coastal restoration. Project-level information under the Natural Capital Innovation Programme has been provided through interviews with key stakeholders and from a report by the Borderlands Partnership/Hatch. The projects listed in Table 24 were provided by stakeholders relevant to the case study and, in consultation with them, mapped against Natural Capital Interventions in the model, and to GFI outcome categories.

Table 24: Projects within the case study area – Borderlands Natural Capital Innovation Programme

Projects within the case study area -	GFI outcome category
Sustainable livestock and species rich grassland pilot for priority species	
Whole Farm Audits and Natural Capital Advisory	
Woodland Pilot: Integrated Land Use and Woodland Creation	
Solway Coast and Marine Pilot Project	

Economic impacts of investments

The key projects outlined under the Borderlands Natural Capital Innovation Programme equate to investment of approximately £13 million[33]. This investment in natural capital activities such as woodland creation & management, regenerative agriculture, regenerative agriculture management and coastal restoration could create significant economic impacts in the Borderlands area. The majority of the expenditure may be attributed to labour (61% of investment), with woodland creation and management being particularly labour intensive (see Appendix D for further breakdown of expenditure). Table 25 below provides a breakdown of capital expenditure, jobs and output effect by SIC industry code.

[33] Capital investment values provided by the Borderlands and converted to hectarage through the model.

Table 25: Capital expenditure, jobs and output effect broken down by SIC industry codes – Borderlands Natural Capital Innovation Programme

SIC Industry	Capital Expenditure	Jobs (Direct & Indirect)	Output Effect
Environmental consulting activities	£0.1 Million	3	£0.2 Million
Renting and leasing of agricultural machinery and equipment	£0.6 Million	9	£0.7 Million
Support services to forestry	£4.0 Million	56	£5.4 Million
Wholesale of agricultural machinery, equipment and supplies	£3.3 Million	48	£4.4 Million
Construction of other civil engineering projects	£0.02 Million	1	£0.05 Million
Silviculture and Other	£2.4 Million	37	£3.3 Million
Hunting, trapping and related service activities	£0.5 Million	10	£0.8 Million
Logging	£0	0	£0
Other professional, scientific, and technical activities (not environmental consultancy)	£0.08 Million	2	£0.1 Million
Support activities for crop production	£1.9 Million	39	£2.9 Million
Construction of water projects	£0.04 Million	1	£0.07 Million
Total	**£13.0 Million**	**204**	**£18.2 Million**

Table 26 examines the economic impacts of the natural capital interventions associated with the case study.

Table 26: Economic Impact of Natural Capital Intervention

Economic Impact Type	Impact
Output effect	The investment would generate an output multiplier effect of over £18.01 million into the local economy, meaning for every £1 invested £1.38 would be added to the local economy. Around half of this output impact would be in the "Support services to forestry" and "Wholesale of agricultural machinery, equipment and supplies" sectors.
Jobs impact	In total, 148 direct jobs would be generated from the investment and 204 direct and indirect jobs. The greatest job impact would be seen in: Support services to forestry, wholesale of agricultural machinery, equipment and supplies and support for crop production industry. Of the direct and indirect jobs generated, there is very low likelihood of jobs leaking out of Scotland. There is potentially one job in coastland restoration that involves engineering to support the design of the restoration (SIC code 42.91), which may be leaked to another region, likely the Highlands and Islands.

Economic Impact Type	Impact
Skills impact	The South of Scotland has approximately 12% of the workforce in 2022 employed in the agriculture industry. This suggests their workforce is relatively well placed to adapt to the new skill demands that nature-related investment will create. One area of potential skills gap relates to coastal restoration, where there exists a limited level of skill and pool of workers relating to construction of water projects. Fulfilling this skill demand, for example, through training initiatives, will enable the economic benefits created from the investment in the South of Scotland's coastline to be recognised by the residents in the South of Scotland.

Financing the investment

Discussion with stakeholders associated with the Borderlands Natural Capital Innovation Programme provided more information on the sources of funding and the various policy and market drivers generating investment for these natural capital interventions.

Finance sources – Funding from the Borderlands Natural Capital Programme , Forestry Grants Scheme, private finance, Woodland Trust, National Lottery Heritage Fund, Tweed Forum. Scottish Blue Carbon Forum. Other public funding sources included: Peatland ACTION, Nature Restoration Fund, South of Scotland Tree Planting Scheme, the SEPA Water Environment Fund. Other private funding sources included: the Riverwoods Pioneer Fund, NithLife and the Tweed Forum Carbon Club.

Drivers and enabling mechanisms – the Woodland and Peatland code have been the main market enabling drivers for private sector funding, as well as biodiversity credits. Related supply chains are dairy, forestry and transport. Our responses also suggested that investment is motivated by clear policies, strategies, plans, regulations. In this case study, these specifically refer to the Solway Tweed River Basin Management Plan 3 (covering statutory targets for water environment improvements), local flood risk management strategies and plans; local biodiversity action plans; the South of Scotland Push for Net Zero; and climate emergency plans and route maps**.**

Case study 3: City of Edinburgh

This case study focuses on a selection of projects in the City of Edinburgh. Of these projects, the natural capital interventions that are relevant include woodland creation and management, clean water, river re-naturalisation and natural flood management, and access creation. The projects listed in Table 27 were provided by stakeholders related to the case study and, in consultation with them, mapped against natural capital interventions in the model, and to GFI outcome categories.

Table 27: Projects within the case study area – City of Edinburgh

Projects within case study area	GFI outcome category
1. FIRNS funding – clean water, habitat creation/restoration. green infrastructure	
2. 1 Million Trees Initiative	
3. Pentland Hills: Linking Leith's Parks	
4. Pentland Hills: Tree planting and woodland protection at Bonaly Country Park in the Pentlands Regional Park	
5. Thriving Green Spaces	
6. Royal Botanic Garden Edinburgh: Saving Scotland's most threatened species	
7. Water of Leith and BBVP Natural Bank Stabilisation	
8. Pentlands to Portobello Greening Project (ELGT)	
9. River Almond fish counter at Fair-a-far Weir (Forth Rivers Trust)	
10. Leith pollinator project & Craigleith and Prestonfield Raingardens including low allergenic wildflower seed mix	

Economic impacts of investments

An investment of £1.702 million in natural capital interventions including woodland creation and management, catchment-based approaches to clean water, river re-naturalisation and natural flood management in the City of Edinburgh. This equates to 424 hectares of intervention and generates 12,267 meters of footpath creation[34]. These interventions create positive economic impacts for the City of Edinburgh. The majority of investment will flow into labour (77%) (see Appendix D for further breakdown of expenditure). Table 28 below provides a breakdown of capital expenditure, jobs and output effect by SIC industry code.

[34] Capital investment values provided by the City of Edinburgh and converted to hectarage through the model.

Table 28: Capital Expenditure, jobs and output effect broken down by SIC industry codes – City of Edinburgh

SIC Industry	Capital Expenditure	Jobs (Direct & Indirect)	Output Effect
Environmental consulting activities	£0.01 Million	0	£0.01 Million
Renting and leasing of agricultural machinery and equipment	£0.1 Million	2	£0.1 Million
Support services to forestry	£0.8 Million	11	£1.0 Million
Wholesale of agricultural machinery, equipment and supplies	£0.07 Million	1	£0.09 Million
Construction of other civil engineering projects	£0.4 Million	8	£0.6 Million
Siviculture and Other	£0.3 Million	4	£0.4 Million
Hunting, trapping and related service activities	£0.1 Million	2	£0.2 Million
Logging	£0	0	£0
Other professional, scientific and technical activities (not environmental consultancy)	£0.002 Million	0	£0.003 Million
Support activities for crop production	£0.002 Million	0	£0.003 Million
Construction of water projects	£0	0	£0
Total	**£1.7 Million**	**27**	**£2.4 Million**

Table 29 examines the economic impacts of the natural capital interventions associated with the case study.

Table 29: Economic Impact of Natural Capital Intervention

Economic Impact Type	Impact
Output effect	The investment would generate an output effect of £2,393,839 into the local economy. Therefore, for every £1 invested roughly £1.41 would be added to the local economy, mainly in the "Support services to forestry" and "Construction of other civil engineering projects" sectors.
Jobs impact	Approximately 19 direct jobs and 27 direct and indirect jobs would be created. The majority of this job creation may be focussed in support services to forestry, and construction of other civil engineering projects. See Appendix D for further breakdown. Of the 27 direct and indirect jobs created roughly 16 are likely to be fulfilled by other Scottish regions outside of Lothian. This is due to the region's relatively low level of specialism and concentration in agriculture related activities (0.1% of the workforce) when compared to the South of Scotland or Highlands and Islands which are more specialised in support services related to forestry and silviculture.
Skills impact	Even though no jobs are likely to be leaked out of Scotland, Edinburgh and the wider Lothian region can improve on training their workforce in agriculture, allowing the potential job creation impact to remain within the city. Scotland's Rural College Edinburgh Campus is one way to encourage this, focusing learning on appropriate skillsets that urban natural capital investment requires, while demonstrating potential career paths available in agriculture in an urban environment.

Financing the investment

Discussion with stakeholders at the City of Edinburgh Council for this selection of projects provided more information on the sources of funding and the various policy and market drivers generating investment for these natural capital interventions.

Finance sources – Funding applications have been put forward for the Facility for Investment Ready Nature in Scotland (FIRNS), the Woodland Trust, Greenspace Scotland, the Future Parks Accelerator (funded by the national Lottery Heritage Trust and Woodland Trust), and the Nature Restoration Fund.

Drivers and enabling mechanisms – the local strategies, plans and regulations relevant to this case study include Edinburgh Adapts, the Climate Change Adaptation Plan, Climate Ready Edinburgh, the Edinburgh Biodiversity Action Plan, and the Thriving Green Spaces Strategy.

Interpreting case studies

The case studies were analysed according to the overarching analytical framework in “Project approach and analytical framework” (Figure 2). In addition to the economic model, the case studies also provided important contextual information relevant to this study. In particular, some important challenges and issues were identified affecting investment in natural capital. Some of these main qualitative issues are summarised below.

Summary of main challenges and issues

Stakeholder consultations for each case study region highlighted overarching barriers to mobilising investment in natural capital. These include:

- a need for more certainty around developments and links with natural capital and carbon markets;
- a need for more certainty regarding financing mechanisms, including integration of different financing mechanisms to ensure a more holistic approach to financing for natural capital projects; and
- a need to understand the balance needed (and possible tensions) between different land use patterns and the impact that this has on natural capital and nature restoration.

Financing mechanisms

For case study regions such as Edinburgh, there are barriers to accessing funding for natural capital due to the complexity of initiatives that need to take place in an urban context in comparison to a rural context; as well as the differing nature of natural capital interventions required when comparing rural and urban contexts.

Delivery challenges in urban areas

The urban context is more complex when considering habitat creation or restoration. In a rural context, a smaller number of landowners can be identified, relatively limited consultation and design work required, and there is a focus on the number of hectares of land being transformed (generally habitat restoration, creation or management). In comparison, initiatives in the urban context can sometimes equate to planting a number of trees on a particular street, for example, as opposed to measuring natural capital interventions in hectares. This being said, the ecosystem services that those trees provide is still significant, not least because there are far more beneficiaries in urban areas. Furthermore, the design work needed in an urban context is complex and often more expensive due to the need for integration with hard landscaping, engaging with utility companies, and adhering to regulations surrounding the streetscape, archaeological and architectural considerations. While this would arguably still be required for rural projects, the consultations and assessments are likely to be fewer.

Balancing land use patterns

Key stakeholders in some regions cite a balance that needs to be struck between different land use patterns, e.g. between land that is set aside for forestry versus land set aside to promote bird species. It is suggested that this balance can be struck through Regional Land Use Partnerships as an effective intermediary.

In regions where tourism is a key economic driver, there is a perceived need to ensure that initiatives that promote tourism centred around natural capital are also consistent with the region and Scotland's net zero ambitions. To achieve this, some regions are considering sustainable travel initiatives, which require local skills development in areas including eco-tourism, agri-tourism and the adoption of electric vehicles.

Some regions recognize a need to adopt initiatives that encourage regenerative agriculture and those that reduce the amount of grazing (both from livestock and deer). It is anticipated that the forestry sector will need to grow in order to increase forestry cover. This will require an increase in forestry skills and related advisory, a skillset which is deemed to be a skills gap in some regions.

Summary of international market opportunities and barriers

The development of natural capital markets within Scotland are likely to provide opportunities for the Scottish business and labour markets to export the newly created skills and business models to the international market. Expansion of natural capital markets is likely to cause an increase in the number of services offered in the field but also drive innovation in how projects are designed and implemented. These new and innovated services are not currently captured within the environment-economy model and therefore not considered within the analysis. This work could be repeated as the SIC codes are updated to ensure they are considered in the analysis.

The majority of these international opportunities are expected to involve selling professional services required for the financing and delivery of the natural capital interventions. These should include but not be limited to: financial services, technical support services and consultancy, fintech, agri-tech, land management, ecosystem restoration, data and analytical services, remote sensing, environmental surveying.

The export of any professional services from Scotland is dependent on a sense of integrity within Scottish natural capital markets and on the good reputation of the advisors. This includes integrity of environmental markets in being robust, such as the additionality of credits, transparent regulation, and good governance. As stated in the Scottish Government report "Mobilising private investment in natural capital" (2023), Scottish peatland carbon credits appear to trade at a premium relative to international peatland units. This is potentially due to a perception of less reputational risk in the purchase of Scottish peatland carbon due to the high standards of the IUCN Peatland Code and the robust jurisdictional framework in Scotland.

These professional services are areas where the UK and Scotland already have a mature export sector. These services can be in a large part delivered from any location, so cost, reputation and expertise are key to successfully selling across the international markets. Scotland has relatively high costs, but also high expertise and this will grow with increased investment in nature recovery. There were approximately 2,000 employees in environmental consulting activities in Scotland in 2021, this number has grown by roughly 150% since 2015. The notional GFI natural capital investment modelled in this study is likely to generate roughly 2,458 direct and 3,269 direct and indirect jobs in environmental consulting activities in Scotland. To fulfil this job demand and requirement, the environmental consulting job market in Scotland must continue to grow at a similar pace. Labour demanded in the other professional services category is also likely to increase with natural capital investment in Scotland. There will be roughly 830 direct and 1,080 direct and indirect jobs created and required in things such as support on policy grants and management strategies. There are currently 8,000 employees in similar roles in Scotland, with a slower 33% growth since 2015 in this job field[35].

Not all the services developed as part of natural capital market expansion are expected to be exportable to the international market. It is unlikely that there will be a market for manufacturing services and supply of equipment and machinery required for natural capital Interventions. This machinery tends to be heavy, and capacity already exists in other markets so it is unlikely that there will be a demand for Scottish products except for specialist equipment (e.g. soil carbon measurement tools perhaps).

[35] Office for National Statistics – Business Register and Employment Survey (2021)

The other challenge facing the international export of services is that the environmental management and investment for each country are very context-dependent and often require knowledge of the historic background. The biomes present within Scotland where natural capital markets operate are likely to limit the regions where expertise can be exported, most likely other temporal regions. This is not expected to be the case for all professional services, especially those related to finance and technology development.

Conclusions

Next steps and recommendations

The estimated £12.5 billion in public and private investment that would help to address the nature finance gap for Scotland and its potential economic impact on outputs and jobs into the Scottish economy presents a significant opportunity to transition towards a green economy. However, these economic benefits can only be achieved through concerted effort, planning and strong partnerships.

Initially the jobs created may be temporary or substituted from other activities, which could dilute the economic benefits. Hence, it is crucial that the additionality impacts of these investments are further explored. In addition, adequate skills and training programmes should support these investments to ensure jobs do not leak out of the region or wages do not rise artificially due to skills shortages.

The workshop discussion also highlighted the “opportunity cost of investment” where delayed investments could mean either risking more environmental decline or experiencing higher costs in the long run (e.g. the cost of mitigating climate change are likely to increase as action is delayed). In which case it would be useful to further explore whether the incentives and market drivers are fit for purpose to scale up responsible private finance. Investment in natural capital interventions can be motivated by institutional investors complying with ESG and SDG principles versus corporates and utility companies looking to reduce costs or generate revenues through nature-based solutions. Hence, it would be helpful to look in more detail at how the market is responding to the needs of private sector investors.

The stakeholder discussions also highlighted that the findings of the economic model should be further complemented by looking at the community impacts of investments in nature-based activities. The social value of these investments can be substantial and recognising these benefits more explicitly could also help to accelerate or scale up these investments.

Moreover, nature-based interventions require strong partnership models, mainly because nature-based solutions can have multiple impacts. For example nature-based flood management can also involve peatland restoration. Impartial intermediaries can help in fostering investment by forming a multi-interest partnership. Intermediaries can have different roles depending on the business model. Different delivery models should be explored further, where intermediaries (local business partnerships, sector-based associations, landscape partnerships) could play a role in pooling finance, providing advice on green interventions, or executing projects.

The results of this study could be expanded to incorporate the marine environment by undertaking research into the relationship between various marine natural capital interventions and economic outputs.

Finally, we recommend that the findings of this study should be considered along with the enabling and delivery frameworks mentioned in Scotland's Biodiversity Strategy to 2045: tackling the nature emergency published in December 2022. The economic model can provide the evidence base for the various investment and delivery plans mentioned in the strategy.

Appendix A

GFI study data extrapolation for Scotland

As time and region-specific data to calculate the finance gap was not always available to input into the GFI model in detail, it was usually necessary to adjust the raw data in some form. This entailed making certain assumptions where the data did not fit one of the three time horizons[36] (which it usually did not) or clear evidence for Scotland was unavailable or deemed insufficient. As England was the sole UK country to have released a strategic policy paper on environmental policy at the time, it was assumed that the government level targets within the *25 Year Environment Plan* were broadly applicable to the other UK countries and Overseas Territories. Apart from this overarching assumption, some of the most common extrapolation methods for time and region (or other location-based assumption) in the GFI study appear below:

- That X (some variable being measured) is proportional to area, population, share of net emissions, etc. (especially when Scotland-specific figures were unavailable);
- That spending is constant over time (i.e. current spending is representative of future spending); and
- That historic spending is representative of current spending.

Detailed timing assumptions per nature-based activity

Table A.1 details the timing assumptions for each nature-related activity by providing individual time horizons for their relevant enabling mechanisms.

Table A.1: Nature-related activities and timing assumptions by GFI outcome

GFI outcomes	Nature-related activities (and area of spend, if applicable)	Timing assumptions
Clean water	All clean water	Increase in 6-10 years
Protect and/or restore biodiversity	Create/restore priority habitats outside protected sites	From Year 1
	Protected endangered species	Increase in 6-10 years
	Increase species abundance	Increase in 6-10 years
	Woodland creation and management	From Year 1
	Peatland restoration	From Year 1

[36] The three time horizons are 2022-2032 (10-year horizon), 2022-2042 (20-year horizon) and 2022-2052 (30-year horizon).

GFI outcomes		Nature-related activities (and area of spend, if applicable)	Timing assumptions
		Increase the proportion of protected and well-managed seas	Increase in 3-5 years
		Ensure populations of key marine species are sustainable	Increase in 6-10 years
		Ensure seafloor habitats are healthy and sustainable (Protect and restore biodiversity (other))	Increase in 3-5 years
		Ensure seafloor habitats are healthy and sustainable (Marine offshore habitats, key marine species, seafloor habitats (*this includes seagrass*))	Increase beyond year 10
		Achieve biodiversity net gain	Increase in 6-10 years
		Scottish Government Nature Restoration Fund*	From Year 1
	Reduce flood risk	Reduce risk of flooding through natural flood management	Increase in 6-10 years
	Improve bio-resource efficiency	Increase sustainability of fish stocks	Increase in 6-10 years
		Sustainable soil management	Increase in 3 years
	Improve access and engagement with natural environment	Safeguard and enhance landscape features	Increase in 10 years
	Climate mitigation through bio-carbon	Climate mitigation through bio-carbon (Other carbon adaptation)	Increase in 2 years
		Climate mitigation through bio-carbon (Hedgerow code)	Increase in 3 years
		Climate mitigation through bio-carbon (Saltmarsh code)	Increase in 6-10 years
	Enhance biosecurity	All biosecurity	*Unknown*

Appendix B – Model User Guide

A model input template has been generated to allow users to convert investment portfolios into a format that can be used by the model.

Natural Capital Intervention Intervention description	Model Input Values	
	Investment amount (£)	Intervention Area (ha)
Woodland Creation & Management The creation and management of new areas of woodland for timber products, carbon sequestration or habitat creation purposes.		
Peatland Restoration The restoration and management of areas of peatlands in line with the Peatland Code.		
Overall Regenerative Agriculture The transition from intensive agriculture techniques to a wide range of management practices designed to maximize plant diversity, develop more resilient soil and support a wide range of biodiversity.		
Coastal Restoration The creation and restoration of habitats such as coastal saltmarsh.		
Woodland Management The management of existing areas of woodland for timber products, carbon sequestration or habitat creation purposes.		
Peatland Management The management of areas of previously restored peatlands in line with the Peatland Code.		
Regenerative Agriculture Management Landscape management practices designed to maximise plant diversity, develop more resilient soil and support a wide range of biodiversity.		
Coastal Management The management of previously restored areas of habitats such as coastal saltmarsh.		
Catchment-based approach to clean water The reduction in surface pollution and nitrate run off through landscape management practices designed to create riparian strips, develop more resilient soil, and support a wide range of biodiversity.		
River re-naturalisation & Natural Flood Management The creation of more natural river flows and floodplains through interventions such as channel widening and re-naturalisation.		
Regenerative Agriculture – Soil Health The transition from intensive agriculture techniques to a wide range of management practices designed develop more resilient soil.		
Access creation The creation of access tracks and footpaths to increase the accessibility to existing areas of habitats such as woodlands or peatland bogs.		

The template would enable users to, for example, compute the economic benefits of projects secured under the Nature Restoration Fund. Table B.1 below provides a list of successful projects under "Transforming Nature 2022-31".[37]

Table B.1: Transforming Nature 2022-2031 – successful projects

Organisation	Project title
Dee District Salmon Fishery Board (DDSFB)	Instream River Restoration – Mar Lodge & Abergeldie Estates
University of St Andrews	Green Shores: Restoring biodiversity and resilience to fringe saltmarshes
Scottish Invasive Species Initiative Partnership (NatureScot)	Scottish Invasive Species Initiative (Phase 2)
Royal Botanic Garden Edinburgh	Saving Scotland's most threatened species
RSPB Scotland	Re-naturalising and Expanding Abernethy Forest
Woodland Trust Scotland	Arkaig Landscape Restoration Project
Wildfowl & Wetlands Trust	Wilder, Wetter Caerlaverock
RSPB Scotland	Biosecurity for Scotland's seabird islands
Froglife Trust	Coalface to Wildspace Scotland
Lockett Agri-Environmental	River Peffery Catchment Development Project
Tarland Development Group	Tarland to Coull River Restoration
Forth Rivers Trust	Unlocking the Leven
Tweed Forum	Reconnecting and restoring the Bluidy Burn
RSPB Scotland	Managed Realignment at Inch of Ferryton
St Andrews Links Trust	Jubilee Shore Restoration
Forth Rivers Trust	Ballimore Landscape Restoration Project
Tweed Forum	Upper Leader Water Scoping and Restoration
RSPB Scotland	Saving Morvern's Rainforest
Glasgow & Clyde Valley Green Network	Clyde Grasslands
Ardtornish Estate Company Ltd	Aline Catchment Restoration
Green Action Trust	Leven River Parks Nature Network
Nith Catchment Fishery Trust	River Nith Restoration
Findhorn, Nairn and Lossie Rivers Trust	Findhorn Watershed Initiative – Upper Catchment Phase 1

[37] Nature Restoration Fund (NRF) 2022 - Transforming Nature successful projects | NatureScot

Organisation	Project title
Bamff Wildland	Braes of Alyth: Wild Cores and Corridors
RSPB Scotland	Cairngorms Connect – Delivering a Vision for Natural Rivers and Floodplains at Insh Marshes
River South Esk Catchment Partnership	Restoring the River South Esk: A Nature Rich and Climate Resilient Catchment
Plantlife International	Transformative Action for Cairngorms Grasslands
Southern Uplands Partnership	Undoing the Silence of the Uplands
Loch Lomond & The Trossachs Countryside Trust	Wild Strathfillan & Glen Falloch Nature Restoration
Argyll and the Isles Coast and Countryside Trust (ACT)	Saving Argyll's Rainforest (Knapdale Rhododendron Control)
St Andrews Botanic Garden Trust	Plants on the Move

ReadMe instructions sheets

1. Readme instruction sheets

This sheet provides an overview of the tool and its purpose, and guides the user on how to carry out an assessment. The sheet includes guidance on the cells the user can edit and those which should remain locked.

2. Data input sheet

This sheet allows the user to input project specific information such as the assessment date and scenario name, location and description. This sheet enables the user to input the proposed area of each natural capital intervention or the investment amount. Users must only enter area or investment amount and not both. The relationship between investment amount and natural capital intervention areas is defined within the reference for each natural capital intervention type. The characteristics entered will define the results of the modelling process.

3. The overall summary sheet

The overall summary sheet shows users the results of the environment-economy model and summarises the results across the different natural capital interventions. The results summarised include the total capital expenditure within different economic categories, the number of jobs potentially created and total output effect. The sheet is read only and will update as the site characteristics and relevant activities are updated by the user.

4. The detailed summary sheet

The detailed summary sheet presents the results of the environment-economy model and breaks down the results of the different natural capital interventions into the component activities and the different SIC codes, and highlights potential overlap. The results summarised include the total capital expenditure within different economic categories, the number of jobs potentially created, and total output effect. The sheet is read only and will update as the site characteristics and relevant activities are updated by the user.

5. The GFI category summary sheet

The GFI category summary sheet shows users the results of the environment-economy model and summarises the results across the different categories. The results summarised include the total capital expenditure within different economic categories, the number of jobs potentially created, and total output effect.

6. Natural capital intervention results sheets

The natural capital intervention results sheets breaks down the individual activities and costs that are used to build up the model and generate the results. The cells within this sheet are mainly locked and for view only purposes. The natural capital intervention results sheets also summarise distribution of investment across economic linkage category, SIC codes and the relevant economic multipliers. The job leakage is calculated using location quotients, which are used to measure an areas industrial specialisation. A location quotient of more than one suggests the area has a specialisation in this industry, and below one vice-versa. Utilising the location quotient as a proxy, estimates as to the amount of jobs generated from the investment which are “leaked out” of the study region can be made. These “leaked” jobs are estimated to go to surrounding regions which have high location quotients, and therefore a specialisation in the given sector. If the jobs created can be done remotely (desk-based), then areas outside of Scotland are considered for potential “leakage” destinations.

7. Reference data sheet

The reference data sheet provides the user with the estimated standard costs used for each natural capital intervention. This sheet contains all of the activities referenced within the original Input-Output models and additional activities that may also be relevant to certain projects. The sheet enables the user to edit the existing values or include new activities when better sources of data are available. The purpose of the sheet is to enable users to tailor the assessment and the values used within it to suit their particular needs.

Appendix C

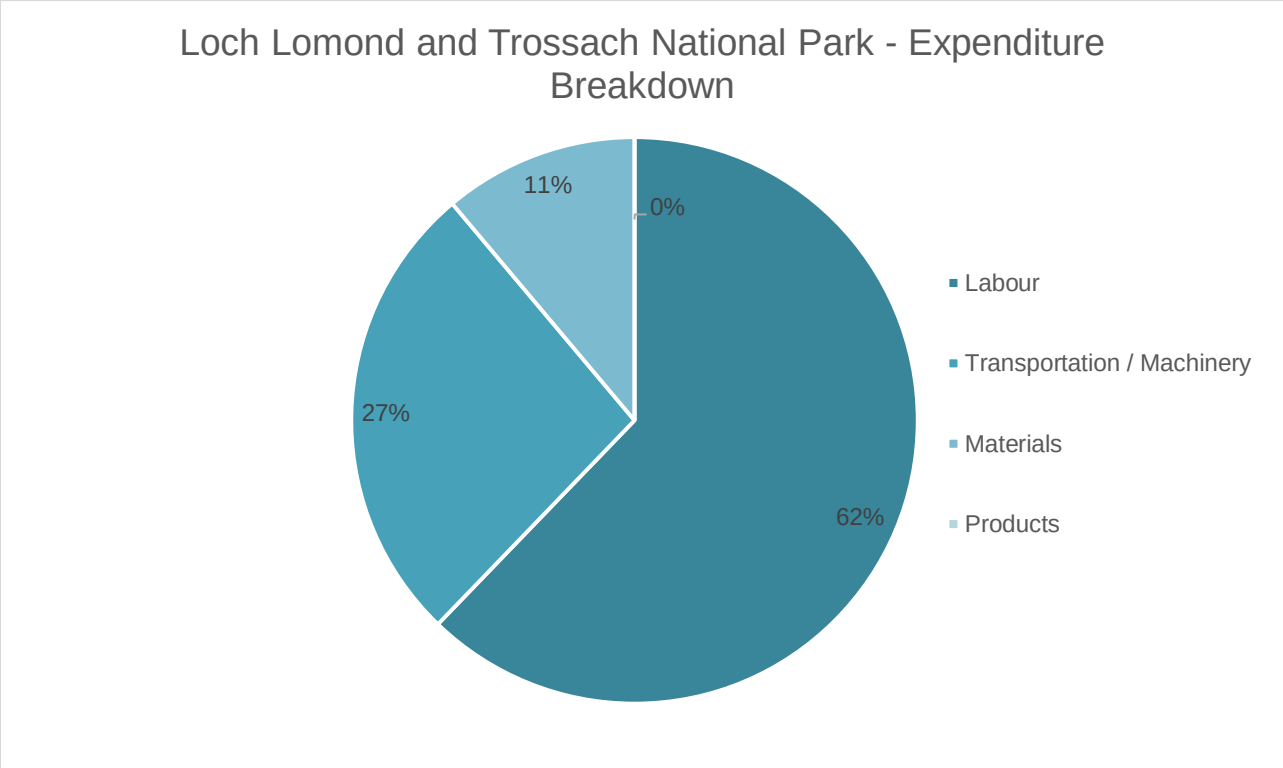
Stakeholders consulted

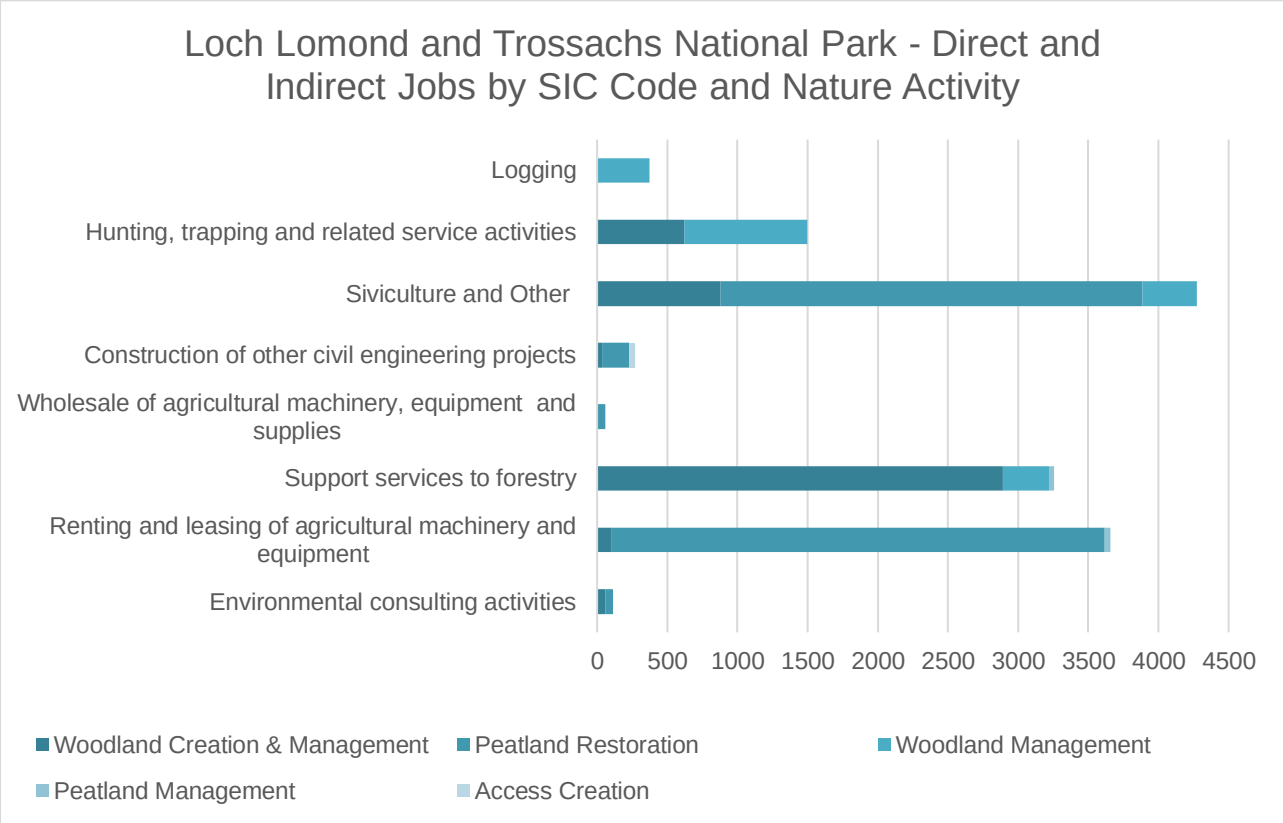
The following table documents stakeholder organisations that were consulted throughout the project.

Stakeholder organisation
City of Edinburgh Council
Finance Earth
Highlands and Islands Enterprise
Hydro Nation Chair, University of Stirling
Kana Earth
Loch Lomond and Trossachs National Park Authority
Marine Scotland
NatureScot
Scottish Environment Protection Agency
Scottish Forestry
Scottish Government
Scotland's Rural College
Scottish Wildlife Trust
South of Scotland Enterprise

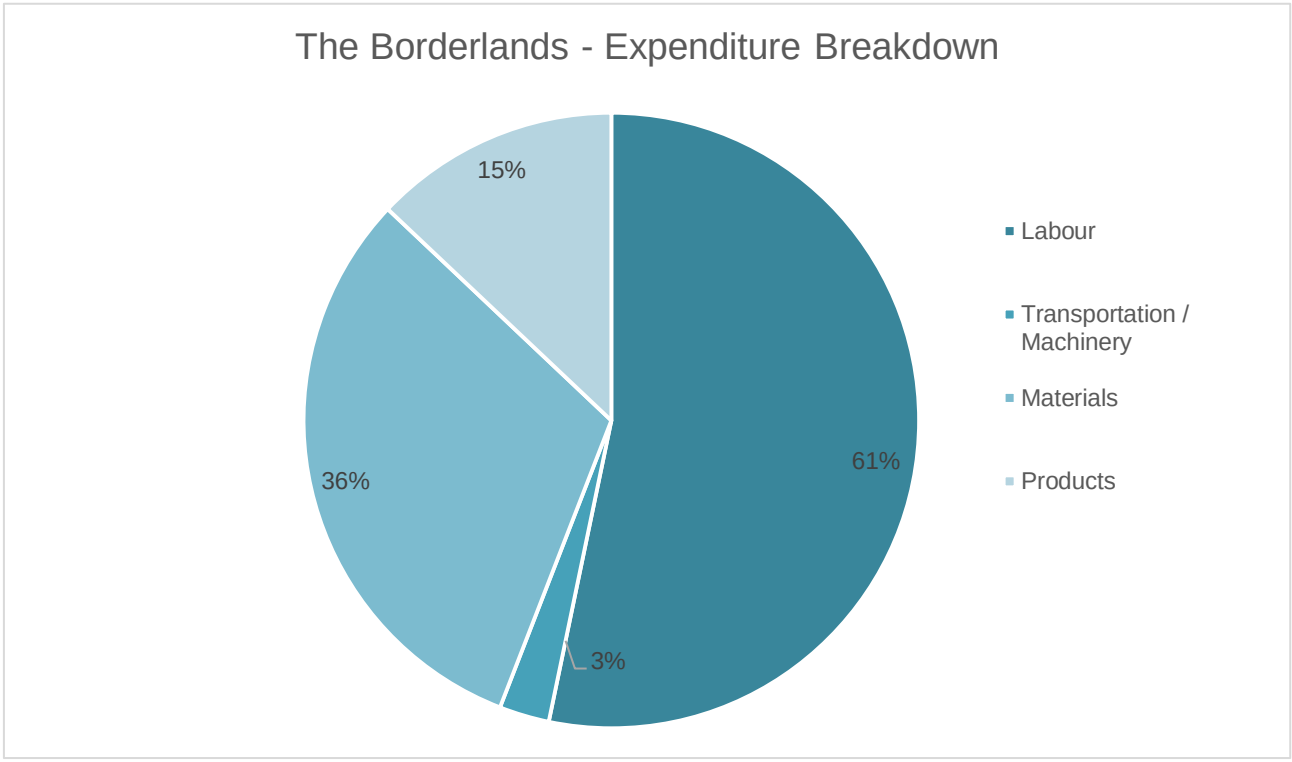
Appendix D

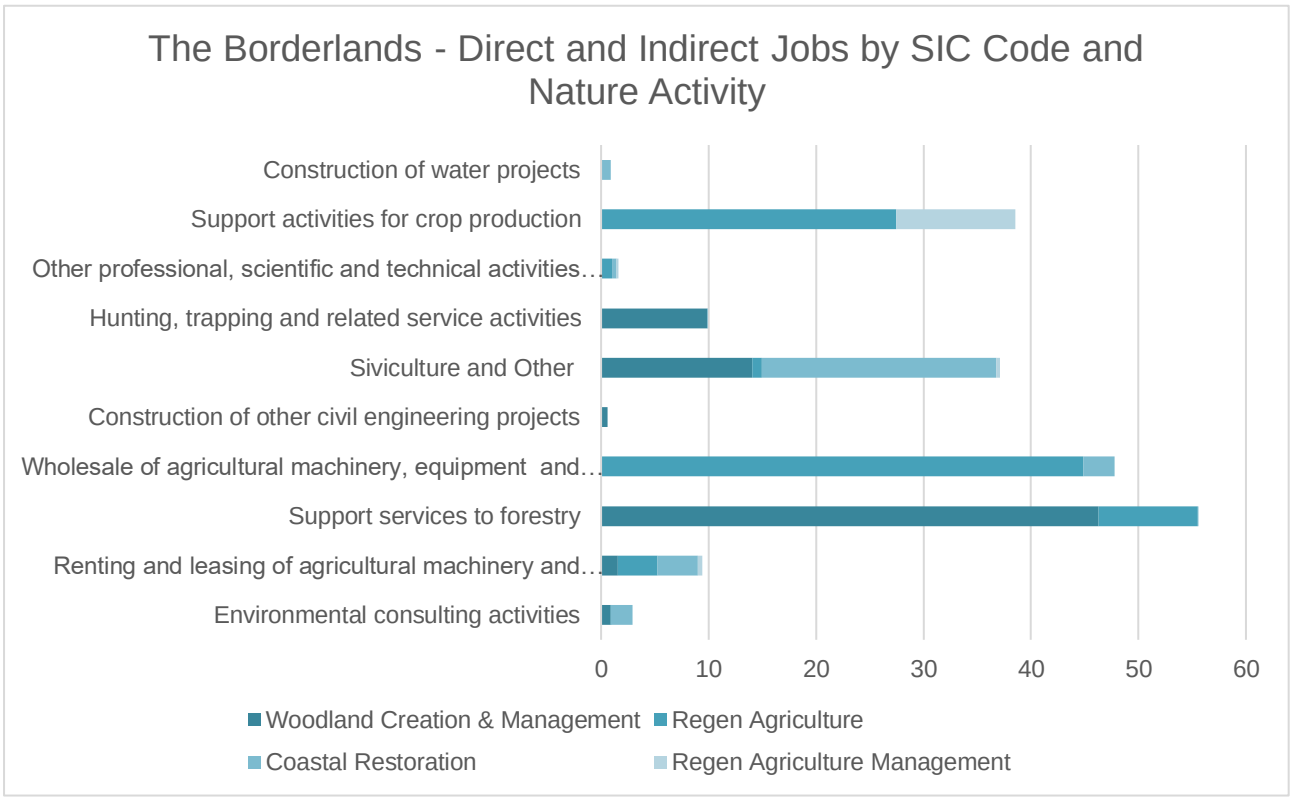
Case Study 1: Loch Lomond and The Trossachs National Park – Results Breakdown Charts



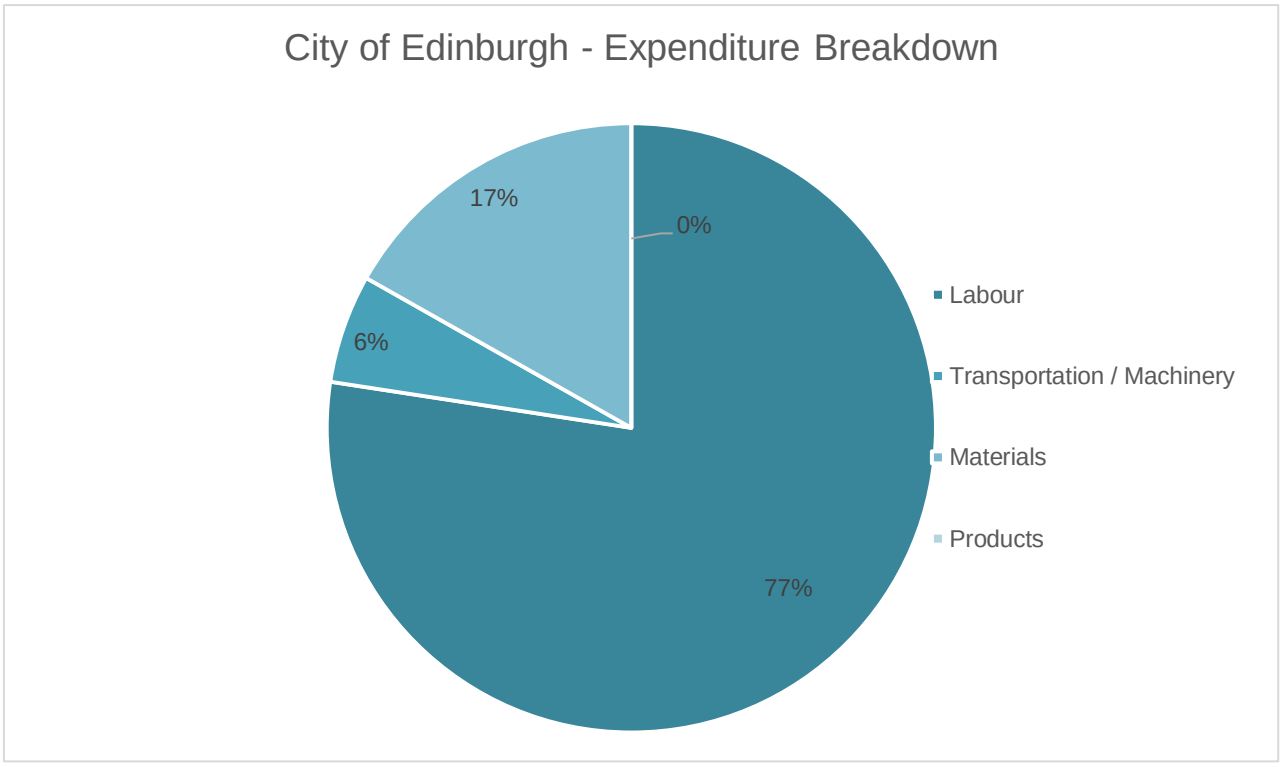


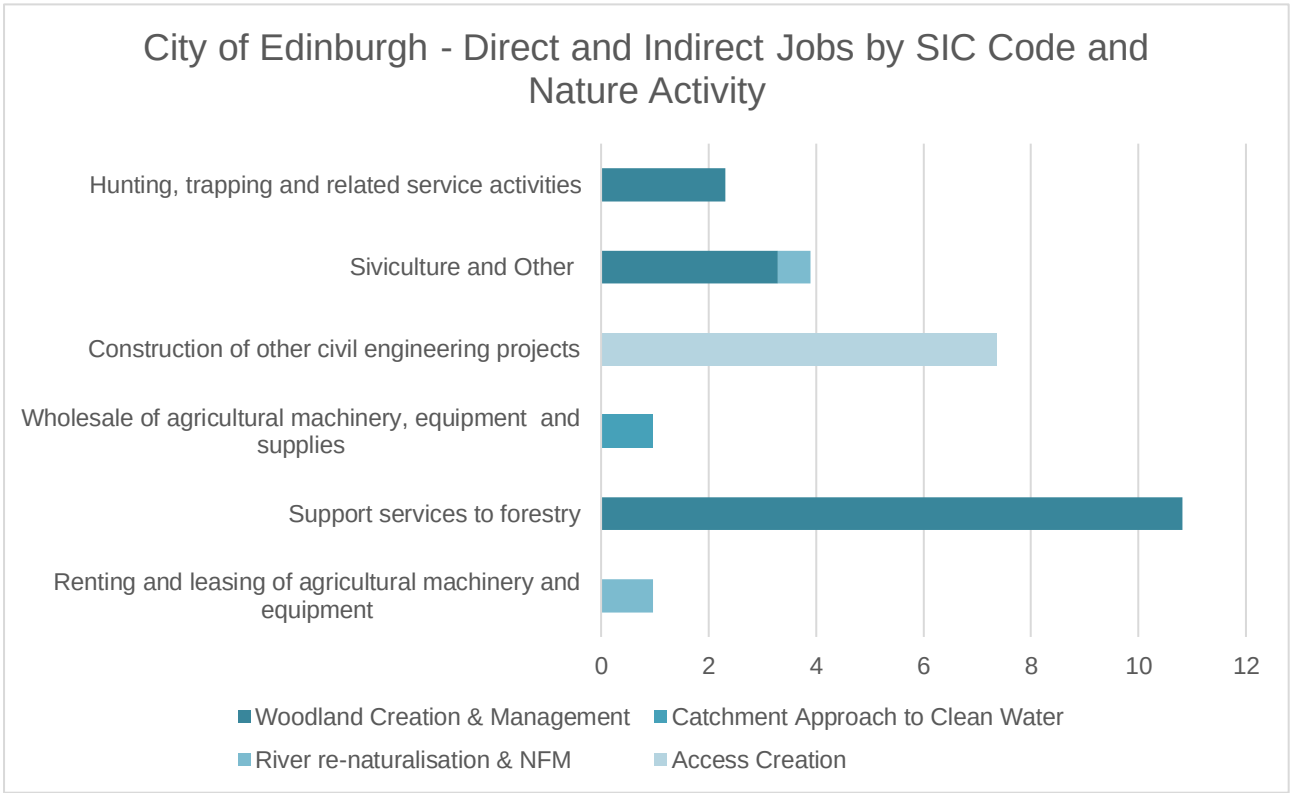
Case Study 2: South of Scotland – Results Breakdown Charts





Case Study 3: City of Edinburgh – Results Breakdown Charts





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The views expressed in this report are those of the researcher and do not necessarily represent those of the Scottish Government or Scottish Ministers.

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