CLIMATE READY SCOTLAND: Second Scottish Climate Change Adaptation Programme 2019-2024

September 2019

Scottish Government
Riaghaltas na h-Alba
gov.scot

Laid before the Scottish Parliament by the Scottish Ministers under Section 53 of the Climate Change (Scotland) Act 2009, September 2019
Printed on 100% recycled paper

SG/2019/150

Scottish Government
Riaghaltas na h-Alba
gov.scot

Ministerial Foreword **5**

How to Use this Document **8**

Executive Summary **10**

Part 1: Climate Change Adaptation **13**
Introduction 14
The Global Climate Emergency 14
Scotland's Changing Climate 15
UK Climate Change Projections 16

Part 2: Second Climate Change Adaptation Programme **19**
Introduction 20
Statutory Requirements 20
UK Climate Change Risk Assessment 20
Outcomes-Based Approach 21
Vision 23
Stakeholder Engagement 23
Strategic Environmental Assessment 24
Climate Change Adaptation Behaviour Change 25
Monitoring and Evaluation 26
National Forum 27

Part 3: Outcomes **29**
Outcome 1: Communities 31
Outcome 2: Climate Justice (including Health) 65
Outcome 3: Economy 89
Outcome 4: Supporting Systems 119
Outcome 5: Natural Environment 147
Outcome 6: Coastal and Marine Environment 177
Outcome 7: International Networks 195

Annexes **213**
Annex 1: Progress to Date 213
Annex 2: UK Climate Projections 2018 215
Annex 3: Monitoring and Evaluation 216

List of Images

Part 1
Hopes Reservoir
#ShowYour Stripes – Temperature change in Scotland from 1884-2018 (Ed Hawkins)
Scotland's Changing Climate Visuals (Met Office)

Part 2
Rum National Nature Reserve (© John MacPherson, SNH)
The Adaptation Programme's relationship to the UN Sustainable Development Goals and Scotland's National Performance Framework
Monitoring and Evaluation Framework Summary

Part 3
Ariundle Nature Reserve (© Lorne Gill, SNH)

Outcome 1
Image 1.1. Edinburgh Castle
Image 1.2. Rum National Nature Reserve (© Lorne Gill, SNH)
Image 1.3. River Forth, Stirling (© Lorne Gill, SNH)
Image 1.4. Visualisation of the Place Standard Tool (© Linda Hunter)
Image 1.5. Scottish Fire and Rescue Service provide assistance during flood event (© SFRS)
Image 1.6. St Kilda National Nature Reserve (© Lorne Gill, SNH)
Image 1.7. Canal and North Gateway Visualisation (© Green Infrastructure Scotland)
Image 1.8. Threave Castle (© Historic Environment Scotland)

Outcome 2
Image 2.1. Blawhorn Moss National Nature Reserve (© Lorne Gill, SNH)
Image 2.2. Moine Mhor National Nature Reserve (© Lorne Gill, SNH)
Image 2.3. Place Standard Tool Visualisation
Image 2.4. Multi-functional greenspace at Eastwood Health and Community Care Centre (© Anne Lumb, Green Exercise Partnership)
Image 2.5. Sustrans Route 75, Oban to Fort William (© Lorne Gill, SNH)

Outcome 3
Image 3.1. Ariundle Oakwood National Nature Reserve (© Lorne Gill, SNH)
Image 3.2. The Effects of Climate Change on Business and Industry (The CCC)
Image 3.3. River Derry (© Lorne Gill, SNH)
Image 3.4. Spring Barley (ScotGov Flickr)
Image 3.5. Invereshie and Inshriach National Nature Reserve (© Lorne Gill, SNH)
Image 3.6. Zepto in Action (© Oxido)

Outcome 4
Image 4.1. Hopes Reservoir
Image 4.2. Reserved, partially devolved and devolved infrastructure sectors in Scotland
Image 4.3. Risk of cascading infrastructure failures (© The CCC)
Image 4.4. Transmission tower
Image 4.5. River Spey
Image 4.6. Queensferry Crossing
Image 4.7. ScotRail train at Tweedbank station
Image 4.8. Wildfire near Aberlour, Moray (© Scottish Fire and Rescue Service)

Outcome 5
Image 5.1. Forsinard Flows National Nature Reserve (© Lorne Gill, SNH)
Image 5.2. Types of Ecosystem Services (© WWF)
Image 5.3. Peatland restoration, Flanders Moss National Nature Reserve (© Lorne Gill, SNH)
Image 5.4. Glasdrum National Nature Reserve (© Lorne Gill, SNH)
Image 5.5. Creag Meagidh National Nature Reserve (© Lorne Gill, SNH)
Image 5.6. Noss National Nature Reserve(© Lorne Gill, SNH)
Image 5.7. Mar Lodge Estate National Nature Reserve (© Lorne Gill, SNH)

Outcome 6
Image 6.1. Bass Rock (© Lorne Gill, SNH)
Image 6.2. Isle of May National Nature Reserve (© Lorne Gill, SNH)
Image 6.3. Bottlenose Dolphins, Moray Firth (© Lorne Gill, SNH)
Image 6.4. Isle of May National Nature Reserve (© Lorne Gill, SNH)

Outcome 7
Image 7.1. Self-sufficient schools feeding programme: Livingstonia, Malawi
Image 7.2. The Global Challenges of Climate Change (The CCC)
Image 7.3. #ShowYourStripes – Temperature change globally from 1850-2018 (Ed Hawkins)
Image 7.4. #ShowYourStripes – Temperature change in Malawi from 1901-2018 (Ed Hawkins)
Image 7.5. Self-sufficient schools feeding programme: Livingstonia, Malawi

List of Acronyms

BRE	Building Research Establishment
CCC	Committee on Climate Change
CREW	Scotland's Centre of Expertise for Waters
CXC	ClimateXChange
DAERA	Northern Ireland Department of Agriculture, Environment and Rural Affairs
DEFRA	UK Department for Environment, Food and Rural Affairs
FSS	Food Standards Scotland
HES	Historic Environment Scotland
HNIR	Hydro Nation International Research
IDF	International Development Fund
IIB	Infrastructure Investment Board
IIP	Infrastructure Investment Plan
INNS	Invasive Non-Native Species
JNCC	Joint Nature Conservation Committee
MCCIP	Marine Climate Change Impacts Partnership
MPA	Marine Protected Areas
MSC	Marine Stewardship Council
MSFD	Marine Strategy Framework Directive
MSS	Marine Scotland Science
NFM	Natural Flood Management
NFRA	National Flood Risk Assessment
NHS NSAT	NHS Sustainability Assessment Tool
NHS NSS	NHS National Services Scotland
NRW	Natural Resources Wales
OSPAR	Oslo/Paris Convention (for the Protection of the Marine Environment of the North-East Atlantic)
RBMPs	River Basin Management Plans
RHS	Royal Horticultural Society
SAC	Special Areas of Conservation
SBP	Scottish Business Pledge
SCIAF	Scottish Catholic International Aid Fund
SEPA	Scottish Environment Protection Agency
SFRS	Scottish Fire and Rescue Service
SIA	Stakeholder Impact Assessments
SIMD	Scottish Index of Multiple Deprivation
SME	Small and Medium-Sized Enterprises
SNH	Scottish Natural Heritage
STPR2	Strategic Transport Projects Review 2
STUC	Scottish Trades Union Congress
UKCCRA	UK Climate Change Risk Assessment
UNESCO	United Nations Educational, Scientific and Cultural Organization

Ministerial Foreword

There is a global climate emergency.
The United Nations states that humans have caused one degree Celsius of warming to the Earth's atmosphere over the past century and 1.5°C of warming could come as soon as 2030. Many regions, such as the Arctic, are already suffering from even greater warming. Poor and disadvantaged people around the world are unfairly affected, including people living on small islands and in rural and coastal communities.

Without strong worldwide action to cut harmful greenhouse gas emissions, we can expect further serious negative impacts, globally and in Scotland. These include threats to food and water supplies, health, biodiversity and ecosystems, transport, businesses, public services and Scotland's iconic historic environment.

Scotland's climate has already changed. The 10 warmest years in the UK have all been since 2003. Since the early 20th century, rainfall levels have increased in Scotland by around 11% and on a shorter timescale, since the early 1960s, by around 27%. We expect these changes to continue and intensify. 1 in 11 homes and 1 in 7 businesses in Scotland are already at risk of flooding and, on average, around 2000 more properties will be at risk every year due to climate change.

Scotland's emissions have almost halved since 1990, but even if global emissions were to stop today, extreme weather and sea level rise would still continue to worsen for decades to come.

In your responses to our consultation on the draft Adaptation Programme, you told us you wanted to see urgent action on emissions cuts – our mitigation effort. Since then, we have acted on advice from the UK Committee on Climate Change (CCC) and amended our Climate Change Bill to set even stronger emission reduction targets of 70% and 90%, by 2030 and 2040 respectively, and net-zero emissions by 2045. This means that Scotland's contribution to climate change will end, definitively, within a generation. You were also clear in your support for a new Adaptation Programme that links our adaptation and mitigation efforts and helps deliver wider objectives for our society and economy.

Scotland has been preparing for climate change for over a decade through our sector-based 2009 Framework and our wide-ranging 2014 Programme, with its 150 actions to address 130 climate risks.

We have built on early knowledge sharing and now have a well-informed Scottish public, and a strong community of climate adaptation experts and enthusiastic champions.

Public bodies, publicly owned companies, and local authorities have strong track records of collaborative working on climate change mitigation, adaptation and resilience. We have seen the emergence of a unique Scottish model of place-

based adaptation partnerships including Climate Ready Clyde, Edinburgh Adapts, Aberdeen Adapts and Levenmouth Adapts.

We are already adapting in response to climate change. Well-established policies are delivering solid progress on: new flood protection schemes, flood warning systems, resilience of our water supply, transport, health services, forestry, peatlands and agriculture. New approaches and actions to meet the urgent challenge are being brought forward: the 2018 Programme for Government and the Climate Change Plan set out a range of adaptation-related policies, including a new approach to managing surface water flooding in line with the international trend of blue-green cities. We have committed to updating the Climate Change Plan within 6 months of the Climate Change Bill receiving Royal Assent and as we do so we will seek to strengthen and reinforce the links and co-benefits inherent in our approaches to climate change mitigation and adaptation.

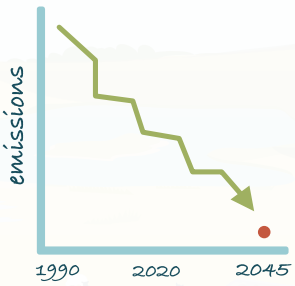
Your enthusiastic and expert contributions to our public consultation, through digital media, workshops and climate conversations across Scotland, from Shetland to the Borders, have helped us strengthen this second, statutory, five-year Adaptation Programme, with its new outcomes-based approach. Together we will build on the strong progress made over the past decade, keeping our approaches to adaptation and mitigation under constant scrutiny and review. In line with the global climate emergency, the new Programme will, with your help, deliver a step change in securing the benefits of a climate-ready, resilient Scotland for current and future generations.

Roseanna Cunningham
Cabinet Secretary for Environment, Climate Change and Land Reform

Climate Ready Scotland: Scotland's Climate Change Adaptation Programme 2019-2024

Scottish Government
Riaghaltas na h-Alba
gov.scot

There is a global climate **emergency.**



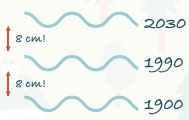
Scotland has almost **halved** its emissions since **1990**

Our Climate Change Bill has a target of net zero emissions by **2045**

Scotland's climate is changing!

We could experience a **hot summer** like 2018 on average every other year by **2050**.

Extreme weather events, such as Storm Ali in September 2018, are expected to become **more frequent**.



Sea level rose by **8cm** between **1900** and **1990**, and is likely to have risen by a similar amount by **2030**.

We need to prepare for these climate impacts.

Scotland's new **five-year Climate Change Adaptation Programme** will help to: safeguard our future; improve our resilience; create a better society; unlock Scotland's immense potential as a nation.

New research by ClimateXChange will target priorities identified by our independent advisers, the Adaptation Committee of the **Committee on Climate Change:** monitoring and evaluation; flood risks; social care; extreme events; soil health.

Public consultation in 2019 strongly supported key features of the new Programme: connecting to strong action on the global climate emergency; a National Forum; linking to UN Sustainable Development Goals and Scotland's National Performance Framework; an outcome-based approach; monitoring and evaluation; behaviour change.

The new Programme builds on a decade of progress:

- **£42m** provided annually by Scottish Government to Local Authorities for flood protection
- Distinctively Scottish place-based initiatives like Climate Ready Clyde, Edinburgh Adapts, Aberdeen Adapts, and Levenmouth Adapts
- Guidance for business and public sectors;
- Actions on: communities; infrastructure; water supplies; historic, terrestrial and marine environments; planning; transport; health; education; agriculture

- National Flood Risk Assessment 2018
- **Dynamic Coast** - National Coastal Change Assessment
- National **"Ready Scotland"** resilience information campaign
- Climate Justice Fund
- Collaboration with the British-Irish Council
- Adaptation Scotland support from sustainability charity Sniffer funded by the Scottish Government

How to Use this Document

This document sets out the Scottish Government's five year Programme for climate change adaptation. Part 1 sets the context for the Programme including the latest projections of what Scotland's climate could be like in the future. Part 2 provides information on the process of developing the second Scottish Climate Change Adaptation Programme. Part 3 is split into seven Outcomes and sets out current policies, proposals and research to increase the capacity of Scotland's communities, businesses and natural environment to adapt to a changing climate.

Each Outcome is broken down into Sub-Outcomes, which in turn, may be broken down further as necessary to provide a framework for adapting to climate change. Policies, proposals and research have been set against the Sub-Outcomes that they are most relevant to. In the case that a policy or proposal relates to more than one Sub-Outcome under the same Outcome, it has been presented as a cross-cutting policy. If a policy or proposal is relevant to more than one Outcome, it has been included in all of the Outcomes that it relates to. Where a policy appears in more than one place, it has been hyperlinked to the primary reference. Case studies have also been included to provide real world examples of climate change adaptation in progress.

In order to better express the organisational structure, visual representations of the structure have been included at the beginning of each chapter. These diagrams include hyperlinks that will allow you to jump to particular sections of the document as needed.

Key

This document uses different box formats to indicate whether the box contains a policy, policy proposal, research project, case study or adaptation behaviours. Each Outcome also has an individual colour scheme, which can be viewed in the Executive Summary on pages 12 and 13. The following box formats demonstrate this for the Climate Justice Outcome:

Policy Title	
Description of policy	
Timeline:	**Owners:**

Research

Case Study

Proposal: Title	
Description of proposal	
Timeline:	**Owners:**

Adaptation Behaviours

Definitions
Vision: The long term desired end state which the Programme works towards.
Outcome: An overarching aim which describes what the Programme is working to achieve at the highest level.
Sub-Outcome: The building blocks of an outcome, which combined ensure that we fulfil our overarching aims.
Performance Indicator: A metric which enables us to track progress towards the achievement of the Outcomes or to monitor how well the Programme is being implemented.
Climate Change Risks: The consequences for Scotland that may occur from the impacts of climate change.
Policy: A course of action that is actively in place.
Proposal: A forthcoming set of actions that is under consideration.
Research: Research currently being undertaken, or already completed.
Future Research: Research that will be undertaken based on funding from this current financial year (2019-2020).

Executive Summary

The second Scottish Climate Change Adaptation Programme sets out policies and proposals to prepare Scotland for the challenges that we will face as our climate continues to change in the decades ahead. The Programme is a requirement of the Climate Change (Scotland) Act 2009 and addresses the risks set out in the UK Climate Change Risk Assessment (UK CCRA) 2017, published under section 56 of the UK Climate Change Act 2008.

The Programme takes an outcomes-based approach, derived from both the UN Sustainable Development Goals and Scotland's National Performance Framework. This cross-cutting approach promotes co-benefits, and integrates adaptation into wider Scottish Government policy development and service delivery. There are seven Outcomes in the Programme, each have been split into Sub-Outcomes which act as building blocks for the Outcomes.

Outcome 1: Our communities are inclusive, empowered, resilient and safe in response to the changing climate

This outcome utilises 'placemaking' as a theme, the idea that each place should be planned, designed, and managed to suit the needs and aspirations of the people who live there. There are two main elements that make up a place: social aspects, and physical aspects. The first Communities Sub-Outcome relates to the social aspects of community, and includes the ways in which communities can be equipped with the knowledge and tools to adapt to climate change, while empowering them to do so. The second Sub-Outcome relates to the physical aspects of community, including the built and historic environment, and all the spaces in between. Aspects related to vulnerable people within communities are included in Outcome 2.

Outcome 2: The people in Scotland who are most vulnerable to climate change are able to adapt and climate justice is embedded in climate change adaptation policy

The negative impacts of climate change are likely to be felt most by those who are already vulnerable to its effects, yet have done little or nothing to cause the problem. The Scottish Government champions climate justice, and promotes a people-centred, human-rights approach that shares the benefits of equitable low carbon development, and the burdens of climate change fairly. To improve the ability of people to adapt to climate change, those who are more vulnerable must first be engaged and empowered in their own communities, as reflected in the first Climate Justice Sub-Outcome. The second Sub-Outcome relates to the provision of health and social care in Scotland, recognising that impacts on these services will likely disproportionately affect those who are already more vulnerable.

Outcome 3: Our inclusive and sustainable economy is flexible, adaptable and responsive to the changing climate.

The businesses and industries that make up Scotland's economy vary in type and size. The natural environment forms a large base for businesses in Scotland, with agriculture, forestry, and aquaculture and fisheries forming an important part of Scotland's identity, economy, and national heritage. The first Economy Sub-Outcome focuses on these businesses, and how they can adapt to the changing climate. Beyond natural resources, the second Sub-Outcome focuses on Scotland's manufacturing, services and wider economy, and considers three key functions of businesses that could be impacted by climate change: capital, labour, and supply chains. Climate change will create risks and opportunities for Scotland's businesses, with changing demands for goods and services presenting opportunities for innovation. The third Sub-Outcome focuses on the opportunities that Scottish businesses could harness as the climate changes.

Outcome 4: Our society's supporting systems are resilient to climate change

Scotland's infrastructure network encompasses the supply networks of energy, water, communications (including digital), roads, and rail that cross our country, and the service delivery areas of government, health and emergency services. Much of this infrastructure is critical, providing lifeline services to Scotland's communities and businesses, particularly those that are located in Scotland's remote highlands and islands. It is important that these networks and services are resilient as the climate changes so we can keep Scotland running, and this forms the basis of the Infrastructure Sub-Outcomes. Cross-cutting these Sub-Outcomes is the recognition that Scottish infrastructure is interdependent, and managing this will enhance resilience.

Outcome 5: Our natural environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change

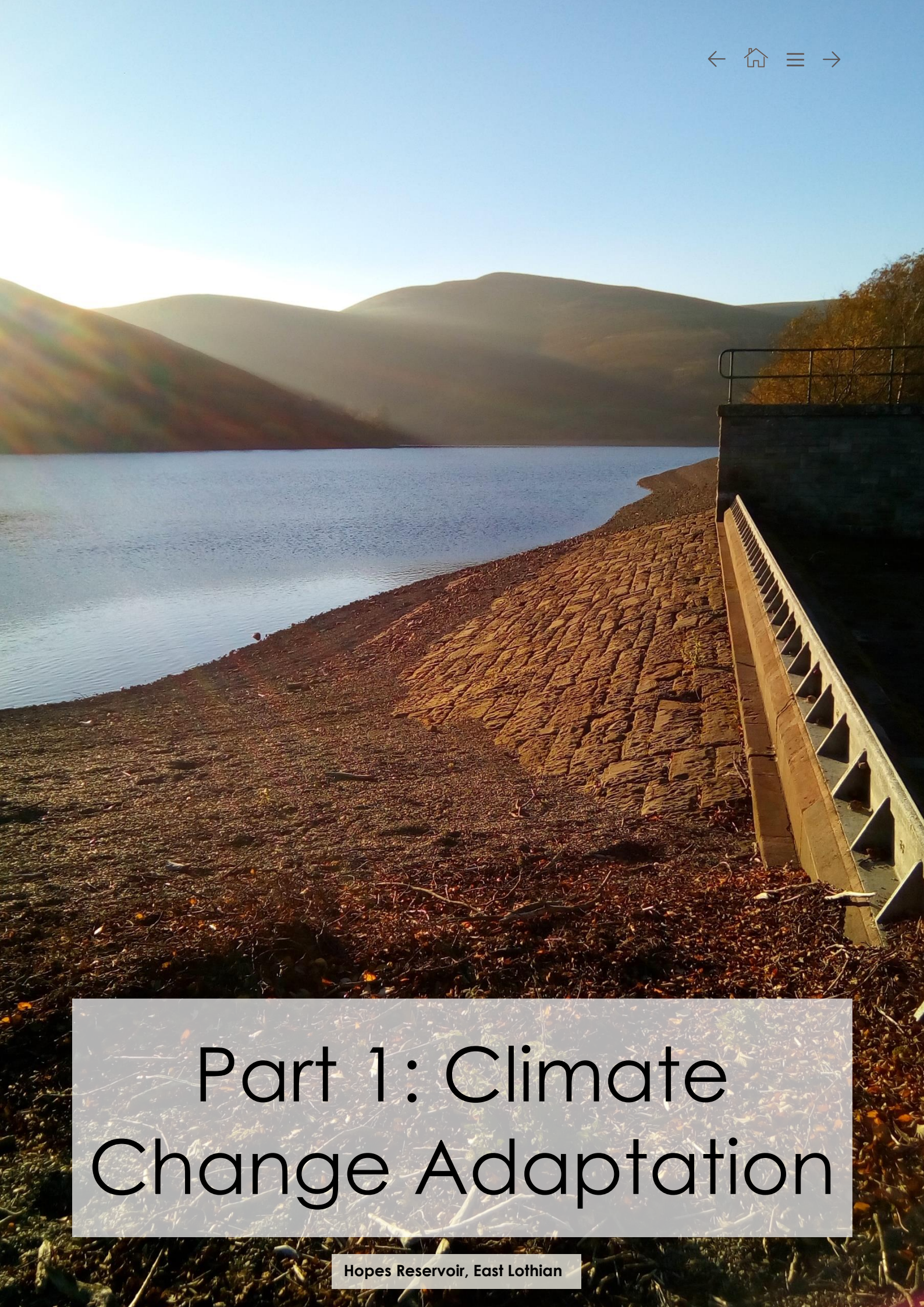
A healthy natural environment is vital to society, the economy and the functioning of our natural systems. Ecosystem services encompass the contributions of ecosystems to human well-being. They are typically split into four categories: regulating, supporting, cultural and provisioning. The four types of ecosystem services have been split across two Natural Environment Sub-Outcomes. The regulating and supporting services are considered under the first Sub-Outcome, the cultural services are considered under the second Sub-Outcome, while the provisioning services are being considered within the Economy Outcome (Outcome 3).

Outcome 6: Our coastal and marine environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change

As in Outcome 5, Outcome 6 uses an ecosystem services approach. The regulating and supporting services are considered under the first Coastal and Marine Sub-Outcome, the cultural services are considered under the second Sub-Outcome, while the provisioning services are being considered within the Economy Outcome (Outcome 3).

Outcome 7: Our international networks are adaptable to climate change

Scotland is already an international leader in mitigating climate change. We want to show that same leadership in adapting to climate change. Outcome 7 has three International Sub-Outcomes. The first focuses on Scotland's food supply networks given that approximately 40% of Scotland's food is produced overseas. The second Sub-Outcome focuses on Scotland's contribution to international governance, managing potential international instability as a result of climate change. The third Sub-Outcome focuses on Scotland's open and connected economy which is adaptable to the changing climate.



Part 1: Climate Change Adaptation

Hopes Reservoir, East Lothian

Introduction

Climate change adaptation is about responding to the changes that we have seen in our climate over the last few decades, and preparing for the challenges that we will face as our climate continues to change. Climate change mitigation refers to efforts to reduce or prevent emissions of greenhouse gases, which have a direct impact on global average temperatures, and reducing the current concentration of CO_2 by enhancing sinks (for example, increasing the area of forest).

Climate change adaptation and mitigation are intrinsically linked. The more global mitigation, the less we have to adapt to the impacts of climate change. The Scottish Government will always strive for the most ambitious, credible, emissions targets, however, our climate is already changing. No matter how successful we are at reducing our greenhouse gas emissions, it will still be necessary to adapt to climate change because many impacts of past emissions are already locked-in and will lead to changes in our climate for decades to come.

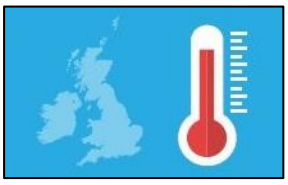
The Global Climate Emergency

In April 2019, the First Minister declared a global climate emergency. This announcement acknowledges the urgent challenge we face to reduce our greenhouse gas emissions and adapt to the changing climate. Scotland is showing strong global leadership in this challenge and has almost halved greenhouse gas emissions compared to the 1990 baseline. In May 2019, the Committee on Climate Change recommended a net-zero emission date for Scotland of 2045. Scottish Ministers acted immediately on that advice, amending the Climate Change Bill to set new emissions reduction targets of 70% and 90% by 2030 and 2040 respectively, and net-zero emissions by 2045. To support this, the Scottish Government has committed to update the Climate Change Plan within six months of the Bill receiving Royal Assent.

Scotland's Changing Climate

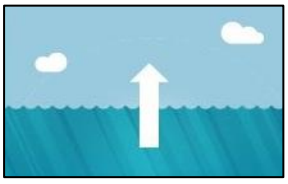
#ShowYourStripes – Temperature change in Scotland from 1884-2018, Ed Hawkins

Scotland's climate is warming, and through our public consultation we have heard about the changes already observed across Scotland, for example, a longer growing season and weather-related travel disruption.



Scotland's 10 warmest years on record have all been since 1997. The average temperature in the last decade (2009-2018) was 0.67°C warmer than the 1961-1990 average.
The warmest year on record was 2014.

Scotland's annual average rainfall in the last decade (2009-2018) was 15% wetter than the 1961-1990 average, with winters 25% wetter.
The wettest year on record was 2011.



Mean sea level around the UK has risen by approximately 1.4 mm per year from the start of the 20th century, when corrected for land movement.

Images © Met Office

In winter 2015-16, Scottish communities experienced unprecedented floods, with long lasting impacts on the affected residents. 2018 brought weather extremes, with an extremely cold winter and hot summer indicating some of the weather challenges that could lie ahead for Scotland.

In other parts of the world, two devastating cyclones in a matter of weeks killed hundreds of people and left around three million needing help in Southern Africa,

including Malawi where Scotland has close connections. These events, globally and in Scotland, clearly demonstrate the dangers of more frequent extreme weather and climate change and the benefits of being prepared. Climate projections indicate that the climate trends observed over the last century will continue and intensify over the coming decades. We can expect future changes in climate to be far greater than anything we have seen in the past.

UK Climate Projections

The UK Climate Projections (UKCP18) illustrate a range of future climate scenarios until 2100 – presenting increasing summer and winter temperatures, more frequent extreme weather and rising sea levels.

The projections are based on the latest climate science from the Met Office and around the world, and include additional observations and updated views of how emissions may change in the future. They have also been subject to an independent peer review, and these improvements increase our confidence in their prediction of future climate.

In 2019, more projections will be provided, to complement those launched in November 2018, at finer spatial scales comparable to those used for weather forecasting. This high resolution data will provide information on events such as localised heavy summer rainfall, which can result in severe flooding.

The UK Government and devolved administrations will make use of UKCP18 to inform their adaptation and mitigation planning and decision-making, including the next Climate Change Risk Assessment (UK CCRA), due in 2022.

Adaptation Scotland, funded by the Scottish Government, are working with Scottish Natural Heritage (SNH), Scottish Environment Protection Agency (SEPA), Historic Environment Scotland (HES) and the Met Office to develop a climate projections summary specifically for Scotland based on UKCP18, due for publication in Autumn 2019.

A summary of projected changes to Scotland's climate is included below[1].

Summer and winter changes by 2070

Summer precipitation change	Winter precipitation change	Summer temperature change	Winter temperature change
11% drier	8% wetter	1.4°C hotter	1.0°C hotter
14% drier	18% wetter	2.6°C hotter	2.2°C hotter

Key:
- Low Emission Scenario
- High Emission Scenario

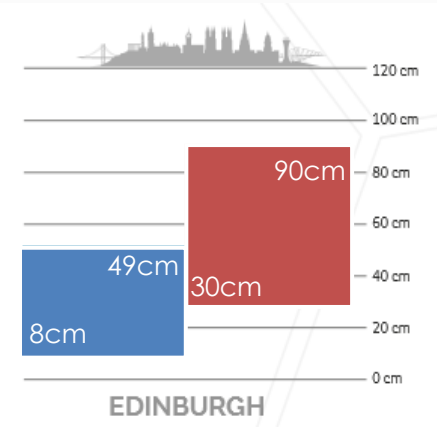
Greater chance of summers being hotter than 2018 in future

In the recent past, the chance of seeing a summer as hot as 2018 was low (<10%)

By mid-century, hot summers could become common (~50%)

By the end of the century, if we continue with high greenhouse gas emissions, these hot summers will become even more likely

Sea Level Rise by 2100 relative to 1981-2000



Ice Sheets

Sea levels could rise further if there is additional large-scale melting of ice sheets. Future melting of Antarctic ice sheets is particularly uncertain.

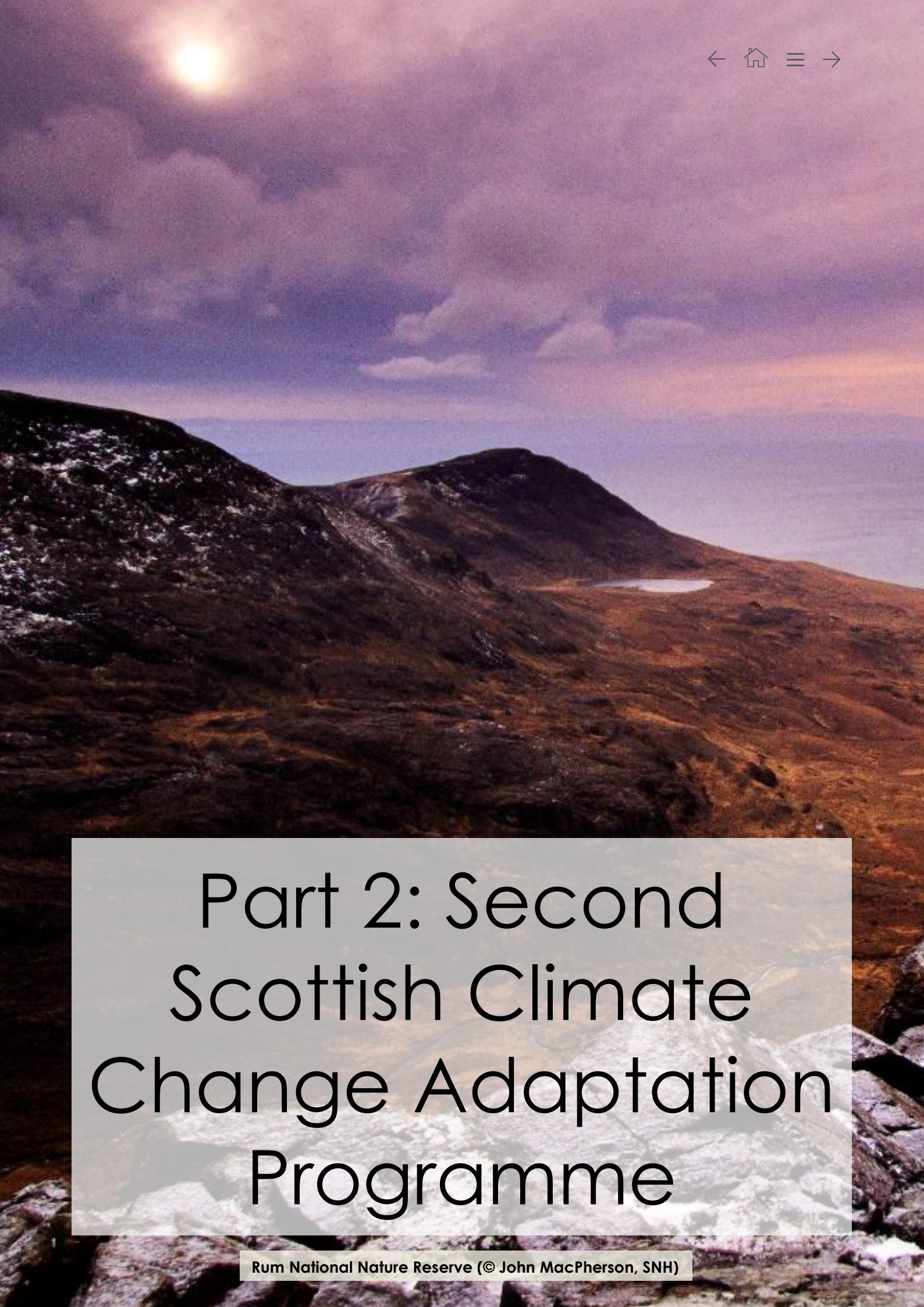
Sea Level Extremes

The risk of coastal flooding from storm surges and high tides will increase as sea levels rise.

Sea Level Beyond 2100

Sea levels will continue to rise beyond 2100, however the uncertainty also increases further into the future.

[1] Results are provided for the 50th percentile for 2070 relative to 1981 – 2000. The full range of results is included in Annex 2.



Part 2: Second Scottish Climate Change Adaptation Programme

Rum National Nature Reserve (© John MacPherson, SNH)

Introduction

The Scottish Climate Change Adaptation Programme 2019-2024 is the Scottish Government's statutory five year programme for adapting to climate change. It sets out the Scottish Government's policies and proposals for the next five years to increase the capacity of Scotland's people, communities, businesses and public sector to adapt to climate change.

This document contains current policies, and proposals for future policies. This document will be regularly reviewed, and updated on a rolling basis rather than waiting until the next statutory five year programme is due before incorporating enhancements.

Statutory Requirements

Section 53 of the Climate Change (Scotland) Act 2009 requires Scottish Ministers to lay a programme before the Scottish Parliament that sets out:

1. their objectives in relation to adaptation to climate change
2. their proposals and policies for meeting those objectives
3. the arrangements for involving employers, trade unions and other stakeholders in meeting those objectives
4. the mechanisms for ensuring public engagement in meeting those objectives
5. the period within which those proposals and policies will be introduced

The Programme must also address the risks identified in the UK Climate Change Risk Assessment (UKCCRA), which is laid before the UK Parliament every 5 years. The UKCCRA contains an assessment of the risks for the United Kingdom from the current and predicted impact of climate change.

UK Climate Change Risk Assessment

The first UK Climate Change Risk Assessment was published in 2012 by the UK Government Department for Environment, Food and Rural Affairs (DEFRA). For the second UKCCRA, the UK Government asked the Committee on Climate Change (CCC) to prepare an independent Evidence Report setting out the latest evidence on the risks and opportunities to the UK from climate change.

What is the Committee on Climate Change?
The Committee on Climate Change is an independent, statutory body established under the Climate Change Act 2008. Its purpose is to advise the UK Government and Devolved Administrations on emissions targets and report to Parliament on progress made in reducing greenhouse gas emissions and preparing for climate change.

In 2016, the Committee on Climate Change published the UK Climate Change Risk Assessment Evidence Report and Synthesis Report, and a National Summary for Scotland. In January 2017, the UK Government published the (second) UK Climate Change Risk Assessment 2017 including a National Summary for Scotland. In total, the UKCCRA Evidence Report consists of over 2,000 pages of analysis, used over 2,000 different sources of evidence and took three years to complete.

The Risk Assessment identified 56 risks and opportunities to the UK from climate change. The Risk Assessment uses the concept of urgency to summarise the findings of the analysis. One of four 'urgency categories' has been assigned by the Adaptation Committee to each risk and opportunity: more action needed, research priority, sustain current action, or watching brief. Some actions identified as priorities for other parts of the UK have been shown to currently have a different level of urgency for Scotland.

Outcomes-Based Approach

The second Scottish Climate Change Adaptation Programme takes an outcomes-based approach, derived from both the UN Sustainable Development Goals and Scotland's National Performance Framework. An outcomes-based approach supports the cross-cutting nature of the Programme and promotes collaboration between sectors which is key to adapting to climate change. It integrates adaptation into wider Scottish Government policy development and service delivery and engages sectors which have not yet fully considered climate change adaptation.

What is an "Outcomes-Based Approach"?
An outcomes-based approach means focusing on what the policy should achieve, rather than inputs and outputs. It is positive and forward-looking, thinking about what type of Scotland we want in the future. It encourages Government to work across traditional boundaries and increases transparency and accountability.

Whilst the structure of the programme is outcomes-led, the Scottish Government wants to ensure that all of the climatic risks to Scotland are addressed within these Outcomes. Whilst the UKCCRA provides a solid foundation for climate change adaptation in Scotland, we do not want to be limited by it. We recognise that climate change poses risks to Scotland beyond those identified in the UKCCRA, including the unequal impacts of climate change on the most vulnerable in our society. An outcomes-based approach allows us to address this.

We have developed a set of seven "outcomes" for the Programme which are shown in diagram below:

The Adaptation Programme's relationship to the UN Sustainable Development Goals and Scotland's National Performance Framework

Vision

"We live in a Scotland where our built and natural places, supporting infrastructure, economy and societies are climate ready, adaptable and resilient to climate change"

Scotland's climate is already changing and therefore action on adaptation cannot wait until the full impact of our mitigation effort can be felt. Action is being taken now and must continue with renewed vigour in light of the global climate emergency.

Our vision for Scotland is of a place where our built and natural places, supporting systems, economy and societies are climate ready, adaptable and resilient to climate change. Climate change adaptation is not an end state but a process. As the planet warms over the next decades our society will need to keep adapting. We want a future Scotland to be flexible in response to these changes and able to manage the uncertainty in predicting how climate change will impact Scotland.

Stakeholder Engagement

In developing this Programme the Scottish Government has engaged with stakeholders across Scotland to understand their views, experiences and priorities for adapting to climate change. This stakeholder engagement has been used to improve the Outcomes and Sub-Outcomes within the Adaptation Programme.

Digital Engagement

The Scottish Government's digital engagement involved seven Twitter events, one for each Outcome. These events were designed to reach out to communities across Scotland and ask them for their experiences of climate change and their priorities for climate change adaptation action. These events allowed us to hear the views of people in remote communities including the Highlands and Islands. The feedback received in these events was incorporated into our stakeholder engagement workshops to inform further policy development.

Engagement Workshops

Six stakeholder engagement events were held across Scotland to engage with key stakeholders on the proposed Outcomes. Attendees were asked to provide feedback on the proposed outcomes-based approach as well as what priorities they would identify for the Programme. The feedback from these events has been considered during the development of all seven adaptation Outcomes as well as the Sub-Outcomes.

Climate Conversations

Building on the success of our mitigation-themed Climate Conversations, we held a series of adaptation-themed Climate Conversations across Scotland. These conversations are part of the Scottish Government's ongoing engagement with the public on climate change. The purpose of these conversations was to discover

people's priorities for adaptation, as well as to raise awareness of the public consultation and climate change adaptation.

Public Consultation on the New Programme
We received 73 responses to our public consultation in early 2019, from 58 organisations including a Primary School in Glasgow, and 15 individuals. Responses indicated the need for the Programme to convey a strong sense of urgency and ambition, in line with the global climate emergency, and link to urgent mitigation action.

The responses support a Climate Change Adaptation Programme that contributes to Scotland's wider social and economic objectives, as well as addressing climate risks.

The consultation responses strongly supported key features of the new Programme, including:

- linking to the UN Sustainable Development Goals and Scotland's National Performance Framework,
- an outcomes-based approach,
- the inclusion of behaviour change,
- the integration of monitoring and evaluation from the outset.

The responses also contained many constructive suggestions, particularly highlighting the need to make the Programme more cross-cutting, which we have incorporated where applicable.

This second, statutory, five-year Adaptation Programme builds on the significant achievements of the past decade, increasing ambition in line with the global climate emergency, and, with the help of the public and stakeholders, will deliver a step change in securing the benefits of a climate-ready, resilient Scotland for current and future generations.

Strategic Environmental Assessment

The second Scottish Climate Adaptation Programme was subject to a Strategic Environmental Assessment (SEA) as detailed in the Environmental Assessment (Scotland) Act 2005. The SEA is a tool for the consideration of likely significant environmental effects resulting from of the programme and is a valuable tool in identifying any opportunities for the enhancement of positive significant effects and the mitigation of any negative ones. Alongside the Programme preparation an assessment of these likely significant effects was conducted and the results of this were included in an Environmental Report published alongside the draft Programme consultation. The assessment findings identified show that the Programme is likely to have significant positive effects on climatic factors through drawing together relevant adaptation measures to maximise their impact, capitalise upon synergies and address any gaps.

The final components of the Programme will be addressed in the Post Adoption Statement and will set out how the environmental considerations have been integrated into the final Programme, how the Environmental Report and opinions of consultees have been taken into account, the reasons for choosing the strategy as adopted and the measures for monitoring any significant environmental effects as a result of the Programme implementation.

Climate Change Adaptation Behaviour Change

Tackling the global climate emergency will require action at all levels of society, from government to individuals. The Scottish Government recognises the importance of behaviour change and we want to ensure that everyone in Scotland is informed, prepared, and ready to adapt to the changing climate. That is why this programme includes examples of how behaviour change can help individuals, businesses and organisations to adapt to climate change.

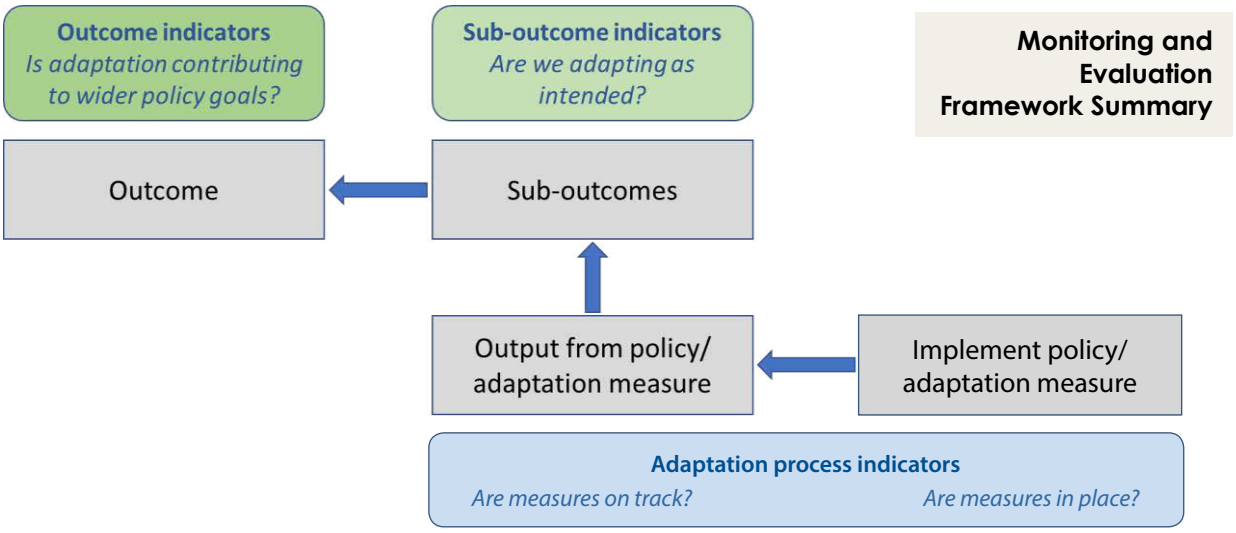
Adaptation behaviours range hugely in scale and scope, cross-cutting the entire Programme. Changes can be one-off, for example, installing flood resilience to a home or business, or habitual, for example, checking weather, pollen and pollution forecasts regularly. At the organisational level, business and industry will also have a role to play, from preparing for an increased tourist season, to altering farming practices to promote decreased soil erosion alongside increasing crop resilience.

To make informed decisions on how to adapt to climate change, people need to understand climate change and its impacts. This is referred to as climate literacy. We will continue to encourage public discussion about climate change, and support people to make changes in their lives to help increase their resilience.

Systemic behaviour change cannot happen in isolation and will require cultural shifts alongside infrastructure and technological advances. People's choices and behaviours are influenced in various ways – within the values and attitudes that we hold, the habits we have learned, the people around us, and the tools and infrastructure available to us in our day-to-day lives. Adaptation behaviours for individuals and organisations form part of each Outcome for the Programme and will assist in its overall delivery. Example behaviours are included alongside policies to serve as building blocks to achieve our vision of a Scotland able to adapt to the changing climate.

Monitoring and Evaluation

Monitoring and Evaluation is integral to the outcomes-based approach, and has been considered throughout the development of the Programme. Indicators used to measure Outcome progress enable ongoing internal and external evaluation of the Programme.



Outcome and Sub-Outcome indicators evaluate Scotland's capacity to adapt to climate change.

Adaptation process indicators assess the implementation of actions which are aimed at achieving the long-term Outcomes.

Indicators

Indicators that monitor progress towards the Outcomes capture key elements at the heart of each Outcome, and have a clear relationship to Scotland's National Performance Framework. This monitoring allows us to evaluate the Adaptation Programme in the context of its contribution to wider government goals.

Indicators that monitor progress towards Sub-Outcomes emphasise *'is it working?'* This allows us to evaluate if Scotland is adapting as intended.

Indicators to monitor the adaptation process monitor *'what is being done?'* They capture the qualitative and quantitative evidence needed to evaluate if adaptation measures are being adequately implemented.

Existing indicators and monitoring frameworks have been used where appropriate. This helps integration of adaptation across other policy areas, and avoids duplication. In some sectors, there is currently limited data available, but as more data and associated monitoring arrangements are developed, these will be incorporated into the adaptation monitoring framework. Improvement and learning underpins the framework, and by identifying what we *need* to measure,

not just what we know we *can*, the framework highlights gaps which could be filled by future measures.

Themes
The monitoring frameworks for each Outcome set out 'themes', which will structure the quantitative (indicator) and qualitative (case study) evidence for evaluating the Programme. The themes have been identified in response to stakeholder consultation and consideration of existing policies and strategies.

The suite of monitoring indicators in this Programme and our overall monitoring approach will be subject to ongoing review and we will continue working with the Committee on Climate Change Adaptation Committee to ensure robust and effective monitoring of implementation.

National Forum

In line with the Paris Agreement and EU Adaptation Strategy, we want to deliver a step change in collaboration and have proposed establishing a National Forum on Adaptation, similar to Ireland's National Adaptation Steering Committee. The Forum would include senior representatives of key sectors and will improve both leadership and collaboration. Based on the supportive responses to our public consultation, we are now considering a National Forum for climate change in light of the global climate emergency.

Part 3: Outcomes

Ariundle National Nature Reserve (© Lorne Gill, SNH)

Outcome 1: Our communities are inclusive, empowered, resilient and safe in response to the changing climate

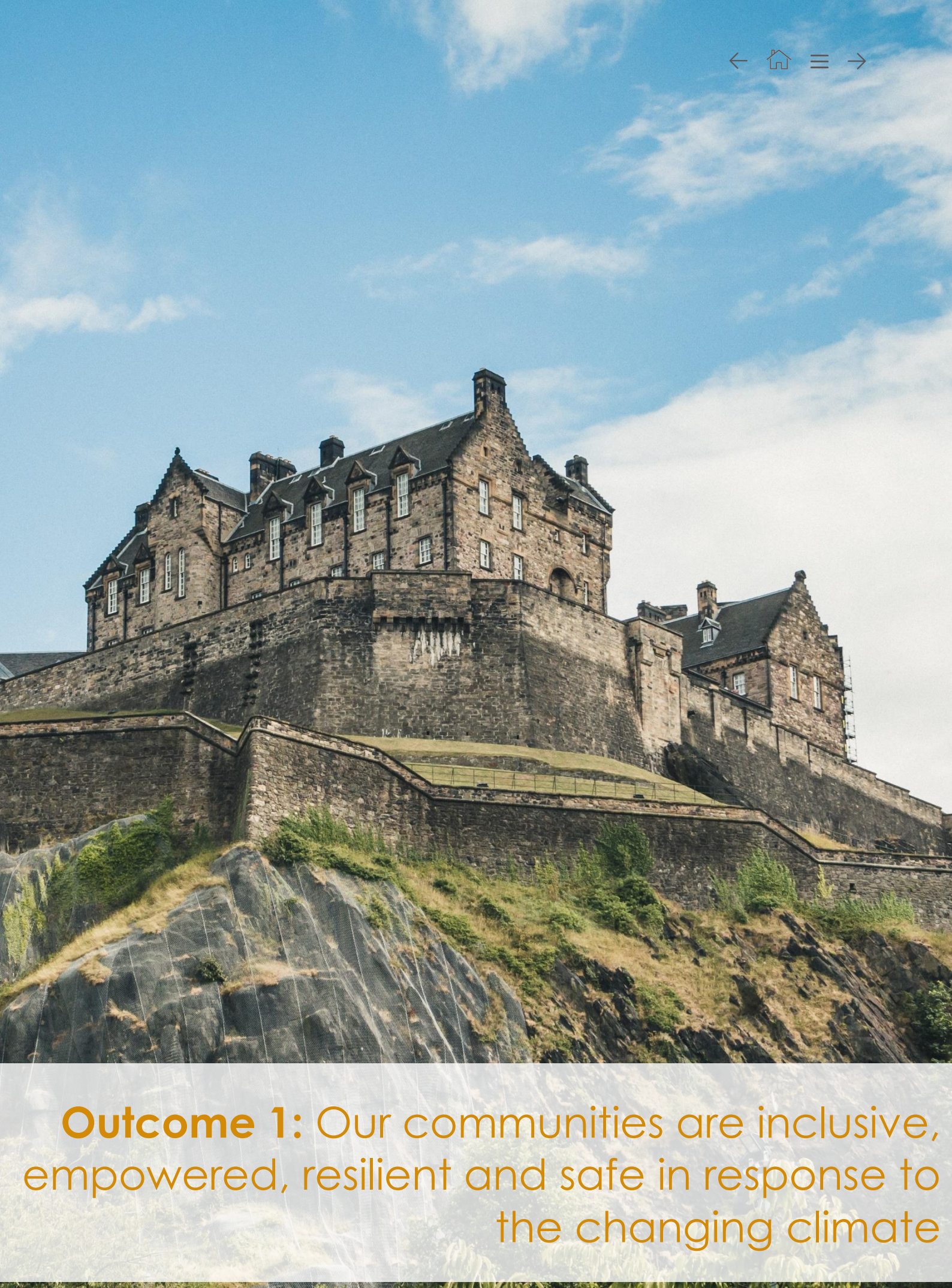


Image 1.1. Edinburgh Castle

Outcome 1: Our communities are inclusive, empowered, resilient and safe in response to the changing climate

Introduction

Our communities are shaped by the quality and character of the places we live and the people we live among. In order for Scotland to continue to flourish, we must ensure that our communities are able to adapt to the effects of climate change. As communities will form a fundamental component of our ability to adapt, our Programme begins with a focus on communities.

A community is defined as a social group of any size whose members reside in a specific locality, share government and often have a common cultural and historical heritage. Scotland's geography and history has led to the creation of diverse communities: from remote highland and island villages and towns, to the cosmopolitan cities of the central belt.

The changing climate will impact all of Scotland's communities and each community will be affected in different ways. Across Scotland, climate change will bring hotter, drier summers and warmer, wetter winters. In summer, more intense rainfall could bring heavy rainstorms with increased surface water flooding. In winter, more frequent rainfall could bring increased flooding from rivers and increased damage to buildings from wind driven rain. Increased storminess could result in increased coastal erosion, surges and wave overtopping of coastal defences and infrastructure. Sea level rise could affect the viability of some coastal communities through flooding and erosion.

Local communities will need to take action to adapt to climate change, some sooner than others, depending on the local geography and social and economic conditions. The Scottish Government believes that communities are best placed to make decisions and take action themselves, shaped by their own local geographies and demographics.

Where We Are Now

Through our Climate Ready Places work, there has been increasing focus on increasing resilience at the community, city and regional levels. Initiatives such as Climate Ready Clyde, Edinburgh Adapts and Aberdeen Adapts have laid strong groundwork to create climate change action plans for those areas. In combination with work from Adaptation Scotland, these initiatives and others also work to empower their local communities to deal with the effects of climate change through education and planning.

Building on a strong history of legislation relating to community empowerment, the Community Empowerment (Scotland) Act 2015 made adjustments to address and

improve community rights in relation to land and the Right to Buy. The Land Reform (Scotland) Act 2016 also built on this work, establishing the Scottish Land Commission and making provision for changes to land ownership and management.

In Scotland, the Flood Risk Management (Scotland) Act 2009, creates a framework for coordination and cooperation at a national and local level. It is underpinned by a National Flood Risk Assessment that embeds climate change into the heart of Scotland's flood risk management approach, whilst combining a comprehensive range of social, environmental and economic impacts into a single assessment. Flood risk management strategies and local flood risk management plans ensure long-term proactive planning and investment decisions protect the most vulnerable and those areas at greatest risk of flooding across the whole of Scotland.

Communities Sub-Outcomes

Placemaking is a multi-faceted approach to revitalising, planning, designing and managing places. It involves working with local people to discover what their priorities are for their local areas. Placemaking and place-based approaches are a useful way to consider adaptation to climate change. Approaches based on 'place' can offer a more holistic view by regarding the interactions and connections between different elements of a community. The Sub-Outcomes have been structured in line with these elements. The first relates to the social aspects of community, such as empowerment, engagement and adaptability; the second Sub-Outcome relates to the physical aspects of community, including the built and historic environment. For aspects related to vulnerable people within communities, see Outcome 2.

Image 1.2. Rum National Nature Reserve (© Lorne Gill, SNH)

Outcome 1: Our communities are inclusive, empowered, resilient and safe in response to the changing climate – policies and research

Cross-Cutting Policies

Planning (Scotland) Act 2019

1.1 People in Scotland's diverse communities are informed, empowered and adapting to climate change

1.1.1 Engaged Public

1.1.2 Empowered Communities

Scottish Flood Forum

Community Adaptation Actions

Resilient Communities Strategic Framework and Delivery Plan

Recovery from Extreme Events

Scottish Flood Forecasting Service

Community Flood Volunteer Project

Are We Ready? Facilitators Pack

The Place Principle

RiverTrack

The Place Standard Tool

Flooding Research

SEPA Flooding Strategy

Fire and Rescue Framework

1.2 Scotland's buildings and places are adaptable to climate change

1.2.1 Resilient Places

1.2.2 Resilient Historic Environment

1.2.3 Resilient Buildings

Flood Risk Management Strategies

Dynamic Coast

SEPA Flooding Strategy

1.2.1.1 Community Planning

1.2.1.2 Greenspace

Active Travel

Green Infrastructure Fund

The Place Standard Tool

Green Infrastructure Community Engagement Fund

The Place Principle

Our Place in Time Climate Change Working Group

Historic Environment Policy for Scotland 2019-2029

HES Climate Change and Environmental Action Plan

Adapt Northern Heritage (Interreg)

Research: Buildings and Heritage Assets

1.2.3.1 Resilient Residential Properties

1.2.3.2 Resilient Non-Residential Properties

Energy Efficient Scotland

CIRIA Flood Resilient Properties

Property Flood Resilience Action Plan

Building Regulations/Standards

National Flood Risk Assessment (NFRA) 2018

SEPA Flood Maps

SEPA Planning Advice

Economic Assessment under Current and Future Flood Risk Scenarios

Tolerable Standards & Scottish Housing Quality Standards

Property Flood Resilience

New Developments in Flood Risk Areas

Scotland's Learning Estate Strategy

Scotland's Schools for the Future Programme

Key

- Policy also found under another Outcome
- Policy also found under another Sub-Outcome
- Policy
- Research

Cross-Cutting Policies

Community influence within the planning system is an important aspect of improving communities' ability to adapt. Building and maintaining a relationship with communities in relation to plans and projects helps to deliver quality places that meet people's needs and aspirations. In this way, the planning system cuts across both the empowerment and built environment aspects of this outcome.

Planning (Scotland) Act 2019

The Planning (Scotland) Bill was passed by the Scottish Parliament on 20 June 2019, and received Royal Assent on 25 July 2019. The Act includes a number of elements, which put communities and interested people and organisations at the heart of land-use planning. Many of these provisions work to enhance the engagement and empowerment of communities in the planning system. Community led preparation of Local Place Plans will mean that communities can lead in setting out the vision for their areas, and could consider climate change adaptation matters. Empowered communities engaged in the planning system will be more able to take forward plans that will increase local resilience to climate change impacts.

Now that the Bill has received Royal Assent, the Scottish Government will work collaboratively with partners, including communities, on a future programme of work to implement the new requirements, and review national planning policy in Scotland.

Image 1.3. River Forth, Stirling (© Lorne Gill, SNH)

Sub-Outcome 1.1: People in Scotland's diverse communities are informed, empowered and adapting to climate change

Community empowerment is a process where people work together to make change happen in their communities by having more power and influence over what matters to them. It involves people taking collective action to enable change to happen on their own terms. Where communities are empowered, we see a range of benefits: local democratic participation is boosted, confidence and skills among local people are increased, higher numbers of people volunteer in their communities, and satisfaction with quality of life in local neighbourhoods is improved. This leads ultimately to the delivery of improved, more responsive services and better outcomes.

The Scottish Government believes that empowered and informed communities will be essential for Scotland to adapt to the changing climate. We also believe that the best people to decide the future of communities are the people who live in those communities. The policies that fall under this Sub-Outcome aim to empower and inform communities. We want to enable people to make informed choices about how best to adapt their community to the changing climate, while also considering their local knowledge and passion for their communities.

Cross-Cutting Policies

Scottish Flood Forum

The Scottish Flood Forum is an independent Scottish charity that provides support in the event of flooding, and has established a network of community resilience groups in areas at risk of flooding, to enable communities to help themselves. The grant for the Scottish Flood Forum is provided on a year by year basis and has been signed off for £190,000 for 2019-20. We aim to continue to fund the Scottish Flood Forum in the coming years to support individuals and communities at risk of flooding.

Timeline:	**Owners:**
Ongoing, annual	Scottish Flood Forum, Scottish Government

Community Adaptation Actions

The Community Adaptation Actions document describes practical actions that communities can take to increase resilience and adapt to changes in the climate. The document describes 20 actions, split over three categories:

1. Community adaptation in the natural environment.
2. Community adaptation for built assets (schools, community centres, homes).
3. Community adaptation to raise awareness and build capacity to adapt.

Each action includes information on what climate change impact will be addressed, how the action supports adaptation, co-benefits of the action, what organisations could be involved and, where available, a case study of where the action has been undertaken.

More information on community adaptation actions can be found here.

Timeline:	**Owners:**
Ongoing	Adaptation Scotland

Resilient Communities Strategic Framework and Delivery Plan (2017-2021)

The strategic aim of this plan is to support Scotland's communities, individuals and organisations to harness resources and expertise to help themselves assess and understand risk, including climate change, take appropriate measures to prevent, prepare for, respond to and recover from emergencies, in a way that complements the work of the emergency responders.

Engaged public
The public have a greater understanding of the risks they face and take appropriate action to prepare for emergencies. People help others in their communities.

Empowered communities
Communities are empowered and supported to take collective action to address the resilience issues that affect them, by developing local initiatives and plans, that complement the actions of the Emergency Responders.

Enabled collaboration and co-production
Public, private, voluntary, and other civil society organisations work together effectively through the Integrated Emergency Management (IEM) process to assess and mitigate risk, prepare for, respond to and recover from emergencies.

Education and learning
Resilience is embedded in teaching practice as part of the Curriculum for Excellence, and is delivered in formal and informal educational settings by teachers and youth workers, working with responders.

Evaluation and improvement
A positive culture of evaluation underpins innovation and supports stakeholder effort, maximising the tangible and intangible resources of both the Scottish Government and other stakeholders.

Timeline:	**Owners:**
2017 to 2021	Scottish Government

Recovery from Extreme Events

The Second Independent Assessment of the SCCAP carried out by the Committee on Climate Change identified a lack of national targets and data to measure recovery from extreme events and a need to improve the effectiveness of recovery plans. A study to set national standards will enable a common understanding of climate resilience and the critical components in planning for local and national recovery from extreme weather.

Future Research

1.1.1 Engaged Public

For communities to adapt to climate change, they must first be informed and understand the potential risks and opportunities for their community. The following policies will help to engage the public with climate change and adaptation, by providing up to date information about climate change impacts in different communities.

Scottish Flood Forecasting Service	
The Scottish Government has invested significantly in improving and supporting the continued development of Scotland's flood warning service, which will be increasingly important as our climate changes. This includes funding to help SEPA and the Met Office operate the Scottish Flood Forecasting Service. This service ensures flood forecasting and warning information is made available to the public and emergency responders throughout Scotland. The service includes a daily Flood Guidance Statement, issued to over 500 emergency responders. This provides shared understanding of current and forthcoming flood risk levels and locations, and advance notice of potential flooding situations to aid planning and coordination of the appropriate emergency response. Floodline's direct warning service is available to members of the public and sends an alert to subscribers when their postcode is at risk of flooding. The Flood Warning Development Framework (2017-2021) sets out plans to enhance the coverage and delivery of flood warning, including 14 new flood warning schemes that have been strategically identified, and prioritised.	
Timeline: Scottish Government funds SEPA annually to operate the Scottish Flood Forecasting Service New flood warning schemes: Annick Water (Ayrshire), Outer Hebrides coast (2019); River Carrion (Falkirk), River Forth (Aberfoyle) (2020); Fife catchments (subject to feasibility assessment) (2021)	**Owners:** SEPA, The Met Office

Are We Ready? Facilitators Pack	
How can your community be better prepared for the impacts of climate change? 'Are We Ready?' is a resource for communities to talk about our changing climate as a starting point for getting climate ready. This resource includes a short film, information about the key consequences of climate change and a guide to running the Are We Ready? workshop in communities.	
Timeline: Ongoing	**Owners:** Adaptation Scotland

RiverTrack

RiverTrack community flood warning is a low cost sensor system that provides real time water levels to local communities where traditional flood warning schemes are not available.

More information on this policy can be found in Section 3.3.1.

Flooding Research

The Scottish Government will continue to fund research and pilot projects to ensure policy is based on the latest evidence. Currently, the Scottish Government funds a wide range of research which includes centres of expertise on water (CREW), and on climate change (ClimateXChange). The centres of expertise are taking forward a number of research projects related to flood risk management and climate change, including:

- Assessing the impacts of winter 2015-16 flooding in and around Ballater, and in the Garioch with a three year study on community impact (more information on this project can be found in Section 2.2.2.2.),
- Using climate projections in economic appraisal for flood risk management measures,
- An assessment of floodplain loss.

We will also support opportunities for knowledge exchange and best practice to be shared.

Research

1.1.2 Empowered Communities

Empowered communities are able to take forward their understanding of how climate change will impact their community, and take action to improve local resilience. When combined, engaged and empowered communities support people in Scotland to be adaptable to the changing climate. The following policies support community empowerment.

Empowering Communities: Community Flood Volunteer Project	
Community volunteers are trained by The Conservation Volunteers, who are a community volunteering charity providing opportunities to help people protect and enhance their local greenspace and biodiversity. Volunteers are then equipped by the local authority to assess watercourses, report blockages to the local authority, and maintain priority watercourses themselves if safe to do so. Climate change is projected to increase the risk of flooding in Scotland. This novel approach enables communities to improve their resilience to respond and recover from flooding.	
Timeline: Ongoing	**Owners:** Scottish Government, The Conservation Volunteers, Local Authorities

The Place Principle	
The Place Principle calls on all those responsible for providing services and looking after assets in a place to work and plan together, and with local communities, to improve the lives of people, support inclusive and sustainable growth and create more successful places that will be capable of adapting to climate change. We will promote the adoption of the Place Principle across Scotland through targeted public events, creation of a Place website, and liaising to embed the Place Principle across government. By doing this, we will ensure that places are shaped by the way resources, services and assets are directed and used by the people who live in and invest in them.	
Timeline: Ongoing	**Owners:** Scottish Government, COSLA

The Place Standard Tool

The Place Standard is a tool to evaluate the quality of places and to help communities, public authorities and industry to work together to create places that can support a high quality of life and protect and enhance the environment. An ongoing programme of work to support the Place Standard and place-based working will promote the relationships and opportunities that place-based approaches can provide for the climate change adaptation agenda. This will strengthen the relationship between place and climate change adaptation and mitigation, and promote co-benefits, particularly in relation to health and wellbeing, and tackling inequality. We will scale up the use and impact of the Place Standard tool across Scotland to increase participation and community engagement with local decision-making processes and deliver effective place-based approaches.

Timeline:	**Owners:**
The Place Standard was launched in 2015 and a new programme of work to support the use of the tool and place-based working will cover 2020-2023.	Scottish Government, NHS Health Scotland and Architecture & Design Scotland, with support from Glasgow City Council and the Improvement Service.

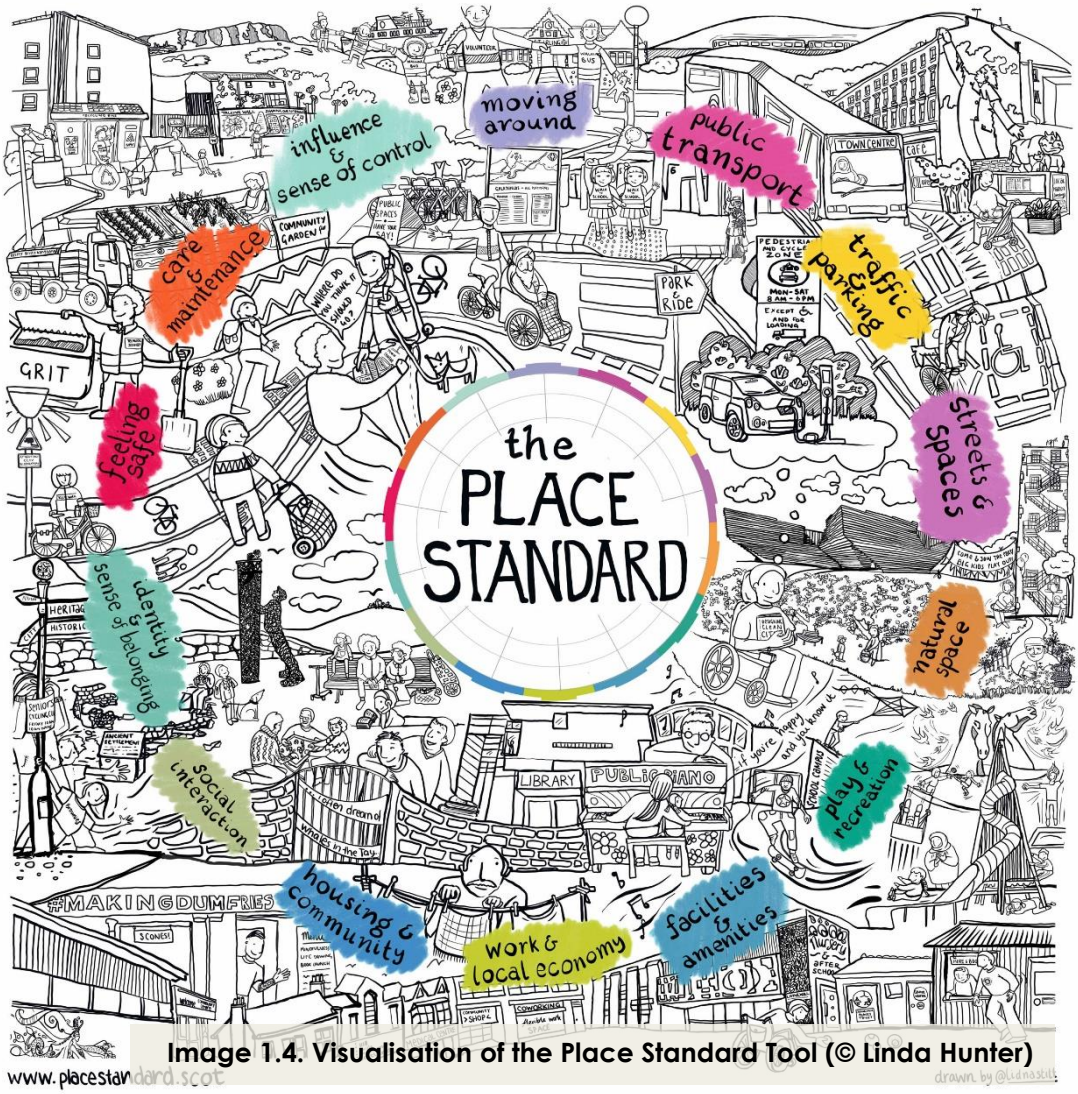


Image 1.4. Visualisation of the Place Standard Tool (© Linda Hunter)

SEPA Flooding Strategy

SEPA is producing a Flooding Strategy which will help to steer and focus their statutory role and responsibilities for flooding. It aims to embed adaptation as a key principle to ensure flood risk management plans and actions tackle future flood risk. The Strategy aims to support individual and community resilience to flooding and take forward flood risk management, involving a wide range of powerful partnerships working to increase Scotland's flood resilience now and in the future.

Timeline:	**Owners:**
Publication target of 2020	SEPA

Fire and Rescue Framework for Scotland

The Scottish Government's Fire and Rescue Framework for Scotland explains that as our climate changes, more communities across Scotland will face risks from flooding than ever before. Moreover, evidence indicates that the impact of such events has increased in financial terms as well as in human terms.

There is projected to be a significant rise in the proportion of people in Scotland who are over 65. This means that during storms and heat waves, there may be an increase in the number of elderly and vulnerable people trapped within their homes requiring rescue from flooding or severe weather.

The Framework states that the Scottish Fire and Rescue Service (SFRS) should have an increasing focus on building resilience in relation to flood risk as well as other threats. A key factor in managing such incidents and in keeping communities safer in general is the resilience of communities themselves. Resilient communities can better withstand adverse events and the Framework notes that SFRS should work together with other public services to enable and support communities to develop and enhance their own resilience.

Timeline:	**Owners:**
Ongoing	Scottish Government

Image 1.5. Scottish Fire and Rescue Service provide assistance during flood event (© SFRS)

Sub-Outcome 1.2: Scotland's buildings and places are adaptable to Climate Change

In 2016, there were 2.58 million residential dwellings in Scotland. It is likely that 80% of housing in use today will still be in use in 2050. The residential sector is diverse and varies in tenure, age, heating and building technique. Three quarters of our homes were built before 1982 and one fifth before 1919. Our current built environment will therefore need to adapt to our changing climate, and in particular, the likely projected increases in temperature (with greater warming in the summer than winter) and projected increases in rainfall in winter and reduced rainfall in summer. As the climate changes, an increasing number of buildings will become at risk of flooding and the increased storminess that we expect may pose a further risk to the fabric of Scottish buildings that were not designed for these weather conditions.

Cross-Cutting Policies

Flood Risk Management Strategies

Flood risk management in Scotland is risk based and plan led, with strategies setting the national direction of future flood risk management in Scotland. They coordinate action across public bodies to where the risk of flooding and benefits of investment are greatest, and give individuals, communities and businesses the information to better manage their own responsibilities. Actions[2] that will tackle flooding in high risk areas, are described and prioritised in six-year planning cycles.

There are 14 Local Plan Districts in Scotland, each with their own strategy. The strategies are approved by the Scottish Government and published by SEPA as Scotland's strategic flood risk management authority.

Scotland's Flood Risk Management Strategies set out the short to long term ambition for flood risk management, with climate change and social justice embedded in the approach.

Since 2008, the Scottish Government has made funding available of £42 million per year (via the Capital settlement) to enable local authorities to invest in flood risk management actions. This level of funding has been guaranteed until 2025-26.

Timeline:	**Owners:**
The strategy is updated every 6 years.	SEPA, Local Authorities, Scottish Water

[2] There are a broad range of actions considered including: Flood protection studies, flood protection schemes/works/ maintenance, natural flood management study/ works, new/ maintain flood warning, flood forecasting, community flood action groups, awareness raising, self-help, property level protection, surface water plan/ study, maintenance, site protection plans, emergency plans/ response, planning policies.

Dynamic Coast

The second phase of Dynamic Coast will investigate the resilience of Scotland's natural coastal defences (for example, identifying where low dunes may breach); estimate how future climate change may exacerbate erosion on our soft (erodible) coast; and develop mitigation, adaptation and resilience plans at super sites, including St Andrews and Montrose.

More details on this policy can be found under Sub-Outcome 6.1.

SEPA Flooding Strategy

SEPA is producing a Flooding Strategy which will help to steer and focus their statutory role and responsibilities for flooding, including support for individual and community resilience.

More details are provided in Section 1.1.2.

Image 1.6. St Kilda National Nature Reserve (© Lorne Gill, SNH)

1.2.1 Resilient Places

The concept of place considers physical and social elements. Physical elements of place include the buildings, spaces and transport, while social elements include people's identity and whether they feel they have a say in decision making. For a place to be resilient, these elements of place must be supported. While Sub-Outcome 1.1 deals with social aspects of place, the following policies focus on the physical aspects of place, specifically spaces. More information on resilient buildings can be found in Section 1.2.3, and information on the resilience of transport systems is included in the Supporting Systems chapter.

1.2.1.1 Community Planning

Community planning focusses on public bodies, and how they work together with local communities to design and deliver better services that make a difference to people's lives. Appropriately designed communities will consider climate change in their planning, and will therefore be more adaptable to change. Planning of communities is also linked closely with community empowerment, as the people best placed to make decisions about how their community develops are those that live there.

Active Travel

The Active Travel vision is for walking and cycling to be the most popular mode of travel for short, everyday journeys. We want to make Scotland's towns and cities friendlier, safer and more accessible. Active Travel is fundamental to the development of a sustainable travel network and a key priority for the Programme for Government. The budget doubled in 2018-19, with that funding sustained for 2019-20. This funding will be used to improve Scotland's active travel infrastructure and as a result its ability to adapt to the changing climate.

Timeline:	**Owners:**
Ongoing	Scottish Government

The Place Standard Tool

The Place Standard is a tool to evaluate the quality of places and to help communities, public authorities and industry to work together to create places that can support a high quality of life and protect and enhance the environment.

More details are provided in Section 1.1.2.

The Place Principle

The Place Principle recognises the importance of places at the heart of communities and promotes a more collaborative and participative approach to services, land and buildings.

More details are provided in Section 1.1.2.

1.2.1.2 Greenspace

Greenspaces provide important benefits for both people and the environment, and can be easily integrated into a place to make it more resilient and adaptable to the effects of climate change. This is predominantly carried out through green infrastructure projects. Improving the quality of our urban and rural environments is vital if we are to deliver on our ambition to make Scotland a greener, wealthier and fairer, smarter, healthier, stronger and more resilient country. Green infrastructure approaches can offer additional benefits compared with conventional approaches to open space planning because they offer greater functionality. They can offer an environmentally friendly approach to development and infrastructure planning. Well-designed green infrastructure and creatively designed greenspaces offer lots of benefits and can support multiple agendas by helping to develop communities and places that are sustainable, attract residents and businesses, support healthy lifestyles and encourage the kinds of behaviour that contribute towards the success of places in social, economic and environmental terms.

Green Infrastructure Fund	
The Green Infrastructure Fund aims to improve Scotland's urban environment by increasing and enhancing greenspace in our towns and cities, especially close to areas of multiple deprivation. This will improve climate change resilience, health and well-being, reduce social isolation and make these areas more attractive for people to live and work in, attracting jobs, businesses and further investment. SNH intend to deliver a minimum of 15 capital projects across Scotland that improve or create at least 140 hectares of urban green infrastructure. They also intend to deliver 10-15 smaller community engagement projects where the focus is on working with people to help them make the most of their local greenspace.	
Timeline: 2019-20 complete Phase 1 projects. Funding awarded to a further 10 capital investment projects.	**Owners:** SNH

Case Study 1: Canal and North Gateway, Glasgow

This flagship project supported by the Green Infrastructure Fund is an example of how blue-green infrastructure can underpin local regeneration. In response to the changing climate, and the increased risk from flooding, the purpose of this project is to develop an innovative surface water management solution. Co-benefits of this project include providing biodiversity corridors and access routes along the canal for local communities.

Surface water management is delivered through a combination approach of canal water level management and Sustainable Drainage Systems (SuDS). Based on weather forecasting, the water level in the canal can be lowered in advance of extreme weather, and excess water taken up by SuDS.

The land used to develop this scheme was previously vacant and derelict, contributing to overall themes of place-making that are so important for local communities.

Image 1.7. Canal and North Gateway (© Green Infrastructure Scotland)

Green Infrastructure Community Engagement Fund	
The Green Infrastructure Community Engagement Fund launched in 2017 and delivers £1.2 million worth of community engagement projects in Scotland's cities and larger towns. The fund is primarily used to support the employment of project staff to work with communities, helping them make better use of their greenspace, or develop their own proposals on how it could be improved. The development of green infrastructure within our towns and cities will support their adaptation to climate change by providing space for natural flood management and increasing biodiversity. The Community Engagement Fund aims to ensure that communities are connected to nature and are able to shape its improvement in their local area.	
Timeline: 2017-2019	**Owners:** SNH

Case Study 2: 10,000 Raingardens for Scotland (Glasgow Pilot)

Central Scotland Green Network Trust (CSGNT)

As climate change will lead to an increase in rainfall and flood events, innovative methods of surface water management are needed. Raingardens are a form of green infrastructure that provide multiple co-benefits, including surface water management, flood alleviation and greenspace creation, which also enhances local biodiversity and community wellbeing. They can range in style, from spaces installed and managed by individuals, or projects such as the raingarden under construction at the Royal Botanic Garden Edinburgh.

As part of the 10,000 Raingardens for Scotland project, CSGNT employed a Raingarden Officer to deliver community information and engagement sessions with the aim of encouraging individuals and communities to set up their own raingardens. The project is currently in the pilot stage, and is being trialled in Glasgow as the city regularly experiences flooding and surface water management issues, which the current drain and sewer system struggle to cope with. The project will trial and monitor the ability of raingardens and nature-based systems to alleviate the impacts of flooding and disseminate this learning.

1.2.2 Resilient Historic Environment

While Scotland's historic environment is inherently resilient, a lack of care and maintenance can make it vulnerable to the changing climate. Changing climatic conditions can alter and accelerate decay processes of historic places, and buildings may become less able to cope with changing weather patterns caused by climate change.

Our Place in Time: the Historic Environment Strategy for Scotland (OPiT) – Climate Change Working Group

The historic environment sector is disparate, and its interface with the climate change agenda complex, for example through individual sub-sectors related to traditional buildings, archaeology, tourism, landscape, collections, materials and skills. This situation requires a focused approach targeting specific sub-sectors in order. A working group has been established under OPiT, to enable the historic environment sector to coordinate action on climate change.

The key deliverable for the Working Group is the 'Climate Change Impacts Guide for the Historic Environment'. This guide provides an introduction to the direct physical impacts of climate change on various types of historic asset in Scotland. It is intended as a resource for understanding what climate change means for Scotland's historic environment.

The aim of the guide is to:

- raise awareness of the impacts of climate change on our historic environment,
- improve the knowledge base of custodians/owners of historic assets,
- form the foundations of a climate change risk assessment for specific assets,
- prompt consideration of what possible climate change adaptation solutions may be most appropriate for certain historic assets,
- identify gaps in knowledge and point people in the direction of relevant resources and research.

Timeline:	**Owners:**
Ongoing – October 2019	Historic environment sector, led and enabled by Historic Environment Scotland

Historic Environment Policy for Scotland (2019-2029)

Historic Environment Policy for Scotland (HEPS) sets out a series of policies and principles for the recognition, care, management and sustainable use for the whole of the historic environment.

HEPS specifically recognises the significant challenges that a changing climate represent for the historic environment. The core principles contained within HEPS are informed by an understanding of the need for decision making affecting the historic environment to recognise and respond to ongoing climate change and support reduction in carbon emissions and waste.

Further detailed advice that supports this policy can be found in the Managing Change in the Historic Environment guidance notes. These serve to inform good decision making and cover a variety of areas such as micro-renewables, gardens and designed landscapes and windows which offer advice and information on climate change and its effect on historic environment assets as well as energy efficiency.

Timeline:	**Owners:**
2019-2029	Historic Environment Scotland

Historic Environment Scotland Climate Change and Environmental Action Plan (CCEAP)

This sets out Historic Environment Scotland's approach to addressing the challenges and opportunities presented by climate change to the organisation and the wider historic environment. Actions in this CCEAP are articulated under strategic themes that have been identified as core areas of climate change work and research for HES.

The CCEAP details how we will work towards making our organisation and the broader historic environment more resilient to and prepared for changes in our climate, alongside playing a leading role in supporting the Scottish Government to meet its ambitious carbon emission reduction targets.

Timeline:	**Owners:**
2019-2024	Historic Environment Scotland

Adapt Northern Heritage (Interreg)

Adapt Northern Heritage is a project supporting communities and local authorities to adapt northern cultural heritage to the environmental impacts of climate change and associated natural hazards through community engagement and informed conservation planning. The project involves four Project Partners and eleven Associated Partners from Iceland, Ireland, Norway, Russia, Scotland and Sweden and is supported by Iceland, Norway and the European Union through the Interreg programme for the Northern Periphery and Arctic.

The Project Partners, including Historic Environment Scotland, are developing a risk assessment method for historic places, and associated guidance for their adaptation. This method is being trialled and demonstrated using nine case studies from across northern Europe, and its future use will be supported by an expert conservation network.

Timeline:	**Owners:**
June 2017 to May 2020	Historic Environment Scotland (Project Lead)

Image 1.8. Threave Castle (© Historic Environment Scotland)

Research for Buildings and Heritage Assets

Historic Environment Scotland have commissioned a number of research themes to improve the resilience of the historic environment in Scotland:

- Thermal performance of the traditional building envelope and upgrading options available to older structures to improve energy efficiency;
- Physical effects on buildings of changing weather patterns and profiles, including rates of decay for materials, building components; soils and sediments;
- Quantify heritage assets affected by climate change;
- Collate action on understanding and mapping anticipated risk to cultural heritage; and
- Pilot studies of adaptation methodologies in the historic environment.

This research will be published and will be used to inform new guidance and updates to existing guidance. It will also be disseminated through training and events, delivered via HES Engine Shed.

Research

1.2.3 Resilient Buildings

Ensuring that buildings are resilient will go a long way in helping communities adapt to the changing climate. As the climate changes, Scotland will experience an increase in frequency of heavy rain and storms as well as high temperatures and heatwaves. These changes to weather can cause damage to Scotland's buildings. Buildings can be considered more resilient when they are energy efficient; have well-regulated internal temperatures; are not easily damaged by wind, rain, or flooding; and are not susceptible to damp.

Cross-Cutting Policies

Energy Efficient Scotland

Energy Efficient Scotland is a 20 year programme that will make our homes and buildings warmer, greener and more efficient and by 2040 will ensure that:

- all homes achieve at least an Energy Performance Certificate (EPC) Rating of C, where technically feasible and cost effective,
- Scotland's non-domestic buildings are assessed and improved to the extent that is technically feasible and cost effective.

Energy Efficient Scotland will put in place a framework of standards making it the norm to invest in energy efficiency improvements. It will also continue to provide significant support to help households and businesses install energy efficiency measures, through a combination of grants and low-cost loans as well as drawing in other private and public resources. By 2021 the Scottish Government will have allocated more than £1 billion since 2008 to improving energy efficiency.

Promoting investment in Scotland's built environment will have additional positive effects including improving the building fabric of both residential and commercial properties. Effective Installation of energy efficiency measures, such as external wall insulation, can improve the resilience of Scotland's buildings to the increased adverse weather projected as a result of climate change.

Timeline:	**Owners:**
2018-2040	Scottish Government, local authorities, social landlords, private landlords, owner occupiers, non-domestic building owners

CIRIA Flood Resilient Properties Code of Practice

The Scottish Government is working with partners across the UK to develop a Code of Practice for resilient flood repairs and property level protection. The Code of Practice will consider the increased risk associated with climate change. The project will develop guidance documents to provide an integrated and authoritative framework that supports good practice and enable property owners, managers and built environment professionals to competently and confidently specify and deliver property flood resilience. The outputs are being developed with a range of stakeholders including the insurance industry and will help deliver the flood resilient properties action plan.

Timeline:	**Owners:**
CIRIA guidance to be available autumn 2019	Scottish Government, Property Flood Resilience Delivery Group

Property Flood Resilience Action Plan

Flooding will become more frequent in the future, with some properties flooding repeatedly. The Scottish Government is working with a range of stakeholders including SEPA, the Scottish Flood Forum, The Association of British Insurers, Flood Re, BRE and local authorities to develop an action plan to improve the resilience of properties at flood risk. Flood resilient properties are an important part of the response to current and future flood risk, particularly in areas where formal flood protection schemes are not suitable.

Property Flood Resilience (PFR) measures are designed to make buildings more resilient to the physical impacts, and people to the emotional impacts of flooding. PFR can be used for all types of flood risk, including river, coastal, surface water, groundwater and sewer. Properties need a package of measures, some of which prevent water entering a house and others that minimise the impact should water enter the house, speeding up the recovery process. Sometimes the water should be let in; in some instances attempting to keep the water out can cause serious structural damage.

It is important that each building is properly surveyed and the flood risk understood prior to resilience measures being designed and installed. The PFR action plan recommends a number of actions that will help to deliver property flood resilience.

Timeline:	**Owners:**
Completed June 2019, and due for publication in autumn 2019.	Scottish Government, Property Flood Resilience Delivery Group

Building Regulations/Standards

Scottish building regulations set standards for new buildings and where new work is undertaken to existing buildings. Regulations set out mandatory functional standards that must be met when undertaking building work and provide guidance on one or more ways of meeting these standards. The application of these standards is verified at building design stage and on completion by Scottish local authorities who are appointed as 'verifiers' of the building standards system. Responsibility for compliance with regulations rests with the 'relevant person', commonly the building owner or developer.

Review of these standards considers the potential impact to buildings and building users of future changes to our climate as relevant to the review topic. Within the mandatory functional standards, provisions are currently set out to address the resilience of buildings to the effects of weather, risk from flood and risk of overheating. Standards also act to limit energy demand and water demand in buildings.

Timeline:	**Owners:**
A review of energy standards is underway, with implementation programmed for 2021. This review will include further consideration of how standards mitigate overheating risk in new buildings, considering future climate predictions.	Scottish Government

National Flood Risk Assessment (NFRA) 2018

The National Flood Risk Assessment is the first step to protect and prepare communities at flood risk by improving our understanding of what and where is potentially at risk of flooding including consideration of climate change. The NFRA assesses the relative adverse consequences of flooding across Scotland and produces a high-level overview of flood risk.

The assessment enables identification of locations with the greatest flood risk, these areas are designated as Potentially Vulnerable Areas. Areas may be vulnerable due to current or future flood risk to people, the environment, cultural heritage and economic activity.

The revised NFRA also includes classification of property types and infrastructure at risk of flooding. This allows improved assessments of risks to sector, business and asset types and can be used to inform appropriate flood risk management actions.

Timeline:	**Owners:**
Revised every 6 years. Next assessment 2024	Scottish Government, SEPA

SEPA Flood Maps	
SEPA's flood maps illustrate where flooding may happen so that people can check whether they live in an area that is at risk. The flood maps help SEPA and other authorities identify the most effective actions to manage flood risk and develop plans to tackle flooding. They support sustainable approaches to managing flood risk, and enable better planning decisions to avoid unnecessary development in high flood risk areas. Climate change projections and their impact on flooding in Scotland are integrated into the development of SEPA's flood maps.	
Timeline: Ongoing	**Owners:** SEPA

SEPA Planning Advice	
SEPA provide support for Planning Authorities to ensure they make informed decisions about appropriate development where flooding impacts are minimised. This assists planning authorities to promote development in areas where communities can thrive without the risk of flooding in the future.	
Timeline: Ongoing	**Owners:** SEPA

Economic Assessment Under Current and Future Flood Risk Scenarios

This project will help improve understanding of Scotland's investment in flood risk management under different climate change scenarios.

Future Research

1.2.3.1 Resilient Residential Properties

Residential properties need to be resilient to the changes in Scotland's weather as the climate changes. The place in which people live can have far reaching impacts on their health and wellbeing. Housing will be more adaptable to climate change if it is designed and maintained to enable fast recovery after an extreme weather or flood event. The risk of damp may increase due to increased rainfall as a result of climate change. Residential buildings that are well insulated and ventilated will be more resilient as the climate changes.

Tolerable Standards and Scottish Housing Quality Standards

The changing climate will impact the standard of Scotland's housing stock. As the climate changes, the fabric of our homes will need to be maintained to ensure that they are resilient to increased extreme weather and wind driven rain. The tolerable standard provides a minimum condemnatory standard which all houses in Scotland must meet. The standard includes being substantially free from rising and penetrating damp as well as having satisfactory thermal insulation (defined as the presence of loft insulation where a property can have it).

The Repairing Standard applies to private rented housing and requires houses to be wind and water tight and in all other respects reasonably fit for human habitation, and the structure and exterior of the house (including drains, gutters and external pipes) to be in a reasonable state of repair and in proper working order.

The Scottish Housing Quality Standard requires social housing to be in a reasonable state of repair and to have a minimum standard of energy efficiency. Registered social landlords are also required to be working towards the Energy Efficiency Standard for Social Housing. These policies require houses to be in a good physical condition reducing water penetration and heat loss, which reduce the energy required to heat homes and increase their resilience to climate change. The Scottish Housing Quality Standard also includes specific measures and targets to improve the efficiency of homes in the social rented sector.

Timeline:	**Owners:**
Tolerable Standard – Currently in force. Repairing Standard – Currently in force Scottish Housing Quality Standard – Currently in force First milestone of Energy Efficient Scotland – December 2020	Scottish Government, local authorities, social landlords

Property Flood Resilience

Research, analysis and evidence will be required to support the delivery of the Property Flood Resilience Action Plan. The development of the action plan is a Programme for Government commitment and will be launched later in 2019. Research needs to support the development of the Action Plan will be identified over the next months.

Future Research

New Developments in Flood Risk Areas

The absence of trend data for new developments in flood risk areas is highlighted in both Scottish Climate Change Adaptation Programme Independent Assessments.

A new study will explore data collection processes and methods to develop an indicator.

Future Research

1.2.3.2 Resilient Non-Residential Properties

To support Scotland's economy, it is important that the buildings in which businesses operate are resilient to the changing climate. Commercial buildings that are climate resilient will be subject to less damage, with less disruption after an extreme weather event and therefore less cost to the business. Additionally, there are many other non-residential properties, such as hospitals and schools, that will face unique challenges as a result of the changing climate.

Scotland's Learning Estate Strategy

Scotland's Learning Estate Strategy highlights the importance of sustainability of Scotland's learning environment including to the risks associated with future climate change. One of the Strategy's guiding principles is that Scotland's learning environments should be greener and more sustainable.

Climate change will impact our learning estate and the Scottish Government want to make sure that it is adaptable as our climate changes and is fit for the purpose of delivering the education curriculum.

Timeline:	**Owners:**
Published May 2019	Scottish Government

Scotland's Schools For The Future Programme

The £1.8 billion 'Schools for the Future' programme means that a total of 117 schools will be constructed or refurbished by March 2020. We provide £1.13 billion with local authorities contributing £665 million. In addition, the Scottish Government will invest a further £1 billion in rebuilding and refurbishing schools from 2021 when the current school building programme ends. This will benefit around 50,000 pupils - in addition to the 60,000 who will see their schools renewed or refurbished by the end of this Parliament.

Our continued investment in Scotland's schools will ensure that they are fit for purpose as the climate changes.

Timeline:	**Owners:**
Schools for the Future programme will complete by summer 2020. While the new investment programme will complete in 2026.	Scottish Government

Adaptation Behaviours

Adapting to climate change requires action from across all areas of society. There are lots of easy ways individuals can get involved in helping their communities be better prepared for risks like flooding and severe weather, either by supporting some of the work already happening in the area or by looking to establish something new, such as a Community Emergency Plan. Organisations and individuals who own property can also take care of our built environment and get into a routine of maintaining their properties, and sign up for flood warnings through Floodline.

Individual Behaviours

1. Increase local drainage and prepare for flood events. Individuals are encouraged to keep greenspace green and surface-water drains free from debris. People can sign up for SEPA Flood Alerts for advance flood warnings and access more information through the Scottish Flood Forum.

2. There are multiple measures that can prevent flood water from entering a home, and minimise the damage if it does. Homeowners in areas at risk of flooding are encouraged, where they can, to consider investing in measures to reduce the impact of a flood event.

3. Property owners can learn more about their historic properties. Some traditional buildings may become less able to cope with changing weather patterns caused by climate change. Historic Environment Scotland have developed a guide that describes the key external aspects of a traditional building that provide protection against the elements. This guide considers how these aspects can be improved or adapted to increase a building's resilience to extreme weather events. It also considers the internal environment within older buildings, and how this can be managed to cope with changing environmental conditions. Historic Environment Scotland and the Scottish Flood Forum have also produced guidance on flood damage to traditional buildings.

Societal Behaviours

1. Communities are encouraged to establish emergency plans. Establishing a Community Emergency Plan helps identify those who are most vulnerable within a community, and ensures they receive the care they need in the event of an extreme weather event. These plans support communities by using the skills and knowledge in a community.

2. Individuals and organisations are encouraged to share information about how they are preparing for and responding to emergencies by contacting readyscotland@gov.scot.

Monitoring and Evaluation: Outcome 1

Monitoring and Evaluation is integral to the outcomes-based approach which encourages consideration at all stages of adaptation policy development. Further information including a general introduction to the framework, and a description of the foundation and principles can be found in the monitoring and evaluation introduction and Annex 3 respectively.

Key sources of existing monitoring evidence for Outcome 1 include: the Resilient Communities Strategic Framework, the Scottish Household Survey, Scottish Transport Statistics, and the National Flood Risk Assessment. There is currently limited data available for some themes, but by identifying what we need to measure not just what we know we can, the framework highlights monitoring gaps which will be filled as more data and associated monitoring arrangements are developed.

Monitoring the Adaptation Process ('What are we doing?') The themes set out the structure to monitor the implementation of and output from adaptation policies and actions which support the Outcome. Indicators will include metrics of, for example: access to information, enhancing access to greenspace, and the use of place-based approaches.

Monitoring the Sub-Outcomes ('Is it working?') The Sub-Outcome monitoring themes highlight the key components of each Sub-Outcome and provide the structure for evaluating progress. Indicators will include metrics of, for example: public awareness, household resilience, and community planning.

Monitoring the Outcome Monitoring at this high level will directly link the outcome to wider government policy and the National Performance Framework by utilising relevant indicators already associated with these high-level monitoring frameworks.

National Performance Framework Indicators	Sustainable Development Goals Indicators
• Social capital • Influence over local decisions • Perceptions of local area • Access to local greenspace • Places to interact • Journeys by active travel • State of historic sites • Satisfaction with housing	• Extent to which education for sustainable development (including climate change education) are mainstreamed • Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies

Monitoring and Evaluation Structure: Outcome 1

Process Monitoring Themes (What are we doing?)	Improving public access to, and uptake of, information across society	Utilising place-based approaches		Assessing resilience	
		Monitoring climate impacts and outcomes from adaptation measures at a local level		Future-proofing maintenance	
	Promoting adaptation through education	Resourcing community resilience initiatives	Creating multi-functioning greenspace	Increasing awareness of adaptation best practice	
	Enabling access to resilience measures	Facilitating joint working	Imbedding adaptation in planning	Conserving and protecting historic assets	Building in adaptation
Sub-Outcome Monitoring Themes (Is it working?)	Increased and equal awareness of climate change risks and adaptation across society	Communities are involved in decision-making, and place-based co-benefits are realised	Community planning considers and manages impacts	Resilience of heritage assets is improved	Resilience of residential buildings is improved
	Homeowners take responsibility for property level resilience	Communities are supported to develop local initiatives	Multi-functional greenspace is enhanced		
	People feel supported by, and support their community	Public, private and voluntary organisations work together	Active/ public transport is supported	Resilience of traditionally constructed properties is improved	Resilience of non-residential buildings is improved
Sub-Outcomes	1.1.1 Engaged Public	1.1.2 Empowered communities	1.2.1 Resilient places	1.2.2 Resilient historic environment	1.2.3 Resilient buildings
	1.1 People in Scotland's diverse communities are informed, empowered and adapting to climate change		1.2 Scotland's buildings and places are adaptable to climate change		
Outcome	Our communities are inclusive, empowered, resilient and safe in response to the changing climate				

UK Climate Change Risk Assessment: Associated Risks

The UK Climate Change Risk Assessment risks that will be addressed by the policies presented in Outcome 1 are set out below:

PB5: Risks to people, communities and buildings from flooding	**PB7:** Risks to building fabric from moisture, wind and driving rain	**PB8:** Risks to culturally valued structures and the wider historic environment	**PB6:** Risks to the viability of coastal communities from sea level rise

Outcome 2: The people in Scotland who are most vulnerable to climate change are able to adapt and climate justice is embedded in climate change adaptation policy

Image 2.1. Blawhorn Moss National Nature Reserve (© Lorne Gill, SNH)

Outcome 2: The people in Scotland who are most vulnerable to climate change are able to adapt and climate justice is embedded in climate change adaptation policy

Introduction

The Scottish Government is committed to taking a human-rights-based approach to tackling the challenges posed by climate change. The UN Special Rapporteur's recent report on climate change and poverty highlighted that the greatest impact of climate change will be felt by those living in poverty, and that climate change also threatens democracy and human rights. The Paris Agreement includes the concept of climate justice, which recognises that the poor and vulnerable at home and overseas are the first to be affected by climate change, yet have done little or nothing to cause the problem.

When people are already vulnerable, climate change can have a compounding effect, worsening overall outcomes, particularly those associated with health and wellbeing. Whilst everyone's health can be affected by climate change, those who are socially disadvantaged, older, very young or experiencing chronic health problems are less able to cope. This is because these groups are disproportionately more sensitive to climate change impacts; are more exposed to the risk because of the environment they live in and/or, have less 'adaptive capacity' – resources to prepare, respond and recover from the impacts of climate change. Location can also be a factor in increasing vulnerability, for example, for those who live in a flood prone area, or those who live in remote, or island communities. Individuals in these locations can be particularly susceptible to extreme weather, which can cause disruption to lifeline transport services.

Where We Are Now

The Scottish Government began work on flood risk and disadvantage in the first Adaptation Programme. In 2015, we published *Mapping Flood Disadvantage in Scotland* which mapped the communities that were most socially and spatially vulnerable to flooding. Work has been further developed with the Mapping Flood Disadvantage Tool, which was used to inform the second National Flood Risk Assessment (NFRA). Recent research in the area of health includes a ClimateXChange scoping study in 2018, on the risk from overheating in buildings that house vulnerable people in Scotland. NHS National Services Scotland (NHS NSS) has carried out a climate change impact assessment to consider key climate risks for each NHS Board.

The following diagram outlines the structure of this chapter. It is divided into two Sub-Outcomes and sets out the policies that contribute towards this Outcome. The Sub-Outcomes are divided along the themes of vulnerable people and health and social care.

Outcome 2: The people in Scotland who are most vulnerable to climate change are able to adapt and climate justice is embedded in climate change adaptation policy – policies and research

2.1 The most vulnerable to climate change in Scotland are engaged, empowered and able to adapt to climate change

2.2 Scotland's health and social care is ready and responding to changing demands as a result of the changing climate

2.1.1 Engaged

- Scottish Flood Forum ☀
- Mapping Flood Disadvantage Report and Tool 🍃
- National Flood Risk Assessment (NFRA) 2018 ☀
- Scottish Flood Forecasting Service ☀

2.1.2 Empowered

- The Place Principle ☀
- Place Standard Tool ☀

2.2.1 Health & Social Care Infrastructure

2.2.1.1 Buildings

- Climate Hazards and Vulnerabilities Risk Screening Tool for Healthcare Assets ☀
- NHS Board Climate Change Risk Assessments and Adaptation Plans
- NHS Scotland Sustainability Strategy
- NHS Scotland Sustainability Assessment Tool
- National Code of Practice for GP Premises
- GP Premises Survey

2.2.1.2 Services

- NHS Standards for Organisational Resilience
- Clinician Strategy for Scotland
- Realistic Medicine
- Delivering Social Care in a Changing Climate

2.2.2 Health Effects

- Fire Service 'Safe and Well' Programme

2.2.2.1 Temperature

- Our Natural Health Service Programme ☀
- A More Active Scotland: Scotland's Physical Activity Delivery Plan ☀
- Walking and Cycling Network ☀
- Water Refills in Public Places: Top Up Taps
- Water Refill Locations: Local Development Plans

2.2.2.2 Flooding

- Mapping Flood Disadvantage Report and Tool 🍃
- Assessing the Long Term Impacts of Flooding on People and Communities

2.2.2.3 Vector-Borne Pathogens

- Vaccination Transformation Programme
- Effective Prescribing and Therapeutics

2.2.2.4 Food-Borne Diseases

- Promoting Food Safety: Commercial
- Promoting Food Safety: Home
- A Strategy for Reducing Foodborne Illness

2.2.2.5 Air Quality

- Cleaner Air for Scotland Strategy
- Electric Vehicle Charging Network through ChargePlace Scotland

Key

- ☀ Policy also found under another Outcome
- 🍃 Policy also found under another Sub-Outcome
- Policy
- Research

Sub-Outcome 2.1: The most vulnerable to climate change in Scotland are engaged, empowered and able to adapt to climate change

The impacts of climate change can affect anyone, however some people and groups are likely to be more affected than others. Impact depends not only on exposure to a climatic event such as flooding, heatwaves or droughts but also on vulnerability. Drivers of social vulnerability include individual characteristics, such as age and health, but also environmental characteristics, such as the availability of greenspace or quality of housing stock, which can increase or offset exposure to flooding or heat; and social and institutional context, such as levels of income, strength of social networks and the day-to-day practices of institutions, such as care regimes in nursing homes, which affect people's ability to adapt. Climate change can act as a stress-multiplier, worsening existing problems, as well as creating new ones.

Socially vulnerable groups sensitive to climate impacts.

Very young children – babies and young children face disproportionately high health effects as a result of climate change impacts. Extreme events can be traumatic and potentially lead to developmental impacts.

Older people – older people also tend to be more sensitive to the health effects from climate impacts.

People in poor health or with poor mobility and access – people with existing physical or mental health problems may have a lower capacity to take action.

Tenancy status – some of the worst adapted homes are inhabited by tenants, who are less able to make changes to their homes. They are also less likely to have adequate insurance and often have less information about risk factors like flooding.

Social isolation – people who are socially isolated may not receive the help they need during flooding or extreme weather events as they lack the necessary support networks.

People on low incomes – income is a strong determinant for people's ability to respond to and recover from climate change impacts.

Location – where people live can be a factor that increases sensitivity to climate change impacts. Those who live in flood prone areas, or remote, or island communities can be particularly susceptible to extreme weather events. More frequent flood events, storms and strong winds can cause damage and disruption to lifeline services.

The Scottish Government works to tackle poverty and social justice in a number of ways. We want Scotland to be a place where people are healthier, happier and treated with respect, and where opportunities, wealth and power are spread more equally. Our Fairer Scotland Action Plan sets out 50 fairness actions for this parliamentary term working towards five high level ambitions including: ending child poverty, a strong foundation for all young people, fairer working lives and a thriving third age. By making Scotland a fairer place, we will also improve the adaptive capacity of Scotland's people.

Cross-Cutting Policies

Scottish Flood Forum

The Scottish Flood Forum is an independent charity that provides support in the event of flooding and helps establish community resilience for areas at risk of flooding. Their Flood Recovery services always seek to support those in greatest need, influenced by a number of factors including disadvantage.

More information on this organisation can be found in Section 1.1.

Image 2.2. Main Mhor National Nature Reserve (© Lorne Gill, SNH)

2.1.1 Engaged

The Scottish Government wants the people of Scotland to be aware and informed about the changes that will be required as we adapt to the changing climate. Climate change is complex and can be overwhelming so it is important that people understand how climate change will impact on their everyday lives. It is particularly important for those who are already vulnerable for economic, social or individual reasons, as they are likely to feel the greatest impact. The following policies will help the Scottish population and policy makers to increase their understanding of the impacts of climate change.

Mapping Flood Disadvantage Report and Tool

We have undertaken research to identify and map flood disadvantaged neighbourhoods. An interactive map shows the most flood disadvantaged neighbourhoods and their underlying flood vulnerability to help us to better understand the social impacts of flooding at a neighbourhood scale.

The outputs are embedded in the National Flood Risk Assessment and inform the flood risk management strategies and local flood risk management plans. The results also support cross-departmental working, identifying priority areas for emergency services, and communicating flood risk issues to local communities.

Local authorities, SEPA, the Scottish Flood Forum and others use the tool to target flood risk management actions including community engagement and awareness raising.

Timeline:	**Owners:**
Ongoing, to be updated within five years	Scottish Government

National Flood Risk Assessment (NFRA) 2018

In 2018, SEPA published the second NFRA. This gives us the clearest picture yet of flood risk in Scotland, embedding climate change and a comprehensive range of social, environmental and economic impacts into a single assessment.

More information on this policy can be found in Section 1.2.3.

Scottish Flood Forecasting Service

As flood risk increases due to climate change, the forecasting service ensures that forecasting and warning information is available to the public and emergency responders.

More information on this policy can be found in Section 1.1.1.

2.1.2 Empowered

The Scottish Government is committed to supporting people to act for themselves and have their voices heard in the planning and delivery of services including climate change adaptation. We want to support people, and particularly those most vulnerable to climate change, to take action to adapt to the changing climate. The policies below set out how we will empower people to adapt to the changing climate.

The Place Principle

We will promote the adoption of the Place Principle across Scotland, to ensure that places are shaped by the way resources, services and assets are directed and used by the people who live in and invest in them. The Place Principle calls on all those responsible for providing services and looking after assets in a place to work and plan together, and with local communities, to improve the lives of people, support inclusive and sustainable growth and create more successful places that will be capable of adapting to climate change.

More information on this principle can be found in Section 1.1.2.

The Place Standard Tool

The Place Standard is a tool to evaluate the quality of a place and can help communities, public authorities and industry to work together to create places that support a high quality of life. By providing an equal opportunity for individuals to consider which elements of place are most important to them, and which could be improved in their local area, the tool can give a voice to those who often do not get heard. As part of an ongoing improvement programme, work will focus on engaging diverse and seldom heard groups, helping to capitalise on opportunities for place-based approaches to support climate justice and climate change adaptation.

More information on this policy can be found in Section 1.1.2.

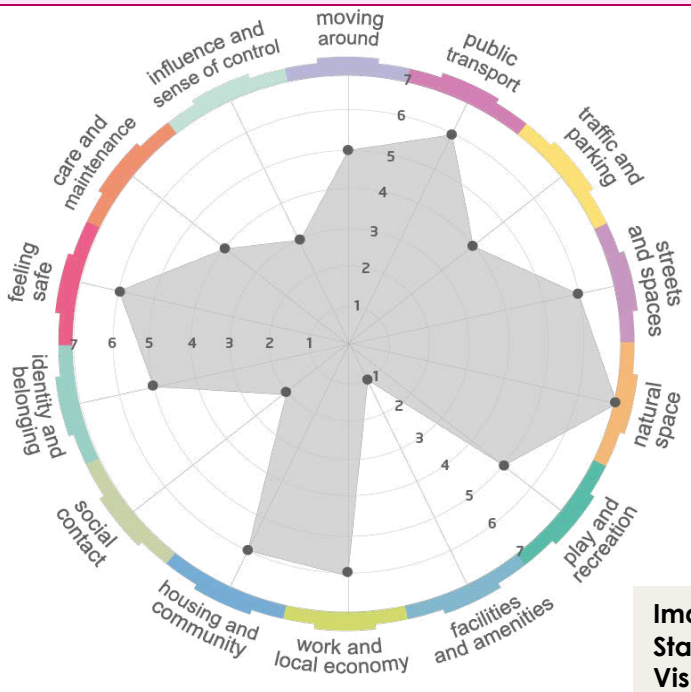


Image 2.3. Place Standard Tool Visualisation

Sub-Outcome 2.2: Scotland's health and social care is ready and responding to changing demands as a result of the changing climate

Climate change will pose new risks to the provision of health and social care in Scotland and amplify existing risks. It will have the greatest impact on those who are already vulnerable. Health and social care systems face climate change risks through impacts to human health and wellbeing from temperature, flooding, pathogens and air quality as well as through impacts to the physical infrastructure and provisioning of services.

The buildings that are used for health and social care need to be adaptable as the climate warms and extreme weather becomes more likely. Wetter, warmer winters will have the potential to lead to increased algal and fungal growth in buildings, with consequential effects on those vulnerable to allergy diseases (e.g. asthma) and other respiratory diseases. Warmer summers and more very hot days could increase water and food-borne disease and rodent-borne diseases.

2.2.1 Health and Social Care Infrastructure

The main risks to the infrastructure of health and social care relate to buildings and the provision of services. Higher and lower temperatures, storms, and flooding worsened by climate change can have a detrimental impact on hospitals, care homes and other health and social care buildings. Extreme weather, heat and flooding can all impact on the ability of health and social care providers to give care. These impacts are not only caused by potential disruptions in care regimes, but also increases in health service demands.

2.2.1.1 Buildings

The adaptability of the built environment of the health and social care system are considered in this section. All other non-health and social care related buildings and sites are considered under Section 1.2.3.2.

Climate Hazards and Vulnerabilities Risk Screening Tool for Healthcare Assets	
A Climate Hazards and Vulnerabilities Risk Screening Tool for Healthcare Assets is being developed for NHS Scotland. The new screening tool – which will complement the existing CCRA Tool (see below) – will provide NHS Boards with a Scotland-wide resource that brings together natural hazard and health-related vulnerabilities to inform NHS Scotland risk assessment and planning processes, including identification of the risk of damage and loss to healthcare assets and sites. The Tool will assist climate change risk assessments at the national and NHS Board level, and inform prioritisation and decision-making for adaptation.	
Timeline: Launched summer 2019	**Owners:** NHS National Services Scotland, NHS Boards

NHS Board Climate Change Risk Assessments and Adaptation Plans

NHS National Services Scotland (NHS NSS) recently undertook an NHS Scotland-wide climate change impact assessment to consider the key climate risks for each NHS Board. This included a flood risk assessment of over 250 NHS sites. Building on these initial studies, NHS NSS have now developed a Climate Change Risk Assessment (CCRA) tool which enables NHS Boards to assess their climate risks and integrate these assessments into resilience planning at each site. The CCRA tool enables Boards to identify mitigating actions, including climate change remedial works where required. Work is now in progress across all NHS Boards to transition from the initial impact assessment to full adaptation plans.

Timeline:	**Owners:**
Launched in 2019	NHS National Services Scotland, NHS Boards

NHS Scotland Sustainability Strategy

A new NHS Scotland Sustainability Strategy is being developed that will encompass all aspects of sustainability as they pertain to the NHS. The Strategy is based around the NHS Scotland sustainability brand: "Sustainability Action: Our NHS, Our People, Our Planet" and will provide clear ambitions and actions against 16 areas of focus, including Climate Change Adaptation, Nature and Biodiversity, Greenhouse Gases, and Governance and Policy. The Strategy will also link to the UN Sustainable Development Goals and the Scottish National Performance Framework.

Timeline:	**Owners:**
The Strategy will be developed during 2019-20.	NHS National Services Scotland, NHS Health Scotland

NHS Scotland Sustainability Assessment Tool

The NHS Scotland Sustainability Assessment Tool (NSAT) enables NHS Scotland Boards to assess their sustainability performance across 16 different areas of focus, including Climate Change Adaptation, Nature and Biodiversity, Greenhouse Gases, and Governance and Policy. The NSAT comprises a series of best practice statements for each area, and NHS Boards are scores against their compliance with these. Each best practice statement can also be tracked back to at least one of the UN Sustainable Development Goals. Going forward, the NSAT will be used to develop sustainability performance management indicators for each Board, and to prioritise action for improvement.

Timeline:	**Owners:**
Baseline scores for each NHS Board were established in March 2019. The online NSAT was launched in May 2019. Annual NSAT scores will be reassessed in January of each year.	NHS National Services Scotland, NHS Boards

National Code of Practice for GP Premises

Climate change may result in increased damage to buildings as a result of increased rainfall, driving rain and extreme weather events. Practice premises are increasingly perceived as an unwanted liability by potential GP partners; and this has become a barrier to recruitment, retention and retirement. The Scottish Government recognises and supports a long-term shift that gradually moves towards a model which does not presume GPs own their practice premises.

The National Code of Practice for GP Premises sets out how the Scottish Government will support a shift, over 25 years, to a new model in which GPs will no longer be expected to provide their own premises. Through a programme of loans and the prioritised assignment of leases Health Boards will take on the responsibility of providing GP premises. These loans can be used to improve the condition of GP premises across Scotland, helping to improve the resilience of primary health care delivery as the climate changes.

Timeline:	**Owners:**
2018-2043	Scottish Government

GP Premises Survey

To understand baseline condition of General Practice premises all premises used to provide General Medical Services by GPs will be surveyed in 2018-19. This will provide the data on the maintenance required in General Practice Premises which NHS Boards will require for their premises plans. This information is essential if NHS Boards are to effectively support practices with premises issues, including the impact of climate change.

Timeline:	**Owners:**
October 2018 - May 2019	Scottish Government

Image 2.4. Multi-functional greenspace at Eastwood Health and Community Care Centre (© Anne Lumb, Green Exercise Partnership)

2.2.1.2 Services

Extreme weather such as floods, storms, cold and hot weather and heatwaves affect the ability of the National Health Service and social care providers to deliver their services, through effects on staff and equipment. The policies and research below set out how the health and social care services are working to adapt to ensure they can continue to deliver their services as the climate changes. How Scotland's emergency services adapt to climate change will be considered in the Supporting Systems chapter of this Programme.

NHS Standards for Organisational Resilience

NHS Scotland's Standards for Organisational Resilience are designed to support NHS Boards to enhance their resilience. There are 41 standards that cover a range of topics that NHS Boards need to be prepared for including climate change. The Standards specify minimum standards and related measures/performance indicator criteria for resilience. A standard is a statement of an expected level of service that demonstrates delivery of practices acknowledged as safe and effective.

Standard 38 sets the minimum standard for NHS resilience to climate change:
"The NHS Board shall develop a robust approach towards implementing a range of actions to assure the continuity of quality healthcare services before, during and after extreme weather events."

Detail regarding the measures of the standard/ indicators can be found here. This Standard is used by the Scottish Government Health Resilience Unit to monitor NHS Boards' preparedness to climate change.

Timeline:	**Owners:**
2019 – 2021	Scottish Government and NHS Boards

Clinician Strategy for Scotland

The Clinician Strategy for Scotland makes proposals for how clinical services need to change in order to provide sustainable health and social care services fit for the future. It lays out a framework to take into account future significant changes to Scotland. A more strategic and sustainable health and social care system will increase the systems resilience to the risks of climate change.

Timeline:	**Owners:**
Sets out the vision up to 2025 - 2030	NHS Scotland

Realistic Medicine

The most recent annual report from the Chief Medical Officer for Scotland, Personalising Realistic Medicine, builds upon the previous reports to set the vision for clinical practice change. It aims to reduce harm, waste and unwarranted variation, all while managing risks and innovating to improve. Creating a sustainable health and social care system in Scotland is at the heart of this policy. Being thoughtful about environmental sustainability and effective stewardship of resources, alongside financial and system sustainability is necessary for co-benefits to be achieved.

Timeline:	**Owners:**
Fourth annual report published in 2019	NHS Scotland

Delivering Social Care in a Changing Climate

For the health and social care sector climate change may pose new risks to services and also multiply existing risks. This project has been initiated to provide data on the impacts of climate change relating to delivery of social care itself (Care at Home), as well as in understanding the extent of the risk for social care facilities and the sector's dependencies on different areas of infrastructure, particularly transport and telecommunications. The study will look at:

- direct impacts on buildings and infrastructure needed for service delivery from extreme weather, rising temperatures and other weather related disruptions,
- indirect impacts from changing demand on services as a result of premature deaths or increases in certain diseases as a result of temperature or precipitation.

Research

2.2.2 Health Effects

The changing climate could have both positive and negative impacts on human health. More extreme weather will increase the risk of flooding, heatwaves, changes to air quality, and potentially new pathogens. These events, in turn, can lead to negative health effects, including heat-related illness, respiratory infections due to damp and air quality changes, and potentially illnesses related to new pathogens. Climate change and associated severe weather events do and will continue to affect population health in Scotland both directly and indirectly.

Cross-Cutting Policies

Fire Service 'Safe and Well' Programme

The Scottish Fire and Rescue Service (SFRS) is working in collaboration with partners and communities to ensure collective resources jointly tackle issues related to inequality and protect those citizens at greatest risk. This is particularly important as individuals with pre-existing vulnerabilities are most at risk from climate change impacts.

The SFRS currently offer everyone in Scotland a free Home Fire Safety Visit, and is particularly focused on delivering this to the most vulnerable citizens. SFRS staff are alert during these visits to the signs of loneliness, fragility, potential slips, trips and falls, signs of drug addiction and / or alcoholism and general health risks within the homes of our most vulnerable Scottish citizens. A lot of these risks occur more frequently with older people, however they can be equally prevalent across other age groups.

Over the next twenty years there will be a significant rise in the proportion of over 65s in Scotland. This will generate new demands as SFRS seek to support the population to age well in safe and resilient communities.

As part of the SFRS Transformation Programme, the Service is also developing its 'Safe and Well' project. This project will see an expansion of the Home Fire Safety Visit programme to incorporate wider health and social care considerations. Working with a range of partners, both internal and external, the project will include the development of bespoke ICT systems to record activity and provide referrals directly to partners.

The overall aim of this project is to ensure people live safely in their homes, reducing not only the risk of fire, but other incidents of unintentional injury.

Timeline:	**Owners:**
April 2018 - March 2021	Scottish Fire and Rescue Service

2.2.2.1 Temperature

Increased mean annual temperatures may cause both positive and negative effects for human health in Scotland. The frequency of heatwaves is projected to increase in the future as a result of climate change. Hot summers are expected to become more common[3]. In Scotland, heat-related mortality is expected to increase from 38 to between 70 and 281 excess deaths per year (considering a population of 5.4 million), under the UKCP09 medium emissions scenario[4]. People living in neighbourhoods with less greenspace, especially urban areas, may experience more extreme impacts from events like heatwaves, due to phenomenon like the urban heat island effect.

Although warmer summers come alongside a risk of dangerous heat waves, a projected rise in mean annual temperature may lead to some healthier outcomes due to the potential for increased outdoor activities. Some of the policies in this section relate to making the most of the potential for increased outdoor activity, which would have positive outcomes on both physical and mental health.

Higher temperatures may also lead to a reduced reliance on heating, helping to alleviate the detrimental effects of fuel poverty. Cold-related human mortality is the biggest weather-related issue currently in Scotland, with between 2,590-3,890 excess deaths per year[5]. Many of the predictions released in the UK Climate Projections 2018 show warmer winters for Scotland, which could reduce the risk of cold-related deaths, particularly for those who have trouble heating their homes. Although the potential for warmer weather throughout the year may lead to some better health outcomes, extreme weather events are also likely to increase in frequency and intensity.

Our Natural Health Service Programme	
The Natural Health Service supports the health sector to embrace green exercise as part of policy and practice. This will see nature-based health programmes used as part of health promotion and improvement, and encourage healthier lifestyle behaviours. Changes to Scotland's climate may support this programme as leisure and other outdoor activities may be taken up autonomously by people as the climate warms.	
Timeline: To 2024, complete current demonstration projects by 2022 and embed good practice into NHS policy.	**Owners:** SNH, NHS

[3] UKCP18. Met Office
[4] UK CCRA 2017: Summary for Scotland. UK Committee on Climate Change
[5] UK CCRA 2017: Summary for Scotland. UK Committee on Climate Change

A More Active Scotland: Scotland's Physical Activity Delivery Plan	
The Physical Activity Delivery Plan sets out actions being taken to encourage and support people in Scotland to be more active, more often. It specifically helps people from inactive, disadvantaged and other under-represented groups enjoy the well-being benefits from being outdoors in nature. Changes to Scotland's climate may support this programme as leisure and other outdoor activities may be taken up by people as the climate warms.	
Timeline: To 2024, work to increase participation in outdoor recreation at the same rate as the last five years, with a particular focus on currently under-represented groups.	**Owners:** Scottish Government, SNH

Walking and Cycling Network
This network will close key gaps, upgrade connecting routes, link to public transport and promote shared use of paths to encourage active travel and enjoyment of Scotland's natural landscapes. More information on this policy can be found in Section 5.2.2.

Image 2.5. Sustrans Route 75, Oban to Fort William (© Lorne Gill, SNH)

Water Refills in Public Places: Top Up Taps	
Scottish Water launched its 'Your Water, Your Life' campaign, which aims to increase customers' appreciation of Scotland's tap water and reduce the use of single-use plastic bottles. Ongoing customer surveys show the campaign is successfully engaging people on both objectives. By April 3 2019, Scottish Water had 10 Top Up Taps in the ground and working. They plan to install 70 taps in locations across Scotland by March 2021. Increasing the availability of tap water can help support Scotland's population adapt to the changing climate by providing a free, accessible way to stay hydrated, particularly important during hot weather.	
Timeline: Top Up Taps in all Local Authority areas by March 2021.	**Owners:** Scottish Water, Scottish Government

Water Refill Locations: Local Development Plans	
The Planning (Scotland) Act 2019 includes a requirement that local development plans prepared by planning authorities in Scotland are to include a statement of the authority's policies and proposals for the provision of water refill locations.	
Timeline: To be included in the new generation of Local Development Plans once the relevant provisions of the Act come into force.	**Owners:** Local authorities, planning authorities, Scottish Government

2.2.2.2 Flooding

Whilst flooding is normally considered as a risk to homes, businesses and infrastructure it can also become a health hazard. When flooding occurs, waste water from sewer systems can back up into houses through drain pipes. Sewer flooding can be caused by prolonged or heavy rainfall, typically in the form of severe localised storms that can overwhelm the sewer system. The increase in severe weather episodes such as flooding may also result in an increase in mental ill health due to distress of displacement, loss of personal possessions and financial losses.

There are a number of environmental, social and personal characteristics that may increase someone's vulnerability to flooding. People living in neighbourhoods with less greenspace, especially urban areas, may experience more extreme impacts from events like flooding. People who have lived in an area for a short time may be unaware of past floods and the potential for future flooding. Social isolation may mean that people do not get the help they need.

Mapping Flood Disadvantage Report and Tool

We have undertaken research to identify and map flood disadvantaged neighbourhoods. An interactive map shows the most flood disadvantaged neighbourhoods and their underlying flood vulnerability to help us to better understand the social impacts of flooding at a neighbourhood scale.

More information on this policy can be found in Section 2.1.1.

Timeline:	**Owners:**
Ongoing, to be updated within five years	Scottish Government

Assessing the Long Term Impacts of Flooding on People and Communities

In 2016 the Scottish Government commissioned a 3 year research project to better understand the long term impacts of flooding for individuals, families and communities. The study follows individuals affected by the 2015-16 floods in Aberdeenshire over a three year period and their journey recovering from the floods. This will help us understand what types of support and advice people and communities need at different stages of a long-term recovery.

Research

2.2.2.3 Vector-Borne Pathogens

The impact of climate change on the distribution of vector-borne pathogens is uncertain. The only significant vector-borne parasite of humans currently established in the UK is Lyme disease, transmitted by Ixodes ricinus (a species of tick). As the climate changes, the incidence of Lyme disease may shift but other factors such as agriculture, land use, tourism and wildlife populations will also be major factors. There is very limited research regarding other vector-borne pathogens however, risk from disease from current vectors, including mosquitoes, is considered very low currently. The UK Climate Change Risk Assessment suggests that it is unlikely that the UK will become habitable for other vectors of disease before the 2050s.

Vaccination Transformation Programme

Vaccinations will progressively move away from a model based on GP delivery to one based on NHS Board delivery through dedicated (and thus more resilient) teams. The Vaccinations Transformation Programme is reviewing and transforming how we deliver vaccinations in Scotland. Delivery will move away from the current position of GP practices being the preferred provider of vaccinations on the basis of national agreements. This will only happen where it is safe to transfer services.

Underserved populations experience inequalities in health and are often under vaccinated, being at greater risk of vaccine-preventable diseases. During the Vaccination Transformation Programme transition, it is important that vaccination coverage is maintained or improved, and the inequalities gap closes further.

This new model will allow swifter adoption of any vaccination programmes without national negotiation ensuring the NHS is able to respond to potential new or increased risks as a result of the changing climate.

Timeline:	**Owners:**
2017-2021	Scottish Government

Effective Prescribing and Therapeutics

The Effective Prescribing and Therapeutics Branch exists to ensure delivery of safe and effective prescribing and use of medicines, within NHS Scotland. The aim of this delivery programme is to make more effective use of therapeutic resources. More effective use can help reduce resource consumption that contributes to climate change. Strategic prescribing and therapeutics usage supports adaptation to the potential new or increased risks that can come as a result of climate change.

Timeline:	**Owners:**
Ongoing	NHS Scotland

2.2.2.4 Food-Borne Disease

As the climate changes, it is possible that current food monitoring programmes and interventions aimed at identifying and preventing food safety risks are inadequate to deal with the state of future threats through food-borne diseases. Overall, the high level of current regulation regarding food safety provides us with a high adaptive capacity. Policies in this area are also being considered in the International Chapter under Sub-Outcome 7.1.1.

Promoting Food Safety: Commercial	
Food Standards Scotland (FSS) engages with food businesses across Scotland to improve understanding of current and emerging food safety risks, including those that may be exacerbated by climate change, and produces guidance to support effective food safety management in all areas of food production and service (from farm to fork).	
Timeline: Ongoing	**Owners:** Food Standards Scotland

Promoting Food Safety: In the Home	
Food Standards Scotland (FSS) raises awareness to the consumer of the importance of undertaking good food hygiene practices in the home through targeted media campaigns and a range of consumer engagement activities. FSS undertakes annual surveys of consumer attitudes and behaviours with respect to food safety and healthy eating. This provides FSS with an up to date understanding of food safety knowledge and supports the targeting of campaigns aimed at raising awareness and promoting behaviour change. FSS's role in supporting consumers to understand food safety risks and protect themselves from foodborne illness considers any risks that may be exacerbated by climate change.	
Timeline: Ongoing	**Owners:** Food Standards Scotland

A Strategy for Reducing Foodborne Illness	
This strategy is supported by a research programme aimed at improving understanding of the transmission of contaminants in the Scottish food chain, and the impacts of foodborne diseases such as Shiga toxin producing E. coli and Campylobacter on the Scottish population. Although this work is not specifically designed to assess the impact of climate change on food safety and quality, it supports the identification of emerging risks associated with changes in food production environments and the development of mitigation strategies.	
Timeline: Ongoing	**Owners:** Food Standards Scotland

2.2.2.5 Air Quality

Clean air is essential for our health and wellbeing, and helps to protect the environment as a natural asset. Whilst we have made great strides towards tackling air pollution in Scotland over recent years, it must be acknowledged that there are still areas of poorer air quality in many of our towns and cities. The impacts of poor air quality are not distributed evenly across the population: it is the most vulnerable members of society – the elderly, the very young and those with cardiovascular and respiratory conditions – who bear the largest burden. Changes in the climate will also impact on air quality; increases in temperature may affect the formation of ozone, increasing the frequency and severity of summer smog events.

Cleaner Air for Scotland Strategy

A review of the Cleaner Air for Scotland Strategy is due for completion at the end of 2019. Low Emission Zones will set an environmental limit on certain road spaces, allowing access to only the cleanest vehicles. We will work in partnership with local authorities and regional transport partnerships to deliver Low Emission Zones that are well designed to consistent national standards. The National Low Emissions Framework document will set the framework within which Low Emissions Zones are introduced and will be published in line with the commitments of the Cleaner Air for Scotland strategy.

Timeline:	**Owners:**
Glasgow – 31 Dec 2018 Aberdeen, Dundee and Edinburgh – by end 2020	Scottish Government

Electric Vehicle Charging Network through ChargePlace Scotland

Electric vehicles will not only help reduce greenhouse gas emissions and tackle climate change, but also help improve local air quality and therefore public health and wellbeing. Transport Scotland is supporting increased uptake of electric vehicles by:

- providing support for home charge points for consumers,
- providing support for workplace charge points,
- working with each of our delivery partners to create Scotland's 'Electric A9', including charging points along the route and demonstrating that electric vehicles offer important advantages to motorists in rural and urban Scotland,
- providing funding for towns and cities to become 'Switched On' – working with partners, local authorities will get funding to meet local EV transition needs such as supporting charging initiatives for tenements and EV incentives,
- providing funding to support the ongoing expansion of the EV charging network,
- supporting the installation of domestic and workplace charge points, and working with partners to identify solutions for households without off street charging.

Delivery of this policy will be supported by changes to the Scottish planning system, such as no longer needing planning permission for on-street charging points.

Milestones/Timeline:	**Owners:**
To 2022	Transport Scotland

Adaptation Behaviours

Adapting to climate change requires action from across all areas of society. The Scottish Government, local government, public bodies, the private sector, third sector, communities and individuals all have a role to play. Individuals can take action to help prevent some of the negative health effects that can result from climate change risks to factors such as air quality, high temperatures and severe weather. Those who are most vulnerable to climate change are encouraged to take additional action, with the rest of society supporting them to adapt.

Individual Behaviours

1. Stay safe in the sun. When enjoying the sun, people are encouraged to cover up with suitable clothing and sunglasses, avoid burning, take care with children and use at least SPF 15 sunscreen with a four star rating. More information can be found on the NHS Inform website.

2. Be aware of pollen and pollution levels. Changing weather patterns may impact pollen count and pollution levels which can exacerbate some existing health conditions. When high levels are forecasted, those who could be more vulnerable such as children and those with respiratory problems are encouraged to have the medication they need.

Societal Behaviours

1. If a severe weather event is forecast people are encouraged to check on vulnerable neighbours and help them prepare. After the event, they are asked to make sure that they are safe and help them make arrangements for any repairs.

2. When extreme weather unexpectedly results in a carer being separated from a cared-for person, an emergency plan ensures that the relevant people have all the necessary information to step into a caring role temporarily.

Monitoring and Evaluation: Outcome 2

Monitoring and Evaluation is integral to the outcomes-based approach which encourages consideration at all stages of adaptation policy development. Further information including a general introduction to the framework, and a description of the foundation and principles can be found in the monitoring and evaluation introduction and Annex 3 respectively.

Key sources of existing monitoring evidence for Outcome 2 include: the Resilient Communities Strategic Framework, the Scottish Household Survey, NHS Scotland, and Health Protection Scotland. There is currently limited data available for some themes, but by identifying what we need to measure not just what we know we can, the framework highlights monitoring gaps which will be filled as more data and associated monitoring arrangements are developed.

Monitoring the Adaptation Process ('What are we doing?') The themes set out the structure to monitor the implementation of and output from adaptation policies and actions which support the Outcome. Indicators will include metrics of, for example: access to information, coverage of health impact monitoring, and the use of place-based approaches.

Monitoring the Sub-Outcomes ('Is it working?') The Sub-Outcome monitoring themes highlight the key components of each Sub-Outcome and provide the structure for evaluating progress. Indicators will include metrics of, for example: public awareness and household resilience in vulnerable groups, organisational resilience, and climate-linked health impacts.

Monitoring the outcome Monitoring at this high level will directly link the outcome to wider government policy and the National Performance Framework by utilising relevant indicators already associated with these high-level monitoring frameworks.

National Performance Framework Indicators	Sustainable Development Goals Indicators
• Social capital • Influence over local decisions • Perceptions of local area • Access to local greenspace • Premature mortality • Mental wellbeing	• Mortality rate attributed to household and ambient air pollution

Monitoring and Evaluation Structure: Outcome 2

<table>
<tr><td rowspan="3">Process Monitoring Themes
(What are we doing?)</td><td rowspan="2">Improving public access to, and uptake of, information across society</td><td colspan="3">Monitoring climate impacts and outcomes from adaptation measures at a national and local level</td></tr>
<tr><td colspan="2">Considering vulnerable groups in adaptation consultation, planning and action</td><td>Maximising the health benefits of the natural environment</td></tr>
<tr><td>Promoting adaptation through education</td><td>Resourcing community resilience initiatives</td><td rowspan="2">Assessing and managing risk</td><td>Improving recovery</td></tr>
<tr><td>Enabling access to resilience measures</td><td>Facilitating joint working</td><td>Reducing exposure</td></tr>
<tr><td>Sub-Outcome Monitoring Themes
(Is it working?)</td><td>Increased and equal awareness of climate change risks and adaptation across society</td><td>Communities are involved in decision-making, and place-based co-benefits are realised</td><td>Health and social care infrastructure is compliant with adaptation best practice</td><td rowspan="3">Climate change impacts on health and wellbeing are successfully managed</td></tr>
<tr><td>Homeowners take responsibility for property level resilience</td><td>Communities are supported to develop local initiatives</td><td rowspan="2">Continuity of health and social care services is maintained</td></tr>
<tr><td>People feel supported by and support their community</td><td>Public, private and voluntary organisations work together</td></tr>
<tr><td>Sub-Outcomes</td><td>2.1.1 Engaged Public</td><td>2.1.2 Empowered Communities</td><td>2.2.1 Health and Social Care Infrastructure</td><td>2.2.2 Health Effects</td></tr>
<tr><td></td><td colspan="2">2.1 The most vulnerable to climate change in Scotland are informed, empowered and able to adapt to climate change</td><td colspan="2">2.2 Scotland's health and social care is ready and responding to changing demands as a result of the changing climate</td></tr>
<tr><td>Outcome</td><td colspan="4">The people in Scotland who are most vulnerable to climate change are able to adapt and climate justice is embedded in climate change adaptation policy</td></tr>
</table>

UK Climate Change Risk Assessment: Associated Risks'

The UK Climate Change Risk Assessment risks that will be addressed by the policies presented in Outcome 2 are set out below:

PB1: Risks to health and wellbeing from increased temperatures.	**PB4:** Potential benefits to health and wellbeing from reduced cold.	**PB9:** Risks to health and social care delivery from extreme weather.
PB10: Risks to health from changes in air quality.	**PB11:** Risks to health from vector-borne pathogens.	**PB12:** Risk of food borne disease cases and outbreaks.

Outcome 3: Our inclusive and sustainable economy is flexible, adaptable and responsive to the changing climate

Image 3.1. Ariundle Oakwood National Nature Reserve (© Lorne Gill, SNH)

Outcome 3: Our inclusive and sustainable economy is flexible, adaptable and responsive to the changing climate

Introduction

Scotland's businesses have made great strides in the transition to a low carbon future. Scotland's climate is already changing, bringing new challenges and opportunities for Scottish businesses.

Scotland's nature-based industries will be the most directly impacted, for example: increased rainfall could lead to flooding of Scottish farms and damage to crops, changes in temperature of Scotland's seas may impact Scotland's fisheries, and Scotland's forests may face new pests and diseases.

Scotland's businesses based on manufacturing, services, and other industries may have other challenges including disruption to supply chains, difficult travelling conditions for staff and water shortages for industrial processes. However, climate change may also offer opportunities for Scottish businesses including the development of products and services for climate change adaptation as well as improved productivity in the forestry and agriculture sectors.

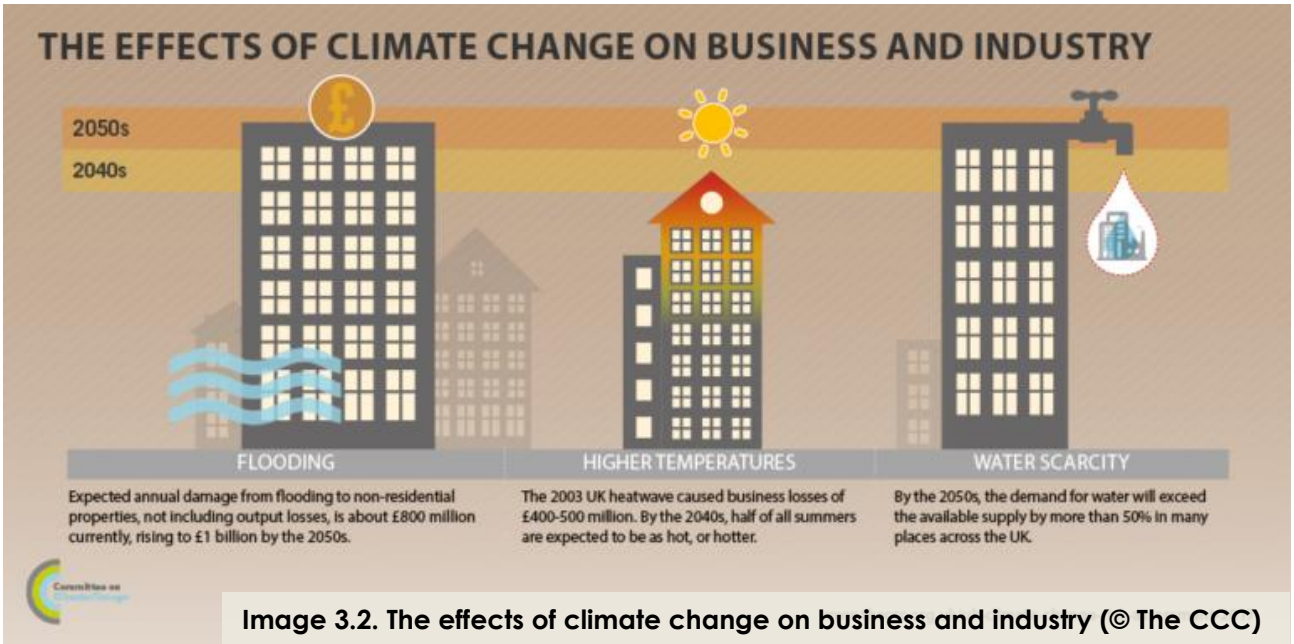


Image 3.2. The effects of climate change on business and industry (© The CCC)

Where We Are Now

Over the last five years, Adaptation Scotland has worked with Scottish businesses to increase their awareness of climate change and help them adapt.

The following diagram outlines the structure of the Economy chapter. It is divided into three Sub-Outcomes and sets out the policies that contribute towards this Outcome. The Sub-Outcomes reflect the different challenges faced by Scotland's natural resource based businesses and the manufacturing, services, and other businesses. The final Sub-Outcome relates to the ability of businesses to harness the opportunities created as a result of climate change.

Outcome 3: Our inclusive and sustainable economy is flexible, adaptable and responsive to the changing climate – policies and research

Cross-cutting Policy

- River Basin Management Plans

3.1 Scotland's businesses based on natural resources are informed and adaptable to climate change

3.1.1 Agriculture

- Farming For a Better Climate
- Monitor Farm Scotland
- The Farm Advisory Service
- Farming and Water Scotland
- Farming with Nature
- Soil and Nutrient Network
- Citizen Science: Pests & Diseases
- Indigenous Crop Pathogens
- Developing Agricultural Options
- Soil Risk Maps

3.1.2 Forestry

- Land Use Strategy
- Scotland's Forestry Strategy 2019 - 29
- Expanding Forests and Woodlands
- Improving Efficiency and Productivity
- Enhancing Environmental Benefits
- Engagement in Woodland Creation and Forest Management
- Adaptability and Resilience of Forests and Woodland
- Risk Management & Climate Change
- Forest Resilience and Adaptation
- Contingency Planning and Forestry Adaptation

3.1.3 Aquaculture and Fisheries

- Farmed Fish Health Framework
- National Marine Plan
- Inshore Fisheries Strategy
- Marine Climate Change Impact Partnership
- Future Fisheries Management Strategy
- Crown Estate Scotland

3.2 Scotland's manufacturing, services and wider economy are informed and adaptable to climate change

3.2.1 Capital

- Climate Ready Business Guidance
- SME Loan Fund & Support Service

3.2.2 Labour

- Fair Work Charter for Severe Weather
- Scottish Business Pledge

3.2.3 Supply Chains & Distribution Networks

- Climate Ready Business Guidance: Logistics
- Forestry Supply Chain Impacts

3.2.4 Building Premises

- National Flood Risk Assessment (NFRA) 2018
- Scottish Flood Forum
- Property Flood Resilience Action Plan
- Floodline Business Page
- Scottish Flood Forecasting Service
- SEPA Flood Maps
- SEPA Planning Advice
- Flood Risk Management Strategies
- Local Flood Risk Management Plans

3.3 Scotland's economy is innovative and harnesses the opportunities created as a result of climate change

3.3.1 Products

- Scottish Environment Business Awards
- Making Things Last: A Circular Economy Strategy for Scotland
- Climate Ready Business Guidance
- Hydro Nation: Water Innovation Service
- RiverTrack
- CivTech®
- Studying Heat Stress to Protect Potato Yields
- Climate Change and Parasitism – Breaking the Cycle

3.3.2 Expertise

- Hydro Nation: Scholars Programme

Key

- Policy also found under another Outcome
- Policy also found under another Sub-Outcome
- Policy
- Research

Cross-Cutting Policies

The following policy supports all businesses to adapt to the changing climate.

River Basin Management Plans

River Basin Management Plans detail Scotland's route map for protecting and improving the water environment. Careful management and future planning of watercourses will benefit businesses by helping them avoid disruption that could be caused by water scarcity or flooding events.

More detail on these plans are included in Section 5.1.1.

Image 3.3. River Derry (© Lorne Gill, SNH)

Sub-Outcome 3.1: Scotland's businesses based on natural resources are informed and adaptable to climate change

Communities across Scotland benefit from the goods and services that our natural environment provides, including food and drink, renewable energy, water purification, flood mitigation and places for recreation, education and inspiration. Scotland's businesses based on natural resources, such as agriculture, forestry and fishing, form an important part of Scotland's identity, economy and national heritage.

Cross-Cutting Policies

The following policy supports both the forestry and agricultural industries adapt to the changing climate.

Land Use Strategy	
The Strategy will encourage the development of place-based partnerships for delivering integrated and sustainable land use at a local, catchment or landscape scale. It will be particularly applicable in the uplands. Climate change adaptation is one of the objectives of the Land Use Strategy. Integrated land use is important in increasing the resilience of the natural environment and promoting adaptive management as well as delivering continued benefits for people.	
Timelines: Ongoing	**Owners:** Scottish Government

3.1.1 Agriculture

Agriculture is uniquely placed within the climate change context. It supports the decarbonisation of our energy system through the production of renewable energy and helps to increase our national carbon sink through the trees, hedgerows and soils on our farms and crofts. However, it is a significant contributor to climate change, totalling around a quarter of Scotland's overall emissions. Agriculture is also one of the sectors most at risk from climate change. Increasing temperatures due to climate change could also result in longer growing seasons for crops, which has been backed up by anecdotal evidence provided during our stakeholder engagement sessions.

Climate change adaptation will play a key role in the future of rural policy. Working with external stakeholders from both the agricultural industry and environmental bodies, we are currently looking to design and develop potential agricultural policy, which will increase the adaptive capacity of farmers as well as reducing greenhouse gas emissions and increasing carbon sequestration within agriculture.

The policies outlined below can help Scotland's farmers, crofters and land managers adapt to a changing climate whilst ensuring a secure food production system for future generations.

Farming For a Better Climate	
The Farming for a Better Climate programme works with farmers to find practical ways to move towards a sustainable, profitable, low carbon future, adapting to a changing climate and securing farm viability for future generations.	
Timeline: 2019 - 2021	**Owners:** SAC Consulting on behalf of Scottish Government

Monitor Farm Scotland	
Monitor Farm Scotland[6] takes a whole farm approach working with Scottish farmers, crofters and land managers to improve profitability, productivity and sustainability within the agricultural industry. This is delivered through a series of practical demonstrations and through the sharing of best practice information through on farm events.	
Timeline: Ongoing	**Owners:** Delivered jointly by Quality Meat Scotland (QMS) and AHDB Cereals & Oilseeds

Image 3.4. Spring Barley

[6] https://www.monitorfarms.co.uk/

The Farm Advisory Service

Farm Advisory Service[7] provides a one stop shop for farmers, crofters and land managers. Providing high-quality advice and information on climate change adaptation and mitigation is a core objective of the service. The service offers a range of practical guides on farm practices that can help adapt to a changing climate, such as identifying and relieving soil compaction, the use of cover crops to prevent soil loss, water management and nutrient planning and use.

Timeline:	**Owners:**
2016 - 2020	Scottish Government delivered by SAC Consulting and Ricardo

Farming and Water Scotland

Farming and Water Scotland[8] is predominantly aimed at helping farmers, crofters and land managers understand the rules, risks and opportunities regarding diffuse pollution. By providing advice and information on actions that can help to maintain quality as well as to manage its use better, Farming and Water Scotland plays a vital role in improving farm and croft climate change adaptive capacity.

Timeline:	**Owners:**
2016 - 2020	SAC Consulting

Farming with Nature

The Farming with Nature programme is a knowledge transfer and innovation programme aimed at Scottish farmers, crofters and land managers that are considering or currently working systems that embrace organic, agro-ecological or High Nature Value production methods. The broad themes covered by the programme include grassland management, animal health and welfare and woodland creation with a focus on best practice. Farming with Nature also looks to promote other evidenced practices that are newer to Scotland such as agro-forestry and mob grazing which can help farms adapt to a changing climate.

Timeline:	**Owners:**
2016 - 2019	Soil Association

Soil and Nutrient Network

Soil and Nutrient Network has established a group of Scottish farms to take part in a 'before and after' project to looking at how to protect and improve Scottish farm soils. Our soils are the cornerstone to a sustainable and productive agricultural industry and its ability to continue to produce food for future generations. The Soil And Nutrient Network farms demonstrate how to make best use of both organic and inorganic fertilisers, the benefits of good pH levels and the importance of good soil structure as we look to help our farmers, crofters and land mangers adapt to a changing climate.

Timeline:	**Owners:**
2016 - 2020	Scottish Government delivered by SAC Consulting

[7] https://www.fas.scot/
[8] https://www.farmingandwaterscotland.org/

Citizen Science: How to Investigate Pests and Diseases Under Climate Change

Climate change is expected to lead to warmer and wetter climates that could increase the number of, and damage caused by, pests and diseases in agriculture, horticulture and forestry. It is therefore vital that we improve our understanding of these potential biological threats, in order to develop strategies to adapt. To help, we have created a state-of-the-art, and free to download, desktop app to provide climate change risk assessments for crops pests and diseases in the UK that anyone can use.

Research

Indigenous Crop Pathogens and Climate Change

Indigenous pathogens of crops are being investigated to determine their spread and survival under different climate change scenarios. For example, field trial sites are being used to assess the influence of climate on Ramularia development in cereals in order to inform and develop risk prediction models to aid treatment decisions. Modelling has also allowed predictions about the future influence of non-indigenous Pectobacterium species on blackleg disease of potato in Scotland, and the risk of viable P. infestans spore dispersal amongst crops in future climate scenarios to provide a disease risk platform for informing integrated pest management (IPM).

Research

Developing Agricultural Options in a Changing Climate

Spring barley yield maps for Scotland for the period (1995-2015) have been completed. The maps show unique combinations of climate and soils across all areas in which spring barley has been grown historically, and for adjacent areas, to assess the potential for new areas to be exploited under climate change.

Research

Soils Risk Maps

A series of soil risk maps for much of the cultivated land in Scotland have been developed to help farmers identify areas vulnerable to erosion, compaction, leaching and runoff. These maps integrate work funded by CREW, Underpinning Capacity and the SRP, and are aimed at improving water quality by reducing diffuse pollution from land-based activities. SEPA, Scottish Water and SNH have asked to be provided with these maps and they will also be accessible via Scotland's Soils for use by land managers.

Research

3.1.2 Forestry

Forestry contributes £1 billion per year to the Scottish economy and supports more than 25,000 jobs. Scottish Ministers are committed to delivering economic, social and environmental benefits through forestry in Scotland. Forest managers need to factor the changing climate into the way that they manage forests. Projections suggest that forests will be subject to a growing risk of damage due to anticipated increases in extreme events such as storms, wildfire, heavy rainfall or droughts. The changing climate, coupled with greater globalisation of trade and travel, is also likely to increase the threat to trees from pests and diseases. The forestry sector's response to the likelihood of climatic change is complicated by the long timescales involved in forest management.

Forests and trees can help non-forestry businesses adapt to climate change by, for example, providing shelter for livestock, shading for buildings in urban areas, and natural flood management.

Scotland's Forestry Strategy 2019-2029

Scotland's Forestry Strategy presents the Scottish Government's 50-year vision for Scotland's forests and woodlands and sets out a 10-year framework for action. It has the principles of sustainable forest management at its core and recognises the need for better integration of forestry with other land uses and businesses, reinforcing the principle of 'the right tree, in the right place, for the right purpose'.

The Strategy supports the delivery of existing forestry commitments, such as the woodland creation and wood product use in construction targets expressed in the Climate Change Plan, and the native woodland and protected sites targets expressed in Scotland's Biodiversity: A Route Map to 2020.

It aims to:

- increase the contribution of forests and woodlands to Scotland's sustainable and inclusive economic growth,
- improve the resilience of Scotland's forests and woodlands and increase their contribution to a healthy and high quality environment,
- increase the use of Scotland's forest and woodland resources to enable more people to improve their health, well-being and life chances.

Timelines:	**Owners:**
An implementation plan for the Forestry Strategy will be published by April 2020	Scottish Government (Scottish Forestry)

Forestry Strategy: Expanding Forests and Woodlands

Scotland's Forestry Strategy 2019-2029 identified six priority areas for action over the following ten years. These priority areas form the framework for co-ordination of Government and partnership working. One of the priority actions identified was: 'Expanding the area of forests and woodlands, recognising wider land-use objectives'.

This priority will help deliver the forestry targets set out in the Climate Change Plan to increase woodland cover to 21% of the total area of Scotland by 2032, using a stepped increase in woodland creation to 15,000 hectares by 2024-25. These new forests and woodlands will be of different types and scales, for a range of purposes. Thus, while they will help to grow Scotland's carbon sink and reduce greenhouse gas emissions, some will also help businesses to adapt to a changing climate, for example, by providing shading and shelter for livestock or urban buildings, or for natural flood management. In the last year, Scotland's tree planting targets were surpassed. In total, more than 11,200 hectares of new planting was undertaken, which exceeded the current 10,000 hectare annual target.

Timeline:	**Owners:**
An implementation plan for the Forestry Strategy will be published by April 2020	Scottish Government (Scottish Forestry)

Forestry Strategy: Improving Efficiency and Productivity

'Improving efficiency and productivity, and developing markets' is a priority within Scotland's Forestry Strategy 2019-2029. This will be achieved by encouraging and supporting innovation, research and development, and the adoption of new technologies and practices, including those which help the sector to adapt to climate change.

It will also be achieved by attracting new and more diverse talent to the forestry sector and improving the capacity and capabilities of the existing workforce to ensure the forestry sector has the skills with which to improve resilience and adapt to a changing climate.

Timeline:	**Owners:**
An implementation plan for the Forestry Strategy will be published by April 2020	Scottish Government (Scottish Forestry)

Forestry Strategy: Enhancing Environmental Benefits

One of the priority actions identified for Scotland's Forestry Strategy 2019-2029 was: 'Enhancing the environmental benefits provided by forests and woodlands'.

This will be achieved, in part, by supporting the management of forests and woodlands to provide natural flood management and shade and shelter for livestock, which will have economic benefits for farmers, improving their productivity.

Timeline:	**Owners:**
An implementation plan for the Forestry Strategy will be published by April 2020	Scottish Government (Scottish Forestry)

Forestry Strategy: Engagement in Woodland Creation and Forest Management	
Scotland's Forestry Strategy 2019-2029 identified six priority areas for action over the following ten years. These priority areas form the framework for co-ordination of Government and partnership working. One of the priority actions identified was: 'Engaging more people, communities and businesses in the creation, management and use of forests and woodlands'. Alongside other benefits, this means ensuring that more people gain economically from Scotland's forests and woodlands. This includes a focus on achieving better integration between forestry and other land-based businesses (in particular crofting, farming and estate management). This will be, in part, achieved by improving people's understanding of the practice and value of forestry, and the wider benefits it provides such as supporting climate change adaptation through natural flood management and provision of livestock shade and shelter.	
Timeline: An implementation plan for the Forestry Strategy will be published by April 2020	**Owners:** Scottish Government (Scottish Forestry)

Image 3.5. Invereshie and Inshriach National Nature Reserve (© Lorne Gill, SNH)

Forestry Strategy: Adaptability and Resilience of Forests and Woodlands

'Increasing the adaptability and resilience of forests and woodlands' is a priority within Scotland's Forestry Strategy 2019-2029. We must safeguard the ability of Scotland's forests and woodlands to provide a wide range of benefits (including economic) to current and future generations. Improvements to the adaptability and resilience of Scotland's forest and woodlands in the face of a changing climate will be achieved by:

- improving the understanding of the threats to Scotland's forests and woodlands and potential mitigating actions, through education, research, surveillance and the development of new technologies,
- managing for, and mitigating against, the threats posed by tree pests and diseases through biosecurity measures and contingency planning,
- supporting forest design and actions which increase the capacity of forests and woodlands to adapt to, and thrive in, a changing climate.

Timeline:	**Owners:**
An implementation plan for the Forestry Strategy will be published by April 2020	Scottish Government (Scottish Forestry)

Lessons on Risk Management from the Finance Sector for Climate Change Adaptation in Scotland's Forestry Sector

Climate related risks must be planned for and managed to ensure that Scotland's forestry sector is well-adapted and continues to support a resilient natural environment and a robust economy. The finance sector (banking, insurance, investment) arguably leads the way in defining and managing risk and has gone through a number of challenges. Therefore, there is scope and interest in learning and applying lessons on risk management from this sector to other sectors. This report identifies the approaches adopted in the finance sector that are applicable to improving risk measurement and management in the forestry sector.

Research

Forest Resilience and Adaptation

A range of research projects are underway that aim to improve understanding of the impacts of climate change on forests and forestry, and of how forestry can adapt to reduce these impacts and benefit from any opportunities. This includes work to:

- assess and evaluate forest resilience, developing tools to assess resilience across the range of functions of forests and woodlands in relation to climate change and policy and operational decisions,
- examine alternative adaptation strategies to build resilience to climatic risks, developing adaptation demonstration areas, guidance and case studies,
- inform the management and future proofing of forests in the light of increased threats from pest and pathogens.

Research

The Role of Contingency Planning in Climate Change Adaptation in the Forestry Sector in Scotland

Contingency plans have the potential to increase adaptive capacity by enabling more rapid and efficient response to climate change risks events. As such, contingency plans provide economic benefits to forestry businesses, minimise the disruption to the natural environment, and support Scotland's forests in continuing to deliver the widest range of ecosystem services. This report considers when contingency plans are necessary, and explores which climate risks to the forest sector in Scotland may benefit from national or regional contingency plans.

Research

3.1.3 Aquaculture and Fisheries

Aquaculture is an increasingly important industry for Scotland, helping to sustain economic growth in the rural and coastal communities of the north and west. Involving the farming or culturing of fish, molluscs, crustaceans and seaweed, aquaculture produces our most valuable food export, Scottish salmon.

The global human population has been projected to reach over 9 billion people by 2050, and over 10 billion people by 2100. Feeding a future population of 9-10 billion people represents a significant challenge, particularly in light of the global climate emergency. Seafood is an important source of healthy protein and any increase in production to feed a growing population must come from aquaculture, in addition to the continued sustainable fisheries management.

In comparison to other animal proteins, salmon farming is one of the most eco-efficient and sustainable forms of protein available. It has the lowest carbon footprint, highest protein retention, lowest use of scarce freshwater and best feed conversation ratio of any of the major animal foods. Shellfish and seaweed also have their part to play in producing healthy seafood in low impact production systems. There may be benefits of farming shellfish and seaweed in terms of climate change and their potential role in carbon storage, although further research is required.

Global marine ecosystems are being affected by climate change (warming of the sea) and ocean acidification. Unless it is able to adapt to climate change, Scotland's aquaculture industry may be adversely impacted. Changes will present both threats and opportunities for Scottish aquaculture producers.

Scotland is also among the largest sea fishing nations in Europe. Changes to the distribution and depth of fish as a result of climate change have already been recorded and are predicted to continue. Cold water species are moving further north, and deeper in the oceans, and warm water species are extending their range north with knock-on effects for Scotland's fishing industry.

It is essential that our aquaculture and fisheries are able to adapt to climate change, in order to feed a growing global population with sustainably produced or sourced seafood. The following policies will support Scotland's aquaculture and fishing industry adapt to the changing climate.

Farmed Fish Health Framework: Climate Change and Ocean Acidification Subgroup

The Climate Change and Ocean Acidification subgroup of Scotland's Farmed Fish Health Framework, plays an integral part in shaping the future climate change adaptation strategy of the aquaculture sector. The subgroup aims to support aquaculture business to adapt by monitoring, reviewing and assessing the impact of climate change and ocean acidification on Scottish waters. The group is considering its role in addressing the global climate emergency and what climate change will mean for Scottish aquaculture producers.

Timeline:	**Owners:**
2018-2028	Marine Scotland, Industry stakeholders

National Marine Plan (2015)

The National Marine Plan considers climate change. It highlights that fisheries will be managed taking into account changes in species distribution and abundance due to climate change.

More information on this plan can be found in Chapter 6 under Cross-Cutting policies.

Inshore Fisheries Strategy

Climate change will put additional pressure on marine species and make it more difficult to maintain fisheries. Sustainably managed fisheries can help marine species adapt to the changing climate by reducing other pressures.

The 2015 Inshore Fisheries Strategy sets out a vision to support the development of a more sustainable, profitable and well-managed inshore fisheries sector in Scotland.
The Strategy focuses on:

- improving the evidence base on which fisheries management decisions are made,
- streamlining fisheries governance, and promoting stakeholder participation,
- embedding inshore fisheries management into wider marine planning.

Timelines:	**Owners:**
Ongoing	Marine Scotland

Marine Climate Change Impacts Partnership (MCCIP)

The Scottish Government contributes funds to the MCCIP which collates expertise from across the UK to present data on climate change impacts in the marine environment. The MCCIP have published Report Cards on climate change and the UK marine leisure industry and produced an assessment of climate change adaptation in UK seafood.

More details on this policy can be found under Section 6.2.3.

Future Fisheries Management Strategy

The Scottish Government is undertaking a discussion with stakeholders to help inform and develop Scotland's Future Fisheries Management Strategy. In partnership with stakeholders, we want to develop a range of ideas and proposals to help deliver a future management structure which will firmly establish Scotland's place as a world leader in responsible and sustainable fisheries management.

The new Strategy will contribute to sustainable and responsible fishing levels and practices. It will take an ecosystem based approach to fisheries management and consider the environmental impact of our future policies and programmes.

Timeline:	**Owners:**
A discussion paper was published on 4 March 2019	Marine Scotland

Crown Estate Scotland

In 2017, decision-making powers over a collection of rights, functions and assets owned by the Crown were devolved to Crown Estate Scotland.

Marine Scotland will work with Crown Estate Scotland to ensure continued commitment to investments to contribute to climate change adaptation and facilitate wider societal adaptation.

More information can be found in Section 6.2.3.

Sub-Outcome 3.2: Scotland's manufacturing, services and wider economy are informed and adaptable to climate change

The changing climate will affect how Scottish businesses are able to work and function. This Sub-Outcome considers the impact of the changing climate through four key business functions which are applicable across different types of businesses.

Scottish businesses could be affected by issues including flooding, supply chain disruption and reduced employee productivity due to higher temperatures. Businesses and industries operating in the coastal zone may also face the loss of premises and infrastructure due to sea level rise and coastal erosion. Scottish businesses will need to adapt their business practices to respond to these challenges.

Cross-Cutting Policies

Climate Ready Business Guidance	
Adaptation Scotland support businesses to build knowledge, confidence and awareness about adaptation; and to work together to adapt. Adaptation Scotland's Climate Ready Business Guide is targeted at small and medium sized enterprises and lays out six key business areas for considering climate impacts, threats and opportunities.	
Timeline: Ongoing	**Owners:** Adaptation Scotland

3.2.1 Capital

The changing climate could impact businesses ability to access capital. Availability and affordability of insurance cover can be affected by rising risk levels, which in turn would also have implications for business access to capital. Credit may become more expensive for companies who are considered to be taking insufficient action to adapt to climate change. A business's ability to adapt may also be limited by the availability of affordable loans to finance adaptation measures. Business and financial regulation are UK Government reserved matters, however, the following policy helps support businesses to continue to access capital as the climate changes.

SME Loan Fund and Resource Efficient Scotland SME Support Service	
The Scottish Government is committed to supporting small and medium sized Scottish businesses to reduce their energy consumption and resource costs and to encourage the uptake of renewable technologies where appropriate. The resultant savings in operating costs, energy consumption and improvements to building fabric and upgraded energy systems not only improves business efficiency but can make businesses more competitive and resilient to the changing climate.	
Timeline: SME Loan funding is ongoing and subject to Ministerial budget approval on an annual basis.	**Owners:** Scottish Government

3.2.2 Labour

The changing climate is likely to have direct impacts on employee productivity. Workers engaged in particular sectors or occupations, such as builders, farmers and factory workers, who are involved in manual labour, may be at greatest risk of heat stress. Other sectors may also be impacted if their work places are not able to manage higher temperatures. Extreme weather can also impact productivity if workers are unable to travel to their work place or have to take leave to deal with extreme weather related problems at home. The following policies will support businesses to adapt their labour practices as the climate changes.

Fair Work Charter for Severe Weather	
We have developed a Fair Work Charter for Severe Weather in conjunction with the Scottish Trades Union Congress (STUC) to support employers to plan for and manage the impacts of severe weather conditions on workers and their business. The Charter also encourages employers to make appropriate allowances for those workers with specific accessible travel needs or caring responsibilities e.g. the impact on parents of school closures. Employers should encourage flexible working practices to enable those who can, to work from home.	
Timeline: Ongoing	**Owners:** Scottish Government

Scottish Business Pledge	
The Scottish Business Pledge (SBP) brings together inclusive, fair work and business practices to drive productivity and competitiveness; it offers a way for business to understand what this means for them. SBP is positioned in Scotland's Economic Strategy as one of the Scottish Government's key policy initiatives, focusing on delivery of inclusive growth through fair work, innovation and internationalisation. We have refreshed and are taking forward implementation of the restructured SBP. Part of this will involve development of a new element focusing on the environment. This will encourage businesses to consider the range of measures they could adopt to improve their own efficiency while supporting climate change mitigation and adaptation aims.	
Timeline: 2019-2020	**Owners:** Scottish Government

3.2.3 Supply Chains and Distribution Networks

Adverse weather conditions are one of the most cited reasons for disruption to a business's supply chains and distribution network. As the climate changes extreme weather could cause increased disruption to supply chains.

Climate Ready Business Guidance: Logistics	
Adaptation Scotland's Climate Ready Business Guidance provides guidance on how business can ensure their supply chains are adaptable to the changing climate.	
Timeline: Ongoing	**Owners:** Adaptation Scotland

Climate Change Impacts on Scotland's Forestry Supply Chain

Scotland's forestry supply chain has numerous stages, from nurseries, forest management, and timber harvesting, through to transport and processing. This report sets out a theoretical overview of climate change impacts on Scotland's forestry supply chain, and potential consequences of adaptation practices implemented in response, with a focus on forest wood products. It looks at impacts on the natural environment including forests, but also on infrastructure such as energy, water, transport and communication, and on business operations.

Research

3.2.4 Building Premises

As the climate changes some businesses may face an increased risk of flooding. Business location, maintenance and management will determine their ability to adapt to climate change. Flooding of business premises is considered in the Communities Chapter. The location of business premises may impact on the availability of water with some water catchment areas in the UK projected to have supply-demand deficits. Water scarcity may become a problem for some businesses, especially water intense industries such as those producing chemical products, paper products and food and drink. The resilience of Scotland's water supply is considered in the Supporting Systems Chapter.

National Flood Risk Assessment (NFRA) 2018
The revised NFRA also includes classification of property types and infrastructure at risk of flooding. This allows improved assessments of risks to sector, business and asset types and can be used to inform appropriate flood risk management actions. More detailed information on the National Flood Risk Assessment is available in Section 1.2.3.

Scottish Flood Forum

The Scottish Flood Forum is an independent Scottish charity that provides support in the event of flooding. The Forum also has resources to help people and businesses prepare for and recover from flood events.

More detailed information on the Scottish Flood Forum is available in Section 1.1.

Property Flood Resilience Action Plan

We are working with a range of stakeholders including SEPA, the Scottish Flood Forum, The Association of British Insurers, Flood Re, BRE and local authorities to develop an action plan to improve resilience to properties at flood risk. Increased uptake of flood resilient properties will create opportunities for building professionals and product manufacturers. There may also be opportunities for products and expertise to be exported to other countries.

More detailed information on the Property Flood Resilience Action Plan is available in Section 1.2.3.

Floodline Business Page

Taking steps in advance of a flood event can significantly reduce the damage and disruption experienced by a business. Floodline can help businesses to identify if they are at risk of flooding and provides information and advice on how to prepare accordingly.

Timeline:	**Owners:**
Ongoing	SEPA

Scottish Flood Forecasting Service

Flood warning will be increasingly important as our climate changes. The Scottish Government is supporting the continued development of Scotland's flood warning service. This includes funding to help SEPA and the Met Office establish a Scottish Flood Forecasting Service. This service ensures flood forecasting and warning information is available to the public, businesses and emergency responders throughout Scotland.

More detailed information on the Scottish Flood Forecasting Service is available in Section 1.1.1.

SEPA Flood Maps

SEPA's flood maps can help businesses avoid exposure to flood risk by locating in appropriate areas where flood risk is low or well managed.

More detailed information on SEPA's flood maps is available in Section 1.2.3.

SEPA Planning Advice

SEPA provides support for Planning Authorities to ensure they make informed decisions about appropriate commercial development where flooding impacts are minimised.

More detailed information on SEPA's flood maps is available in Section 1.2.3.

Flood Risk Management Strategies

Flood risk management in Scotland is risk based and plan led, with strategies setting the national direction. Action is distributed across public bodies to where the risk of flooding and benefits of investment are greatest, and give individuals, communities and businesses information to better manage their own responsibilities.

More detailed information is available under Sub-Outcome 1.2.

Local Flood Risk Management Plans

Local Flood Risk Management Plans have been developed in parallel to Flood Risk Management Strategies. They take each strategy and provide additional local detail on the costs, benefits and delivery timetable for actions.

More detailed information is available under Sub-Outcome 1.2.

Case Study 3: Scotch Whisky Association, Environmental Strategy

The Scotch Whisky Industry launched its first Environmental Strategy in 2009, with the last review carried out in 2016. The Strategy considers the industry's responsibility to minimise its use of natural resources, its impact on the environment and sets a series of targets for a more circular production process. Targets include those set for energy and water efficiency, packaging weight, site waste, recycled content and reusable packaging, as well as the use of non-fossil fuel energy.

Water is an essential part of the whisky distilling process and climate change may increase the frequency of water scarcity events in Scotland. As part of their Environmental Strategy, the Scotch Whisky Association set a target to improve distilling water efficiency by 10%, by 2020. In 2016, water efficiency had already improved by 29%, exceeding the original target.

The Scotch Whisky Association will be reviewing their environmental strategy in 2019-2020, and are committed to further raising their ambitions and environmental reach.

Sub-Outcome 3.3: Scotland's economy is innovative and harnesses the opportunities created as a result of climate change

Climate change will also create opportunities for Scotland's businesses. Changing demands for goods and services could provide opportunities for innovation. The policies in this sub-outcome aim to support businesses in harnessing these opportunities.

Cross-Cutting Policies

The following policies support businesses to be innovative and harness the opportunities of climate change in multiple ways by supporting businesses to develop adaptation products and adaptation expertise.

Scottish Environment Business Awards

The annual Scottish Environmental Business Awards (The VIBES) celebrate and showcase Scottish businesses which are taking significant steps to reduce their impact on the environment and support the wider goals of sustainable development. Adaptation Scotland since 2018 have sponsored adaptation commendations across all categories. These seek to recognise the innovative work already underway in Scottish businesses to adapt to the impacts of climate change, and to create the tools and services we will need in future.

Timeline:	**Owners:**
Ongoing	Adaptation Scotland

Making Things Last: A Circular Economy Strategy for Scotland

The Circular Economy Strategy for Scotland focusses on innovation, seeking new ways to reduce consumption of natural resources and keep materials flowing through the economy at high value for as long as possible. The opportunities from a more circular economy are fundamental to tackling the greenhouse gas emissions that arise from the consumption of goods, preserving natural capital, and taking action on climate change.

Underpinning the circular economy is the idea of sustainable resource management, through reuse, repair and remanufacturing. This extends to both natural and manufactured materials. Reducing consumption of water, and other natural materials can help to reduce pressure on the natural environment, leaving increased space and capacity for it to adapt.

Timeline:	**Owners:**
Ongoing	Scottish Government

Climate Ready Business Guidance

Climate change is a significant challenge that needs to be built in to business planning today. The businesses which are already taking action are reaping benefits, including cost-savings, enhanced reputation and increased investor confidence. New business opportunities are also emerging for climate-related products and services.

More information regarding the Climate Ready Business Guidance can be found under Sub-Outcome 3.2

3.3.1 Products

As the climate changes, individuals, households, and businesses may need access to products to help them adapt to the changing climate. There are two aspects of this: emerging markets for new products such as those required in construction for more resilient buildings, and changing consumer demand for existing products in response to climate change, such as food and beverages. The Committee on Climate Change identifies that climate change can present both a risk and an opportunity to products and services in Scotland.

Hydro Nation: Water Innovation Service (HNWIS)	
The Hydro Nation Water Innovation Service helps to accelerate the route to market for companies developing innovative water technologies benefiting the economy as a whole as well as consumers.	
Timeline: Ongoing	**Owners:** Scottish Enterprise, Highlands and Islands Enterprise, Scottish Government

RiverTrack	
RiverTrack gives people in flood risk areas a local flood alerting tool. The system uses low-cost sensors to send accurate time-sensitive information to individuals about water levels in their local watercourse. It was developed through the Scottish Government's Digital Directorate CivTech programme. In 2018 the Scottish Flood Forum and SEPA supported community trials of the technology.	
Timeline: Ongoing	**Owners:** SEPA, Scottish Flood Forum, The Conservation Volunteers, Scottish Government, Local Authorities, private sector

CivTech®	
The CivTech® Programme brings together public sector expertise and private sector creativity to solve real problems, develop new products, and deliver better, faster services for everyone. Rather than setting out a specification for a particular product or service, the process enables public sector organisations to submit 'challenges' that they would like to have solved. The rest of the process works similarly to a traditional procurement process, and businesses and entrepreneurs are encouraged to apply with an innovative technical solution to these challenges. The programme is now in its fourth year, with multiple successful challenges already solved. Previous projects have included RiverTrack (a local flood alert tool) and a project with SNH designed to reconnect people with nature in urban environments. The next round of challenges will include a project focusing on repairs to tenement buildings, which can be particularly vulnerable to the changing climate.	
Timeline: Ongoing	**Owners:** Scottish Government

Case Study 4: Zepto and the Natural Environment

Scottish Natural Heritage, CivTech Challenge 3.0

Spending time in nature has enormous benefits for health and wellbeing, educational attainment and personal development. Mental health, inactivity, disaffection and loneliness are, or are becoming, major public health problems in Scotland and across the world. This problem is particularly acute in young people. A powerful way of combatting these problems can be found in the natural world: people who experience the outdoors, even for relatively short times, benefit hugely – especially when that experience has context and meaning. By connecting more to the natural environment, we are also more likely to protect it, and therefore, support the ability of the natural environment to adapt to climate change.

In CivTech 3.0, SNH put forward a challenge: how can we use tech to enhance the experience of the outdoors, in a way that will deliver its benefits to young people? The challenge was won by Oxido, a Glasgow-based software development and consultancy company. To deliver on the challenge, Oxido developed Zepto – a scalable set of experiences for users to connect with the natural environment both on their doorstep, and wider afield. Zepto is a mobile phone game application that encourages and embeds exploration and discovery of the real world. Through user research and testing, Oxido discovered that simply getting people outdoors is not enough, and young people want to understand why nature has such an important role to play.

Zepto produces a lot of data – about places, species and people's experiences. It includes Citizen Science activities that allow Zepto to generate a 'BioHealth' score for every site in terms of biodiversity, pollution and other markers that understand whether the environment is thriving or struggling. As more data is gathered, analysis will be able to reveal, understand and explain trends in these areas, and suggest activities that can have positive impacts on the health of the environment. Zepto can also proactively promote participation when seasons change, when unusual weather occurs, or when one unusual observation prompts a wider need for data.

Zepto provides graded game levels for users to climb through, either promoting wider activity across more of nature, or building new skills as confidence grows. Those skills not only include discovery and exploration, but conservation and improvement in the natural environment.

Image 3.6. Zepto in Action (© Oxido)

Studying Heat Stress to Protect Potato Yields

Temperature has a pronounced effect on the formation of potato tubers: when temperature is too high, potato plants form less or no tubers, which can greatly decrease yields. Scientists at the Friedrich-Alexander-University Erlangen Nuremberg (Germany) and the James Hutton Institute have uncovered the genetic mechanism behind the decrease of potato yields under high temperatures, which may help develop heat-tolerant varieties and protect future potato yields.

Research

Climate Change and Parasitism – Breaking the Cycle

Teladorsagia circumcincta is one of the most common and economically important endemic parasites to control in sheep in the UK. SEFARI scientists have found that as temperatures gradually get warmer there could be a 'tipping point' where parasite burdens suddenly get a lot higher. They have also shown that climate change can increase parasite burdens, which can substantially drive-up greenhouse gas emissions, and ineffective parasite control can lead to further increases in emissions. The positive is that parasitic gastroenteritis is one of the most cost-effective and feasible diseases to control in Scottish sheep.

Research

3.3.2 Expertise (Skills and Services)

To adapt to the changing climate, households and businesses both at home and abroad may need specialised services and skilled trades. The following policies support businesses to develop climate change adaptation expertise.

Hydro Nation: Scholars Programme

The Hydro Nation Scholars Programme delivers high-quality PhD posts, directly funded by the Scottish Government, to study cutting-edge water topics. These posts are funded to help solve pressing challenges for the industry, create new expertise within Scotland, and develop the water leaders of the future, building Scotland's international profile as a centre of water knowledge.

More information on this policy can be found in Section 4.2.2.

Adaptation Behaviours

Adapting to climate change requires actions from across all areas of society. There are many choices that businesses can take to build their resilience and become better prepared for risks, including extreme weather and flooding.

Individual Behaviours

1. Farmers can provide shelter for livestock. Increasing tree cover and shelterbelts like hedgerows can help to provide shelter for livestock during extreme weather conditions, for example, excessive heat and rain. This can also have the added benefit of connecting habitats and increasing biodiversity. For information on how increasing tree cover can benefit farms and livestock, visit Sheep and Trees.

2. To help reduce the spread of pests and diseases in Scottish forests, people should consider cleaning shoes, bikes, toys, equipment and dogs before visiting a forest. This helps to slow disease spread. For more information, visit Forestry Scotland.

3. Adapting farming practices can help to reduce erosion. Increased rainfall, wind and dry spells could increase erosion from fields. Farmers can help reduce erosion by ploughing horizontally along slopes, maintaining soil cover and limiting livestock access to waterlogged areas.

Further information and advice to farmers on adapting to climate change is provided on the Farming For a Better Climate website.

Societal Behaviours

1. Businesses are encouraged to prepare for flood events by having flood action plans. Businesses could also consider registering to receive flood alerts for advance warning. People are also informed of actions they can take to minimise the damage that flooding can cause, for example by keeping computer servers and stock away from basement and ground floor levels.

2. The Fair Work Charter for Severe Weather provides a set of guiding principles to support employers and workers to plan for and manage the impact of severe weather. It promotes fair working practices and encourages shared responsibility and mutual respect between workers and employers in developing their response.

3. Businesses are encouraged to consider how they will operate if staff are unable to get to work. This could be managing without certain staff members, or considering remote or flexible working.

For more information on maintaining business continuity, visit Ready Scotland.

Monitoring and Evaluation: Outcome 3

Monitoring and Evaluation is integral to the outcomes-based approach which encourages consideration at all stages of adaptation policy development. Further information including a general introduction to the framework, and a description of the foundation and principles can be found in the monitoring and evaluation introduction and Annex 3 respectively.

Key sources of existing monitoring evidence for Outcome 3 include: Ecosystem Health Indicators, Scottish Agricultural Statistics, Scottish Forestry, Climate Change Plan indicators, and Marine Scotland. There is currently limited data available for some themes, but by identifying what we need to measure not just what we know we can, the framework highlights monitoring gaps which will be filled as more data and associated monitoring arrangements are developed.

Monitoring the Adaptation Process ('What are we doing?') The themes set out the structure to monitor the implementation of and output from adaptation policies and actions which support the Outcome. Indicators will include metrics of, for example: usage levels of decision-support tools, uptake of sustainable resource management, and active engagement in knowledge exchange.

Monitoring the Sub-Outcomes ('Is it working?') The Sub-Outcome monitoring themes highlight the key components of each Sub-Outcome and provide the structure for evaluating progress. Indicators will include metrics of, for example: ecosystem health, business flexibility, and climate-related disruption to business.

Monitoring the Outcome Monitoring at this high level will directly link the outcome to wider government policy and the National Performance Framework by utilising relevant indicators already associated with these high-level monitoring frameworks.

National Performance Framework Indicators	Sustainable Development Goals Indicators
• Natural capital • Sustainability of fish stocks • Productivity • Innovative businesses	• Proportion of agricultural area under productive and sustainable agriculture • Progress towards sustainable forest management • Number of companies publishing sustainability reports

Monitoring and Evaluation Structure: Outcome 3

Process Monitoring Themes (What are we doing?)	Increasing knowledge exchange		
	Utilising adaptation management tools to inform decision-making		
	Adaptive planning, diversification, investment		
	Management to minimise impacts		
	Increasing monitoring and research		
	Sustainably managing resources		
Sub-Outcome Monitoring Themes (Is it working?)	Resilience to the impacts of climate change is increased	Resilience of assets is increased	Businesses harness new opportunities
	Natural resources are sustained	Resilience of the workforce is increased	Businesses are transformative
	Business flexibility and responsiveness is increased	Resilience of supply chains and distribution networks is increased	Businesses are innovative
Sub-Outcomes	3.1 Scotland's businesses based on natural resources are informed and adaptable to climate change	3.2 Scotland's manufacturing, services and wider economy are informed and adaptable to climate change	3.3 Scotland's economy is innovative and harnesses the opportunities created as a result of climate change
Outcome	Our inclusive and sustainable economy is flexible, adaptable and responsive to the changing climate		

UK Climate Change Risk Assessment Associated Risks

The UK Climate Change Risk Assessment risks that will be addressed by the policies presented in Outcome 3 are set out below:

Ne3: Risks and opportunities from changes in agricultural and forestry productivity and land suitability.	**Ne6**: Risks to agriculture and wildlife from water scarcity; and flooding.	**Ne8:** Risks of land management practices exacerbating flood risk.	**Ne9:** Risks to agriculture, forestry, landscapes and wildlife from pests, pathogens and invasive species.
Ne10: Risks to agriculture, forestry, wildlife and heritage from changes in frequency and/or magnitude of extreme weather and wildfire events.	**Bu1:** Risks to business sites from flooding.	**Bu2:** Risks to business from loss of coastal locations and infrastructure.	**Bu3:** Risks to business operations from water scarcity.
Bu4: Risks to business from reduced access to capital.	**Bu5:** Risks to business from reduced employee productivity, due to infrastructure disruption and higher temperatures.	**Bu6:** Risks to business from disruption to supply chains and distribution networks.	**Bu7:** Risks and opportunities for business from changes in demand for goods and services.

Outcome 4: Our society's supporting systems are resilient to climate change

Image 4.1. Hopes Reservoir

Outcome 4: Our society's supporting systems are resilient to climate change

Introduction

Scotland's supporting systems, or infrastructure, comprise the facilities, systems, sites and networks necessary for the functioning of the country and to enable, sustain or enhance societal living conditions. Communities across Scotland depend on our infrastructure, including housing and cultural facilities, access to transport, communication, health services and supplies of energy and water.

Infrastructure in Scotland both depends on, and is impacted by, the environment. Flooding and landslides can make roads and rail impassable, high winds and heavy rain can cause damage to electricity networks, and erosion can damage coastal infrastructure. Maintaining delivery of services is critical, and is particularly important for rural and island communities in Scotland, where these services can provide lifelines.

In Scotland, some parts of infrastructure are devolved to the Scottish Government, while some remain reserved at the UK level. Where sectors are devolved, the related decision making power rests with the Scottish Government.

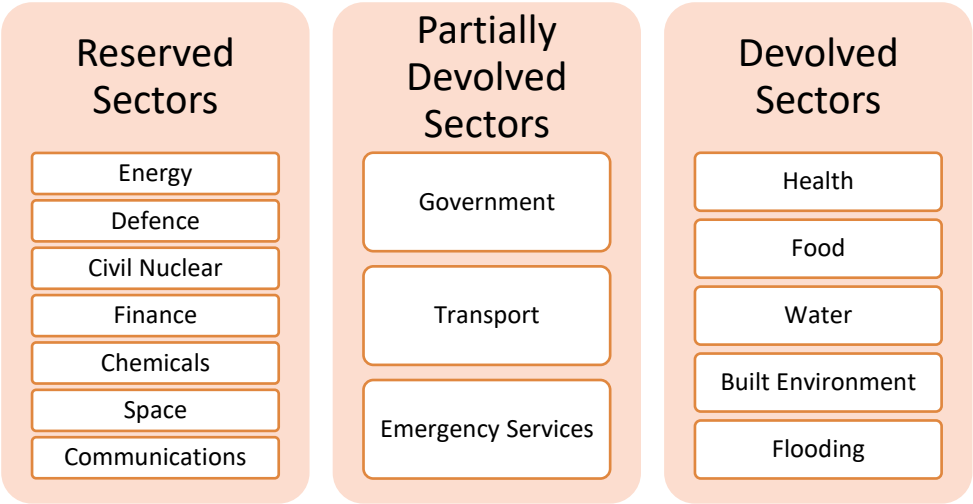


Image 4.2. Reserved, partially devolved and devolved infrastructure sectors in Scotland

Critical infrastructure is essential to the functioning of the society and economy in Scotland. This may be direct, in the form of a major trunk road, or indirect, such as the energy supply that underpins a data centre. The loss or disruption of these systems could lead to severe social or economic consequences. As climate change increases the likelihood of extreme weather events (including flooding, storms and heat waves), it is important that our infrastructure systems are resilient to the future climate.

Infrastructure sectors do not operate in isolation and having interconnected sectors increases the risk of cascading infrastructure failures, for example, energy supply underpins water and wastewater treatment systems, IT infrastructure, and signalling for roads and rail. Infrastructure assets, such as bridges, may support cables and pipes carrying energy and water.

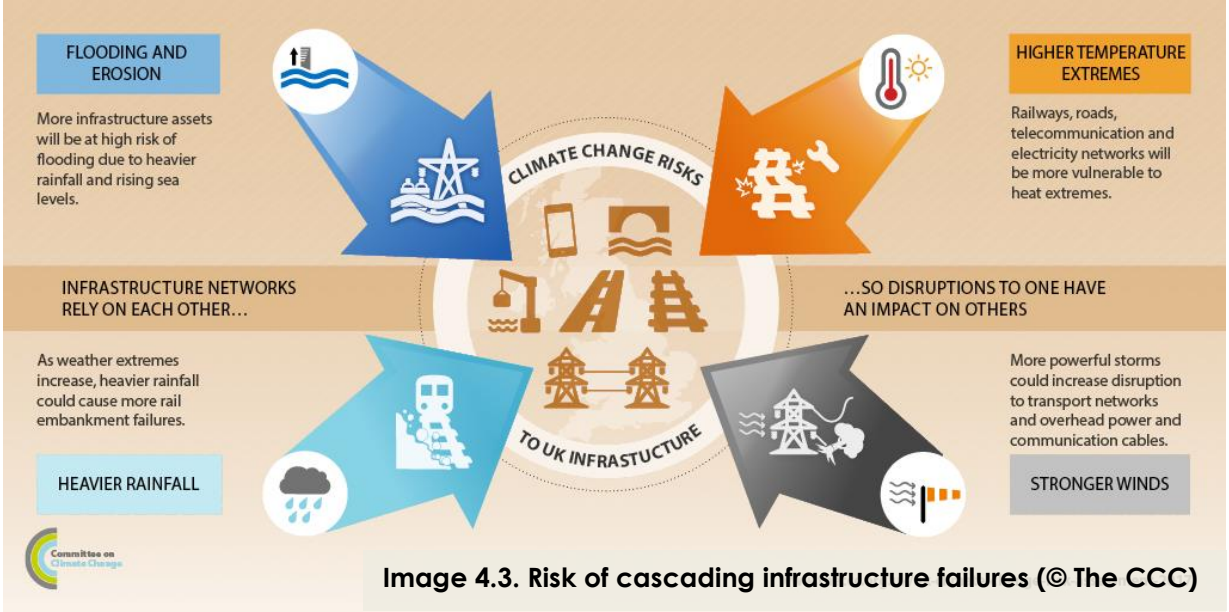


Image 4.3. Risk of cascading infrastructure failures (© The CCC)

Where We Are Now

Investment in infrastructure is vital to supporting and delivering a prosperous and successful Scotland. At a fundamental level, infrastructure requires construction and maintenance of the physical buildings and networks that facilitate service delivery across Scotland. Infrastructure is also a critical element for achieving sustainable economic growth and boosting international competitiveness.

Our National Infrastructure Mission, set in 2018, commits us to a steady increase in the level of infrastructure investment from now until the end of the next Parliament. To support the delivery of this Mission, we have established an independent Infrastructure Commission for Scotland which will advise the Scottish Government on national infrastructure priorities, including how to prioritise investment to deliver low carbon objectives. In 2020, we will produce the next Infrastructure Investment Plan which will set out a comprehensive plan across the sectors for the next 5 years.

Infrastructure plays a critical role in how a place functions. Infrastructure can help us to build places where people have choices about how they move around, access facilities and live sustainable healthy lives. Scotland's building standards underpin the quality of our built environment, ensuring buildings are safe, efficient and sustainable. The Scottish Government also supports place-based approaches to adaptation, with Climate Ready Clyde, Edinburgh Adapts, Aberdeen Adapts and Levenmouth Adapts being examples of these. These approaches are cross-sector initiatives that aim to create a shared vision of adaptation for a region. Adapting and maintaining climate resilient infrastructure is an integral part of this vision.

Infrastructure projects can range in scale and provide multiple co-benefits to different areas. Blue-green infrastructure, for example, can act to enhance drainage and reduce flooding, whilst also increasing air quality, biodiversity, human health and emotional wellbeing through access to greenspace. Improvements in the resilience of Scotland's infrastructure will have positive impacts on multiple areas, and contribute to each of the outcomes in the Adaptation Programme.

Significant progress has been made to improve the resilience of Scottish infrastructure over the last few years, with more action ongoing. One of the most visible recent projects is the opening of the Queensferry Crossing, the biggest infrastructure project in Scotland in a generation. Since opening, its wind shielding has made it less susceptible to closure during high winds than the Forth Road Bridge. Other design features have increased the bridge's resilience to extreme weather and the changing climate.

The Perceptions of Trunk Road Networks in Scotland survey showed that in 2017, 67% of respondents had at least one journey over the previous year disrupted by severe weather. Data on this issue continue to be collected through passenger and customer care focussed surveys. In 2005, Transport Scotland published the Scottish Road Network Climate Change Study, it was refreshed in 2008 and 2011. Following the publication of new UK Climate Projections in 2018 (UKCP18), consideration is being given to a further refresh.

The second National Flood Risk Assessment, published in 2018, provides increased detail regarding flood risk. In addition to mapping risk to communities and heritage sites from flooding, it also maps potential areas of vulnerability for infrastructure assets. Better understanding of flood risk vulnerable areas enables prioritisation of actions.

In 2011, Secure and Resilient was published, providing a strategic framework for critical national infrastructure in Scotland. This strategy remains active, establishing governance arrangements and providing strategic direction for critical national infrastructure resilience stakeholders. Climate change is a key factor that critical national infrastructure stakeholders must consider in implementing the strategy.

The following diagram outlines the structure of the Supporting Systems chapter. It is divided into three Sub-Outcome and sets out the policies that contribute towards this outcome. The Sub-Outcomes consider devolved and reserved infrastructure and the interdependencies between these infrastructure systems.

Outcome 4: Our society's supporting systems are resilient to climate change – policies and research

- Cross-cutting Policies
- The Infrastructure Investment Plan
- The Infrastructure Commission for Scotland
- The Infrastructure Investment Board
- Stakeholder Impact Assessments
- The National Transport Strategy 2
- Dynamic Coast
- National Flood Risk Assessment (NFRA) 2018

4.1 Scotland's reserved supporting systems are resilient to climate change

4.1.1 Energy
- Electricity and Gas Networks Vision Statement

4.1.2 Communication
- Reaching 100% Programme
  - Scottish 4G Infill Programme

4.1.3 Government

4.1.4 Transport

4.2 Scotland's devolved supporting systems are resilient to climate change

4.2.1 Government
- Major Incident Management Plan
  - Directorate Business Continuity Plans
    - Business Continuity Tools

4.2.2 Water
- Scottish Water Policy and Planning
  - Scottish Water Surface Water Policy
    - Private Water Supplies
      - Blue-Green Infrastructure
        - HN: Scotland's Centre of Expertise for Waters (CREW)
        - HN: Scholars Programme

4.2.3 Transport
- Strategic Transport Projects Review 2
  - Integrated Roads Information System & Disruption Risk Assessment Tool
    - Landscape Management
      - Scottish Road Network: Climate Change Study and Implementation Plan
- Scottish Road Network Landslides Study
  - Scour Management Strategy and Flood Risk Emergency Plan
    - Preparing for Severe Weather Events
      - Scottish Ministers' High Level Output Specification, Control Period 6

4.2.4 Health
- Climate Hazards and Vulnerabilities Risk Screening Tool for Healthcare Assets
  - Health Infrastructure is considered in Outcome 2

4.2.5 Emergency Services
- Scottish Wildfire Forum
  - Scottish Fire and Rescue Service Community Asset Register

4.2.6 Food
- Food is considered in Outcome 3

4.2.7 Built Environment
- The Built Environment is considered in Outcome 1

4.2.8 Flooding
- Flooding is considered in Outcome 1

Key

- Policy also found under another Outcome
- Policy also found under another Sub-Outcome
- Policy

Cross-Cutting Policies

The following policies support the understanding of the likely impacts of climate change on our infrastructure and supporting systems.

The Infrastructure Investment Plan

The 2015 Infrastructure Investment Plan set strategic priorities for infrastructure investment across Scotland. The plan is framed by four themes: tackling inequalities, supporting a low carbon economy, high quality public services, and supporting employment opportunity across Scotland.

The next Infrastructure Investment Plan (IIP) will build on the Infrastructure Commission's recommendations and take account of our National Infrastructure Mission. The Plan will be published by June 2020 and cover the next Parliamentary term. The IIP will reflect this commitment to delivering infrastructure projects which support our transition to a net-zero emissions economy by 2045. In developing the IIP we will also carefully consider the UK Risk Assessment, UK Climate Impact Projections and Scottish policy documents in informing how our infrastructure should adapt to changing climate.

Timeline:	**Owners:**
Next Infrastructure Investment Plan due for publication in 2020	Scottish Government

The Infrastructure Commission for Scotland

The Infrastructure Commission was set up to provide independent, informed advice on the vision, ambition and priorities for infrastructure in Scotland. The Commission will support delivery of our National Infrastructure Mission and development of the next Infrastructure Investment Plan until 2023. A central part of the Commission's remit is to consider managing the transition to a more resource efficient, lower carbon economy.

Further information on the Commission's work and its membership, can be found at www.infrastructurecommission.scot .

Timeline:	**Owners:**
The Infrastructure Commission will publish its recommendations in December 2019, followed by a report on delivery of infrastructure in the middle of 2020.	Infrastructure Commission for Scotland

The Infrastructure Investment Board

The Scottish Government established the Infrastructure Investment Board (IIB) in November 2010 to take an executive role in infrastructure governance, working alongside individual portfolio investment boards. The IIB's objectives are:

- to deliver sustainable economic growth through increasing competitiveness and tackling inequality,
- to manage the transition to a more resource-efficient, lower-carbon economy,
- to support delivery of efficient and high-quality public services,
- to support employment and opportunity across Scotland.

Timeline:	**Owners:**
Ongoing, IIB meets quarterly	Scottish Government

Stakeholder Impact Assessments

The delivery of the Scottish Government's Critical Infrastructure strategy "Secure and Resilient," includes a Stakeholder Impact Assessment (SIA). The SIA provides an overview of individual key companies and organisations that make up each sector, why they are critical and their identified vulnerabilities. It also describes the mitigation, protection and contingency plans in place to tackle vulnerabilities.

Within the SIA, there is a specific section that identifies Climate Change as a vulnerability, ensuring infrastructure owners assess the likely impact of climate change on their delivery of essential services over the next 30 years.

Timeline:	**Owners:**
Ongoing	Scottish Government

The National Transport Strategy 2

Transport Scotland will publish the new National Transport Strategy (NTS) in 2019, setting out policy for transport in Scotland over the next 20 years. This Strategy takes into account targets for decarbonisation of transport, accessibility, and elimination of poverty. The new NTS will seek to ensure that Scotland adapts to the effects of climate change, takes steps to mitigate further climate change and promotes greener, cleaner choices.

The Strategy states that: "Adaptation of the strategic transport network to cope with effects of climate change is also vital to ensure the continued health of the Scottish economy." It emphasises the importance of a Sustainable Travel Hierarchy which promotes walking, cycling, public transport, and bike, car or ride sharing in preference to single occupancy car use. The Strategy will align with the emerging policy and legislative landscape in Scotland including the outcomes from the independent planning review, Climate Change Plan, local government review, Enterprise and Skills review, City and Region Growth Deals and the Transport Bill.

Timeline:	**Owners:**
Due for publication in 2019	Transport Scotland, Scottish Government

Dynamic Coast

The second phase of Dynamic Coast will investigate the resilience of Scotland's natural coastal defences; estimate how future climate change may exacerbate erosion on our soft (erodible) coast; and develop mitigation, adaptation and resilience plans at super sites.

More information on this policy can be found under Sub-Outcome 6.1.

National Flood Risk Assessment (NFRA) 2018

In 2018, SEPA published the second NFRA. The assessment identifies infrastructure assets, such as utilities and transport, at risk of flooding. Improved assessment of risk can be used to inform appropriate flood risk management actions.

More information on this policy can be found in Section 1.2.3.

Sub-Outcome 4.1: Scotland's reserved supporting systems are resilient to climate change

There are a number of Infrastructure sectors that are fully reserved to the UK Government including finance, civil nuclear, defence, chemicals and space. Although energy and communications sectors are reserved, the Scottish Government works collaboratively with the UK Government and service providers to improve Scotland's energy and digital networks.

4.1.1 Energy

Energy is a vital supporting system underpinning our society and economy. In the future, it will be increasingly important that energy systems are resilient to climate change. As the climate changes, the energy supply for Scotland's homes could experience damage and disruption. An increase in the frequency and severity of extreme weather and flooding could interrupt electricity generation at the source and damage energy networks, preventing transmission.

Although predominantly a reserved sector, the Scottish Government has influence over the promotion of renewable energy and policy control over energy efficiency schemes. Energy efficiency schemes are included in Section 1.2.3.

The Scottish Government works closely with the UK Government, electricity network operators and owners to ensure the resilience of Scotland's energy networks (to climate change and other factors), and their restoration in the event of a nationwide system failure and power loss.

Image 4.4. Transmission Tower

Electricity and Gas Networks Vision Statement	
Alongside the Scottish Government's Energy Strategy, the Electricity and Gas Networks Vision Statement, published in March 2019, takes a more detailed look at the role and evolution of Scotland's energy networks. This includes the ways in which Scotland's energy networks will need to change to remain resilient and effective, to support our energy and climate change goals.	
Timeline: Published March 2019	**Owners:** Scottish Government

4.1.2 Communications

The communications sector comprises telecommunications, public broadcast, postal services and the internet. The sector is reserved, however, the Scottish Government funds digital initiatives, believing digital infrastructure to be integral to Scotland's future.

Digital infrastructure is an essential tool to help people become more resilient and adaptable as the climate changes. Access can help people to stay connected and informed, particularly in the event of extreme weather or disruption to other infrastructure. For this reason, it is essential that digital infrastructure is itself resilient.

Reaching 100% Programme	
The Reaching 100% programme will deliver superfast broadband access to 100% of homes and business in Scotland. Connectivity is a vital part of our national infrastructure. Businesses depend on it to improve productivity, support customers and open new markets. Fibre broadband is generally more resilient than copper. Fibre has the potential to allow businesses and individuals more flexibility to adapt to climate change by supporting remote working and reducing the need to travel during extreme weather.	
Timeline: Ongoing	**Owners:** Scottish Government

Scottish 4G Infill Programme	
The S4GI programme aims to deliver 4G infrastructure and services to selected mobile "not spots" in Scotland. Greater access to 4G has the potential to allow businesses and individuals more flexibility to adapt to climate change by supporting remote working and reducing the need to travel during extreme weather events.	
Timeline: Ongoing	**Owners:** Scottish Government

4.1.3 Government

Maintaining government operations during disruptive events is crucial to ensure other services across Scotland can also be delivered. Assets or buildings relating to the UK Government are reserved. Other aspects of government are devolved to the Scottish Government and are included in Section 4.2.1.

4.1.4 Transport

In Scotland, transport relating to air, rail and ports is partly reserved to the UK Government. Highlands and Islands Airports Limited, Caledonian Maritime Assets Limited and CALMAC are owned by the Scottish Government. Climate change could disrupt Scotland's transport systems through increases in high winds, lightning, extreme heat, landslides, flooding or erosion. Devolved transport policy is included in Section 4.2.3.

Ferries, Ports and Airports

A full refresh of the National Transport Strategy will be completed within the fifth session of the Scottish Parliament. A formal consultation on the National Transport Strategy 2 will be launched over the summer 2019, with expected adoption before the end of 2019. Following this refresh, the Strategic Transport Projects Review will also be updated. Updates to these strategies will include consideration of how ferries, ports and Scottish Government owned airports (Highlands and Islands Airports Limited) will adapt to climate change.

Rail

The rail network in Scotland is partially reserved to the UK Government with the exception of the ScotRail franchise which is let by Scottish Ministers. Transport Scotland works in partnership with Network Rail to help prepare Scotland's rail infrastructure for the impacts of climate change. This work includes the *Route Weather Resilience and Climate Change Adaptation Plans (Scotland)*, published 2014.

Sub-Outcome 4.2: Scotland's devolved supporting systems are resilient to climate change

The Scottish Government is working to improve the resilience of devolved sectors. Devolved infrastructure sectors include health, food and water. In addition, some aspects of government and transport have been devolved. Emergency services are also fully devolved to the Scottish Government, with the exception of Her Majesty's Coastguard.

4.2.1 Government

Within Scotland, there are multiple layers of government, with different functions. Maintaining government operations during disruptive events, such as extreme weather as a result of climate change, is crucial to ensure other services across Scotland can also be delivered. The policies below increase the adaptive capacity of government operations.

Major Incident Management Plan	
The Major Incident Management Plan applies to the internal Scottish Government responses and coordination processes for internal and external incidents that are impacting on, or may have an impact on, the Scottish Government. This includes instances of disruption to the Scottish Government from extreme weather events and other climate change related impacts. When Scotland is faced with an emergency or major incident that has an external impact on people and services in Scotland beyond the Scottish Government itself, this is dealt with by a separate process led by the Scottish Government Resilience team, and by Ministers, as appropriate.	
Timeline: Ongoing	**Owners:** Scottish Government

Directorate Business Continuity Plans	
There are 43 directorates within the Scottish Government, working on a range of topics from culture to social security and everything in between. These directorates also provide the corporate infrastructure required to deliver business. For the Scottish Government to maintain delivery of essential business operations in the event of a significant incident, failure or disruption occurring, each directorate has its own Business Continuity Plan. Advance contingency planning ensures directorates are able to respond to a range of potentially disruptive scenarios, including extreme weather.	
Timeline: Ongoing	**Owners:** Scottish Government

Business Continuity Tools	
During times of disruption the Scottish Government has systems in place to act to keep staff safe and ensure it can keep operating during periods of disruption.	
Timeline: Ongoing	**Owners:** Scottish Government

4.2.2 Water

There are two aspects to water management: ensuring Scotland's people can access a reliable supply of clean water, and ensuring drainage and sewerage are sufficient enough to prevent or minimise flooding. Warmer, drier summers could cause water scarcity, while warmer, wetter winters could cause flood events.

Scottish Water is investing around £600 million in Scotland's water infrastructure and are consulting on priorities for future investment for 2021-27 and beyond. A significant issue to address is our approach to surface and storm water management. Ageing assets, population growth and climate change all pose challenges.

The Scottish Government continues to deliver on our vision of Scotland as the world's first Hydro Nation. We are committed to managing our water environment and resources to their best advantage, and employing our knowledge and expertise effectively at home and internationally. Scotland as a Hydro Nation will respond to the immense water challenges that population growth and climate change bring.

The following describes the individual policies that supports Scotland's water infrastructure to adapt to climate change.

Scottish Water Policy and Planning	
As part of the SR21 programme, Scottish Water completed its largest ever-public engagement programme with 'Shaping the Future'. Scottish Water are co-creating with stakeholders a strategic plan for the 2021-27 period. Scottish Water continues to develop knowledge of the impact of extreme and unpredictable weather events on its assets, infrastructure and essential services by assessing current and future risks in several ways. This includes Climate Change Risk Assessments, Vulnerability Assessments, which are incorporated into Scottish Water's 25 Year Water Resource Plan, Water Resilience plans, Integrated Catchment Studies, and Asset Flood Risk Assessments. Scottish Water is also developing its wastewater resilience strategy, the aim of which is to identify and undertake mitigation and adaptation measures to enhance resilience to future climate change.	
Timeline: Strategic plan in development for 2021-27	**Owners:** Scottish Water, Scottish Government

Scottish Water Surface Water Policy

Scottish Water recently signed a Sustainable Growth Agreement with SEPA, under the terms of which they will work together to explore new and innovative ways to manage resilience in rural and urban drainage catchments.

Through a partnership of Glasgow City Council, Scottish Canals and Scottish Water under the umbrella of the Metropolitan Glasgow Strategic Drainage Partnership construction of Europe's first ever 'smart canal' commenced in May 2018. With sewer networks reaching design capacity across North Glasgow, fresh ideas for surface water management were needed to unlock future development potential. The project will use sensors, predictive weather technology and active management of the canal to lower water levels, creating space for surface water run-off. This pioneering project will unlock 110 hectares across the north of the city for investment, regeneration and development, paving the way for more than 3000 new homes.

Scottish Water have joined with SEPA, the Scottish Government and Local Authorities to form the Edinburgh and Lothians Strategic Drainage Partnership to develop innovative and integrated solutions to manage rainwater, flooding, flood risk and growth.

Timeline:	**Owners:**
Ongoing	Scottish Water, Scottish Government

Private Water Supplies

In Scotland, nearly 4% of the population relies on drinking water sourced from private water supplies. These are supplies that are owned and/or managed by their users. There are over 22,000 private supplies in Scotland, of which approximately 2,500 supply a commercial or public building such as food producers, hotels, B&Bs or holiday accommodation. Private water supplies are typically found in the more rural parts of Scotland and are not managed by Scottish Water (Scotland's public water authority). The water used in these supplies can come from small streams, lochs, groundwater springs and boreholes.

Private water supplies are especially vulnerable to climate change. Changing rainfall patterns (including snowfall) and increasing temperatures will have impacts on the amount and quality of source waters. Research is underway to understand the likely impacts of climate change on water availability to support private water supplies on a regional basis. This is due be completed in early 2020 and will inform the range of policy and practical measures needed to improve the resilience and quality of these supplies. In addition, work is underway to assess financial support. A grant of £800 is currently available to owners of these supplies to support improvements. However, it is recognised that financial assistance needs to be better targeted.

Timeline:	**Owners:**
Ongoing	Scottish Government

Case Study 5: Water Scarcity Event, July – September 2018

In 2018, the prolonged dry and hot weather in late spring and early summer resulted in many private water supplies running dry, with large areas of Scotland experiencing significant water scarcity between July and September 2018. Requests were received by local authorities for emergency supplies of drinking water from households served by some 500 private water supplies which had reportedly run dry. During this time, it is likely that many more than 500 supplies ran dry, but their users made alternative arrangements with neighbours and relatives to secure alternative supplies.

165 of the reported private water supplies that ran dry were located in Aberdeenshire. This region was particularly impacted due to the severity of the water scarcity (highest ever recorded by SEPA), but also because many private water supplies in this area rely on shallow, surface-based water sources with small catchment areas.

In response to the unprecedented nature of the events in 2018, the Scottish Government agreed to fund the provision of emergency assistance to affected households. Emergency supplies were provided by Scottish Water in response to requests from local authorities.

Image 4.5. River Spey

Blue-Green Infrastructure	
The Scottish Government is working together with Scottish Water, SEPA, Local Authorities and other stakeholders under the Blue-Green Cities Programme for Government commitment to develop approaches to drainage, which will reduce the burden on the sewerage. By retaining more water in rivers and soils, we can improve the environment, supporting biodiversity, while increasing leisure and activity potential. We will build on examples of work underway in Glasgow and elsewhere to establish new pilots of the Blue-Green cities approach.	
Timeline: Ongoing	**Owners:** Scottish Government

Hydro Nation: Scotland's Centre of Expertise for Waters (CREW)	
CREW[9] is a Scottish Government funded partnership between the James Hutton Institute and Scottish Universities, supported by the Marine Alliance for Science and Technology Scotland (MASTS). The centre provides a vital knowledge hub where calls for research are coordinated across academic institutions, government and the water sector, helping improve understanding of water in the environment, industry, pollution, resource management and technology.	
Timeline: Ongoing	**Owners:** Scottish Government

Hydro Nation: Scholars Programme	
The Hydro Nation Scholars Programme[10] delivers high-quality PhD posts, directly funded by the Scottish Government, to study cutting-edge water topics. These posts are funded to help solve pressing challenges for the industry, create new expertise within Scotland, and develop the water leaders of the future, building Scotland's international profile as a centre of water knowledge.	
Timeline: Ongoing	**Owners:** Scottish Government

[9] https://www.crew.ac.uk/
[10] https://www.hydronationscholars.scot/scotland-hydro-nation

4.2.3 Transport

Transport in Scotland is a mixture of devolved and reserved competence. The road and bridge network has been devolved to the Scottish Government, as well as ScotRail, Scotland's only rail franchise. Ensuring the resilience of these networks as the climate changes will be essential, as the Scottish Government adapts to the changing climate.

Strategic Transport Projects Review 2	
Following the publication of the second National Transport Strategy, Transport Scotland will seek to publish the Second Strategic Transport Projects Review (STPR2). STPR2 will examine the strategic transport infrastructure interventions required to support Scotland's Economic Strategy, including inclusive growth objectives, reflecting outcomes and priorities to be set out in the National Transport Strategy. The Strategic Transport Projects Review, published in December 2008, sets out the Scottish Government's 29 transport investment priorities over the period to 2032.	
Timeline: Due for review following publication of the National Transport Strategy 2.	**Owners:** Transport Scotland, Scottish Government

Image 4.6. Queensferry Crossing

Roads

Scotland's roads are essential for connecting communities and delivering goods and services across the country. To continue to provide these connections, roads must be maintained so they remain accessible despite the potential damage and disruption caused by climate change.

Transport Scotland oversees the trunk road network in Scotland. The trunk road and motorway network is 3,507 km (2,179 miles) long, including slip roads and roundabouts. It has a gross asset value of over £20.8 billion and represents 6% of the total Scottish road network. It carries 35% of all traffic and 60% of heavy goods vehicles. Transport Scotland are working to enhance, manage and maintain a resilient transport network with reliable journey times and enhanced connections which promotes sustainable economic growth. Our management of trunk roads also includes ongoing maintenance work, looking after bridges and other structures, and putting landslide control measures in place.

Scottish Road Network Landslides Study and Implementation Report

Climate change will impact on slope stability due to changes in soil moisture. Parts of Scotland may see a seasonal increase or decrease in the amount of rainfall experienced which can lead to an increase in the frequency of landslides. Adapting to landslides and flooding will form a key area of work for the Transport Sector.

In 2005, Transport Scotland published the Scottish Road Network Landslides Study, following road closures after landslides the previous year. In 2009, we published an Implementation Report. This report identifies areas of current high hazard in Scotland and makes recommendations as to how to assess the Scottish road network and management approaches which could be adopted to mitigate the effects of landslides.

Timeline:	**Owners:**
Published in 2009. A review of recommendations started in 2018, with publication due in 2019.	Transport Scotland, Scottish Government

Integrated Roads Information System and Disruption Risk Assessment Tool

Collecting and analysing data to determine areas of the transport network that are susceptible to flooding, inundation and subsidence is vital to improve our knowledge about the capability of assets to respond to climate change. The use of the Integrated Roads Information System tool to record incidents such as flooding will allow identification of vulnerable locations in the trunk road network and prioritise sites that require engineering interventions or continued monitoring.

Timeline:	**Owners:**
Ongoing	Transport Scotland, Scottish Government

Scour Management Strategy and Flood Risk Emergency Plan

Bridge scour is the process where sediment from around bridge abutments or piers is removed by fast moving water. An increase in rainfall and flooding as a result of the changing climate could cause an increase in the frequency of scour, potentially causing structural damage.

A Scour Management Strategy and Flood Risk Emergency Plan has been developed and implemented across Transport Scotland's Operating Companies and Design-Build-Finance-Operate providers. The aim is to ensure a consistent approach to inspecting, monitoring, assessing and recording scour and erosion at structures and to improve interventions and mitigation measures. The strategy includes the monitoring of trunk road bridges and other structures, and enhanced monitoring of those structures which are known to be at risk. The strategy also includes installation of flood level marker plates next to high risk structures so that, during high rainfall events, inspectors can identify when flows approach or exceed critical flood assessment levels and recommend closure or restrictions of the structure until water levels recede and scour inspections can be undertaken.

Timeline:	**Owners:**
Implemented February 2018	Transport Scotland, Scottish Government

Landscape Management

Within the work of the Trunk Road divisions, the potential impact of climate change on our natural resources is managed via our Landscape Policy document, Fitting Landscapes. Through application of this mandatory policy, all works undertaken on the network must take account of the impact on the environment and local landscape character, whilst seeking opportunities to enhance the resource. The policy also requires designers and managers to consider the longer-term impacts of their works and build-in sustainability objectives.

Timeline:	**Owners:**
Ongoing	Transport Scotland, Scottish Government

Preparing for Severe Weather Events

The UKCP18 projections note that there is likely be an increase in extreme weather events. Winter service operations allow safe use of the trunk road network and minimize disruption to users caused by snow or ice.

Transport Scotland continues to develop and improve high wind management plans. All weather related incidents (including wind) are routinely reviewed to determine any necessary improvement actions. Our Met Office advisor based in the Traffic Scotland National Control Centre provides high wind forecasting for major bridges on the trunk road network to monitor, manage and disseminate information on restrictions and closures to operational partners, the public and the freight/haulage industry.

Timeline:	**Owners:**
Ongoing	Transport Scotland, Scottish Government

Scottish Road Network: Climate Change Study and Implementation Plan	
The Scottish Road Network: Climate Change Study (2005) and Implementation Plan (2008) gives direct recommendations to adapt the Scottish road network to cope with climate change. This study and implementation plan was updated following UK Climate Projections 2009 and consideration is being given to a further update following the UK Climate Projections 2018.	
Timeline: Further detail will be available following publication of the National Transport Strategy 2.	**Owners:** Transport Scotland, Scottish Government

Rail

Rail infrastructure in Scotland is mainly reserved to the UK Government with the exception of the ScotRail franchise which is let by Scottish Ministers. The following policy supports the increased resilience of Scotland's railways.

Scottish Ministers' High Level Output Specification, Control Period 6	
The most recent High Level Output Specification sets out how investment strategies must become more sustainable and ensure enhanced network resilience from adaptation interventions. Scottish Ministers also require Network Rail to work with the rail industry to develop and apply suitable Key Performance Indicators to monitor the impact and mitigation of climate change on network disruption and provide the means to measure the benefits of adaptation interventions.	
Timeline: Ongoing	**Owners:** Transport Scotland, Scottish Government

Image 4.7. ScotRail train at Tweedbank station

4.2.4 Health

Ensuring continued health service delivery despite possible climate-related disruption is essential. As Scotland's climate changes, individuals can experience impacts on their health. Health infrastructure like hospitals, GP surgeries and treatment centres can also experience damage and disruption due to high winds, increased rainfall and flood events. Policies to support health resilience are included in Section 2.2.

Climate Hazards and Vulnerabilities Risk Screening Tool for Healthcare Assets

A Climate Hazards and Vulnerabilities Risk Screening Tool for Healthcare Assets is being developed for NHS Scotland. The new screening tool will provide NHS Boards with a Scotland-wide resource that brings together natural hazard and health-related vulnerabilities to inform NHS Scotland risk assessment and planning processes. This includes identification of the risk of damage and loss to healthcare assets, sites and the infrastructure that supports them, for example, roads.

More information can be found in Section 2.2.1.1.

4.2.5 Emergency Services

Emergency services will likely become more important as the climate changes. Extreme weather events such as flooding and wildfires may become more frequent and emergency responders may have difficulty accessing certain areas to provide assistance. In Scotland, the police, ambulance, and fire and rescue service are all devolved to the Scottish Government. HM Coastguard is the only exception and is reserved to the UK Government.

Scottish Wildfire Forum	
Wildfires already cause substantial ecological and environmental damage and demand considerable and costly fire-management resources. They are expected to increase in magnitude and frequency due to the warmer and drier summers associated with climate change, and may also be exacerbated by land use change. The Scottish Wildfire Forum is committed to reducing the number and severity of wildfires in Scotland through collaborative working across all relevant sectors. The forum has developed a strategy, built upon prevention and communication, which complements the Scottish Government's strategic objectives of "Safer and Stronger" and "Greener" and will strengthen the resilience of Scotland to the economic and social impact of wildfires.	
Timeline: Ongoing	**Owners:** Scottish Fire and Rescue Service

Image 4.8. Wildfire near Aberlour, Moray (© Scottish Fire and Rescue Service)

Scottish Fire and Rescue Service Community Asset Register	
During storms and heat waves, individuals, especially those who are elderly or more vulnerable, may become trapped in their homes and require rescue. In addition, key workers (emergency services, doctors, nurses etc.) may be trapped in their homes and unable to get to work. The Community Asset Register provides accurate information about the Voluntary Sector, organised groups', business owners' and individual's skills, capabilities and equipment which could be made available to emergency responders to assist with emergency events. The Community Asset Register was developed by Scottish Fire and Rescue Service (SFRS) and launched across Scotland in October 2017. The register is also available to other agencies when responding to emergency events. The Scottish Government Resilience Division is currently drafting guidance, collaboratively with the Voluntary Sector and other Resilience Partners, to establish a 'best practice' model around how best to integrate the Voluntary Sector into wider Resilience Partnership structures and working arrangements and includes building on the Community Asset Register as a key resource.	
Timeline: Ongoing	**Owners:** Scottish Fire and Rescue Service

4.2.6 Food

Climate change may cause changes to patterns of availability and distribution of different types of food for Scottish people. As agriculture is a cornerstone of Scotland's economy, more detail on this can be found with provisioning ecosystem services, in Section 3.1.1.

4.2.7 Built Environment

Our built environment will need to adapt to our changing climate, and in particular, the likely projected increases in temperature (with greater warming in the summer than winter) and projected increases in rainfall in winter and reduced rainfall in summer. As the built environment is an integral part of community wellbeing, more detail can be found on this in Section 1.2.2 and Section 1.2.3.

4.2.8 Flooding

Climate change will likely increase the frequency of flood events across Scotland. It will be important to ensure that existing and new infrastructure is resilient to the impacts of flooding, as well as invest in specific flood risk management infrastructure, including blue-green infrastructure. As flooding impacts on people and the built environment, more detail on this can be found in Sub-Outcome 1.2.

Adaptation Behaviours

Adapting to climate change requires action from across all areas of society. The Scottish Government, local government, public bodies, the private sector, third sector, communities and individuals all have a role to play. While utility companies in Scotland have well-tested plans in place, individuals can also take simple steps to prepare for a short period without electricity, gas or mains water supplies. Individuals, communities and businesses can also take action to reduce pressure on our utilities and increase their resilience.

Individual Behaviours

1. A smooth running water cycle. Flushing wipes, nappies or cotton buds down the toilet can cause drains to block, resulting in flooding, people are encouraged to take care in what they flush.

2. Maintaining a well-stocked emergency kit at home can help if infrastructure networks are disrupted. Information on emergency kits is provided on the Ready Scotland website.

3. Individuals are encouraged to notify their energy supplier if they have a disability, are chronically sick, or depend on a continuous supply of power for medical equipment or mobility equipment, such as stair lifts and hoists. Energy suppliers work with local authorities so vulnerable people get the support they need during any disruptions to normal service.

Societal Behaviours

1. Businesses can prepare for severe weather by ensuring that they have appropriate insurance cover for all aspects of their business and talk to their staff about what 'essential travel' means for them and their business.

2. Businesses are also encouraged to put contingency plans in place for power, phone or other utility failure and plan how they would operate if they could not access or use part of their premises, and how they would evacuate staff or move stock.

Monitoring and Evaluation: Outcome 4

Monitoring and Evaluation is integral to the outcomes-based approach which encourages consideration at all stages of adaptation policy development. Further information including a general introduction to the framework, and a description of the foundation and principles can be found in the monitoring and evaluation introduction and Annex 3 respectively.

Key sources of existing monitoring evidence for Outcome 4 include: the National Flood Risk Assessment, Scottish Water, National Transport Statistics, and the Scottish Fire and Rescue Service. There is currently limited data available for some themes, but by identifying what we need to measure not just what we know we can, the framework highlights monitoring gaps which will be filled as more data and associated monitoring arrangements are developed.

Monitoring the Adaptation Process ('What are we doing?') The themes set out the structure to monitor the implementation of and output from adaptation policies and actions which support the Outcome. Indicators will include metrics of, for example: coverage of condition assessments and resilience plans, staff training, and the use of place-based approaches.

Monitoring the Sub-Outcomes ('Is it working?') The Sub-Outcome monitoring themes highlight the key components of each Sub-Outcome and provide the structure for evaluating progress. Indicators will include metrics of, for example: exposure risk of key infrastructure, disruption to services, and satisfaction level of service users.

Monitoring the Outcome Monitoring at this high level will directly link the Outcome to wider government policy and the National Performance Framework by utilising relevant indicators already associated with these high-level monitoring frameworks.

National Performance Framework Indicators	Sustainable Development Goals Indicators
• Quality of public services • Journeys by active travel • Access to superfast broadband • Access to green and blue space	• Direct economic loss in relation to global GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters

Monitoring and Evaluation Structure: Outcome 4

Process Monitoring Themes

(What are we doing?)

- Improving monitoring to inform assessment and prioritisation
- Ensuring strategies are in place and the system has the flexibility and capacity to respond
- Improving maintenance and reliability
- Improving sustainability of resources and services
- Futureproofing and building for climate resilience
- Improving knowledge exchange and communication
- Identifying interdependencies

Sub-Outcome Monitoring Themes

(Is it working?)

- Exposure to climate hazards is prevented or minimised
- Impacts from exposure are reduced
- Recovery from climate impacts is improved
- The risk and impact of cascading failure is reduced

Sub-Outcomes

- 4.1 Scotland's reserved supporting systems are resilient to climate change
- 4.2 Scotland's devolved infrastructure is resilient to climate change

Outcome

Our society's supporting systems are resilient to climate change

UK Climate Change Risk Assessment: Associated Risks

The UK Climate Change Risk Assessment risks that will be addressed by the policies presented in Outcome 4 are set out below:

In1: Risks of cascading failures from interdependent infrastructure networks	**In2:** Risks to infrastructure services from river, surface water and groundwater flooding	**In3:** Risks to infrastructure services from coastal flooding and erosion
In4: Risks of sewer flooding due to heavy rainfall	**In5:** Risks to bridges and pipelines from high river flows and bank erosion	**In6:** Risks to transport networks from slope and embankment failure
In7: Risks to hydroelectric generation from low or high river flows	**In8:** Risks to subterranean and surface infrastructure from subsidence	**In9:** Risks to public water supplies from drought and low river flows
In10: Risks to electricity generation from drought and low river flows	**In11:** Risks to energy, transport and ICT infrastructure from high winds and lightning	**In12:** Risks to offshore infrastructure from storms and high waves
In13: Risks to transport, digital and energy infrastructure from extreme heat	**In14:** Potential benefits to water, transport, digital and energy infrastructure from reduced extreme cold events	**PB2:** Risks to passengers from high temperatures on public transport
PB13: Risks to health from poor water quality	**PB14:** Risk of household water supply interruptions	

Outcome 5: Our natural environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change

Image 5.1. Forsinard Flows Natural Nature Reserve (© Lorne Gill, SNH)

Outcome 5: Our natural environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change

Introduction

Scotland's natural environment is globally renowned. Many of our species and habitats are internationally important. Scotland's peatlands, mountain landscapes, coastal cliffs and seas, machair and diversity of woodland ecosystems are exceptional by European standards. They support a fantastic range of species, as well as being key assets for health and wellbeing. Unfortunately, our species and habitats are currently under threat, facing the twin challenges of climate change and biodiversity loss.

Where We Are Now

Scotland's first Climate Change Adaptation Programme (SCCAP) had a strong focus on protecting Scotland's much loved natural environment. Adaptation has been firmly embedded within the core work of the wider public sector, including a long track record at Scottish Environment Protection Agency (SEPA), Scottish Natural Heritage (SNH), Scottish Forestry (SF), Historic Environment Scotland (HES) and Marine Scotland (MS).

SNH has developed a suite of eight Adaptation Principles which contribute to natural environment climate change adaptation work. SNH uses these principles in land management and advice improving understanding of the effects of climate change on species and habitats. The Principles complement our Sub-outcomes.

SNH Adaptation Principles – Helping Nature Adapt to Climate Change

1. Reduce other pressures on ecosystems, habitats and species – e.g. pollution, unsustainable use, grazing, habitat fragmentation and invasive non-native species.

2. Make space for natural processes including geomorphological, water and soil processes, and species interactions.

3. Enhance opportunities for species to disperse by reducing fragmentation and increasing the amount of habitat available.

4. Improve habitat management where activities such as grazing, burning or drainage cause declines in diversity or size of species populations, or where modifying management or increasing habitat diversity could improve resilience to climate change.

5. Enhance habitat diversity, e.g. by varying grazing or plant cutting management on grassland or moorland, or creating new habitats on farms.

6. Take an adaptive approach to land and conservation management e.g. by changing objectives and management measures in response to new information.

7. Plan for habitat change where assessments indicate losses of habitats or species are inevitable, for example as a result of sea-level rise.

8. Consider translocation of species in circumstances where assessments indicate the likely loss of a species despite new management measures, and where there are suitable areas for nature to adapt.

The following diagram outlines the structure of the natural environment chapter. It is set out by Sub-Outcome providing further detailed policies which follow an ecosystem services approach.

Outcome 5: Our natural environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change – policies and research

Cross-cutting Policies

- Scottish Biodiversity Strategy and Route Map to 2020
- Scotland's Forestry Strategy 2019 - 2039
- Land Use Strategy
- National Planning Framework
- Ecological Resilience

5.1 Scotland's biodiversity, ecosystems and landscapes are adaptable to the changing climate

5.1.1 Regulating Ecosystem Services

- Enhancing Environmental Benefits
- Scotland's National Peatland Plan
- Peatland Restoration Grants
- Protected Species: Beavers
- Pollinator Strategy for Scotland 2017-2027
- Biodiversity Challenge Fund
- River Basin Management Plans
- Building with Nature: the Eddleston Water Project
- Expanding Forests and Woodlands
- River Temperatures are Rising

5.1.2 Supporting Ecosystem Services

- Adaptability and Resilience of Forests and Woodlands
- Ensuring Sustainable Management of Forests and Woodlands
- Proposal: Protected Areas
- Increasing Resilience of Threatened Native Species
- Pests and Diseases
- Soil Health

5.2 Scotland's natural environment and its contribution to wider societal adaptation is enjoyed, valued and maintained

5.2.1 Provisioning Ecosystem Services

- Green Infrastructure Fund
- Walking and Cycling Network
- A More Active Scotland: Scotland's Physical Activity Delivery Plan
- Our Natural Health Service Programme
- Enhancing Environmental Benefits

5.2.2 Cultural Ecosystem Services

- Engagement in Woodland Creation and Forest Management
- Proposal: National Nature Reserves

5.2.3 Understanding and Recognition

- Outdoor Learning in Nature
- Proposal: National Monitoring Strategy

Key

- Policy also found under another Outcome
- Policy also found under another Sub-Outcome
- Policy
- Research

Natural Environment Sub-Outcomes

People derive a wide range of benefits from the natural environment. Ecosystem services are the direct and indirect contributions of ecosystems to human well-being. Ecosystem services are vital to society, the economy and the functioning of our natural systems. They are typically split into four categories: provisioning, regulating, supporting and cultural, as shown in Figure 5.1 below.

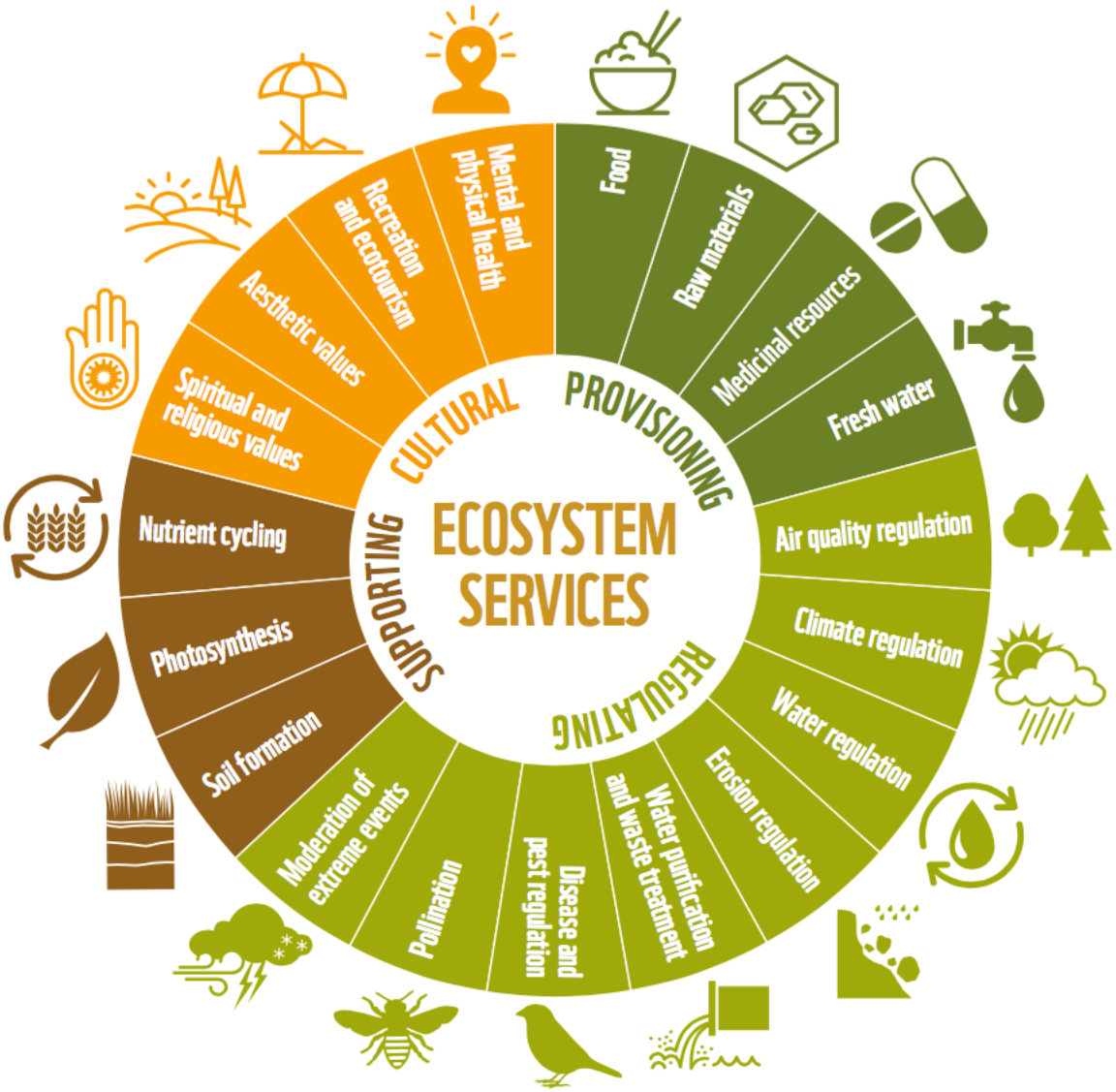


Image 5.2. Types of Ecosystem Services (© WWF)

Provisioning services are the products obtained from ecosystems. Regulating services are the benefits we obtain from the regulation of ecosystem processes. Cultural services are the nonmaterial benefits that people obtain from ecosystems, while supporting services are those that are necessary for the production of all other ecosystem services.

The intent of using an ecosystem services approach is to provide a framework for understanding and beginning to value all of the varied benefits that we receive

from the natural environment, be it direct or indirect. When we have a better understanding of the value of nature, we are more likely to treat it with proper care. Additionally, ecosystem services allow us to see how the natural environment functions within wider systems and how important these systems are to our everyday lives.

Considering an ecosystem services approach, the four types of services have been split across three sub-outcomes. The regulating and supporting services are considered under Sub-Outcome 5.1; the cultural services are considered under Sub-Outcome 5.2, while the provisioning services are being considered under the economy outcome in Sub-Outcome 3.1.

Cross-Cutting Policies

The following policies relate to the whole of the Outcome. As they are higher level strategies and include many diverse policies and themes, they affect multiple Sub-Outcomes. Some of the key individual policies within these strategies have been drawn out further below.

Scottish Biodiversity Strategy and Route Map to 2020

The original strategy – Scotland's Biodiversity: It's in Your Hands – was published in 2004. In 2013, it was supplemented by the 2020 Challenge for Scotland's Biodiversity. The two documents together now constitute the Scottish Biodiversity Strategy. Further focus is provided in the 2015 Route Map to 2020.

The 2020 Challenge for Scotland's Biodiversity sets out the major steps needed to improve the state of nature in Scotland.

It aims to:

- protect and restore biodiversity on land and in our seas, and to support healthy ecosystems,
- connect people with the natural world, for their health and well-being, and to involve them more in decision making,
- maximise the benefits for Scotland of a diverse natural environment and the services it provides, contributing to sustainable economic growth.

The main elements delivering adaptation include:

- enhancing ecosystem resilience through targeted habitat expansion, restoration and management at a landscape scale (including green networks in/around settlements), with an adaptive approach embedded – Route Map Big Steps 1, 4 and 5,
- targeted investment into elements of our natural capital, such as peatlands, that can contribute most to the resilience of society and economy – Route Map Big Step 2,
- enhancing the capacity and confidence of communities, especially the most disadvantaged, through increased engagement with nature and recognition of its benefits for people – Route Map Big Step 3,
- maximising the resilience of the marine environment by reducing pressures, and planning in advance for adaptation at the coast using healthy habitats to protect assets. – Route Map Big Step 6.

To further support this, SNH manage a challenge fund promoting practical conservation and partnership working across Scotland.

Timeline:	**Owners:**
To 2020	Scottish Government and SNH

Scotland's Forestry Strategy 2019-2029

Woodlands cover around 19% of land in Scotland (Forestry Statistics 2018) and deliver a wide range of benefits, including environmental benefits that contribute to improvements in our quality of life, including our air, biodiversity, water, soil, geological resources and land. Scotland's Forestry Strategy presents the Scottish Government's 50-year vision for Scotland's forests and woodlands and sets out a 10-year framework for action. It has the principle of sustainable forest management at its core and recognises the need for better integration of forestry with other land uses and businesses, reinforcing the principle of 'the right tree, in the right place, for the right purpose'.

The Strategy supports the delivery of existing forestry commitments, such as the woodland creation and wood product use in construction targets expressed in the *Climate Change Plan*, and the native woodland and protected sites targets expressed in *Scotland's biodiversity: a route map to 2020*.

It aims to:

- increase the contribution of forests and woodlands to Scotland's sustainable and inclusive economic growth,
- improve the resilience of Scotland's forests and woodlands and increase their contribution to a healthy and high quality environment,
- increase the use of Scotland's forest and woodland resources to enable more people to improve their health, well-being and life chances.

The Scottish Government will publish an implementation plan for the Forestry Strategy by April 2020 (one year after the Strategy was laid in Parliament).

More information on this strategy can be found in Section 3.1.2.

Timeline:	**Owners:**
2019-2029	Scottish Government (Scottish Forestry)

Land Use Strategy

The strategy will encourage the development of place based partnerships for delivering integrated and sustainable land use at a local, catchment or landscape scale.

More detailed information on this strategy can be found in Section 3.1.1.

National Planning Framework	
A 'natural, resilient place' is a core theme of Scotland's long term vision for spatial development, set out in the National Planning Framework 3, published in 2014, and is supported by Scottish Planning Policy, published in 2014. The Planning (Scotland) Act 2019 is clear that the next National Planning Framework must be prepared with a view to contributing to six outcomes including securing positive effects for biodiversity. It must also be prepared with regard to a number of Scottish Government strategies including the Land Use Strategy.	
Timeline: Ongoing	**Owners:** Scottish Government

Learning By Doing: Understanding and Managing for Ecological Resilience

Our natural environment is facing threats from a range of environmental drivers, including climate change, invasive non-native species, novel pests and diseases, over-exploitation, and pollution. It is difficult to predict exactly how nature will respond to these drivers and to tailor management solutions precisely to each threat. An alternative approach is to try to understand what makes species and ecosystems generally more resilient, and to develop management plans which aim to enhance resilience. The James Hutton Institute have been working along this pathway from trying to understand the underlying processes and properties that make ecosystems resilient, to exploring how this knowledge might be implemented in site management planning to help increase the resilience of our natural heritage, helping conserve nature despite the rapidly-changing environment in which we are currently living.

Research

Sub-Outcome 5.1: Scotland's biodiversity, ecosystems and landscapes are adaptable to the changing climate

This Sub-Outcome relates to the policies that help with the adaptation of regulating and supporting ecosystem services. Helping nature to adapt will in turn provide us with benefits such as clean water, flood risk management, biodiversity and carbon storage. We must consider the resilience of wildlife, habitats and ecosystems to adapt to our changing climate. Building ecological resilience to address risks to species and habitats is one of the key recommendations of the Climate Change Risk Assessment 2017.

Cross-Cutting Policies

Forestry Strategy: Enhancing Environmental Benefits

Scotland's Forestry Strategy 2019-2029 identified six priority areas for action. These form the framework for Government and partnership working.

One of the priority actions identified was: 'Enhancing the environmental benefits provided by forests and woodlands'.

This will be achieved (in part) by:

- supporting and enabling design and management of forests and woodlands to increase their positive impacts on air, water, soils, biodiversity and landscapes,
- supporting the management of forests and woodlands to provide natural flood management and shelter for livestock.

Timeline:	**Owners:**
An implementation plan for the Forestry Strategy will be published by April 2020	Scottish Government (Scottish Forestry)

5.1.1 Regulating Ecosystem Services

Regulating services are those that regulate ecosystem processes. These services include natural flood management, carbon sequestration, erosion control, pollination, water and air purification, and climate regulation. The following policies address the protection and support related to regulating services.

Scotland's National Peatland Plan

Scotland's National Peatland Plan, published in 2015, highlights how important peatlands are to Scotland. It proposes building on existing initiatives to secure their sustainable use, management and restoration. Only with wide support can we ensure that our peatlands are managed as a national asset that benefits society as a whole. The National Peatland Plan also sets out some proposals for research and for raising awareness. The National Peatland Group, chaired by SNH, promotes the plan and supports its implementation.

Timeline:	**Owners:**
Published in 2015	Scottish Government and SNH

Peatland Restoration Grants	
Restoration helps peatland and its valuable biodiversity adapt to climate change. That in turn provides us with adaptation benefits including reducing flood risk and soil erosion, and improving water quality. We will support an increase in the annual rate of peatland restoration, from 10,000 hectares in 2017-2018 to 20,000 hectares per year thereafter. We are providing grant funding to support eligible land managers to deliver peatland restoration. This will enable at least 20,000 hectares of peatland restoration per year from 2018-19. Public sector action will be led by SNH through the Peatland Action initiative. In addition to providing support and advice, this will offer financial support to peatland restoration projects initiated by individual land managers. Experience from the Peatland Action Initiative to date demonstrates significant interest in restoration projects.	
Timeline: Ongoing	**Owners:** Scottish Government and SNH

Image 5.3. Peatland Restoration, Flanders Moss National Nature Reserve (© Lorne Gill, SNH)

Protected Species: Beavers

Beavers are protected by law as a European Protected Species. This protection came into force on 1st May 2019 with the view from the Scottish Government that the species should be allowed to expand its range naturally. This decision will see the return of a species that was part of our wildlife for thousands of years before becoming extinct here around the 16th century.

Beavers benefit nature and could assist our ecosystems adapt to the changing climate. As 'ecosystem engineers' their activities can create wetland habitats, improve habitat structure and diversity and enhancing biodiversity. They can also alleviate flooding, improve water quality and bring socio-economic benefits.

A Management Framework for Beavers in Scotland has been published on the Scottish Natural Heritage website.

Timeline:	**Owners:**
Ongoing	Scottish Government, SNH

Pollinator Strategy for Scotland 2017-2027

The Pollinator Strategy sets out how Scotland can continue to be a place where pollinators thrive, along with actions that are needed to help achieve that objective. It encourages the use and development of wildflower meadows, living walls, green roofs and bee hotels, as well as projects which tackle habitat fragmentation and increase 'stepping stone' opportunities for pollinators. Resilient populations of pollinators will greatly help our nature and agriculture adapt to climate change.

Timeline:	**Owners:**
2017-2027	SNH

Image 5.4. Glasdrum National Nature Reserve (© Lorne Gill, SNH)

Biodiversity Challenge Fund	
Announced in the 2018-19 Programme for Government, funding of around £1.8 million has been offered to 14 projects that will help Scotland meet its Aichi targets on reducing habitat loss, tackling invasive species, helping ecosystems vulnerable to climate change, and supporting sustainable agriculture, aquaculture and forestry.	
Timeline: Up to £1 million of investment available for 2019-20	**Owners:** SNH

River Basin Management Plans	
River Basin Management Plans detail Scotland's objectives and action programmes for protecting and improving the water environment. There are two River Basin Management Plans: one covering the Scotland River Basin District; and the other cross border for the Solway Tweed River Basin District. Climate change will increasingly affect demands on water resources, the ability of the water environment to accommodate water use, the pattern of land use and the ability of non-native species to spread. As part of Scotland's river basin planning work over the period to 2027, work will be undertaken to improve understanding of when and where there will need to be action to manage these effects. Climate change thinking is integrated into any improvement measures that are used to address pressure on the water environment in each river basin district. Each improvement measure is considered through the lens of preparing Scotland for a future climate, and how effective the measure will be under a changed climate. This combines the potential impacts of an action on flood risk, drought and ecosystem services while also considering whether the action will need to be adapted for a future climate. More information on Scotland's River Basin Management Plans can be found here.	
Timeline: 12-year period covering objectives for 2015-2027	**Owners:** Scottish Government, SEPA, Scottish Water

Building with Nature: the Eddleston Water Project

Building with Nature is an EU Interreg project to gather evidence to support working with natural processes to manage flood risk and coastal erosion, whilst enhancing ecosystem services. The Eddleston Water project, which is managed by the Tweed Forum, is one of the catchment projects monitoring the impacts of wetlands, woodlands, ponds and leaky barriers on flood risk in the catchment and downstream to Peebles.

The Eddleston Water project aims to assess the benefits of working with natural processes across a catchment to help manage flood risk and improve the status of the river. An extensive monitoring network has been set up to collect evidence to support the use of measures such as woodland planting and floodplain reconnection for flood management.

More information on this policy can be found in Section 7.2.

Timeline:	**Owners:**
To June 2020	Scottish Government, Tweed Forum, SEPA

Forestry Strategy: Expanding the Area of Forests and Woodlands

Scotland's Forestry Strategy 2019-2029 identified six priority areas for action over the following ten years. These priority areas form the framework for co-ordination of Government and partnership working.

One of the priority actions identified was: 'Expanding the area of forests and woodlands, recognising wider land-use objectives'.

This priority will help deliver the forestry targets set out in *The Climate Change Plan* to increase woodland cover to 21% of the total area of Scotland by 2032, using a stepped increase in woodland creation to 15,000 hectares from 2024-25.

In doing so, we will help to grow Scotland's carbon sink and reduce greenhouse gas emissions.

Timeline:	**Owners:**
An implementation plan for the Forestry Strategy will be published by April 2020	Scottish Government (Scottish Forestry)

River Temperatures are Rising

Sustaining cool river temperatures in Scotland is essential for salmonid habitat and health. It is also critical for sport fishing (contributing around £113 million per year to the Scottish rural economy) and whisky production. Long-term monitoring in the River Spey identified a 2 degree increase in the river temperature over the past 105 years. This could mainly be explained by increasing air temperature and less snow melt. This will inform action to make rivers more resilient to future change through the implementation of adaptation measures at a catchment scale. Practical guidance in the form of a factsheet and short film were produced to raise awareness and inform policy and practice.

Research

5.1.2 Supporting Ecosystem Services

Supporting services describes those which are necessary for the production of all other services. They differ from other services as their impacts tend to be more indirect to humans or occur over a long period of time. Some examples of supporting services are nutrient cycling, photosynthesis, soil formation, habitat provision and biodiversity. Helping these services to adapt, in turn helps to ensure the adaptation of the other types of ecosystem services.

Forestry Strategy: Adaptability and Resilience of Forests and Woodlands

Scotland's Forestry Strategy 2019-2029 identified six priority areas for action over the following ten years. These priority areas form the framework for co-ordination of Government and partnership working.

One of the priority actions identified was: 'Increasing the adaptability and resilience of forests and woodlands'.

This priority recognises the importance of safeguarding the ability of Scotland's forests and woodlands to provide a wide range of benefits to current and future generations. Given the degree of uncertainty about future environmental, ecological, economic and social conditions, relative to the lifespan of Scotland's trees, the Government's approach will be to support and enable improvements to the adaptability and resilience of Scotland's forests and woodlands.

This will be achieved by:

- Improving the understanding of the threats to Scotland's forests and woodlands and potential mitigating actions, through education, research, surveillance and the development of new techniques.
- Managing for, and mitigating against, the threats posed by tree pests and diseases through biosecurity measures and contingency planning.
- Supporting forest design and silvicultural actions which increase the capacity of forests and woodlands to adapt to, and thrive in, a changing climate.
- Maintaining and enhancing biodiversity, in particular by using the recruitment of natural regeneration and improving mitigation of the risks posed by invasive non-native species, deer and other herbivores.

Timeline:	**Owners:**
An implementation plan for the Forestry Strategy will be published by April 2020	Scottish Government (Scottish Forestry)

Forestry Strategy: Ensuring Sustainable Management of Forests and Woodlands	
Scotland's Forestry Strategy 2019-2029 identified six priority areas for action over the following ten years. These priority areas form the framework for co-ordination of Government and partnership working. One of the priority actions identified was: 'Ensuring forests and woodlands are sustainably managed. As a cornerstone of activity under the Forestry and Land Management (Scotland) Act (2018), Scottish Government will maintain and enhance Scotland's forest and woodland resources for the benefit of current and future generations. This will be achieved by: • maintaining and promoting the UK Forestry Standard as the benchmark of good forestry practice, and assessment of the quality of forest and woodland expansion proposals and forest management plans, • further developing our shared understanding of the application of sustainable forest management principles in a Scottish context.	
Timeline: An implementation plan for the Forestry Strategy will be published by April 2020	**Owners:** Scottish Government (Scottish Forestry)

Proposal: Protected Areas	
Protected Areas will promote an ecological network approach and improved health of protected sites through collaboration. This will improve the resilience of species and habitats in protected sites, as well as wider populations and ecosystems to climate change and related pressures.	
Timeline: Ongoing	**Owners:** SNH

Case Study 6: Cairngorms Connect

Cairngorms Connect is a partnership of neighbouring land managers, committed to a bold and ambitious 200-year vision to enhance habitats, species and ecological processes by working together across a vast area of the Cairngorms National Park.

Large Scale Habitats

The effects of climate change will be most significant where habitats such as forests or peatlands are small. Where habitats are extensive - as in the Cairngorms Connect area - the impact of individual incidents of fire, flood, disease, and wind-throw of trees is less than in smaller areas of forest or peatland.

Woodland Management

Increasing the biodiversity and health of our native woodland will increase its resilience to the changing climate. Through managing herbivore impacts, eradication of non-native trees and shrubs where appropriate and planting of tree species that have been lost from our native woods the partnership will improve pinewood biodiversity and ecosystem health.

Woodland Expansion to its Natural Limit

Climate change may make parts of our forests unsuitable for some species. By extending forests higher up the hills, we can create new or alternative 'niches', providing homes for wildlife displaced by climate change. In expanding forests we also increase water uptake and because trees create a 'rougher' catchment, slow the water flow.

Peatland Restoration

As well as being an important way of capturing and storing atmospheric carbon, functioning blanket bogs play an important role in holding water high in the catchment. Eroded blanket bog has deep channels through which water rushes into rivers, contributing to flood risk. Restored bog has pools and Sphagnum mosses that hold water, and intact peat functions as a huge sponge to hold water. All of this helps to slow movement of water into the lower catchment, reducing flood risk.

Image 5.5. Creag Meagidh National Nature Reserve (© Lorne Gill, SNH)

Case Study 7: Building a Fire Resilient Landscape

Climate Change is having a significant effect on the number, size and duration of wildfires in Scotland. We are seeing more extreme fire behaviour and have had a steady increase in the number of wildfires and area of ground burned. The combination of longer warmer summers, colder drier winters and an increased fuel load is providing a challenging set of circumstances. In 2018 Scotland had the largest area burned due to wildfire anywhere in Europe, and already in 2019 the UK has had more wildfires over 25 hectares than the total in 2018, with 17000 hectares burned so far (18000 hectares in 2018). (European Forest Fire Information System)

The Scottish Fire and Rescue Service has contributed to the recent review of the Muirburn Code and supports the safe and planned use of Muirburn by Land Managers to control the fuel loads on Scotland's hills and moorland. We also recognise that there are other land management techniques that do not use burning, such as cutting, re-wetting peatbog areas, and using grazing to control the fuel, and while they may not be as effective at reducing the availability and quantity of fuel they are valid and appropriate.

Controlling the fuel loading on the hillsides is essential to ensure that uncontrolled wildfires do not continue to destroy huge areas of land. Muirburn does just this and has been used for centuries in Scotland as a land management technique. The techniques used by Land Managers to carry out Muirburn can also be used during wildfires to control the size and direction of the fires, and as a tool to reduce the number of firefighters required to extinguish the blaze.

By working with Land Managers during the Muirburn season there are opportunities to use prescribed burning to create tactically located firebreaks and protection for vulnerable areas such as windfarms and water catchment areas as well as sites of Special Scientific or Historical Interest. This technique is used extensively in other parts of the World by Fire Services and Land Managers as a preventative measure against the risk of Wildfires. By controlling the fuel in such a way it is possible to reduce the intensity of wildfires which occur, and provide safe areas that firefighting operations can be mounted from.

Building a fire resilient landscape is a key theme in both the international Wildfire community, and in the work being encouraged by the Scottish Wildfire Forum. Land Managers should be encouraged to carry out fire risk assessments for the estate/forest they are responsible for and make provision in the form of fire breaks, access points, availability of water supplies and suitable training. All of these measures are becoming more important as the climate changes and our wildfire season expands as a result.

SFRS is developing a strategy which will ensure that it has the right resources in the right place at the right time to fight wildfires.

Increasing the Resilience of Threatened Native Species

The distribution of many of Scotland's native species has been reduced over time through multiple pressures, including over-grazing, the effect of invasive species and air pollution. Research has shown how species in small and isolated populations will be less able to cope with climate change because of lower genetic diversity and reduced fitness. To increase species resilience, and to help deliver Scotland's Biodiversity Strategy, we have carried out experimental translocations – such as for the Schedule 8 plant 'alpine blue sow-thistle' in the Cairngorms National Park, and the temperate rainforest lichen 'lungwort' in the Loch Lomond and Trossachs National Park. These experiments provide robust evidence for translocation best practice, contributing to landscape-scale initiatives including delivery of the Cairngorms Nature Action Plan and the Atlantic Woodland Alliance Strategy.

Research

Pests and Diseases

Numerous pests continue to threaten our borders. While some may thrive in our climate, others will be limited. Having identified the main threats, including *Xylella fastidiosa* and *Ips typographus*, research is now developing tools to model the future spread, survival and infection rates of such threats, working with international partners who may already have the pest or disease and the associated outbreak data. Through national mapping of the plant hosts and vector species associated with these threats, it will be possible to better understand their potential distribution under different climate scenarios, and this information can be included in the Scottish Biodiversity Strategy. To complement this, an online plant health resource tool for the natural environment has been developed, which includes information on the likelihood of threats to Scotland and the role of climate on these threats.

Research

Soil Health

Soils are severely impacted by climate change but there is currently insufficient data and metrics to assess their vulnerability to climate change. This has been raised in both Independent Assessments of the first SCCAP carried out by the Committee on Climate Change. Building on a recent report by CXC for the Scottish Government on the institutional governance for soil in Scotland, a new research project will look across the metrics and policy issues to establish a framework for soil health.

Future Research

Sub-Outcome 5.2: Scotland's natural environment and its contribution to wider societal adaptation is enjoyed, valued and maintained.

Helping our natural environment adapt also helps sustain us in many less tangible ways. Our natural environment contributes to our health and wellbeing, enjoyment of the outdoors, sense of place and who we are as a nation. The policies under this Sub-Outcome help to ensure that the contributions of the natural environment to culture are understood, enjoyed and maintained.

5.2.1 Provisioning Ecosystem Services

Provisioning services are the products that are obtained from ecosystems, such as: food, timber, fresh water, medicinal resources and raw materials. They are tied to the concept of natural capital which is a country's stock of natural resources and environmental assets including plants, animals, air, water, soils and minerals. Scotland's natural capital is a source of significant international competitive advantage, and its continuing health and improvement is fundamental to sustainable economic growth. These services are considered in Sub-Outcome 3.1.

5.2.2 Cultural Ecosystem Services

Cultural services are the more intangible benefits that people receive from ecosystems. They include mental and physical health and well-being, recreation, tourism, aesthetic values, spiritual and religious values, cultural heritage and sense of place. The policies in this section connect people better with the natural environment that surrounds them, and in doing so, help them receive the most benefits from the cultural ecosystem services. By connecting more to the natural environment, we are more likely to protect it, and therefore, support the ability of the natural environment to adapt to climate change.

Image 5.6. Noss National Nature Reserve (© Lorne Gill, SNH)

Forestry Strategy: Engagement in Woodland Creation and Forest Management

Scotland's Forestry Strategy 2019-2029 identified six priority areas for action over the following ten years. These priority areas form the framework for co-ordination of Government and partnership working.

One of the priority actions identified was: 'Engaging more people, communities and businesses in the creation, management and use of forests and woodlands'.

This will be achieved (in part) by:

- supporting the provision of more opportunities for children to play and learn in forests and woodlands, particularly in urban areas,
- increasing the use of forests and woodlands to improve people's health and well-being,
- providing more opportunities for urban and rural communities to influence the decisions affecting the local forests and woodlands, including through increased community ownership,
- encouraging a more diverse range of people to value and use forests and woodlands, particularly those close to where they live.

Timeline:	**Owners:**
An implementation plan for the Forestry Strategy will be published by April 2020.	Scottish Government (Forestry Scotland)

Green Infrastructure Fund

The green infrastructure fund aims to improve Scotland's urban environment by increasing and enhancing greenspace in our towns and cities, especially close to areas of multiple deprivation.

More information on this fund is included in Section 1.2.1.1.

Walking and Cycling Networks

This network will close key gaps, upgrade connecting routes, link to public transport and promote shared use of paths to encourage active travel and enjoyment of Scotland's natural landscapes. Stronger walking and cycling networks diversify the transport system, providing additional options for travel in the event of weather related disruption. Changes to Scotland's climate may support this programme as leisure and other outdoor activities may be taken up by people as the climate warms, and active travel and recreation become more accessible.

The Strategic Transport Projects Review will include the National Walking and Cycling Network, the National Cycle Network, and other strategic walking and cycling networks on local and trunk roads.

Timeline:	**Owners:**
Consider a further phase of work as part of the review of the National Planning Framework.	Transport Scotland, SNH, Sustrans and Scottish Canals

A More Active Scotland: Scotland's Physical Activity Delivery Plan

The Physical Activity Delivery Plan sets out actions to encourage and support people in Scotland to be more active, more often.

More information on this policy can be found in Section 2.2.2.1.

Our Natural Health Service Programme

The Natural Health Service supports the health sector to embrace green exercise as part of policy and practice. This will see nature-based health programmes used as part of health promotion and improvement, and encourage healthier lifestyle behaviours.

More information on this policy can be found in Section 2.2.2.1.

Forestry Strategy: Enhancing Environmental Benefits

Scotland's Forestry Strategy 2019-2029 identified six priority areas for action. These form the framework for Government and partnership working.

One of the priority actions identified was: 'Enhancing the environmental benefits provided by forests and woodlands'.

More information on this policy can be found in Section 5.1.1.

Proposal: National Nature Reserves	
The application of a natural capital approach on SNH reserves aims to better communicate the socio-economic values of nature, including its role in supporting climate change adaptation. SNH uses their National Nature Reserves to test, refine and demonstrate climate change adaptation in practice, monitoring their work to understand which adaptation methods work best in different situations. Specific areas of adaptation work include: • sea level rise and the benefits afforded by coastal habitats that can move and change, • reducing other pressures, for example, reversing water pollution, • making space for natural processes, such as forest to bog restoration, • enhancing opportunities for species to disperse, • improving habitat management, • managing Scotland's pinewoods, • considering species translocation. More information about these areas of adaptation work can be found here.	
Timeline: 2019: complete a pilot application of a natural capital approach on SNH reserves. 2020: complete an audit of all National Nature Reserve management plans to identify potential for enhanced and new contributions to adaptation.	**Owners:** SNH (other National Nature Reserve Partnership bodies could be involved)

Case Study 8: Considering Translocation

Learning Lessons from Lichens at Creag Meagaidh National Nature Reserve

As our climate changes, species are moving in order to track their preferred conditions. Species' ranges are often climate-influenced and have tracked previous climatic fluctuations in the past. However, the current rate of climate change combined with habitat fragmentation in many locations means there is a gap between the necessary rate of range shifting and the actual ability of species to move. As a result, many species may become stranded, as they are unable to relocate and may eventually be lost.

A five year project is underway at Creag Meagaidh National Nature Reserve to test the feasibility of physically moving some samples of the lichen species *Flavocetraria nivalis* from the high Cairngorms into Creag Meagaidh. Although the Creag Meagaidh sits outside the lichen's climatic range, this project aims to find pockets of suitable habitat, while also highlighting the risks associated with this climate change adaptation measure, known as 'assisted colonisation'.

5.2.3 Understanding and Recognition

Using an ecosystem services approach provides a framework for understanding and recognising the value of all the benefits we receive from the natural environment. We are more likely to care for nature if we have a good understanding of its value. More than just understanding the value of nature, it is also important that we understand our connection to it. As humans, we are also part of ecosystems. We are not separate from nature but part of it. Related to this, it is important that we also recognise the intrinsic value of nature. Our natural systems are valuable not just because of their connection to us as humans, but for its own sake as well. The policies under this sub-outcome help to build our understanding and recognition of the natural environment.

Forestry Strategy: Engagement in Woodland Creation and Forest Management

Scotland's Forestry Strategy 2019-2029 identified six priority areas for action over the following ten years. These priority areas form the framework for co-ordination of Government and partnership working.

One of the priority actions identified was: 'Engaging more people, communities and businesses in the creation, management and use of forests and woodlands'.

More information on this policy can be found in Section 5.2.2.

Outdoor Learning in Nature

Learning in Greenspace is working with 100 schools serving disadvantaged communities to improve local greenspace for regular outdoor learning and play. The Teaching in Nature programme will enable teachers to take teaching outdoors.

Learning outdoors has been shown to increase attainment, improve physical health, social interactions, develop risk taking skills and supports emotional wellbeing. Spending time in nature increases an understanding of its relevance and can help embed a life-long commitment to its care.

Timeline:	**Owners:**
To 2024, 100 greenspaces to be improved and regularly used for outdoor learning and play.	SNH, Local Authorities

Proposal: National Monitoring Strategy	
Supporting long term initiatives that encourage citizen science and their use in helping to detect and increase awareness of the effects of climate change on the natural environment. This information is important in supporting decisions on adaptive management.	
Timeline: Ongoing	**Owners:** SNH

Proposal: National Nature Reserves
The application of a natural capital approach on SNH reserves aims to better communicate the socio-economic values of nature, including its role in supporting climate change adaptation. More information on this proposal can be found in Section 5.2.2.

Image 5.7. Mar Lodge Estate National Nature Reserve (© Lorne Gill, SNH)

Adaptation Behaviours

The adaptation behaviours outlined below help individuals and organisations to adapt to a changing climate. They also provide opportunities to provide climate adaptation functions. Actions to create and improve greenspace act at both individual and organisational levels. They increase opportunities for people to engage with nature as well as producing multiple environmental benefits.

Individual Behaviours

1. Individuals are encouraged to check the weather forecast regularly and be prepared. For example, by having plenty of water and seeking shade on hotter days.

2. Increasing or maintaining greenspace can have benefits for adaptation. Greenspace increases surface water drainage, and encourages pollinators like bees. The Royal Horticultural Society (RHS) has created a document with advice on how to garden in a changing climate.

Societal Behaviours

1. Increasing greenspace. Organisations or businesses with access to outdoor space could consider converting it to greenspace by planting trees and wildflowers. Creating greenspace has many co-benefits including flood management and improvements in staff health and wellbeing.

2. Employee volunteering opportunities. Businesses could consider encouraging employees to take part in natural environment based volunteering. The Scottish Government fund Volunteer Scotland, a digital gateway for anyone looking for volunteering opportunities.

Monitoring and Evaluation: Outcome 5

Monitoring and Evaluation is integral to the outcomes-based approach which encourages consideration at all stages of adaptation policy development. Further information including a general introduction to the framework, and a description of the foundation and principles can be found in the monitoring and evaluation introduction and Annex 3 respectively.

Key sources of existing monitoring evidence for Outcome 5 include: Ecosystem Health Indicators, Scottish Biodiversity Indicators, Climate Change Plan indicators, and SEPA. There is currently limited data available for some themes, but by identifying what we need to measure not just what we know we can, the framework highlights monitoring gaps which will be filled as more data and associated monitoring arrangements are developed.

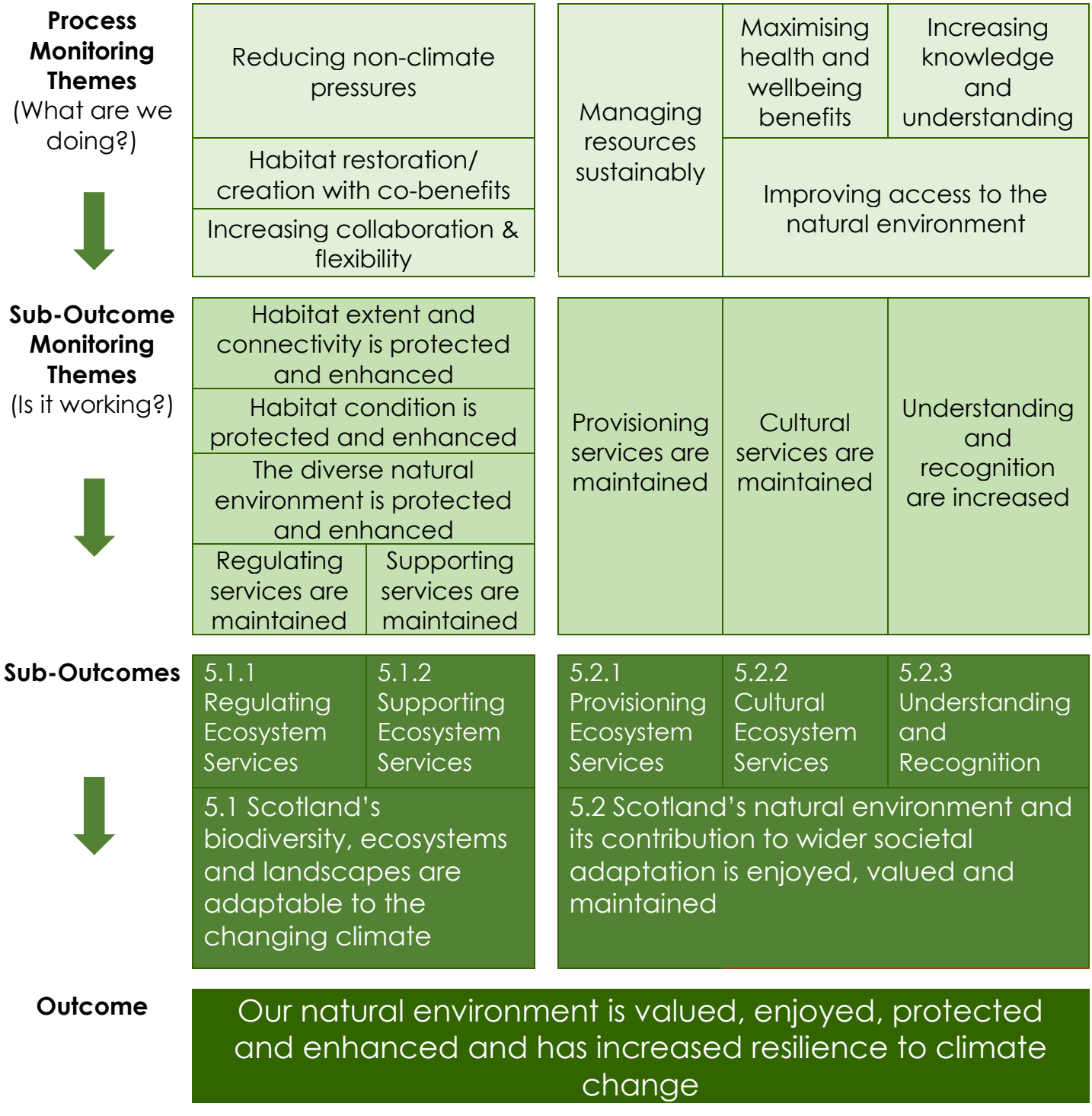
Monitoring the Adaptation Process ('What are we doing?') The themes set out the structure to monitor the implementation of and output from adaptation policies and actions which support the Outcome. Indicators will include metrics of, for example: usage levels of decision-support tools, habitat restoration, and sustainable resource management.

Monitoring the Sub-Outcomes ('Is it working?') The Sub-Outcome monitoring themes highlight the key components of each Sub-Outcome and provide the structure for evaluating progress. Indicators will include metrics of, for example: extent and condition of key habitats, biodiversity, and soil health.

Monitoring the Outcome Monitoring at this high level will directly link the Outcome to wider government policy and the National Performance Framework by utilising relevant indicators already associated with these high-level monitoring frameworks.

<table>
<tr><th>National Performance Framework Indicators</th><th>Sustainable Development Goals Indicators</th></tr>
<tr><td>• Natural capital
• Condition of protected sites
• Access to green and blue space</td><td rowspan="3">• Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas
• Coverage by protected areas of important sites for mountain biodiversity
• Proportion of land that is degraded
• Mountain Green Cover Index
• Red List Index
• Relevant national legislation and adequately resourcing the prevention or control of invasive alien species</td></tr>
<tr><th>Aichi Target indicators</th></tr>
<tr><td>• Progress towards Aichi targets</td></tr>
</table>

Monitoring and Evaluation Structure: Outcome 5



UK Climate Change Risk Assessment: Associated Risks

The UK Climate Change Risk Assessment risks that will be addressed by the policies presented in Outcome 5 are set out below:

Ne1: Risks to species and habitats due to inability to respond to changing climatic conditions.	**Ne2:** Opportunities from new species Colonisations.	**Ne4:** Risks to soils from increased seasonal aridity and wetness.	**Ne5:** Risks to natural carbon stores and carbon sequestration.	**Ne6:** Risks to agriculture and wildlife from water scarcity; and flooding.
Ne7: Risks to freshwater species from higher water temperatures.	**Ne9:** Risks to agriculture, forestry, landscapes and wildlife from pests, pathogens and invasive species.	**Ne10:** Risks to agriculture, forestry, wildlife and heritage from changes in frequency and/or magnitude of extreme weather and wildfire events.	**Ne14:** Risks and opportunities from changes in landscape character.	**PB3:** Opportunities for increased outdoor activities from higher temperatures.

Outcome 6: Our coastal and marine environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change

Image 6.1. Bass Rock (© Lorne Gill, SNH)

Outcome 6: Our coastal and marine environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change

Introduction

Scottish waters are a special place for marine habitats and wildlife, thanks to the unique combination of:

- our position at the edge of the European continental shelf,
- Scotland's long coastline and large area of sea,
- the mixing of warm Gulf Stream currents and cold currents.

Glacial activity created our highly intricate coastline, which includes around 800 islands mostly off the west and north coasts. At about 18,000 km long, our coastline would stretch from Scotland to Australia were all of its curves and creases straightened out.

Coastal habitats including sand dunes, cliffs, saltmarsh and saline lagoons are thus a very big part of the Scottish landscape. Machair is a remarkable living landscape that's unique to Scotland and Ireland.

Scotland's territorial seas are those found up to 12 nautical miles from the coast. They cover a total area of 90,404 km^2. Beyond these 12 miles and out to the limits of the Exclusive Economic Zone, which is the zone where Scotland claims exclusive rights to economic activities, are a further 371,859 km^2 of Scottish waters. Our waters combined total 462,263 km^2, approximately six times greater than the area of the Scottish mainland and islands added together.

Scotland's seas are positioned between subpolar and subtropical influences and support a spectacular and diverse range of habitats and species. There remains much to be discovered about Scottish marine wildlife, but current best estimates suggest there are tens of thousands of species, from microscopic plants and animals to seals, dolphins and whales.

Scottish seas and coasts also provide many socio-economic roles including fisheries and aquaculture.

Where We Are Now

Scotland's first Climate Change Adaptation Programme (SCCAP) had a strong focus on protecting Scotland's much loved natural environment. Adaptation has been firmly embedded within the core work of the wider public sector, including a long track record at the Scottish Environment Protection Agency, Scottish Natural Heritage, Scottish Forestry, Historic Environment Scotland and Marine Scotland.

Recent reports have found Scotland's coastal waters to be in good ecological condition. Targets to designate 10% of coastal waters as protected areas have already been met. As climate change increases pressures on our coastal and marine environments, it is important that we keep working to protect and support these areas, in order to protect this good ecological status.

Coastal erosion is another major factor of concern as the climate changes. Over time, the data on coastal change has significantly improved with Dynamic Coast: Scotland's National Coastal Change Assessment. In 2017, the Scottish Government launched phase 1 of its Dynamic Coast project, which quantified the coastal changes between the 1890s, 1970s and modern times. Erosion is expanding and quickening in some places. Consequential implications for designated sites, mitigation and adaptation plans are being considered by SNH. The second phase of Dynamic Coast, taking place from January 2018 to March 2020, is investigating the anticipated impact of climate change on future coastal change and erosion exacerbated flooding. Seven 'super sites' have also been identified, including St Andrews, Montrose and Skara Brae, where the project will forecast future change, anticipated damage, and develop mitigation and adaptation plans with stakeholders.

The Marine Climate Change Impacts Partnership (MCCIP) brings together scientists, policy makers, government agencies and NGOs to provide coordinated advice on climate change impacts and adaptation in our seas around our coast. Through MCCIP's Annual Report Cards, the understanding of marine climate change impacts is synthesised in an accessible and actionable way. In 2017, MCCIP published its 10-year report card which summarised our understanding of impacts. Marine Scotland and others have contributed to MCCIP's Climate Smart Working initiative. This new approach provides a way to explore the issues, challenges, opportunities and achievements in marine climate change adaptation, as well as communicating and celebrating the marine adaptation work that has been taking place in the UK. In 2018, through this project, some case studies were published on climate change and conservation features, including, seagrass, coastal lagoons, coral gardens, saltmarshes, maerl and sand eels as seabird prey. Marine Scotland and Scottish Natural Heritage are providing funding to MCCIP for 2018 – 2019. Both organisations will continue to participate on the MCCIP Steering Group and the Report Card Working Group, which will prepare the next UK marine climate change report cards this year.

The following diagram outlines the structure of the coastal and marine chapter. It is set out by Sub-Outcome providing further detailed policies which follow an ecosystem services approach.

Outcome 6: Our coastal and marine environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change – policies and research

Cross-cutting Policies

- Scottish Biodiversity Strategy and Route Map to 2020
- Scotland's National Marine Plan

6.1 Scotland's coastal and marine biodiversity, ecosystems and landscapes are adaptable to the changing climate

6.1.1 Regulating Ecosystem Services

- Farmed Fish Health Framework
- Dynamic Coast
- Building with Nature

6.1.2 Supporting Ecosystem Services

- Marine Protected Areas (MPA) Network and Monitoring Strategy
- Marine Litter Strategy for Scotland
- Managing Marine Invasive Non-Native Species (INNS)
- Marine Conservation Strategies

6.2 Scotland's marine and coastal environment and its contribution to wider societal adaptation is enjoyed, valued and maintained

6.2.1 Provisioning Ecosystem Services

6.2.2 Cultural Ecosystem Services

- Cultural ecosystem services are considered in Outcome 5.

6.2.3 Understanding and Recognition

- Scotland's Marine Atlas
- Monitoring Climate Change Impacts in Scottish Seas
- Marine Climate Change Impacts Partnership (MCCIP)
- Research on Vulnerabilities to Climate Change
- Crown Estate Scotland

Key

- Policy also found under another Outcome
- Policy also found under another Sub-Outcome
- Policy

Coastal and Marine Sub-Outcomes

Ecosystem services are the direct and indirect contributions of ecosystems to human well-being. Ecosystem services are vital to society, the economy and the functioning of our natural systems. They are typically split into four categories: provisioning, regulating, supporting and cultural services. Provisioning services are the products obtained from ecosystems. Regulating services are the benefits we obtain from the regulation of ecosystem processes. Cultural services are the non-material benefits that people obtain from ecosystems, while supporting services are those that are necessary for the production of all other ecosystem services. More information on ecosystem services can be found in Outcome 5.

Considering an ecosystem services approach, the four types of services have been split across three Sub-Outcomes. The regulating and supporting services are considered under Sub-Outcome 6.1; the cultural services are considered under Sub-Outcome 6.2, while the provisioning services are being considered under the economy outcome in Sub-Outcome 3.1.

Image 6.2. Isle of May National Nature Reserve (© Lorne Gill, SNH)

Cross-Cutting Policies

The following policies relate to the whole of the outcome. As they are higher level strategies and include many diverse policies and themes, they affect multiple sub-outcomes. Some of the key individual policies within these strategies have been drawn out further below.

Scottish Biodiversity Strategy and Route Map to 2020

The strategy and route map aim to protect and restore biodiversity and support healthy ecosystems.

More details on this strategy can be found in the Cross-Cutting Policies section of Outcome 5.

Scotland's National Marine Plan

Adopted on 25 March 2015, the Plan sets out how Scottish Ministers intend marine resources to be used and managed out to 200 nautical miles and applies to all decisions taken by public authorities that affect Scotland's marine area.

The Plan specifies High Level Marine (Strategic) Objectives and core General Policies which apply to all planning and decision making in the marine environment, supplemented by sector specific policies. Each sectoral chapter includes a section on adaptation.

Examples of objectives relating to climate change include:

- the use of the marine environment is spatially planned where appropriate and based on an ecosystems approach which takes account of climate change and recognises the protection and management needs of marine cultural heritage according to its significance (HLMO 18),
- marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change (GEN 5 Climate change),
- adaptive management practices should take account of new data and information in decision making informing future decisions and future iterations of policy (GEN 20).

The 1st review of the National Marine Plan was published in March 2018 in line with statutory duties. Scottish Ministers considered the Review Report and decided not to replace or amend the Plan. The review highlighted a number of areas of emerging activity, strategies and policy areas which will influence future Plan policy and content.

Timeline:	**Owners:**
The next review of the National Marine Plan should be published on or before 23 March 2021 for Scotland's offshore area and 23 March 2023 for the inshore area.	Scottish Ministers, but applies to all decisions taken by public authorities that affect Scotland's marine area.

Sub-Outcome 6.1: Scotland's coastal and marine biodiversity, ecosystems and landscapes are adaptable to the changing climate

This Sub-Outcome relates to the policies that help with the adaptation of regulating and supporting ecosystem services. Helping nature to adapt will in turn provide us with benefits such as clean water, flood risk management, biodiversity and carbon storage. We must consider the resilience of wildlife, habitats and ecosystems to adapt to our changing climate. Building ecological resilience to address risks to species and habitats is one of the key recommendations of the Climate Change Risk Assessment 2017.

6.1.1 Regulating Ecosystem Services

Regulating services are those that regulate ecosystem processes. These services include natural flood management, carbon sequestration, erosion control, climate regulation, and moderation of extreme events. The following policies address the protection and support related to the regulating services provided by Scotland's coastal and marine ecosystems.

Farmed Fish Health Framework

Scotland's Farmed Fish Health Framework includes a Climate Change and Ocean Acidification subgroup. The subgroup aims to monitor, review and assess the impact of climate change and ocean acidification on Scottish waters. This policy creates a framework to support the adaptation of marine aquaculture to climate change.

More details on this policy can be found in Section 3.1.3.

Dynamic Coast

Rising sea levels, increased coastal erosion and erosion-enhanced flooding will progressively impact Scotland's soft coastlines, its assets and communities. Our 'natural defences,' beaches and dunes, are protecting £13bn of assets. Some of these are eroding and £400m assets will be threatened by 2050, if erosion continues.

The second phase of Dynamic Coast will investigate the resilience of Scotland's natural coastal defences (e.g. identifying where low dunes may breach); estimate how future climate change may exacerbate erosion on our soft (erodible) coast; and develop mitigation, adaptation and resilience plans at super sites, including St Andrews and Montrose.

Timeline:	**Owners:**
Phase 2 will be completed in 2020.	Scottish Government

Building with Nature

Building with Nature is an EU Interreg project to gather evidence to support working with natural processes to manage flood risk and coastal erosion, whilst enhancing ecosystem services.

More information on this policy can be found in Section 7.2.

6.1.2 Supporting Ecosystem Services

Supporting services describes those which are necessary for the production of all other services. They differ from other services as their impacts tend to be more indirect to humans or occur over a long period of time. Some examples of supporting services are nutrient cycling, habitat provision and biodiversity. Helping these services to adapt, in turn help to ensure the adaptation of the other types of ecosystem services.

Marine Protected Areas (MPA) Network and Monitoring Strategy	
The Marine Protected Area (MPA) network has been developed to meet a range of National, European, and International obligations. The primary purpose of the MPA network is to maintain or enhance marine biodiversity. By doing this, the resilience of habitats and species is improved, giving them more space to adapt to the changing climate. The network demonstrates sustainable management, and protects our heritage. Approximately 22% of our seas are covered by the network. Current work is focused on improving the coherence of the network by expanding the range of habitats and species protected, and delivering site specific management measures. A research programme is underway, with the aim of developing a map of blue carbon to better understand its role in mitigating and adapting to climate change. SNH helps to manage the MPAs. They will work closely with key marine stakeholders, including local coastal communities, to trial new approaches to marine management including through marine monitoring and citizen science, and the development of regional approaches to MPA management. The MPA Monitoring Strategy will ensure the necessary information is collected from the Scottish MPA network to underpin assessment and reporting obligations. The strategy is regularly reviewed and updated in collaboration between the partner organisations.	
Timeline: Improving the coherence of the MPA network by 2020, and delivering specific management measures by 2024.	**Owners:** Marine Scotland, SNH, Joint Nature Conservation Committee (JNCC)

Marine Litter Strategy for Scotland

Marine litter is a global challenge affecting the world's oceans, seas and coastlines. It is caused by a range of slowly degrading material including plastics, metals and glass. Of these materials, plastic is the most common.

Marine plastics have a negative impact on our marine environment, our economy, and potentially human health. Plastic items in our seas can cause damage to habitats, wildlife entanglement and obstruction and physical damage to animals who ingest them. A reduction in the amount of litter in Scotland's marine environment will reduce the overall pressure on marine species, leaving more space for them to adapt to the changing climate.

Published in 2014, the Marine Litter Strategy aims to develop current and future measures to ensure that the amount of litter entering the marine and coastal environment is minimised to bring ecological, economic and social benefits. The strategy is currently under review to reflect the output of the discussions hosted at the International Marine Conference 2019, and the British-Irish Council Marine Litter Symposium. This will improve focus on actions to affect the most change, including more emphasis on marine litter removal.

Timeline:	**Owners:**
The Strategy will be reviewed in 2019-20, and new milestones applied.	Owned by Marine Scotland with links to the National Litter Strategy.

Managing Marine Invasive Non-Native Species (INNS)

As Scotland's climate changes, the marine environment may enable more non-native species to become common and increase pressure on native biodiversity. Some species may expand their range or may be more likely to establish if introduced. It is also possible that some species which are currently benign may become invasive.

Marine Scotland will continue to work in partnership with other key authorities such as SEPA and SNH to respond, where feasible, to marine INNS in Scottish waters in order to minimise negative impacts on biodiversity and promote ecological resilience.

Marine Scotland will continue to keep under review how it approaches INNS management going forward, including how we work with stakeholders across marine sectors to minimise the threats posed by INNS.

Timeline:	**Owners:**
Feasibility of eradication / control of arriving INNS will be assessed and responses undertaken as necessary.	Marine Scotland

Marine Conservation Strategies	
The Scottish Government is currently developing the Scottish Seabird Conservation Strategy and the UK Dolphin and Porpoise Conservation Strategy. The purpose of the UK Dolphin and Porpoise Conservation Strategy is to deliver and/or maintain a favourable conservation status for nine species of cetaceans in UK waters (to the extent of the continental shelf). The high level actions of the Strategy will enable better delivery of management, research, monitoring and communication. Marine Scotland is working with UK, Welsh and Northern Irish Government departments to develop and, following consultation, implement the Strategy. The Scottish Seabird Conservation Strategy is in the early stages of development. It will include a number of high level actions to optimise the conservation prospects of seabirds in Scotland through effective management of existing and emerging threats.	
Timeline: Consultation on the UK Dolphin and Porpoise Conservation Strategy will take place in 2019. A stakeholder event will take place for the Scottish Seabird Conservation Strategy in 2019 ahead of public consultation. Both strategies are expected to be adopted in 2020.	**Owners:** Marine Scotland, SNH, Joint Nature Conservation Committee (JNCC), Department for Environment, Food and Rural Affairs (DEFRA), Northern Ireland Department of Agriculture, Environment and Rural Affairs (DAERA), Natural Resources Wales (NRW) and the Welsh Government.

Image 6.3. Bottlenose dolphins, Moray Firth (© Lorne Gill, SNH)

Sub-Outcome 6.2: Scotland's marine and coastal environment and its contribution to wider societal adaptation is enjoyed, valued and maintained

Helping our coastal and marine environment to adapt also helps sustain us through many intangible ways. It contributes to our health and wellbeing, enjoyment of the outdoors, sense of place and who we are as a nation. The policies under this Sub-Outcome help to ensure that the contributions of the coastal and marine environment to culture are understood, enjoyed and maintained.

6.2.1 Provisioning Ecosystem Services

Provisioning ecosystem services are the products that are obtained from ecosystems, such as: fish and shellfish. Provisioning ecosystem services are often tied to the concept of natural capital. Natural capital is defined as a country's stock of natural resources and environmental assets including plants, animals, air, water, soils and minerals. Scotland's natural capital is a source of significant international competitive advantage, and its continuing health and improvement is fundamental to sustainable economic growth. Because of the links to economic growth, these services will be considered under the economy chapter. Policies related to the provisioning of ecosystem services can be found in Sub-Outcome 3.1, which relates to Scotland's businesses that depend on natural capital, including fisheries and aquaculture. Sub-Outcome 3.1 relates to the risks to natural resource based businesses, where Sub-Outcome 3.3 relates to the opportunities that these businesses have as a result of climatic changes.

6.2.2 Cultural Ecosystem Services

Cultural ecosystem services describe the more intangible or nonmaterial benefits that people receive from ecosystems. These benefits can include mental and physical health and well-being, recreation, tourism, aesthetic values, spiritual and religious values, cultural heritage and sense of place. People's experiences with the coastal and marine environment are tightly linked with those of the natural environment. For this reason, policies relating to cultural ecosystem services have been included in Section 5.2.2.

6.2.3 Understanding and Recognition

One of the main reasons for using an ecosystem services approach is to provide a framework for understanding and recognising the value of all of the benefits that we receive from the natural environment. We are more likely to care for nature if we have a good understanding of its value. More than just understanding the value of nature, it is also important that we understand our connection to it. As humans, we are also part of ecosystems. We are not separate from nature but part of it. Related to this, it is important that we also recognise the intrinsic value of nature. Our natural systems are valuable not just because of their connection to us as humans, but for its own sake as well. The policies under this sub-outcome help to build our understanding and recognition of the natural environment.

Scotland's Marine Atlas

Scotland's Marine Atlas (2011) provides an Overall Assessment of the condition of Scotland's seas, based on scientific evidence. It reported on the Scottish Government's vision for the seas as 'clean, healthy, safe, productive, biologically diverse marine and coastal environments, managed to meet the long term needs of nature and people'.

The Atlas provides baseline information from which the national marine plan was developed.

Since 2011, a large range of spatial information and monitoring data have been added to the MS Maps NMPi (National Marine Plan interactive) web portal to provide more up to date information.

Timeline:	**Owners:**
A new Overall Assessment is being prepared for publication in 2020.	Marine Scotland

Monitoring Climate Change Impacts in Scottish Seas

Marine Scotland will use marine research strategies and monitoring programmes to gather data on the impact climate change is having within Scottish seas, including:

- inshore environment and ecosystems using the Scottish Coastal Observatory,
- offshore environment and ecosystems using Marine Scotland Science (MSS) offshore environmental surveys,
- fish and shellfish populations using the MSS fish stock assessment programme.

These data are used to help inform future policy development.

Timeline:	**Owners:**
Annual implementation of Marine Scotland Science survey programme. Annual delivery of data to national and international databases. Annual update of climate change impact assessments through ICES (e.g. the ICES Report on Ocean Climate), OSPAR and national (e.g. Scotland's Marine Atlas) published assessments.	Marine Scotland Science

Marine Climate Change Impacts Partnership (MCCIP)	
MCCIP collates expertise from across the United Kingdom and uses this to develop high quality evidence supported by scientific consensus – including Annual Report Cards (summaries of current and future CC impacts on specific environment and ecosystem components) and Climate Smart Working Reports (CC adaptation advice for specific marine industry / management sectors). By providing a small financial contribution, Scotland gains a significant added-value process, and quality, peer-reviewed scientific support for adaptation policies.	
Timeline: An annual payment is made to support MCCIP work.	**Owners:** Marine Scotland

Research on Vulnerabilities to Climate Change	
An ongoing project on intertidal habitat extents will help to identify possible effects of sea level rise at the coast. This will help in understanding the role of intertidal habitats in vulnerability to coastal flooding and erosion, and inform prioritisation of SNH's future monitoring and management advice.	
Timeline: Ongoing	**Owners:** SNH

Image 6.4. Isle of May National Nature Reserve (© Lorne Gill, SNH)

Crown Estate Scotland

In 2017, decision making powers over a collection of rights, functions and assets owned by the Crown were devolved to Crown Estate Scotland. Crown Estate Scotland is now responsible for:

- managing approximately half the foreshore around Scotland,
- leasing of seabed out to 12 nautical miles,
- managing the rights to lease the seabed for offshore renewable energy, gas and carbon dioxide storage out to 200 nautical miles.

Marine Scotland will work with Crown Estate Scotland to ensure continued commitment to investments in projects and activities related to the Scottish Crown Estate contribute to climate change adaptation and facilitate wider societal adaptation.

To value and maintain the assets they manage, Crown Estate Scotland are undertaking a study to better understand the social, economic and environmental value of the Scottish Crown Estate. A new approach will then be developed to assess the possible social, economic and environmental benefits and impacts of future decision making. This will assist with delivering the new legal framework contained in the Scottish Crown Estate Act 2019, which includes a legal duty to act in a way to further the achievement of sustainable development in Scotland.

Timeline:	**Owners:**
Ongoing	Marine Scotland

Adaptation Behaviours

Adapting to climate change requires action from all levels of society. Local government, public bodies, the private sector, third sector, communities and individuals all have a role to play. The behaviours outlined below help individuals and organisations provide opportunities to increase their own resilience and the resilience of the coastal and marine environment to the effects of climate change. With a marine environment under strong pressures as a result of climate change, including warming ocean temperatures and increased acidity, it is important that we help reduce our impact as much as possible. By reducing the pressure we are putting on our ocean environments, we give our marine ecosystems a better chance to be able to adapt.

Individual Behaviours

1. Opt for sustainably sourced or different types of fish. Changing sea temperatures may put pressure on fish that traditionally inhabit Scottish waters. Individuals can help to reduce pressure on these species by choosing to purchase fish that carry an independent sustainability certification, such as the Marine Stewardship Council (MSC) certification or purchasing different types of fish in the supermarket where they are available.

2. Reduce plastic consumption. Ocean plastics are adding additional stress to the marine environment, alongside the effects of climate change. By reducing the amount of plastic we use and throw away, we can help to reduce the pressure on marine ecosystems. Individuals are encouraged to use refillable water bottles or cups or take their own bags to the supermarket.

Societal Behaviours

1. Reduce plastic consumption. Organisations can help support a move away from disposable plastic by offering incentives like discounts for customers who bring their own reusable bottles or cups. Businesses can also work to design packaging and utilise business procedures, staff training and customer engagement to reduce the amount of plastic litter being produced and encourage personal responsibility for the disposal of waste.

2. Flood management in coastal locations. Organisations based near the coast can adapt to some changes and help reduce the impact of flooding. One way of doing this is to promote natural flood defences such as dune systems. This has been particularly successful in golf courses located near the coast. Allowing and encouraging the natural dynamics of dune systems, beaches, and saltmarshes supports valuable coastal habitats and their crucial role in reducing the risk of flooding and erosion.

Monitoring and Evaluation: Outcome 6

Monitoring and Evaluation is integral to the outcomes-based approach which encourages consideration at all stages of adaptation policy development. Further information including a general introduction to the framework, and a description of the foundation and principles can be found in the monitoring and evaluation introduction and Annex 3 respectively.

Key sources of existing monitoring evidence for Outcome 6 include: the National Coastal Change Assessment, Biodiversity Strategy indicators, and Marine Scotland Science. There is currently limited data available for some themes, but by identifying what we need to measure not just what we know we can, the framework highlights monitoring gaps which will be filled as more data and associated monitoring arrangements are developed.

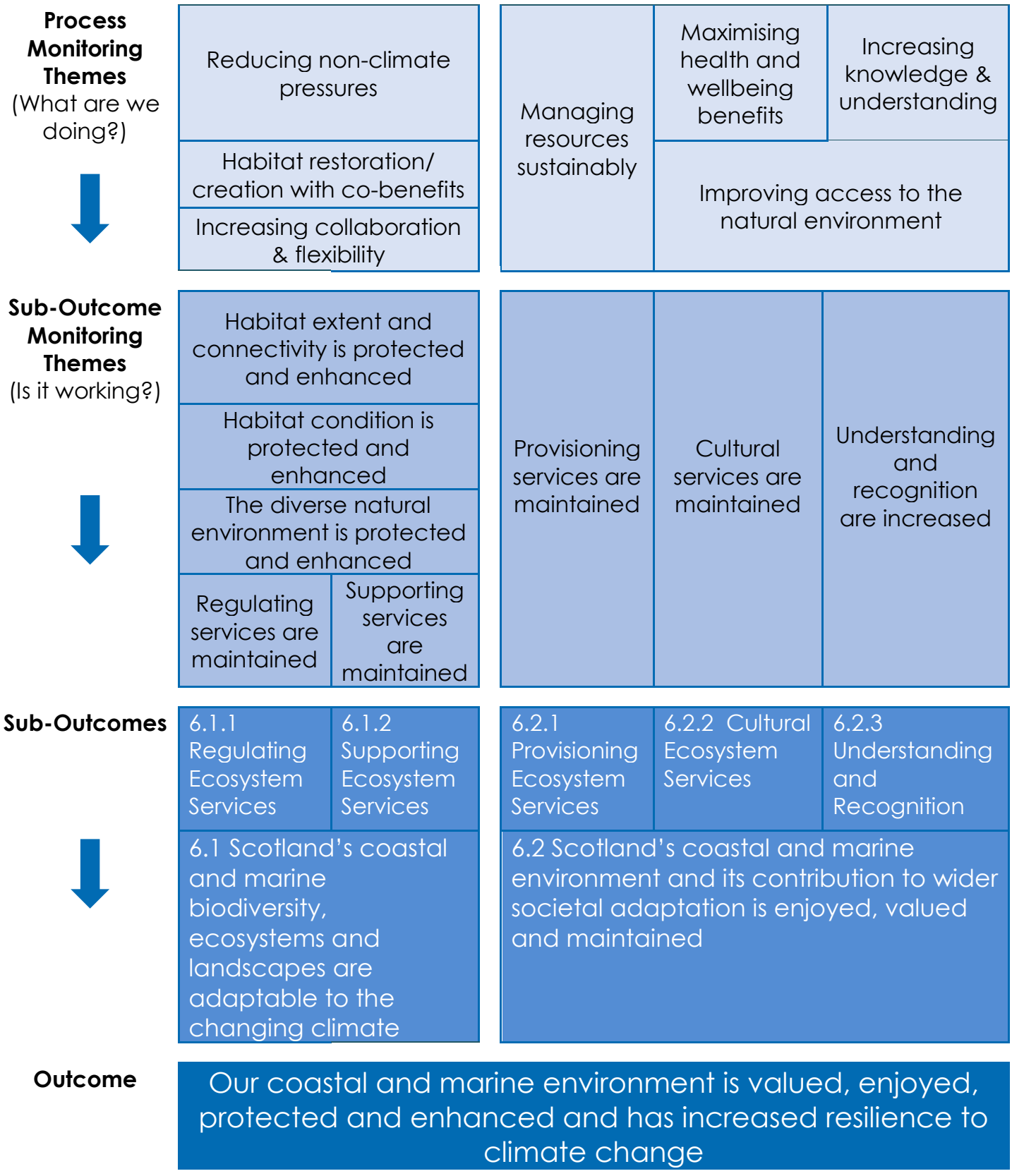
Monitoring the Adaptation Process ('What are we doing?') The themes set out the structure to monitor the implementation of and output from adaptation policies and actions which support the Outcome. Indicators will include metrics of, for example: habitat restoration, sustainable resource management, and the extent of marine monitoring.

Monitoring the Sub-Outcomes ('Is it working?') The Sub-Outcome monitoring themes highlight the key components of each Sub-Outcome and provide the structure for evaluating progress. Indicators will include metrics of e.g. extent and condition of key habitats, biodiversity, and; progress towards marine conservation objectives.

Monitoring the Outcome Monitoring at this high level will directly link the Outcome to wider government policy and the National Performance Framework by utilising relevant indicators already associated with these high-level monitoring frameworks.

<table>
<tr><th>National Performance Framework Indicators</th><th>Sustainable Development Goals Indicators</th></tr>
<tr><td>• Sustainability of fish stocks
• Clean seas</td><td rowspan="3">• Proportion of national exclusive economic zones managed using ecosystem-based approaches
• Proportion of fish stocks within biologically sustainable levels
• Coverage of protected areas in relation to marine areas</td></tr>
<tr><th>Marine Strategy Framework Directive</th></tr>
<tr><td>• Progress towards achieving Good Environmental Status (GES) in Scottish waters</td></tr>
</table>

Monitoring and Evaluation Structure: Outcome 6



UK Climate Change Risk Assessment: Associated Risks

The UK Climate Change Risk Assessment risks that will be addressed by the policies presented in Outcome 6 are set out below:

Ne11: Risks to aquifers, agricultural land and freshwater habitats from saltwater intrusion.	**Ne12:** Risks to habitats and heritage in the coastal zone from sea-level rise; and loss of natural flood protection.	**Ne13:** Risks to, and opportunities for marine species, fisheries and marine heritage from ocean acidification and higher water temperatures.

Outcome 7: Our international networks are adaptable to climate change

Image 7.1. Self-sufficient schools feeding programme: Livingstonia, Malawi

Outcome 7: Our international networks are adaptable to climate change

Introduction

Scotland's international networks are the interactions between Scotland and the rest of the world, and include food supply networks, international trade, governance, knowledge exchange, and development.

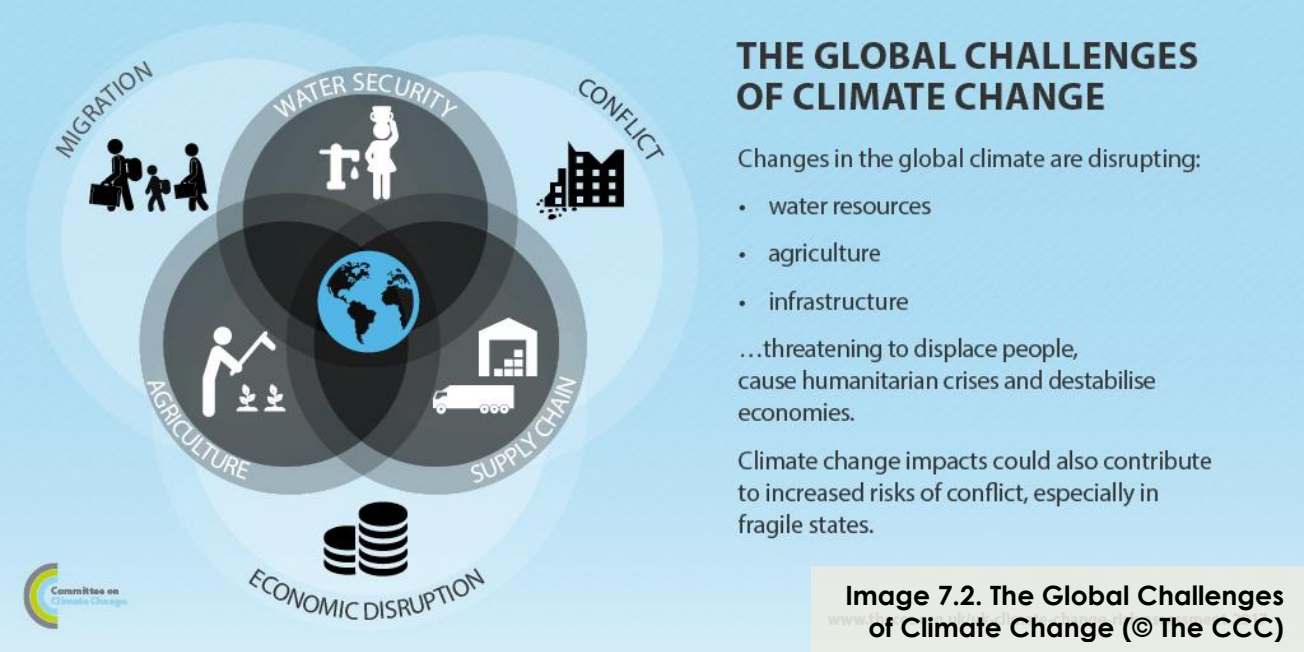


Image 7.2. The Global Challenges of Climate Change (© The CCC)

There are two strands to Scotland's International Framework:

- to create an environment within Scotland that supports a better understanding of international opportunities and a greater appetite and ability to seize them; and
- to influence the world around us on the issues that matter most in helping Scotland flourish.

In addition, we place great importance on Scotland being a good global citizen. This means playing our part in tackling global challenges including poverty, injustice and inequality.

The International Development Fund (IDF) is at the forefront of our efforts, with annual funding of £10 million. The main aim is to support and empower our partner countries: Malawi, Rwanda, Zambia, and Pakistan. We have three funding streams under the IDF: development assistance (aid) projects; capacity strengthening initiatives; and commercial investment initiatives. Specifically relating to climate

change, we currently provide additional annual funding to the Climate Justice Fund.

Scotland supports the Paris Agreement, which puts a strong emphasis on adaptation and resilience. Adaptation requires international cooperation and those who experience the greatest impact may need support to adapt. Climate change will impact how Scotland interacts and engages with the international community, and Scottish Ministers continue to actively participate in international climate change conferences, including championing climate justice. In line with the aims of the Scottish Government's International Framework, we will share our experiences, values and expertise in areas such as justice, education, and climate change with a view to seeing the human rights of people across the world fully realised. Exchange of learning and knowledge will support countries to adapt, with positive indirect benefits for international governance and global political stability. We also want to learn from our international partners, ensuring that Scotland has the best possible evidence informing our adaptation action.

Scotland's economic networks will also need to adapt. Trade patterns may change as the production of goods shifts with changing climate. Global transport infrastructure may be disrupted as sea levels rise and the risk of storms increases. There may also be opportunities for Scottish businesses to sell adaptation products and expertise internationally and make use of new trade routes to sell their goods.

Scotland's international food networks will also need to adapt. The resilience of Scotland's food system will depend on effective management of natural resources both here and overseas and on understanding and managing the response of international markets to climate risks. Food safety may also be affected as the risk of contamination increases in extreme weather events, such as flooding.

Where We Are Now

In June 2017 Scotland hosted the European Climate Change Adaptation Conference in Glasgow. Adaptation Scotland worked with partners to showcase Scotland's adaptation work to an international audience of adaptation experts. Scotland's approach to adaptation planning and action is highly regarded internationally and the Adaptation Scotland programme has close links with international partners including the British-Irish Council.

The following diagram outlines the structure of the International Chapter. The policies for this Outcome are set out under three Sub-Outcomes. The first focuses on climate change adaptation and imported food quality and safety, the second on Scotland's role in international adaptation governance and the third focuses on the adaptive capacity of Scotland's international trade.

Outcome 7: Our international networks are adaptable to climate change – policies and research

7.1 Scotland's international food supply networks are resilient to the effects of climate change

- **7.1.1** Food Safety and Quality
  - Food Risk Assessments
  - Structured Horizon Scanning Procedures
  - Food Substitution
- **7.1.2** Food Security
  - EU Exit Preparation
  - International Collaboration for Expanding Potato Production and Mitigating Climate Change Impacts
  - Food Forever

7.2 Scotland is active in international governance helping to manage the potential international instability caused by climate change

- RegionsAdapt
- British-Irish Council (BIC)
- Traction Learning Exchange Project
- Hydro Nation: International Knowledge Sharing
- Building with Nature
- Climate Justice Fund
- The Climate Challenge Programme Malawi (CCPM)
- The Climate Justice Innovation Fund
- 2050 Young Malawian Climate Leaders
- Support for Kasisi Agricultural Training Centre
- Horizon 2020 – Rivertrack Flooding Warning
- Hydro Nation: International Services (HNIS)

7.3 Scotland has an internationally open and connected economy which is adaptable to the changing climate

- EU Exit Planning

Key

- Policy also found under another Outcome
- Policy also found under another Sub-Outcome
- Policy
- Research

Sub-Outcome 7.1: Scotland's international food supply networks are resilient to the effects of climate change.

As Scotland's climate changes, its international food supply networks may change. This includes disruption of transport routes and infrastructure as a result of increases in extreme weather and sea level rise. Trade patterns and international food production may be affected as extreme weather and water scarcity reduce the quantity and type of crops grown in different countries.

7.1.1 Food Safety and Quality

Scotland may also face new challenges associated with food safety and quality. Climate change could impact on imported food quality and safety in a variety of ways. Increased risk of flooding could increase the risk of environmental contamination. There may be additional risks from increased pesticide use in response to new pests and diseases; and transmission of diseases and toxicity through food. There may also be an increased risk of substitution of food in the supply chain if supplies are limited as a result of extreme weather.

Food Standards Scotland (FSS) is the public sector food body for Scotland and is responsible for the implementation and monitoring of food safety legislation. The Chemicals Regulation Division, part of the UK Government's Healthy and Safety Executive, is responsible for ensuring the safe use of pesticides to protect the health of people and the environment. This includes monitoring levels of pesticide residue in both domestically produced and imported food.

Food Risk Assessments	
Food Standards Scotland (FSS) has developed the relevant risk assessment for a major contamination incident for the first iteration of the classified Scottish Risk Assessment (SRA). The purpose of the SRA is to help the resilience community in Scotland to understand the disruptive challenges that we may face, and to use this to anticipate, assess, protect, mitigate, prepare, respond and recover.	
Timeline: Ongoing	**Owners:** Food Standards Scotland

Structured Horizon Scanning Procedures	
Food Standards Scotland (FSS) has developed a structured horizon scanning procedure. Regular review of data, and intelligence sources is undertaken to identify, new, emerging and increasing risks in relation to food safety, food standards and food crime, including those associated with climate change. FSS works closely with the Food Standards Agency to ensure a joint approach to horizon scanning and emerging risks identification.	
Timeline: Ongoing	**Owners:** Food Standards Scotland

Food Substitution	
Food Standards Scotland (FSS) manages a programme of research and surveillance activities aimed at identifying food products which may be vulnerable to substitution and fraud. Commodities are targeted through horizon scanning and intelligence collated by FSS's Scottish Food Crime and Incidents Unit, and may include, but will not be limited to, foods that may be impacted due to climate change effects.	
Timeline: Ongoing	**Owners:** Food Standards Scotland

7.1.2 Food Security

As the climate changes, trade patterns and international food production may be affected. In some parts of the world, increasing heat, water scarcity and extreme weather may reduce the quantity and type of crops grown, as well as the productivity of the workforce. This may result in food price volatility or a reduction in the range of foods available. Scotland's domestic food production may benefit from climate change due to warmer temperatures and longer growing seasons. Taking advantage of this may increase the resilience of Scotland's food supply.

EU Exit Preparation	
As part of the Scottish Government's preparation for EU exit, project work is underway to understand how leaving the EU without a deal may impact on the price, availability and source of food. This work will increase resilience in the event of disruption to food supplies to Scotland, and can be applied to instances of disruption due to extreme weather.	
Timeline: Ongoing	**Owners:** Scottish Government

International Collaboration for Expanding Potato Production and Mitigating Climate Change Impacts

The link between drought tolerance in potato and virus pathogen spread in plants has been elucidated, allowing strategies for improved drought tolerance and reduced viral spread to be developed. The work is being extended via co-funding from the Global Challenge Research Fund (UKRI GCRF). In collaboration with partners in Kenya and Malawi, potato types carrying traits for heat tolerance, rapid maturity and virus resistance are being trialled, underpinning efforts to expand potato production in hot environments and mitigate potential impacts of climate change. All of these link to maintaining yield, reducing inputs, and increasing food security for climate change mitigation.

Research

Food Forever

The diversity present in our crops and livestock, and the wild plants and animals that are their relatives, is key to addressing current and future food and climate related challenges. In Scotland, scientists in the SEFARI collective are working on a range of economically important species to understand their potential for adaptation and make better use of available genetic resources. To raise awareness and support this effort nationally and internationally, the F197oo d Forever exhibition, developed in Scotland, will tour globally over the next five years.

Research

Sub-Outcome 7.2: Scotland is active in international governance, helping to manage the potential international instability caused by climate change.

The Scottish Government wants to be an active partner in international governance helping to influence the world around us on the issues that matter most. We want to be a good global citizen, making a distinctive contribution to addressing global challenges, sharing our knowledge, skills and technical expertise for global good. Scotland supports the Paris Agreement, which puts a strong emphasis on adaptation and resilience. All countries are expected to undertake adaptation planning and action, and communicate those actions to the global community. We continue to work with our international partners to champion a climate justice approach overseas. The policies below will set out how we will communicate and share our knowledge of climate change adaptation with the global community.

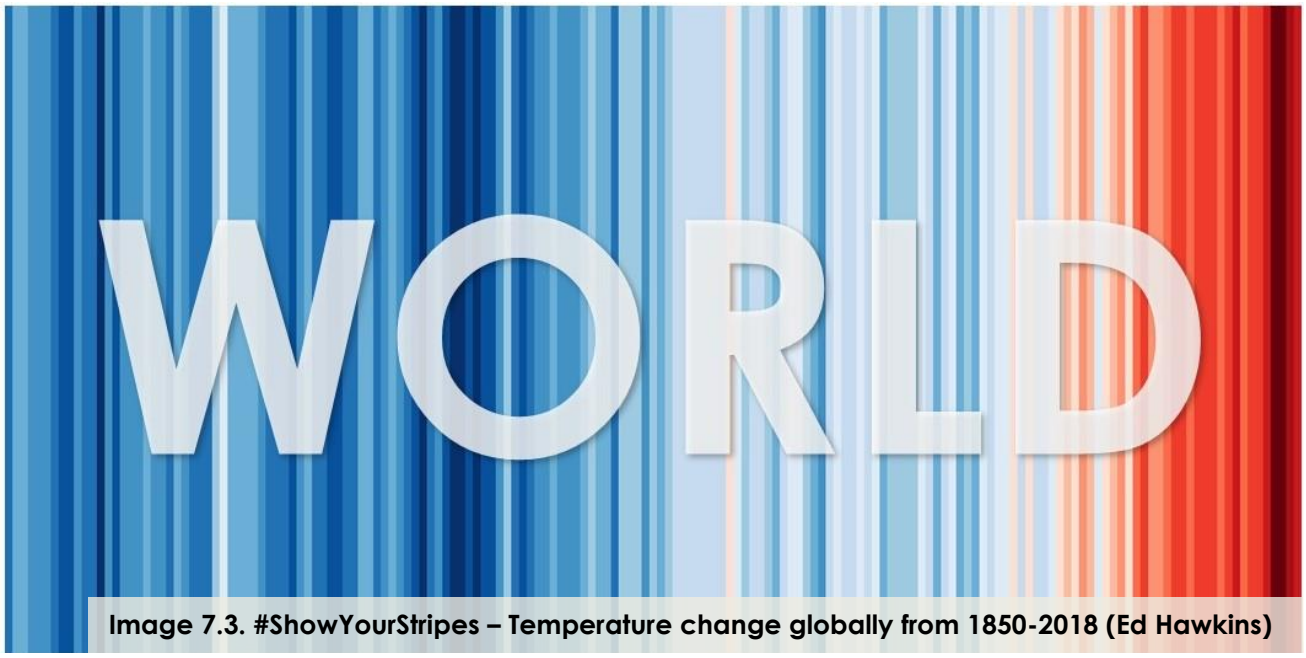


Image 7.3. #ShowYourStripes – Temperature change globally from 1850-2018 (Ed Hawkins)

RegionsAdapt	
RegionsAdapt is an international initiative, created alongside the 2015 Paris Climate Conference (COP21) as a framework for regional governments' action, collaboration and reporting on climate change adaptation. Initiated by Rio de Janeiro and Catalonia, RegionsAdapt now has almost 70 signatory regional governments including Scotland, Basque Country, California, Lombardy, Quebec, South Australia and Wales. RegionsAdapt represents a combined population of more than 295 million inhabitants from 26 countries on 5 continents. It facilitates the development of joint solutions to climate change adaptation, and promotes cooperation, knowledge sharing and sharing of best practice.	
Timeline: Ongoing	**Owners:** Scottish Government

British-Irish Council (BIC)	
The British-Irish Council was created under the Good Friday Agreement. It was established to further promote positive, practical relationships among the people of the islands, and to provide a forum for consultation and co-operation. Membership of the Council comprises representatives of the Irish and British governments and of the devolved administrations in Northern Ireland, Scotland and Wales, together with representatives of the Isle of Man, Guernsey and Jersey. It provides a forum for its members to discuss, consult and use best endeavours to reach agreement on co-operation on matters of mutual interest within the competence of its Member Administrations. The Environment work sector is led by the UK Government and has proved a constructive and unique forum for facilitating evidence exchange and practical collaboration since the Council was first established. During 2018, climate adaptation was a focus for discussion alongside addressing the threat of invasive non-native species (INNS) and the issues of food waste and recycling.	
Timeline: Ongoing	**Owners:** Governments of the UK, Ireland, Northern Ireland, Scotland, Wales, and representatives from Isle of Man, Guernsey and Jersey

Traction Learning Exchange Project	
The Scottish Government is supporting the Traction project for international knowledge exchange on national adaptation efforts. This links peers and counterparts in Malawi and among the Least Developed Countries group at the UNFCCC. It works to understand their approaches and establish new opportunities to promote international collaboration, enhancing adaptive capacity.	
Timeline: 2017-2020	**Owners:** Funded by Scottish Government and delivered by Sniffer and International Institute for Environment and Development

Hydro Nation: International Knowledge Sharing	
The Scottish Government believes that as a Hydro Nation we should share our academic excellence and expertise in water governance and water management technology. We established Hydro Nation International Research (HNIR) to improve alignment and consistency between the various strands of activity, building on Scotland's Centre for Expertise in Waters (CREW) model. HNIR activity includes management of international collaborative research projects, delivering networks across the academic sector, assisting the Scottish Government's contribution to the Sustainable Development Goals by deploying Scottish public sector expertise to support key international partners such as the Government of Malawi , and helping to develop the role and profile of the UNESCO Centre for Water Law, Policy and Science at Dundee University.	
Timeline: Ongoing	**Owners:** Scottish Government, The James Hutton Institute/CREW

Building with Nature	
Across the North Sea Region, climate change is likely to increase flood and coastal erosion risk from storm surges in coastal and estuarine areas, and flooding of rivers and inland lochs and lakes caused by increased heavy rainfall. We are working with partners across the North Sea Region, as part of an EU Interreg project, to build the evidence base for nature based solutions, to help justify investment, optimise their effectiveness and encourage mainstreaming of approaches across the region. The overall objective of the Building with Nature project is to make coasts, estuaries and catchments of the North Sea Region more adaptable and resilient to the effects of climate change. Demonstration sites for climate change adaptation have been set up at seven coastal and six catchment scale sites across the North Sea Region including the **Eddleston Catchment** in Scotland. These gather evidence for solutions that use natural processes to deliver flood risk and coastal erosion management whilst enhancing ecosystem services.	
Timeline: Project complete in June 2020	**Owners:** Scottish Government, Tweed Forum, SEPA

Climate Justice Fund	
The Scottish Government is determined to take action on climate change through the lens of climate justice, recognising that those most vulnerable to climate change are often those who have contributed least to the problem, and have the least capacity to deal with its effects. The Climate Justice Fund was launched in 2012, and committed £21 million to projects designed to further Climate Justice between 2012 and 2021. In 2015, at COP21 in Paris, we committed to providing £3 million per year from 2016 to 2021, alongside £10 million spent by us in our International Development Fund. By supporting and empowering communities to tackle the impacts of climate change in their home countries, Scotland can help to promote climate change action and international stability, increasing capacity to adapt to the changing climate.	
Timeline: 2012-2021 (Current programmes 2017-21)	**Owners:** Scottish Government

The Climate Challenge Programme Malawi	
The Climate Challenge Programme Malawi is a 3-year, £3.2 million, strategic and integrated programme to help vulnerable communities in Malawi build resilience to the effects of climate change. The Programme is community-led, working with 120 rural village communities across the four districts of Machinga, Balaka, Zomba and Chikwawa in Southern Malawi. On-the-ground development officers are supporting a number of rural communities to identify the problems that have arisen as a result of climate change, and to help them design the solutions that work best for them, across the key areas of water, food and energy.	
Timeline: 2017-2020	**Owners:** Scottish Government, SCIAF (Scottish Catholic International Aid Fund)

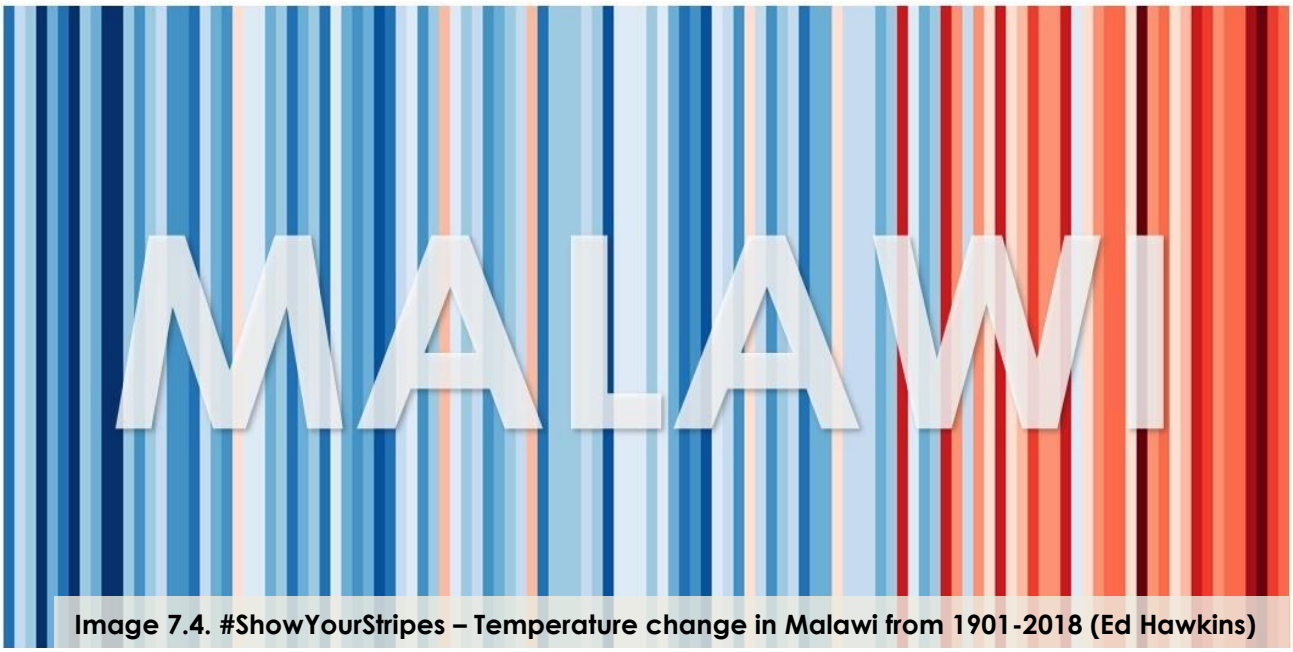


Image 7.4. #ShowYourStripes – Temperature change in Malawi from 1901-2018 (Ed Hawkins)

The Climate Justice Innovation Fund	
The Scottish Government launched the Climate Justice Innovation Fund in June 2017 to support projects developing innovative solutions to the problems caused by climate change, with a view to expanding and scaling up. Applicants can apply for smaller grants over a two to three-year period, and it is managed by the Corra Foundation. We awarded £600,000 to six projects in 2017, and a further £600,000 to six projects in 2018.	
Timeline: 2017-2021	**Owners:** Scottish Government, Corra Foundation

2050 Young Malawian Climate Leaders	
This project is designed to build a network of young people who will be active in advocating for action on climate change mirroring the approach of the 2050 Climate Group in Scotland. Activities have included workshops, knowledge sharing and cultural exchanges, focusing particularly on uplifting the views of young people in response to climate change. After a successful start, the project is going on to expand in its second year of activity in Malawi.	
Timeline: 2018-2020	**Owners:** Scottish Government, the 2050 Climate Group, Malawi Scotland Partnership

Support for Kasisi Agricultural Training Centre	
The Climate Justice Fund and International Development Fund alongside SCIAF are supporting the Kasisi Agricultural Training Centre in Zambia which contributes to adaptation objectives through promoting sustainable organic agriculture.	
Timeline: 2017-2020	**Owners:** Scottish Government, SCIAF

Case Study 9: Self-sufficient school feeding programmes, Malawi

The Scottish Government's Climate Justice Innovation Fund (CJIF) is one strand of the climate justice work that the Scottish Government carries out in Malawi. The Programme is designed to support small, innovative projects to test new strategies for approaching climate change issues.

One of these projects in Northern Malawi helps schools on the elevated Livingstonia plateau to grow their own food for the school feeding programme. Increases in rainfall and unpredictable weather patterns, partially resulting from climate change, have made access to these schools from nearby towns difficult, with access roads often damaged or washed away entirely. By growing food at the schools themselves, it's possible for participants to adapt to this problem, whilst also providing the opportunity for schoolchildren to learn about agricultural techniques and the local ecology and climate.

Schools reported that by the second year of the project, they were able to feed the children entirely from food grown in school gardens and fields, and that teachers and parents worked co-operatively to maintain them. In addition to crops, schools are also growing tree seedlings to use in reforestation. This will increase local resilience against increased rainfall, as root systems can prevent soil from being washed away, which could otherwise lead to mudslides and flooding in valleys.

Image 7.5. Self-sufficient schools feeding programme: Livingstonia, Malawi

Horizon 2020 – Rivertrack Flooding Warning	
Through the Horizon 2020 EU project, Scotland's Rivertrack flood warning technology is being piloted in campsites across Catalonia. This will help campsite owners fulfil their obligations to have flood plans and alert owners and holiday makers to rising water levels.	
Timeline: Ongoing	**Owners:** Scottish Government's CivTech programme, SEPA, RiverTrack Ltd, private sector

Hydro Nation: International Services (HNIS)	
The Hydro Nation International Services (HNIS) aims to develop and support opportunities to export our collective water knowledge around the globe including in areas where Scotland has a growing international reputation, such as water governance.	
Timeline: Ongoing	**Owners:** Scottish Government

Sub-Outcome 7.3: Scotland has an internationally open and connected economy which is adaptable to the changing climate.

Climate change will impact on Scotland's ability to import and export goods and services. Food and drink exports, including beverages (particularly whisky), fish, crustaceans and molluscs are significant for Scotland's economy and are often important livelihoods for people living in rural and coastal communities. Maintaining our international connections, despite the disruption to trade that climate change may cause, will be vital to ensure Scotland's economy remains open and connected.

EU Exit Planning	
As part of the Scottish Government's preparation for EU exit, work is underway to understand how leaving the EU without a deal may impact food and drink exporters in Scotland. This work aims to increase overall resilience in the event of disruption, learning which could be applied to disruption due to extreme weather.	
Timeline: Ongoing	**Owners:** Scottish Government

Adaptation Behaviours

Adapting to climate change requires action from across all areas of society. The choices and decision we all make in Scotland have impacts on other parts of the world. Consumers may want to consider shopping more locally which may reduce the pressure on long distance supply chains. Businesses may want to consider new markets and supply chain routes that are opened up as the climate changes.

Individual Behaviours

1. Shop locally and seasonally. Increasing the amount of food that is grown and purchased locally and in season can help to increase the resilience of food supply networks, by making them shorter and less vulnerable to severe weather.

Monitoring and Evaluation: Outcome 7

Monitoring and Evaluation is integral to the outcomes-based approach which encourages consideration at all stages of adaptation policy development. Further information including a general introduction to the framework, and a description of the foundation and principles can be found in the monitoring and evaluation introduction and Annex 3 respectively.

Key sources of existing monitoring evidence for Outcome 7 include: Food Standards Scotland, Health Protection Scotland, and Export Statistics Scotland. There is currently limited data available for some themes, but by identifying what we need to measure not just what we know we can, the framework highlights monitoring gaps which will be filled as more data and associated monitoring arrangements are developed.

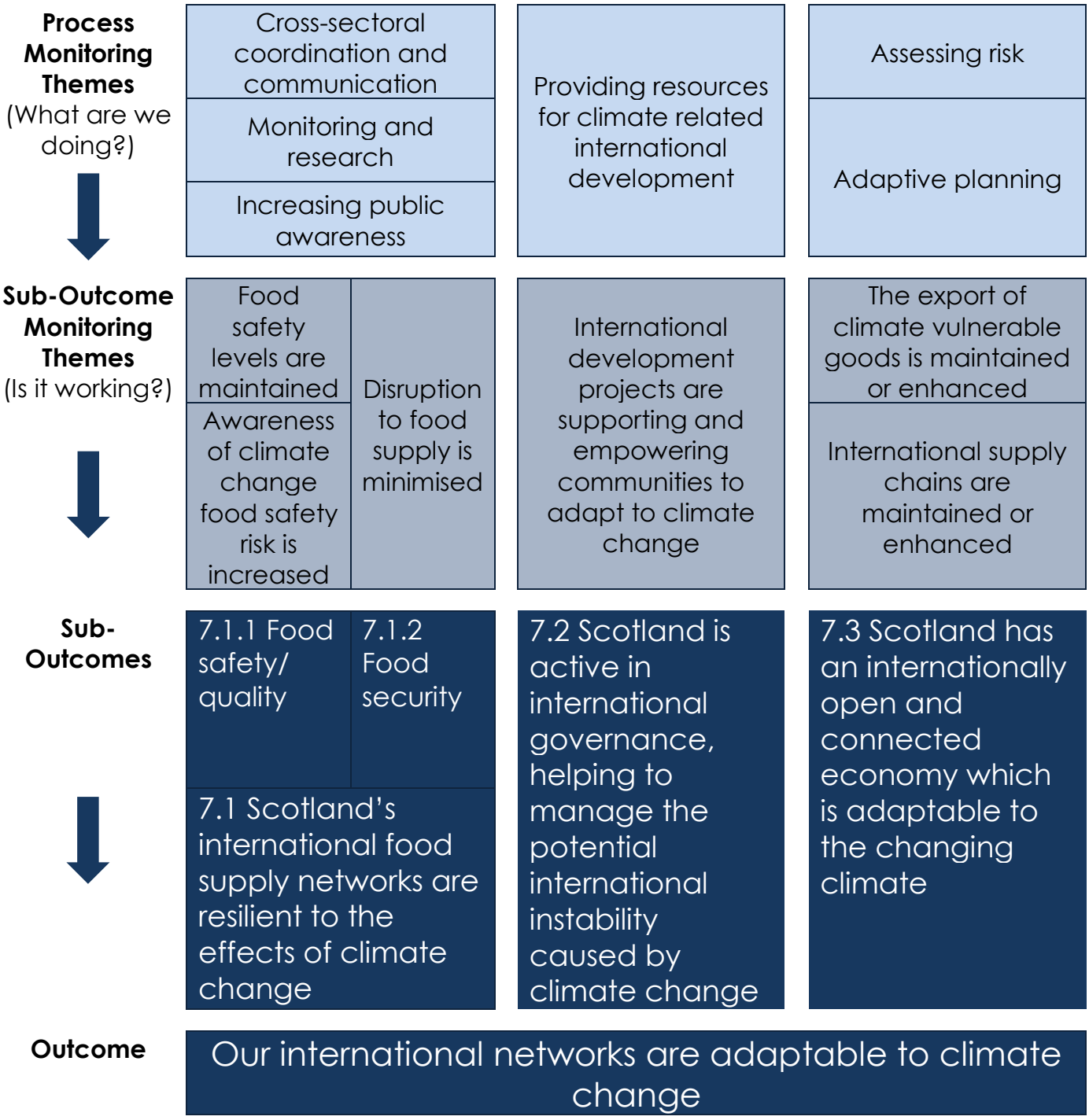
Monitoring the Adaptation Process ('What are we doing?') The themes set out the structure to monitor the implementation of and output from adaptation policies and actions which support the Outcome. Indicators will include metrics of, for example: extent of monitoring of food borne disease, the reach of public awareness campaigns, and funding for climate change adaptation related projects in developing countries.

Monitoring the Sub-Outcomes ('Is it working?') The Sub-Outcome monitoring themes highlight the key components of each Sub-Outcome and provide the structure for evaluating progress. Indicators will include metrics of, for example: food borne disease, public awareness levels, and export statistics for climate vulnerable products.

Monitoring the outcome Monitoring at this high level will directly link the Outcome to wider government policy and the National Performance Framework by utilising relevant indicators already associated with these high-level monitoring frameworks.

National Performance Framework Indicators	Sustainable Development Goals Indicators
• Food insecurity • International networks • Contribution of development support to other nations • International exporting (value of Scottish exports excluding oil and gas)	• Food price anomalies • Prevalence of moderate or severe food insecurity in the population • Total official international support to infrastructure • Number of least developed countries receiving specialised support for raising capacities for effective climate change-related planning and management

Monitoring and Evaluation Structure: Outcome 7



UK Climate Change Risk Assessment: Associated Risks

The UK Climate Change Risk Assessment risks that will be addressed by the policies presented in Outcome 7 are set out below:

It1: Risks from weather related shocks to international food production and trade.	**It2:** Imported food safety risks.
It3: Risks and opportunities from long term, climate-related changes in global food production.	**It4:** Risks to the UK from climate-related international human displacements.
It5: Risks to the UK from international violent conflict.	**It6:** Risks to international law and governance.
It7: Opportunities from changes to international trade routes.	

Annex 1: Progress to Date

Annual Progress Reports
Under Section 54 of the Climate Change (Scotland) Act 2009, Scottish Ministers must make annual reports to the Scottish Parliament setting out their assessment of progress towards implementing the objectives, proposals and policies set out in Scotland's statutory Adaptation Programme. The fifth Annual Progress Report was published in May 2019.

2009 Adaptation Framework
Scotland has been preparing for the impacts of climate change for over a decade. In 2009 we published Scotland's Climate Change Adaptation Framework. Sector action plans to support the Framework were published in 2010.

2014 Adaptation Programme
Climate Ready Scotland, Scotland's first statutory five-year Climate Change Adaptation Programme, was published in May 2014. The 2014 Programme aimed *"to increase the resilience of Scotland's people, environment and economy to the impacts of a changing climate"*.

The Programme set out Scottish Ministers' objectives in addressing over 130 climate risks identified for Scotland in the UK Climate Change Risk Assessment 2012.

Independent Assessments
As required by the Climate Change (Scotland) Act 2009, Scottish Ministers must commission an independent assessment of how well Scotland is preparing for climate change under the 2014 Programme from the Adaptation Committee of the Committee on Climate Change. The first Assessment in 2016 found that the Programme had made a positive start. Many policies and plans already took account of climate change; commitments within the Programme were being fulfilled, and it provided a solid foundation for further progress.

The second and final Assessment was laid before the Scottish Parliament on 19 March 2019. The report focused on what had changed since the Committee's assessment in 2016, in implementing policies and actions set out in the 2014 Programme and in managing Scotland's vulnerability to climate risks. The key findings were:

- Significant progress on peatland restoration, increased marine resilience and an improved understanding of flood risk in Scotland.
- The areas of greatest continued concern included increases in pests and diseases in Scottish forests, declines in seabird populations and soil health.
- Key data and evidence gaps that make it difficult to assess progress for a number of adaptation priorities remain, including the extent of housing and other infrastructure development in flood risk areas and health impacts from climate change.

Business Sector
In February 2018, Adaptation Scotland launched a Climate Ready Business guide, which includes practical examples of steps that businesses can take to increase resilience and adapt to the impacts of climate change. The guide was developed in partnership with Scottish Enterprise, Visit Scotland and the 2020 Climate Group, and was sent to over 20,000 businesses.

Adaptation Scotland
Day-to-day support for this Programme is provided by Adaptation Scotland through sustainability charity Sniffer and funded by the Scottish Government. Adaptation Scotland has supported the growth of a large "adaptation community" of leaders and experts in Scotland. It provides advice and support to help Scotland be prepared and resilient to the effects of climate change. It helps the public sector, businesses and communities to understand what climate change will mean across Scotland, and to identify the best ways to plan for future impacts. Adaptation Scotland has produced important resources, including Climate Ready Places visualisations, guidance for the business sector, and new public sector capability guidance published in May 2019.

Place-Based Initiatives
Sniffer has also led the development of a distinctive Scottish place-based partnership approach to adaptation. The Climate Ready Clyde partnership, initiated with £100,000 support from the Scottish Government, covers the Glasgow City Region including a third of Scotland's population and economy and many of Scotland's most disadvantaged communities. Other significant place-based initiatives are Edinburgh Adapts, Aberdeen Adapts and the newly launched Levenmouth Adapts.

Climate Ready Clyde: Climate Change Assessment
In October 2018, in a link-up with the UN's World Cities Day summit in Liverpool, over 70 of Glasgow City Region's decision-makers attended the launch of Climate Ready Clyde's comprehensive Risk and Opportunity Assessment. Publication in April 2019 of supporting detailed analysis and an economic impact study, and a toolkit for assessing climate change for major projects in May 2019, have made the Glasgow City Region among the best informed regions in the world on its climate risks.

Climate Ready Clyde is now developing an Adaptation Strategy and Action Plan for Glasgow City Region, due in 2020. The aim is to ensure that Glasgow City Region doesn't just adapt, but prospers in the face of climate change.

Annex 2: UK Climate Projections 2018 (UKCP18)

Scotland's Climate Projections: Summer and Winter Changes by 2070				
Season	Emissions Pathway	10th Percentile	50th Percentile	90th Percentile
Rainfall*				
Summer	Low (RCP 2.6)	-37%	-11%	19%
Summer	High (RCP 8.5)	-46%	-14%	21%
Winter	Low (RCP 2.6)	-21%	8%	35%
Winter	High (RCP 8.5)	-14%	18	52
Temperature				
Summer	Low (RCP 2.6)	-0.1°C	1.4°C	2.9°C
Summer	High (RCP 8.5)	0.6°C	2.6°C	4.6°C
Winter	Low (RCP 2.6)	-0.6°C	1.0°C	2.5°C
Winter	High (RCP 8.5)	0.3°C	2.2°C	4.3°C
* Negative percentages indicate drier conditions, positive percentages indicate wetter conditions.				

Scotland's climate projections are taken from the UKCP18 Climate Projections. Met Office © Crown Copyright 2018

The UKCP18 Climate Projections provide probability ranges for future climate change. The figures shown in the 50th percentile column are the central estimates. Figures shown in the 10th and 90th percentile columns show the '*very likely*' range of change. This means the change is very likely to be above the 10th percentile value and very likely be below the 90th percentile value.

Annex 3: Monitoring and Evaluation

Foundation and Principles

Establishing a comprehensive monitoring and evaluation (M&E) framework for the Adaptation Programme is vital to ensure the effectiveness of Scotland's efforts to adapt to the impacts of climate change, identify whether resilience is increasing and opportunities are being realised, and ensure that reporting on progress and implementation is evidence-based.

The first Adaptation Programme was accompanied by significant developments in adaptation monitoring in Scotland and evaluation of the first Programme was able to draw on:

- Annual Public Sector Climate Change Reporting
- Adaptation Indicators published in 2016 by ClimateXChange (Scotland's centre of expertise on climate change).

The monitoring and evaluation framework for the second Adaptation Programme builds on this monitoring foundation and has been developed in response to specific recommendations from both the Adaptation Sub-Committee (of the UK Climate Change Committee) and ClimateXChange to ensure that we can effectively monitor implementation of the Adaptation Programme and track progress towards the outcomes.

The following principles guided the development of the framework:

PRINCIPLE 1: Indicators to measure progress will be considered *at the same time* that planned outcomes are identified. This will encourage the development of *measurable* objectives to enable:

- external evaluation of progress
- internal evaluation of delivery and progress
- timely changes to the programme in response

PRINCIPLE 2: The adaptation process will be monitored to assess whether the programme actions are taking place and that policies and interventions are on track. Process indicators support accountability in the short term, but also monitor the implementation of actions which are aimed at achieving long-term outcomes out-with the usual programme timeframes.

PRINCIPLE 3: The framework will link the adaptation process to adaptation outcomes and aims to discourage the listing of policies and actions without considering their potential effectiveness.

PRINCIPLE 4: The identification of outcome and process milestones will be encouraged to assess interim progress. Routinely identifying milestones and targets, specifying a timetable and considering potential effectiveness, will aid the reporting process and enable the delivery of flexible adaptation strategies.

PRINCIPLE 5: Existing indicators and monitoring frameworks will be utilised where appropriate. This will facilitate integration of adaptation across other policy areas, help to align M&E mechanisms and minimise duplication of reporting effort.

PRINCIPLE 6: Improvement and learning underpins the framework- by identifying what we *need* to measure not just what we know we *can*, the framework can be used as a tool to highlight monitoring gaps which could be filled by future adaptation measures.

The Use of Themes to Structure Monitoring and Evaluation
Outcome and process monitoring themes will structure the quantitative and qualitative evidence for evaluating progress. The following tables for Outcome 5 and 6 provide examples of how this structure will:

- Draw upon existing indicators where possible and appropriate,
- Identify potential indicators for future development,
- Provide case studies where more appropriate or where metrics are unavailable, and
- Help to highlight monitoring gaps.

Outcome 5: Monitoring and Evaluation Indicators Process Monitoring (What are we doing?)	
Themes	**Indicators**
Reducing non-climate pressures	**Existing indicators:** ➢ Area of woodland with active, approved deer management plans (Scottish Forestry Strategy; CXC Adaptation indicator NF14) ➢ Freshwater bodies affected by diffuse pollution due to agriculture (SEPA River Basin Management Plans (RBMPs) pressure data; CXC Adaptation indicator NA14) ➢ Freshwater bodies with less than good morphological status (SEPA RBMPs classification data) ➢ Soil sealing (Ecosystem Health Indicator 13) **Potential indicators:** ➢ Management of Invasive Non-Native Species (Ecosystem Health Indicator 11- currently utilises presence data for a number of key species but '*In the future, absence records will show where these species have been effectively removed through management*')
Habitat restoration/ creation with co-benefits	**Existing indicators:** ➢ Peatland restoration (Climate Change Plan indicators; Ecosystem Health Indicator 10) o Number of hectares of restored peatland per year o Number of hectares on the road to recovery o Number of projects approved for funding from the Peatland Action restoration project funding ➢ Native woodland and forest creation (Climate Change Plan indicators) o Number of hectares of woodland created o Area of new woodland created with grant scheme support o Area of new woodland created on the national forest estate ➢ Extent of urban greenspace (State of Scotland's Greenspace) ➢ Number of planning authorities with current Forest and Woodland Strategies (Climate Change Plan indicator) **Potential indicators:** ➢ Extent of Natural Flood Management schemes (NFM network) **Case studies:** ➢ Creation of pollinator friendly habitats (Pollinator Strategy progress reports)

Increasing collaboration & flexibility	**Potential indicators:** ➢ Area of land under landscape scale conservation (CXC Adaptation Indicator NB7- based on 2014 data gathered by Scottish Forestry) ➢ Progress towards a National Ecological Network (SNH) **Case studies:** ➢ Place-based partnerships for sustainable land use
Managing resources sustainably	**Existing indicators:** ➢ Sustainability Certification Schemes (Aichi Target 7 monitoring) ➢ High Nature Value farming and forestry (Aichi Target 7 monitoring; Ecosystem Health Indicators; CXC Adaptation Indicators NA9 and NF3) ➢ Use of the Ecological Site Classification (ESC) decision support tool (Forest Research; CXC Adaptation Indicator NF6) **Case studies:** ➢ Sustainable land management projects which protect and improve water quality in catchments. Sustainable management of natural resources is also considered under sub-outcome 3.1 in the Economy outcome.
Maximising health and wellbeing benefits	**Potential indicators:** ➢ Prescriptions for Green Exercise (NHS Greenspace/ Our Natural Health Service Programme) ➢ Extent/ creation of greenspace in Air Quality Management Areas **Case studies:** ➢ Green exercise projects The health benefits of the natural environment are also considered under sub-outcome 2.2 in the Climate Justice outcome.
Increasing knowledge and understanding	**Existing indicators:** ➢ Number of land managers/ consultants trained through the Peatland Action programme (Climate Change Plan indicators) **Case studies:** ➢ Citizen science monitoring programmes (e.g. Pollinator Monitoring Scheme) ➢ Natural capital approach on National Nature Reserves (SNH to pilot this to better communicate the socio-economic values of nature)

Improving access to the natural environment	**Potential indicators:** ➢ Green Infrastructure funding (Green Infrastructure Strategic Intervention) ➢ Number of greenspaces improved and regularly used for outdoor learning (Outdoor Learning in Nature Fund) ➢ Extent and connectivity of green corridors for active travel (Sustrans) **Case studies:** ➢ Green Infrastructure projects (e.g. funded through the Green Infrastructure Strategic Intervention)

Sub-Outcome Monitoring (Is it working?)	
Habitat extent and connectivity is protected and enhanced	**Existing indicators:** ➢ Extent of deep peat habitat (James Hutton Institute soil data; CXC Adaptation Indicator NB11) ➢ Extent of native woodland (CXC Adaptation Indicator NB10a based on the Native Woodland Survey Scotland) ➢ Functional habitat connectivity (Ecosystem Health Indicator 8)
Habitat condition is protected and enhanced	**Existing indicators:** ➢ Condition of native woodland (Ecosystem Health Indicator 3) ➢ Condition of freshwater bodies (Ecosystem Health Indicator 6; CXC Adaptation Indicator NB24) ➢ Invasive non-native species (Ecosystem Health Indicator 11; CXC Adaptation Indicators NB37 & NB39 specific for native woodland and freshwater INNS) **Potential indicators:** ➢ Condition of peatland (CXC Adaptation Indicators NB13- draws upon evidence from various sources, update sources to be determined) **Case studies:** ➢ Impact of extreme events on protected sites or key habitats The condition of protected sites is an National Performance Framework indicator considered at outcome level.

The diverse natural environment is protected and enhanced	**Existing indicators:** ➢ Abundance of wintering water birds (Scotland Biodiversity Indicator; CXC Adaptation Indicator NB6b/NB17b) ➢ Abundance of specialist and generalist butterfly species (Scotland Biodiversity Indicator; CXC Adaptation Indicator NB16b) **Potential indicators:** ➢ Changes in species suite (under-development as an Ecosystem Health Indicator) ➢ Measurement of genetic diversity (under-development to enable assessment of Aichi Target 13)
Regulating services are maintained	**Existing indicators:** ➢ Pollinator monitoring (Indicators of Ecosystem Services in Scotland; Pollinator Strategy) ➢ Soil organic carbon stocks (Indicators of Ecosystem Services in Scotland; Ecosystem Health Indicator 7) ➢ Carbon sequestration (Scottish natural capital: ecosystem service accounts) ➢ Air pollutant removal by vegetation (Scottish natural capital: ecosystem service accounts)
Supporting services are maintained	Monitoring will draw on the cross-cutting themes above on habitat extent, condition and diversity.
Provisioning services are maintained	**Existing indicators:** ➢ Area of class 1 agricultural land available (James Hutton Institute Land Capability for Agriculture; CXC Adaptation Indicator NA2) ➢ Abstraction of water for irrigation (SEPA Water Resources Data Returns System; CXC Adaptation Indicator NA13) ➢ Natural regeneration in native woodland (Native Woodland Survey Scotland; CXC Adaptation Indicator NB23) **Potential indicators:** ➢ Contribution of woodlands, forests and the forest sector to the Scottish economy ➢ Volume of available wood fibre Provisioning services are also considered under sub-outcome 3.1 in the economy outcome.
Cultural services are maintained	**Existing indicators:** ➢ Outdoor recreation visits (Scotland's People and Nature Survey, SNH; Scottish Household Survey) **Potential indicators:** ➢ Combined health and ecosystem indicator (under development by NHS Scotland, SNH and SEPA) ➢ Numbers of visits to forests and woodlands (Scotland's People and Nature Survey)

Understanding and recognition are increased	**Existing indicators:** ➢ Attitudes towards the natural environment/ Identification of benefits gained from visits to the outdoors (Scotland's People and Nature Survey/ Scottish Nature Omnibus, SNH) ➢ Numbers of people taking active steps to improve the natural environment (Scottish Nature Omnibus, SNH) **Potential indicators:** ➢ Evidence of public understanding of ecosystem services **Case studies:** ➢ Examples of businesses considering the environment (and its value) in decision-making

Outcome 6: Monitoring and Evaluation Indicators	
Process Monitoring (What are we doing?)	
Themes	**Indicators**
Reducing non-climate pressures	**Potential indicators:** ➢ Proportion of Marine Protected Areas (MPAs) conservation objectives with measures in place (MPA reporting) ➢ Proportion of vulnerable areas identified in the National Coastal Change Assessment covered by Shoreline Management Plans **Case studies:** ➢ Evidence of good practice in the prevention of biofouling
Habitat restoration/ creation with co-benefits	**Potential indicators:** ➢ Extent of restoration of coastal habitats (saltmarsh, dunes) ➢ Creation/ restoration of coastal habitats for flood prevention **Case studies:** ➢ Managed realignment projects
Increasing collaboration & flexibility	**Potential indicators:** ➢ Use of the Place Standard Tool in coastal community planning ➢ Development of regional Marine Planning Partnerships
Managing resources sustainably	**Existing indicators:** ➢ Proportion of fish stocks exploited below F_{MSY} (fishing mortality consistent with achieving maximum sustainable yield) (Marine Plan; UK Marine Strategy indicator) **Potential indicators:** ➢ Vessel monitoring (Outcome 2 of Inshore Fisheries Strategy: '*Marine Scotland will implement an appropriate form of vessel monitoring to provide good quality information on the footprint of inshore fishing'*) ➢ Sustainable development of offshore renewables (Scottish Marine Energy Research (ScotMER)) ➢ Proportion of coastal planning decisions that consider climate change impacts (e.g. anticipated coastal erosion) Sustainable management of natural resources is also considered under sub-outcome 3.1 in the Economy outcome.
Maximising health and wellbeing benefits	The health benefits of the natural environment are also considered under sub-outcome 2.2 in the Climate Justice outcome.

Increasing knowledge and understanding	**Potential indicators:** ➢ % MSS (Marine Scotland Science) survey programme completion ➢ % MSS data submission ➢ Marine Scotland research spend (internal projects and external commissions) ➢ Extent of marine invasive non-native species (INNS) monitoring (Scottish Marine INNS Working Group) ➢ Number of beaches routinely surveyed for litter (Marine Conservation Society Beachwatch programme) **Case studies:** ➢ Citizen science monitoring programmes (e.g. CoCoast, Bioblitz)
Improving access to the natural environment	**Potential indicators:** ➢ Survey of connectivity between the public and marine systems

Sub-Outcome Monitoring (Is it working?)	
Habitat extent and connectivity is protected and enhanced	**Existing indicators:** ➢ Extent of key coastal habitats e.g. dunes, machair, saltmarsh (CXC Adaptation Indicator NB10b) ➢ Extent of key marine habitats e.g. sea grass, kelp-beds, cold-water coral (National Marine Plan, Marine Scotland) **Potential indicators:** ➢ Total area of protected sea (MPAs, SACs)
Habitat condition is protected and enhanced	**Existing indicators:** ➢ Prevalence of marine/ coastal litter (OSPAR; Marine Conservation Scotland; MSS Pilot Scottish Beach Litter Performance Indicators) ➢ Condition of Marine Protected Areas (SNH/ Marine Scotland) **Potential indicators:** ➢ Prevalence of key marine/ coastal non-native invasive species (Scottish Marine INNS Working Group) ➢ Seafloor integrity assessment (Marine Strategy Framework Directive (MSFD) descriptor 6) Good Environmental Status in Scottish waters is an MSFD indicator considered at outcome level.

The diverse natural environment is protected and enhanced	**Existing indicators:** ➢ The numbers and breeding success of seabirds (Biodiversity Strategy indicator; MSFD indicator) ➢ Composition and relative proportions of ecosystem components (MSFD indicator) ➢ Abundance trends of functionally important selected groups/species (MSFD indicator) **Potential indicators:** ➢ Relative abundance of warm water species (Good Environmental Status indicator- ratio between abundance of warm and cold water species; Community Temperature index - MarClim)
Regulating services are maintained	**Existing indicators:** ➢ Blue carbon resources in Scotland's MPA network (Marine Scotland) **Potential indicators:** ➢ Evidence of coastal protection afforded by coastal habitats (Dynamic Coast) ➢ Evidence of saline intrusion (SEPA) ➢ Marine regulating services (e.g. waste remediation, coastal protection, nursery habitats) (SNH feasibility study for a marine natural capital asset index; National Marine Plan)
Supporting services are maintained	Monitoring will draw on the cross-cutting themes above on habitat extent, condition and diversity.
Provisioning services are maintained	**Existing indicators:** ➢ Fish and shellfish stocks/landings (Marine Scotland) ➢ Aquaculture fish and shellfish production (Marine Scotland) Provisioning services are also considered under sub-outcome 3.1 in the Economy outcome.
Cultural services are maintained	**Existing indicators:** ➢ Number of harmful algal blooms (Food Standards Scotland; MCCIP; CXC Adaptation Indicator NM7) ➢ Bathing water quality (SEPA) ➢ Numbers of visits to beaches (Scotland's People and Nature Survey) **Potential indicators:** ➢ Public perceived value of coastal sites

Understanding and recognition are increased	**Existing indicators:** ➢ Awareness of MPAs and their role (Scottish Nature Omnibus, SNH) **Potential indicators:** ➢ Proportion of Crown Estate Scotland assessed for social, economic and environmental benefits and impacts of future decision-making (Marine Scotland and Crown Estate Scotland- under development)

© Crown copyright 2019

OGL

This publication is licensed under the terms of the Open Government Licence v3.0 except where otherwise stated. To view this licence, visit **nationalarchives.gov.uk/doc/open-government-licence/version/3** or write to the Information Policy Team, The National Archives, Kew, London TW9 4DU, or email: **psi@nationalarchives.gsi.gov.uk**

Where we have identified any third party copyright information you will need to obtain permission from the copyright holders concerned.

This publication is available at **www.gov.scot**

Any enquiries regarding this publication should be sent to us at
The Scottish Government
St Andrew's House
Edinburgh
EH1 3DG

ISBN: 978-1-83960-121-7

Published by The Scottish Government, September 2019

Produced for The Scottish Government by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
PPDAS612890 (09/19)