November 2023

Adapting to climate change

Progress in Scotland

Climate Change Committee

Contents

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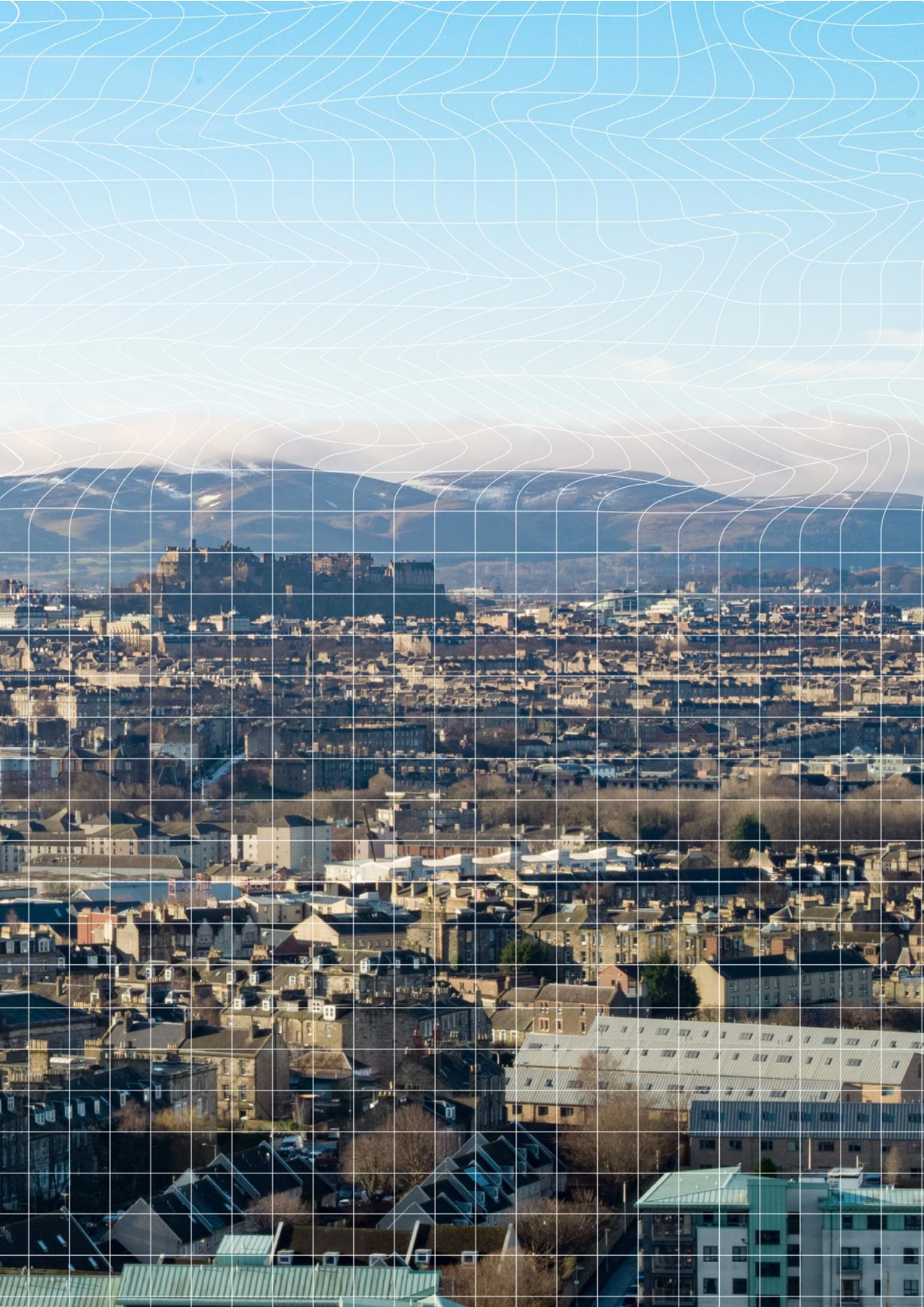


Executive summary

This report sets out the Climate Change Committee's independent assessment of progress in adapting to climate change in Scotland. This report comes near the end of the second Scottish Climate Change Adaptation Programme (SCCAP2) and is our second assessment of this programme, following our report in 2022. It comes ahead of the subsequent Scottish National Adaptation Plan 3 (SNAP3) due to be published in 2024, and soon after significant flooding in October 2023 highlighted the impacts that extreme weather can have on Scotland.

The key messages in our assessment are:

- **Over the last eighteen months there have been several notable steps forward on adaptation policy, but important gaps remain.** The new fourth National Planning Framework makes explicit reference to climate resilience and nature-based solutions and is a clear improvement on planning for flooding and coastal change. New building standards have been implemented to address overheating in new residential buildings. The draft biodiversity strategy, NHS Scotland's climate emergency and sustainability strategy and an adaptation strategy for transport networks are all examples of significant progress in policies and plans for adaptation. Despite this progress, critical gaps remain across sectors. There are insufficient policies and plans in place across all outcomes for water supply, with gaps in drought resilience standards and insufficient leakage reduction targets. Identifying and managing interdependencies across infrastructure sectors remains limited.

- **Overall progress on adapting to climate change in Scotland remains slow, particularly on delivery and implementation.** For only one out of the 33 outcomes identified by the Committee for climate resilience across devolved areas do we find good progress on adaptation delivery. For four outcomes we find clearly insufficient progress; 16 show mixed progress; and for 12 there are insufficient data to meaningfully evaluate progress.

- **Monitoring and evaluation of adaptation is slowly improving but remains limited.** Since our last report in 2022, more analysis of public body reporting on adaptation has become available and data on wildfire incidents are now being recorded, but in many areas insufficient data collection is hampering adaptation efforts. Alongside SNAP3, the Scottish Government is also developing a monitoring and evaluation framework for adaptation which is urgently needed.

- **The next national adaptation plan must embed adaptation in upcoming legislation and drive delivery.** SNAP3, coming in 2024, must build on SCCAP2. It needs to ensure that there are quantified targets for climate resilience, that there are clear linkages between activities and outcomes, with clear ownership of delivery, and must finally address the long-standing absence of an effective monitoring and evaluation system. For it to address the current shortfall in adaptation delivery it must seek to unlock public and private investment in adaptation, and be fully integrated with upcoming legislation and cross-Government objectives on decarbonisation, health and nature.

This executive summary is laid out in two sections:

1. Adaptation progress in Scotland

2. Priorities for the next Scottish National Adaptation Plan

Recent extreme weather reinforces the urgency of adapting to climate change in Scotland.

There is a clear need for further urgent action on adaptation in Scotland. Since our last report in 2022, recent weather extremes have continued to highlight Scotland's ongoing vulnerability to weather and climate extremes.

- 2022 was Scotland's warmest year on record. Scotland's hottest ever day was seen in July 2022 with temperatures reaching nearly 35°C in the Scottish Borders. Heat guidance was issued during this heatwave to limit the impact on people's health across Scotland.

- Early October 2023 brought widespread and prolonged rainfall to Scotland, leading to significant flooding. Major trunk roads were closed; ten people were airlifted from their vehicles to safety; properties were flooded; and Scottish farmers reported the loss of several million pounds worth of produce. Later in October 2023, Storm Babet hit the UK, with record-breaking rainfall totals and river levels occurring in north east Scotland. Flooding was widespread, leading to several deaths, and hundreds of homes impacted alongside transport and power system disruptions.

The Scottish Government must take a lead in preparing for climate change now.

The recent weather extremes highlight the urgency with which the adaptation delivery and planning gaps identified our report must be addressed. Both heatwaves and heavy rainfall are being made more intense by climate change in Scotland. In future, hotter and drier summers are expected, leading to hotter heatwaves, and warmer and wetter winters, alongside rising sea levels, will continue to increase flood risks. These continued changes in weather extremes, and their associated impacts on Scotland's infrastructure, people, nature, built environment and economy must be prepared for with urgency today. The Scottish Government must take a stronger lead.

Assessment findings

There have been several important policy developments since the Committee's first assessment of the current Scottish Climate Change Adaptation Programme in 2022.

This report is the Committee's second assessment of progress in delivering the second Scottish Climate Change Adaptation Programme (SCCAP2). The first assessment of the SCCAP2 programme was published in March 2022. For this progress report we have evolved our assessment framework to increase focus on the tangible changes which need to be supported by adaptation policy through identifying a set of outcomes needed to deliver climate resilience across sectors. In the last eighteen months since our 2022 progress report, there have been several important steps forward in Scottish adaptation policy.

- **The fourth national planning framework** (NPF4) is a significant step forwards in delivering adaptation. It makes explicit reference to climate resilience and nature-based solutions and shows a clear improvement on planning for flooding and coastal change. However, in our last report we recommended that NPF4 should include explicit reference to the location of new infrastructure to consider future climate change impacts, which has not been included.

- **Updated building standards** have been introduced to assess and mitigate against the risk of summertime overheating in new, but not existing, residential buildings. Conversions from non-domestic to residential are also included.

- **The draft Scottish Biodiversity Strategy** sets out Scottish Government's vision for halting biodiversity loss by 2030 and reversing declines by 2045. It focuses on nature restoration, improving protected areas, supporting nature-friendly farming, fishing and forestry, and recovering vulnerable species. The supporting Delivery Plan provides high-level information on the actions to support delivery of the 2030 and 2045 milestones.

- **NHS Scotland's climate emergency and sustainability strategy: 2022-2026** was published in August 2022. The strategy sets out plans to adapt to climate change, review progress annually (both at Health Board and wider NHS Scotland level) and includes several commitments which should help drive forward adaptation, including for all NHS Boards to conduct a risk assessment and prepare an adaptation plan.

- **Transport Scotland's adaptation plan** sets out a vision for a well-adapted transport system, along with four strategic outcomes linked to that vision for trunk roads, rail, aviation and maritime networks. The strategy makes a range of high-level commitments, including publishing a Trunk Roads Adaptation Strategy and ensuring climate change is factored into policy plans from ferry and port operators, with further details expected over the next year.

The level of consideration of adaptation in policy remains mixed across areas and there is slow progress overall in reducing vulnerability and exposure.

These developments are welcome and, if implemented successfully, will make an important difference to Scotland's resilience to climate change. However, the overall extent and quality of policies and plans for adaptation varies across areas, with examples of credible policy and important steps forward in some areas, while additional action urgently needed in others. Delivery and implementation scores show slow progress in translating policy into reduced vulnerability and exposure.

- **In devolved policy areas, policies and plans have generally improved since our last assessment but delivery and implementation remain slow.** There is credible or partial planning for adaptation for a third of climate resilience outcomes where policy levers are devolved (Figure 1). Community preparedness and response scores highly within our monitoring framework, reflecting strong local-level action, and increased emergency response capabilities. Delivery and implementation scores show that plans are not yet reducing risks for communities, ecosystems and the economy, with only one outcome out of 33 with demonstrable good progress.

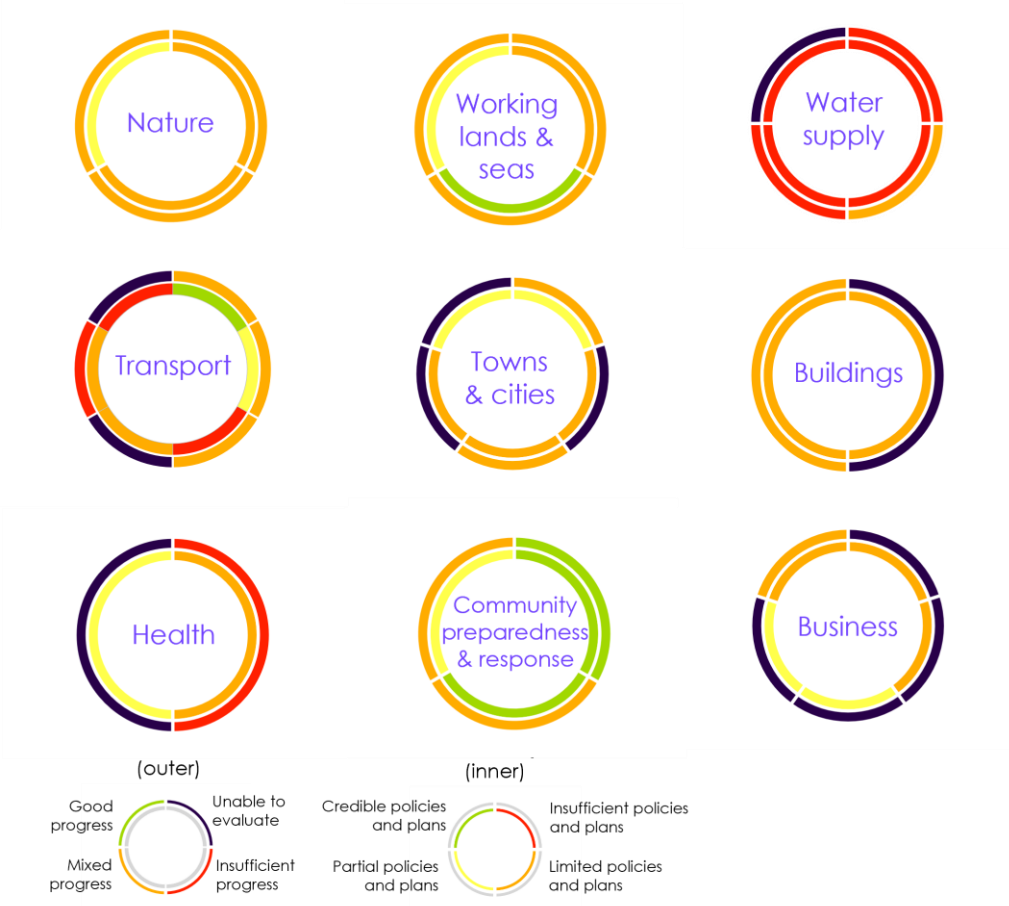
- **In policy areas reserved to the UK Government, data to assess progress are very limited or do not show clear evidence of good progress**. Understanding and monitoring progress on delivering adaptation, even for reserved policy areas (such as telecoms and ICT or the financial system), is important for understanding the adaptation gap and how vulnerable Scotland might be to the full range of climate impacts. For most outcomes across reserved areas we were either unable to evaluate delivery and implementation or available indicators show insufficient or mixed progress (Figure 2).

Insufficient monitoring and evaluation continues to be a barrier to understanding effective adaptation in Scotland.

For each sector the main conclusions of our assessment are summarised in Box 1 (devolved areas) and Box 2 (reserved areas) respectively. As with our previous assessment of adaptation progress in Scotland, a full understanding of climate risks and adaptation progress continues to be limited by significant data gaps. For almost half (20 out of 45) of adaptation outcomes, there are insufficient indicator data at national scale - preventing a full assessment of progress on delivery and implementation. This is a clear consequence of the failure to develop a comprehensive monitoring and evaluation system for SCCAP2.

Some welcome improvements in adaptation monitoring have occurred since our previous progress report. More analysis of public body reporting on adaptation is available and data on wildfire incidents are now being recorded.

Figure 1 Overview of adaptation areas with devolved policy levers



Source: CCC analysis.
Notes: Each segment of the charts corresponds to an identified climate resilience outcome within our framework. The outer ring assesses delivery and implementation, while the inner ring assesses policies and plans. 'Unable to evaluate' for the delivery and implementation score is used when sufficient relevant indicator datasets are not available, up to date, or do not allow a trend to be robustly estimated. Segments are left white where policy is largely reserved.

Figure 2 Overview of adaptation areas with reserved policy levers

Source: CCC analysis.
Notes: Each segment of the charts corresponds to an identified climate resilience outcome within our framework. The outer ring assesses delivery and implementation, while the inner ring assesses policies and plans. 'Unable to evaluate' for the delivery and implementation score is used when sufficient relevant indicator datasets are not available, up to date, or do not allow a trend to be robustly estimated. Segments are left white where policy is largely reserved.

Box 1
Sectoral summaries for devolved policy areas

For each adaptation area with largely devolved policy levers the main conclusions are:

- **Nature:** There has been mixed progress in delivering adaptation outcomes for terrestrial, freshwater, and marine and coastal habitats and species, but data gaps persist in many areas. Peatland restoration rates remain below target. A range of key policies and legislation are in development, which, if designed and delivered effectively will help build the climate resilience of nature in Scotland.
- **Working land and seas:** Progress in delivering adaptation in agricultural productivity, commercial forestry and Scotland's fisheries has been mixed. Monitoring action remains challenging due to the persisting knowledge and data gaps. Policy development across all three sectors has been more promising, with plans for commercial forestry a good example of a coherent strategic approach to adapting to climate impacts. However, there remain areas where substantial improvements are needed, including planning for wildfire risks and introducing the Agriculture Bill, which is necessary to embed the delivery of adaptation into farming practices.
- **Water supply:** Total leakage has reduced slightly but household water consumption increased following the COVID-19 pandemic and has not yet fallen back to pre-pandemic levels. Scottish Government's planned consultation on water industry adaptation should include proposals for drought resilience standards to inform the balance of necessary action across the adaptation outcomes of reduced demand, improved system performance and increased supply.
- **Transport:** There is mixed progress in indicators of road and rail resilience, and evidence of worsening resilience for ferries. Further details and timelines for achieving climate resilience for these transport modes are needed, as well as guidance to inform plans for local roads. Transport Scotland's Approach to climate change and resilience is a welcome step, setting out a vision for a well-adapted trunk roads, rail, aviation and maritime networks.
- **Towns and cities:** There has been some progress towards delivering well-adapted towns and cities. Some plans for resilient development are in place, but data are lacking to comprehensively assess delivery and impact of adaptation interventions for addressing heat, flood and coastal risks. Further guidance, funding and monitoring are required, including as part of the new national flood strategy
- **Buildings:** Available data on overheating in Scotland's building stock is limited and there are gaps in addressing impacts of overheating and flooding in existing buildings. Updates to building standards and national planning policy include flood resilience and will mitigate the risk of overheating in new, but not existing, residential buildings. Delivery and uptake of property level flood resilience remain slow and local authorities lack guidance and funding to implement schemes.
- **Health:** Data to track mortality and morbidity, and disruption to health and social care services due to impacts from weather are not regularly recorded. Public Health Scotland has committed to developing an adverse weather and health plan. Recent commitments and tools from NHS Scotland are an important step in understanding climate risk across NHS Boards and planning adaptation. More coordinated action is needed on understanding and addressing vulnerabilities across the care sector.
- **Community preparedness and response:** There has been good progress in the number of local adaptation actions and mixed progress in upgrading the capabilities of emergency responders and communities, as well as mixed progress in adaptation in the cultural heritage sector. There are promising plans for place-based action, long-term incident response and protection of cultural heritage. Gaps remain in funding allocations and plan evaluation.
- **Business**: Some progress has been made on policy to ensure the resilience of Scotland's supply chains and the provision of guidance for businesses on how to monitor and manage climate risks. However, there are very few data to assess the effectiveness of these policies and the overall climate resilience of businesses.

Box 2
Sectoral summaries for reserved policy areas

For each adaptation area with largely reserved policy levers the main conclusions from our assessment are:

- **Food security:** There is insufficient evidence to evaluate how well food and feed import supply chains are managed due to minimal private sector reporting. Household food insecurity remains high, indicating a high vulnerability to food price shocks. Although policy levers for supply chains are largely reserved, reducing vulnerability of local consumers is gaining policy prioritisation and some positive policies are in place to support food insecure households.
- **Energy:** There is insufficient evidence to comprehensively assess risks to energy assets from climate change in Scotland. Progress on system-level security of supply is mixed; plans are in place for further progress on hydrogen and carbon capture and storage in Scotland, and continued growth in renewable capacity; however, it remains unclear to what extent geographical diversity of assets or other system level adaptation strategies are being factored into planning decisions. Insufficient progress is being made to quantify and manage interdependencies with other infrastructure systems.
- **Telecommunications and ICT:** There is insufficient evidence to assess asset or system level resilience in telecoms and ICT networks in Scotland, or the extent to which interdependencies with other infrastructure systems are being identified and managed. There are examples of system resilience being considered in the delivery of Scottish Government-led digital programmes. The Scottish Government should consider resilience in all their schemes, including the green datacentres action plan.
- **Finance:** There are few data on how financial institutions are incorporating climate risks into their decision-making. Lack of data also hinders the progress assessment on financing gaps that exist for adaptation projects. Large financial institutions in Scotland report their climate risks through the Task Force on Climate-Related Financial Disclosures (TCFD). However, there are shortcomings in current TCFD requirements on disclosing physical climate risk and adaptation measures.

Some areas with significant policy concern remain.

There remain areas where the current state of adaptation policy gives serious concern. There are insufficient policies and plans in place across all outcomes for water supply, with gaps in drought resilience standards and insufficient leakage reduction targets. Identifying and managing interdependencies across infrastructure sectors remains limited. This lack of action will put Scotland at increasing risk of damaging cascading impacts across the economy when weather extremes occur in future.

Priorities for the next Scottish National Adaptation Plan

The next Scottish National Adaptation Plan must build on and strengthen the current programme.

The next Scottish National Adaptation Plan (SNAP3) is expected in 2024. We encourage the Scottish Government to go further in the next programme, building on the outcome-based foundations of SCCAP2 – which started to set out a vision of a well-adapted Scotland – to produce a programme that makes the needed step-change in supporting adaptation delivery across sectors and across all climate risks facing Scotland.

Our key recommendations for the structure of the next adaptation programme are:

- **Quantified targets for climate resilience:** The Scottish Government should set specific and quantified targets for levels of resilience across Scottish society under each outcome of the National Adaptation Programme. This would allow the Scottish Government to measure progress against targets and increase accountability for their delivery.

- **Clear linkages between SNAP activities and outcomes:** A clear framework is needed to link SNAP activities to outcomes. This would also enable better assessments of whether adaptation actions are happening at sufficient scale as well as where key gaps exist.

- **Clear ownership for outcome delivery:** Ownership of each outcome should be clearly assigned to a specific part of Government to ensure accountability.

- **Strengthened monitoring and evaluation:** Monitoring and evaluation of adaptation and climate resilience needs to be prioritised. A lack of sufficient at-scale data collection is hampering the ability to adequately assess progress towards climate resilience across areas. Implementing an effective monitoring and evaluation framework is critical to ensuring that adaptation activity is leading to real reductions in the vulnerability to climate risks towards achieving the SNAP target outcomes. Since our last report, Scottish Government has committed to developing a monitoring and evaluation framework for adaptation which will use indicators to track progress towards the long-term outcomes of SNAP3 and the more specific objectives for the programme. This will be a significant step forwards for the next plan.

Linking with wider policy priorities and unlocking investment are key for the success of the next adaptation plan.

Driving delivery on adaptation means ensuring the SNAP3 is fully integrated with wider upcoming key legislative opportunities, and successfully unlocks more public and private investment to support adaptation actions.

- **Legislative opportunities:** The proposed Land Reform Bill, Agriculture Bill and Natural Environment Bill could be transformational in how Scotland prepares its land and seas for future climate change. If designed and implemented effectively, these bills have the potential to support a wide range of adaptation action including improving upstream flood management and reducing urban heat risks, as well as supporting the resilience of natural ecosystems. The National Care Service (Scotland) Bill 2022, if enacted, would establish the National Care Service in Scotland and create opportunities to enhance services, including on climate resilience.

- **Unlocking investment:** Our report repeatedly finds that increasing Scotland's ambition on adaptation will require new investment, from both public and private sources. Several barriers exist to this investment in climate resilience currently.* A key task for SNAP3 is to understand these barriers better, and to engage on and remove those barriers that sit within Scottish Government control.

Recommendations to address policy gaps in the next adaptation plan are provided throughout this report.

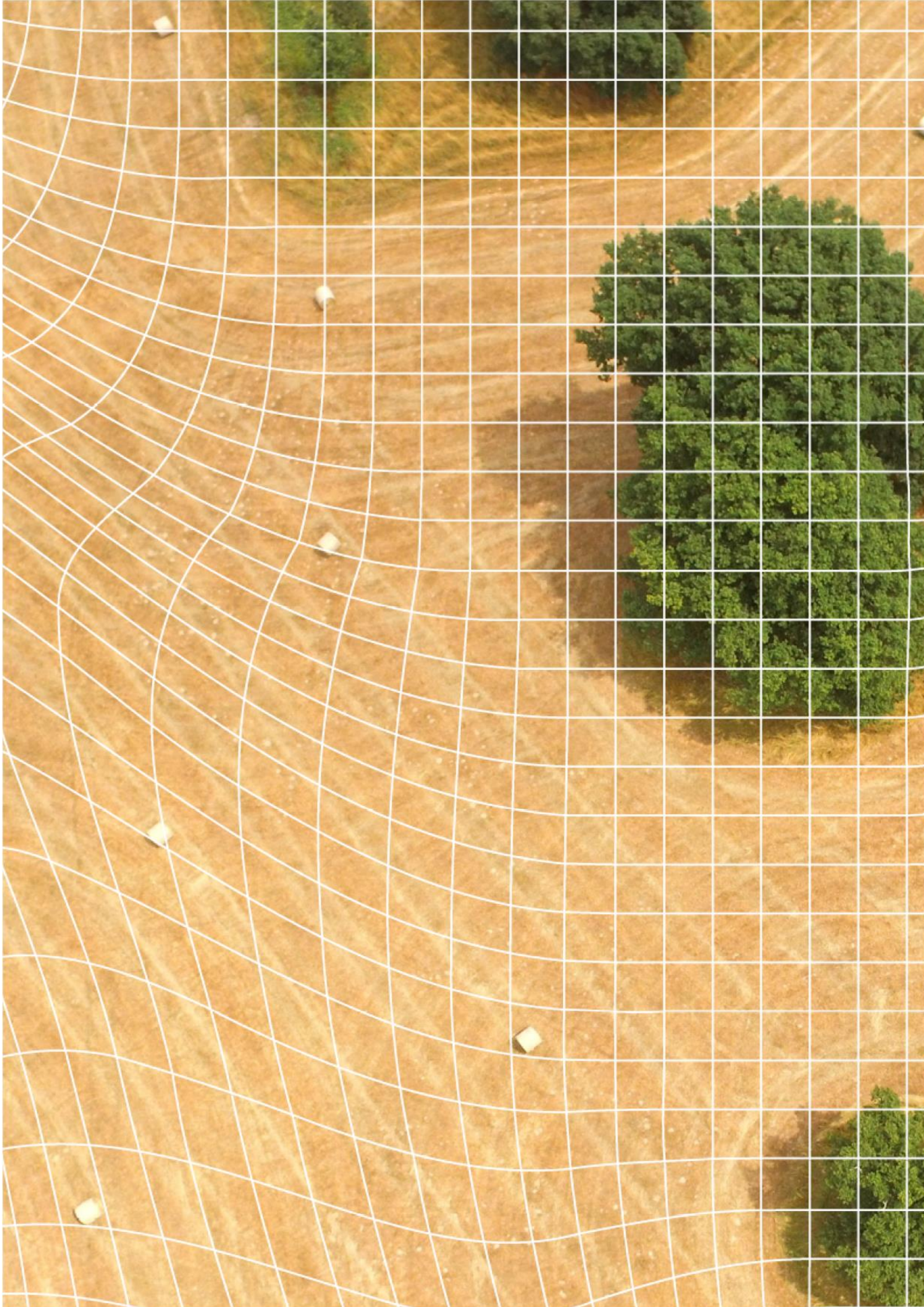
Throughout this report we also provide a detailed set of specific recommendations for SNAP3 to strengthen adaptation across sectors. Table 1 summarises our nine highest priority recommendations for the Scottish Government which, if addressed through SNAP3, will have the greatest impact on reducing Scotland's climate risks. We will assess to the extent to which SNAP3 delivers on these in future.

Table 1
Highest priority recommendations for Scottish Government to address in SNAP3

Chapter	Recommendation	Primary responsibility
Nature	Identify barriers to achieving current peatland targets and consider financial incentives or facilitating private investment in peatland restoration.	Environment and Forestry Directorate
Working lands and seas	Ensure the developing Agriculture Bill and associated policies fully integrate and support adapting to climate change and building climate resilience for the agricultural sector.	Agriculture and Rural Economy Directorate; Land Use Transformation Board; Environment and Forestry Directorate
Water, Energy, Telecoms and ICT, Transport	Include a national assessment of the scale of current and future risks from weather-related cascading infrastructure failures in the Scottish National Adaptation Plan, as well as specific policies and/or actions to plan for, and manage, risks from interdependent infrastructure.	Energy and Climate Change Directorate; Performance, Delivery and Resilience Directorate
Water	The consultation on water sector policies planned for 2023 should include proposals for setting clear drought resilience standards under a changing climate, to inform leakage reduction and per capita consumption targets and future water supply needs.	Energy and Climate Change Directorate
Transport	Develop guidance for local authorities on developing climate change risk assessments (based on UK Climate Projections 2018) and climate change resilience and adaptation plans for local roads.	Transport Scotland
Towns and cities	The new national flood strategy must include a clear vision for managing future flood risk, with measurable targets informed by updates to the National Flood Risk Assessment and the most recent climate projections, accompanied by multi-year funding for local authorities for a wider range of resilience measures.	Environment and Forestry Directorate
Health	Address data gaps on adaptation for health and social care, including conducting or commissioning time series analyses of temperature-related mortality data and establishing monitoring programmes to gather data on disruptions to healthcare due to flooding and overheating.	Population Health Directorate; Public Health Scotland; Directorate General Health and Social Care

* Barriers to investment in adaptation are documented in the Committee's 2023 report Investment for a well-adapted UK.

Buildings	Ensure that support for adaptation alongside decarbonisation is included in key building policies such as the Housing to 2040 Strategy and route map and the Scottish Green Public Sector Estate Decarbonisation Scheme.	Local Government and Housing Directorate; Directorate for Energy and Climate Change
Cross-cutting	Ensure the key data gaps regarding exposure, vulnerability and adaptation are closed across all sectors with the provision of a comprehensive, well-funded and integrated monitoring and evaluation system operational from the start of the next Scottish National Adaptation Plan.	Energy and Climate Change Directorate



Chapter 1: Context

Introduction

This chapter introduces our second independent assessment of the second Scottish Climate Change Adaptation Plan (SCCAP2). It summarises the evidence of past and expected future climate change in Scotland, the assessment framework that we use across this report, and the key recommendations for the next national adaptation programme in Scotland.

The key messages of this chapter are:

- **Climate change is already happening in Scotland and will continue over coming decades**. Temperature and rainfall patterns are already changing in Scotland. The climate will continue to change over the coming decades in all future scenarios, with increasing risks across the Scottish economy and ecosystem if additional adaptation actions are not taken.

- **We assess progress in both planning for a changing climate and in managing climate risks**. We look at adaptation across all aspects of society and ecosystems to assess each one against criteria for credible policies and plans and clear evidence of delivery and implementation.

- **The next national adaptation programme needs to go further to drive delivery.** It should create a clear framework linking adaptation actions to desired outcomes, with quantifiable targets and robust monitoring and evaluation.

This chapter is set out in three sections:

1.1 Observed and projected climate change in Scotland

1.2 Assessment approach

1.3 The next Scottish National Adaptation Plan

1.1 Observed and projected climate change in Scotland

This section covers the latest evidence regarding observed and projected changes in Scotland's weather and climate.

1.1.1 Observed climate change

Observations of Scottish weather and climate continue to document several clear trends in aspects of Scottish climate, consistent with those expected due to global climate change:

- **Warmer average temperature.** Scotland's annual average temperature over the last decade (2013-2022) is now around 0.65°C warmer than it was around 30 years ago (an average of the 1981-2000 period).[1] Scotland's 10 warmest years on record have all occurred since 1997.[2]
  - 2022 was the warmest year ever recorded in Scotland with annual average temperatures of 8.5°C.[3] Scotland's hottest ever day was seen in July 2022 with temperatures reaching 34.8°C in the Scottish Borders at Charterhall.[4]

Scotland's climate has already changed, seeing warmer average temperatures, higher sea levels, increased rainfall.

- **Increased rainfall.** There has been an increase in rainfall over Scotland in the past few decades (with an increasing proportion of rainfall coming from heavy rainfall events). The annual average rainfall over the last decade (2013-2022) is currently around 0.5% wetter than the 1981-2000 average, with summers and winters around 11% and 7.5% wetter respectively.*[,5]
  - In early October 2023, Scotland experienced widespread and prolonged rainfall, marked as the wettest two-day period since 1891 and leading to significant flooding. Major trunk roads were closed; ten people were airlifted from their vehicles to safety; properties were flooded; and Scottish farmers reported the loss of several million pounds worth of unharvested vegetables. Over 50 flood warnings were issued across Scotland.[6]
  - Later in October 2023, Storm Babet hit the UK, with record-breaking rainfall totals and river levels occurring in North-eastern Scotland. Some areas in Angus and Aberdeenshire saw over 150 mm of rainfall in 36 hours.[7] The Met Office issued a rare 'red' weather warning for rainfall in the area. The full extent of the impacts of Storm Babet is yet to be established. Flooding was widespread causing several deaths and hundreds of homes impacted alongside transport and power system disruptions.
- **Higher average sea level.** Mean sea level around the UK has risen by approximately 1.4 mm a year from the start of the 20th century.[8]

* The long-term projection is for decreased summer rainfall totals, but more intense summer rainfall when it does occur. Long-term increases in average Scottish summer rainfall remains within the distribution of climate projections.

1.1.2 Projected climate changes

The UK's Third Climate Change Risk Assessment (CCRA3) was published in 2021. CCRA3 provided a detailed assessment of the changes in the UK and Scotland's weather and climate that are expected in the future. The latest climate projections indicate significant further changes in the Scottish climate:[9]

In the future, annual temperatures in Scotland are projected to rise further, rainfall will likely increase and extreme weather events will become more likely.

- **Temperature.** Annual temperatures in Scotland are expected to rise by around 1°C by 2050 (relative to a 1981-2000 baseline) and between 1°C and 2°C by the end of the century, depending on global efforts to reduce greenhouse gas emissions. Risks associated with rising temperatures, such as more extreme heatwave events causing impacts on people's health and wellbeing, are likely to become more prevalent as a result, with their magnitude depending on the degree of change that is experienced.

- **Rainfall.** In winter, rainfall is expected to increase by approximately 7% by the 2050s and by 7% to 13% by the 2080s (from a 1981-2000 baseline), depending on global efforts to reduce greenhouse gas emissions. This is projected to lead to an increase in the likelihood of flooding of infrastructure, businesses and homes. Conversely, summer rainfall is expected to decrease by approximately 7% by the 2050s and by 12% to 16% by the 2080s. Periods of water scarcity are projected to become more prevalent under these scenarios, leading to possible implications in agriculture and industry.

- **Sea level rise.** Using scenarios for Edinburgh, sea level is expected to rise by between approximately 12 and 18 cm by 2050 (relative to a 1981-2000 baseline) and by approximately 23 to 54 cm by 2080, and depending on global efforts to reduce greenhouse gas emissions. Such rises would lead to an increase in likelihood of associated risks, such as flooding of coastal communities. These rates of sea level rise are lower than for other more southerly UK locations. This is due to the effects of land rebound from the last ice age.

- **Weather extremes.** The frequency and intensity of extreme temperature and rainfall events is also likely to increase in future, with the extent of change depending on global efforts to reduce greenhouse gas emissions. At 2°C of global mean warming, hot summer days will warm by 1 to 1.5°C across Scotland in the 21st century, similar to the change for summer average temperatures.[10] As well as winters becoming wetter overall, the intensity of rainfall is also projected to increase throughout the year. Despite overall summer drying, when it does rain rainfall will be more intense, leading to surface water flooding risks.

Scotland's weather and climate will also continue to be highly variable, with large fluctuations (year-to-year and over longer periods) around the long-term trend.

The CCC was commissioned by the Scottish Government to conduct an independent assessment of the status and effectiveness of climate adaptation planning and action in Scotland. This is the Committee's second assessment of progress in delivering Climate Ready Scotland: Second Scottish Climate Change Adaptation Programme (SCCAP2).

1.2.1 Assessment areas and methodology

A separate publication, CCC Adaptation Monitoring Framework, explains in detail the approach of our updated assessment framework which is applied within each chapter of this report.

(i) Assessment areas

We assess progress across thirteen chapters (Box 1.1) which are structured around assets or systems impacted by climate risks. Often key assets and systems are impacted by multiple risks and require joined up policy to manage them.

Box 1.1
Areas of adaptation covered within each chapter of this report

The areas of adaptation covered within each chapter of this report are:

- **Nature** (Chapter 2): covers protecting terrestrial (including on farmland), freshwater, and marine and coastal habitats and biodiversity from climate change.
- **Working lands and seas** (Chapter 3): covers the necessary adaptation needed to ensure that agriculture, forestry and fisheries and aquaculture sectors remain economically productive under changing climate conditions.
- **Food security** (Chapter 4): covers domestic and imported food supply chains and their climate resilience, as well as the vulnerability of society to climate-related food disruption.
- **Water supply** (Chapter 5): covers the public water system which supplies households and businesses.
- **Energy** (Chapter 6): covers adaptation within the key energy systems including the electricity system (generation, transmission and distribution), gas networks and novel sources of energy supply (such as hydrogen), as they develop.
- **Telecoms and ICT** (Chapter 7): covers the communications and ICT infrastructure (data centres, networks and other critical national infrastructure) that needs to be climate resilient.
- **Transport** (Chapter 8): covers the road networks (both the national strategic road network and local roads), railways, ports and airports.
- **Towns and cities** (Chapter 9): covers adaptation needed within, or for, the built environment. Only settlement-scale adaptation is covered in this chapter. This includes flood defences to protect people and property, urban design to limit urban heat islands and surface water flooding, coastal protection for settlements on the coast and the planning system.
- **Buildings** (Chapter 10): covers building-level interventions to ensure that they are protected from overheating and flooding.
- **Health** (Chapter 11): covers actions needed to ensure public health is maintained and improved despite climate change. This includes mortality and morbidity risks

from overheating as well as climate-sensitive vector-borne diseases and the delivery of health care during periods of extreme weather.

- **Community preparedness and response** (Chapter 12): covers the preparedness of communities for climate impacts, including the ability to protect cultural heritage, and their ability to effectively respond when climate and weather-related disruptions occur.
- **Business** (Chapter 13): covers the adaptation required of business, specific to their function as a commercial entity. This includes adapting their supply chains (both domestic and international), their business sites and assets, access to capital and productivity impacts.
- **Finance** (Chapter 14): covers adapting the UK's financial system so that systemic risks from climate change are minimised and it can effectively support the economy in investing in necessary adaptation actions.

(ii) Assessment methodology

Within each chapter our assessment framework has the following components:

- **A monitoring map**, which lays out an indicative high-level goal or vision for what being resilient to climate change in this area might mean, and identifies tangible key outcomes, enablers and policies that the Committee believes will need to be in place to help deliver this.
- **Evaluation of relevant delivery and implementation indicators** to track progress towards the delivery of the identified outcomes and the extent to which key enabling factors are in place.
- **An assessment of progress against policy and planning requirements** described in the monitoring maps. We document recent developments in relevant policies and plans and assess: to what extent the relevant policy milestones identified on the monitoring maps are in place; to what extent they are appropriately ambitious; and whether there is appropriate monitoring and evaluation to allow them to function effectively.

We assess all relevant policy development since our last report in March 2022 to mid-October 2023, whether it is formally included within the SCCAP2 document or not.

(iii) Scoring

We score progress on adaptation across 'delivery and implementation' and 'policies and plans'.

Within this report, we score progress in preparing for climate change at the level of the identified key outcomes within each chapter. For each outcome we identify two summary scores, one for 'delivery and implementation' and one for 'policies and plans'. The full scoring criteria are outlined in the CCC Adaptation Monitoring Framework.

Whilst most policy areas that are relevant to climate change adaptation are devolved, some areas are reserved to the UK Government. For this assessment we have considered the actions that the Scottish Government could take within this regulatory context in the scoring. We also highlight relevant major actions at a UK-level that will impact Scotland, though this is not included in the scoring of progress. The CCC separately undertakes an assessment of the UK National Adaptation Programme every two years which covers those reserved matters in more detail.[11]

1.3 The next Scottish National Adaptation Plan

The next Scottish National Adaptation Plan (SNAP3) is expected to be published in 2024. It is an opportunity to close gaps identified in this progress report on the current Scottish Climate Change Adaptation Programme (SCCAP2) and build on progress made during its delivery. This report includes detailed recommendations relevant for each of the adaptation areas within the chapters, and a set of highest priority recommendations in the executive summary.

We include recommendations across the chapters in this report, as well as priority recommendations in the executive summary.

In our last assessment of progress in March 2022, we included set of cross-cutting recommendations for how the overall adaptation programme could be strengthened.[12] These were to enable the positive foundation of the SCCAP2 outcomes-based approach to be built on and drive more effective delivery:

- **Quantified targets for climate resilience**: The Scottish Government should set specific and quantified targets for levels of resilience across Scottish society under each outcome of the National Adaptation Programme. This would allow the Scottish Government to measure progress against targets and increase accountability on their delivery.

- **Linkages between activities and outcomes:** A clear framework is needed to link adaptation activities to outcomes. This would also enable better assessments of whether adaptation actions are happening at sufficient scale as well as where key gaps exist.

- **Clear ownership for outcome delivery:** Ownership of each outcome within the National Adaptation Programme should be clearly assigned to a specific part of Government to ensure accountability.

- **Monitoring and evaluation:** Monitoring and evaluation needs to be prioritised. Implementing an effective monitoring and evaluation framework is critical to ensuring that adaptation activity is leading to real reductions in the vulnerability to climate risks and towards achieving target outcomes. The Scottish Government's comprehensive monitoring and evaluation framework developed for reaching greenhouse gas emission reduction goals in Scotland should serve as a benchmark to be replicated for tracking adaptation progress.

These recommendations have largely not been delivered during the remaining course of the SCCAP2 programme but remain critical to a successful programme. They should be fully embedded within the structure and design of SNAP3 from the outset.

SNAP3 should take an outcomes-based approach to provide a vision of a well-adapted Scotland.

In addition, SNAP3 should maintain an outcomes-oriented structure to ensure it presents a coherent vision of what a well-adapted Scotland means. It should ensure that all risks identified for Scotland by CCRA3 are incorporated within the programme and should bring forward needed additional public funding for adaptation as well as seeking to remove barriers to private financing where appropriate. To be successful it must also ensure that climate resilience is fundamental to relevant upcoming pieces of legislation and policy. We have identified numerous important examples of these throughout this report.

Endnotes

[1] Met Office *UK and regional series,* https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-and-regional-series

[2] Adaptation Scotland (2021) *Climate trends and projections,* https://www.adaptationscotland.org.uk/why-adapt/climate-trends-and-projections

[3] Met Office (2023) *Climate change drives UK's first year over 10°C,* https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2023/climate-change-drives-uks-first-year-over-10c

[4] Met Office *UK climate extremes,* www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-extremes

[5] Met Office *UK and regional series,* https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-and-regional-series

[6] Met Office (2023) *Exceptional Rainfall in Scotland, 6 to 7 October 2023*, https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2023/2023_07_scotland_rain.pdf

[7] Scottish Environment Protection Agency (2023) *Storm Babet brings significant flooding with more rain expected,* https://media.sepa.org.uk/media-releases/2023/storm-babet-brings-significant-flooding-with-more-rain-expected/

[8] Sniffer (2021) *Evidence for the third UK Climate Change Risk Assessment (CCRA3) Summary for Scotland.*

[9] Sniffer (2021) *Evidence for the third UK Climate Change Risk Assessment (CCRA3) Summary for Scotland*.

[10] Met Office (2019) *UKCP18 Factsheet: Derived projections*.

[11] CCC (2023) *Progress in adapting to climate change – 2023 Report to Parliament*, https://www.theccc.org.uk/publication/progress-in-adapting-to-climate-change-2023-report-to-parliament/

[12] CCC (2022) *Is Scotland climate ready? – 2022 Report to Scottish Parliament*, https://www.theccc.org.uk/publication/is-scotland-climate-ready-2022-report-to-scottish-parliament/

Chapter 2: Nature

Table 2.1
Progress summary - Nature

	Delivery and implementation	Policies and plans	Summary
Outcome 1: Terrestrial habitats are in good ecological health	Mixed progress	Limited policies and plans	• Available indicators present a mixed, yet patchy, picture of progress. There has been a fall in the proportion of protected sites in favourable condition but improvements in the abundance of some species. Peatland restoration rates remain below target. A lack of data remains an issue in many areas. • Draft key policies (Scottish Biodiversity Strategy) and legislation (Natural Environment Bill, Agriculture Bill) suggest actions are planned that will help build the resilience of nature in Scotland. However, shortfalls in funding levels could be a significant barrier to effective delivery.
Outcome 2: Freshwater habitats are in good ecological health	Mixed progress	Limited policies and plans	• The headline condition indicator of Scotland's freshwaters shows slight improvement, with supporting metrics (e.g. water quality, water flows and levels) showing a relatively high proportion in 'good or better' condition. Human interference in freshwater environments remains a risk to long-term resilience. • Government funding is available to support nature-based solution projects in freshwater habitats, with early findings showing signs of progress. However, noticeable gaps remain in some flagship policies, which still lack clear consideration of climate change.
Outcome 3: Marine and coastal habitats are in good ecological health	Mixed progress	Partial policies and plans	• Available indicators show mixed progress. The extent of marine protected areas is unchanged, but remains above target. Abundance indicators suggest varying trends across species, while new evidence on the condition of sea floor environments in Scotland's marine regions shows around half to be in poor condition. Significant data gaps continue to limit our ability to comprehensively assess progress. • The forthcoming update to the National Marine Plan will include increased focus on managing climate impacts. Plans to place enhanced protections on one-tenth of the Scottish marine environment are to be replaced following stakeholder consultation.

Relevant risks from CCRA3: Risks to terrestrial habitats and species (N1, N2, N3; Risks to soils (N4); Risks and opportunities for natural carbon stores, carbon sequestration and GHG emissions (N5:) Risks to freshwater habitats and species (N11, N12); Opportunities to freshwater habitats and species (N13); Risks to marine habitats and species, and fisheries (N14, N16); Opportunities to marine habitats and species, and fisheries (N15) Risks and opportunities to coastal habitats and species. (N17); Risks and opportunities to landscape character (N18).

This chapter covers adaptation to climate change for habitats and species native to Scotland's terrestrial, freshwater, marine and coastal environments.*

Climate resilient natural ecosystems are vital to ensure the range of benefits that nature provides to the people and the economy of Scotland are protected and maintained.

Thriving natural ecosystems that can prosper despite climate change are important both for the intrinsic value of nature and for the range of benefits that nature provides (often implicitly) to the people and the economy of Scotland (e.g. pollination and improved flood mitigation). If natural ecosystems are damaged by climate change, other societal goals (including climate adaptation, nature recovery and Net Zero) will increasingly be jeopardised. Scotland's nature can be impacted by a wide variety of climate-induced changes, as ecosystems and the species within them are generally adapted for a particular climatic niche. For example, changes to average temperatures, average rainfall, and temperature extremes, as well as increased flood and drought occurrences can affect the viability of ecosystems around Scotland. Degraded and fragmented ecosystems are more vulnerable to climate change as they limit the ability for species to move to their preferred climate niche.

In Scotland, nature and farming policy is largely devolved. NatureScot is the lead public body responsible for advising Scottish Ministers on all matters relating to Scotland's natural heritage, and all public bodies in Scotland have a statutory duty to further the conservation of biodiversity through the proper exercising of their functions.

Climate resilience in nature is strongly linked to resilience across the systems covered in other sections of this report.

Climate resilience in this chapter is strongly linked to resilience across several other sectors (see Box 2.1).

Box 2.1
Interactions with other chapters in this report

This chapter has important interactions with other parts of this report:

- **Working land and seas.** Land-use change and pollution associated with agriculture, forestry and fisheries are drivers of biodiversity loss, while water abstraction by agriculture can also undermine the health of ecosystems and their ability to function.
- **Food.** The food system depends on a healthy, functioning natural environment. This includes diverse and abundant assemblages of biodiversity, which can pollinate crops and control pests. For example, diverse and abundant soil microbiota can enhance soil fertility, which supports crop yields and healthy grasslands.
- **Water.** Measures to improve the condition of nature support its capacity to supply clean water for consumption and use by the public and industry (e.g. improved water supply and filtration benefits through peatland restoration). However, overuse and pollution of water by society can harm nature.
- **Health and community.** Nature helps to keep us healthy in many ways. Trees and hedgerows can improve air quality; access to nature can support mental health; certain plant species can absorb harmful minerals such as lead; and biodiversity has a crucial role to play in mitigating the threat of pests and diseases.
- **Flooding, towns and cities, and infrastructure.** Ensuring adequate adaptation plans are in place using nature-based solutions (NbS), such as riverine tree planting, re-meandering rivers, and green/blue infrastructure (such as urban ponds) help increase infiltration of water, reducing run-off and downstream flooding that can impact infrastructure and urban areas.

* In a change to previous progress reports, farmland habitats are now assessed within the outcome 'Terrestrial habitats are in good ecological condition'.

2.1.1 Outcome 1: Terrestrial habitats are in good ecological health

(i) Delivery and implementation progress

There has been 'mixed progress' in the delivery and implementation of plans and actions to ensure terrestrial habitats are in good ecological health in Scotland.

Indicators for this outcome show **mixed progress** in the delivery and implementation of plans and actions to ensure terrestrial habitats are in good ecological health in Scotland. A fall in the proportion of protected sites in favourable condition and increasing threats from invasive non-native species (INNS) contrast with improvements in the abundance of pollinators. While the rate and diversity of woodland planting in Scotland continues to improve (see Chapter 3), peatland restoration rates, although rising slowly, remain consistently below target. However, data are still severely lacking across many topics.

- **Mixed progress in efforts to improve the condition of natural features in protected sites.*** Over three quarters (76%) of natural features are either in, or recovering towards, a favourable condition status (Figure 2.1). However, there has been a slow decline in the number of features in favourable condition, down from 68% in 2005 to 65% in 2023.[1]

- **Peatland restoration rates remain below annual target levels.** In 2022-23, an estimated 7,000 hectares of peatland were restored by delivery partners as part of the Scottish Government-funded Peatland ACTION programme.[2] This is only around a third of the rate committed to in the 2018 climate change plan, which is to restore 20,000 hectares of peatlands each year.[3]

Despite some improvement, peatland restoration rates remain only around a third of the rate committed to.

- **Abundance indicators for Scotland's pollinator species show long-term increases in most cases, but some bee species are struggling**. The all-species butterfly index increased by 43% over the 1979 to 2021 period (see Figure 2.2). Within this, the generalist species group increased 46%, while the specialist group remained stable.[4] Data on monitored bee populations was more mixed, with some showing steep declines – down 18% between 2010 and 2020.[5] (See also Chapter 3). Under the Pollinator Strategy for Scotland (2017-2027), NatureScot has helped deliver a range of on-the-ground and research projects to help support pollinators to thrive.[6]

- **Northward shift in invasive non-native species (INNS) across Great Britain.** Indicators show an increasing spread northward of 190 established INNS across Great Britain's terrestrial, as well as freshwater and marine environments during the last six decades.[7] Rhododendron is now present in 53,300 hectares in Scotland, while abundance indicators for grey squirrels show almost a five-fold increase in their number over the last two decades.[8,9]

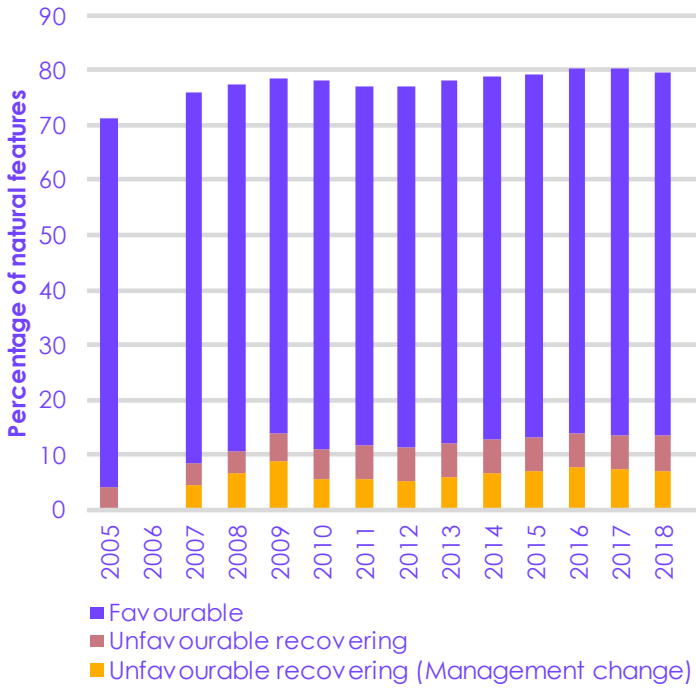
* Natural features relate to a given site's flora, fauna geology or geomorphology. A site can be designated as special interest due to one or a mixture of these features.

- **Conifer species dominate woodland areas in Scotland, but the proportion of broadleaved species is increasing.** In 2023, conifer species represented around 70% of Scottish woodland, down from 80% in 1998. Diverse broadleaved woodlands support climate resilience by providing a healthier, more diverse ecological environment for the community of species it supports compared with conifer plantations; they are also less susceptible to wildfire and wind damage.

The area of certified woodland in Scotland has increased by over a third in the last 20 years.

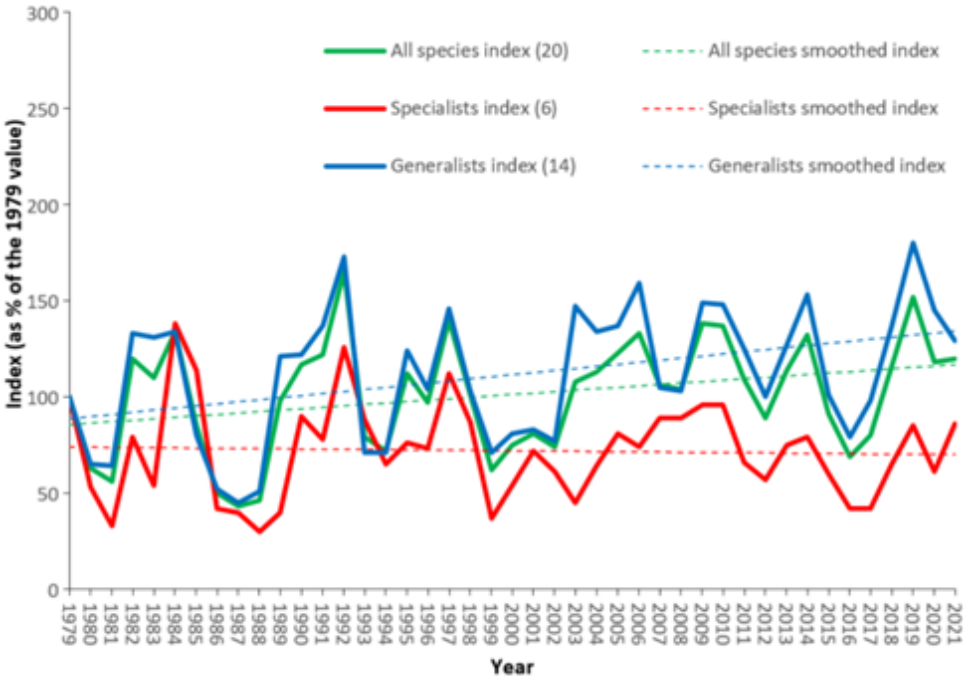
- **The area of certified woodland in Scotland has increased significantly in the last two decades.** The extent of certified Scottish woodland is up by over a third from 664,000 ha in 2004 (49% of total woodland) to 905,000 ha (61% of total woodland) in 2023. However, the total area certified has remained largely unchanged since 2021.[10]

Figure 2.1 Condition of natural features on protected sites in Scotland



Source: NatureScot (2023) *The proportion of Scotland's Protected Sites in Favourable Condition*.
Notes: NatureScot assigns one of eight condition categories to each individual natural feature assessed. Definitions for those presented are: Favourable maintained – An interest feature should be recorded as maintained when its conservation objectives were being met at the previous assessment, and are still being met; Favourable recovered – A feature of interest can be recorded as having recovered if it has regained favourable condition, having been recorded as unfavourable at the previous assessment. Unfavourable recovering – A feature of interest can be recorded as recovering after damage if it has begun to show, or is continuing to show, a trend towards favourable condition. Definitions for the remaining five categories (Favourable declining, Unfavourable no change, Unfavourable declining, Partially destroyed and Totally destroyed) can be found at this link.

Figure 2.2 Scottish butterfly population trends



Source: NatureScot (2022) *Scotland's indicators - Terrestrial Insect Abundance – Butterflies.*

(ii) Policy and planning progress

This outcome has been assessed as having **limited policies and plans**. Emerging details on a range of Government policy initiatives and legislation suggest the Scottish Government is in the process of developing a range of actions that will, if delivered effectively, help build the resilience of nature in Scotland. However, many will not be fully operational until 2025, which places time pressures on the ability to meet proposed targets for nature. Potential delays in implementation could increase risk.

Terrestrial habitats and species are assessed as having 'limited policies and plans' in place to manage risks from climate change.

- **New plans to improve nature in Scotland will require an ambitious delivery programme.** The draft 2022 Scottish Biodiversity Strategy (SBS) sets out Scottish Government's vision for halting biodiversity loss by 2030 and reversing declines by 2045. It focuses on nature restoration, improving protected areas, supporting nature-friendly farming, fishing and forestry, and recovering vulnerable species.[11] Further elements of Scotland's Strategic Framework for Biodiversity were published in September 2023.[12] This included the draft five-year Delivery Plan for the SBS (covering high-level information on the actions to support delivery of the 2030 and 2045 milestones) and draft elements of the new Natural Environment Bill (including some detail on the statutory nature restoration targets being considered). The Bill is not expected to become legislation until year four of the current parliament (2024-25), which will place pressures on the rate of delivery required, if the initial 2030 milestone is to be met.

- **Plans are being developed for a more sustainable approach to managing Scottish farmland, but the pace is slow.** The Agriculture Bill will provide a framework for farmers and crofters to meet food needs sustainably and to farm and croft with nature. Payments partly conditional on achieving climate adaptation outcomes are included in the Bill's proposed 'Future Payments Framework' (FPF).[13] While details are limited, the SBS Delivery Plan

includes actions that will be incorporated within the new agricultural payments scheme.[14] Due to be introduced in 2025, the scheme will support delivery of statutory targets for nature. Separately, plans under the new Land Reform Bill (due end-2023) includes proposals for large landowners to publish Land Management Plans demonstrating how they will meet requirements for sustainable land management.[15]

The new 'Future Payments Framework' proposed under the Agricultural Bill will be a key delivering of statutory targets for nature.

- **Biodiversity enhancement features heavily in the fourth National Planning Framework (NPF4), including some provision for healthy soils.** It includes an outcome to ensure soils are healthy and provide essential ecosystem services. NatureScot provides guidance for ensuring carbon rich soils under development meet NPF4 requirements.[16] However, planning requirements for windfarm developments on carbon rich soils under NPF4 must ensure peatland condition is not compromised. More broadly, soil health protection is covered under the Agriculture Bill commitment to provide guidance on regenerative agriculture, while emerging plans for the forthcoming rural support scheme (see above) include proposals for a new 'Good Agricultural and Environmental Condition' (GAEC) measure for peatland protection.[17,18] Separately, the forthcoming Wildlife Management and Muirburn Bill includes provisions to ensure grouse moors are managed sustainably, including regulation on the use of muirburn.*

- **Additional government funding for improving nature has been allocated, but levels are well short of those required.** The finance gap for nature in Scotland for the next decade has been estimated to be £20 billion.[19] The Scottish Government recognises that the public sector alone will not be able to fund the gap and has published initial guidance covering the role of private finance in helping to address the shortfall. This includes an interim set of principles that set out the Government's ambitions and expectations for a values-led, high-integrity market for responsible private investment in natural capital.[20]

- **A new wildfire strategy for Scotland is in development.** Details on the new strategy are limited, although the CCC understands it is currently at the implementation stage and will focus on developing and enhancing the Scottish Fire and Rescue Service's wildfire capability.[21]

There has been 'mixed progress' in reducing vulnerability and exposure of freshwater habitats to climate change.

2.1.2 Outcome 2: Freshwater habitats are in good ecological health

(i) Delivery and implementation progress

Indicators for this outcome support a score of **mixed progress** in reducing vulnerability and exposure of freshwater habitats to climate change. The headline condition indicator of Scotland's freshwaters shows a slight improvement since 2015, however, anthropogenic pressures continue to hinder the ability of the water environment to remain resilient under climate change.

Several metrics to inform on the health the freshwater environments in Scotland show a relatively high proportion to be in 'good or better' condition.

- **The number of freshwater bodies classified as being in 'good or better' condition overall has increased slightly since 2015.** Two-thirds (66%) of Scotland's water environment was assessed as being in 'good or better' condition in 2020. This is up 3% since the second River Basin Management Plans (RBMPs) were published in 2015.[22] Scotland's rivers and lochs cover 2%

* The controlled burning of vegetation on peatland.

of Scotland's land area and contain 90% of the UK's surface freshwater.[23] The overall condition score is determined based on a range of water condition themes. The Scottish Environment Protection Agency (SEPA) classifies each part of the water environment based on the worst condition of any category. Analysis of the underlying condition categories shows a relatively high proportion to be in 'good or better' condition (Figure 2.3):[24,*]

- Water quality is now in good or better condition in 87% of Scotland's water environment, up from 82% in 2015.
- Flows and levels assessed at good or better condition were found in 90% of rivers, lochs and groundwaters, up from 88% in 2015.
- 88% of Scotland's rivers and lochs are at good or better condition for fish migration, up from 86% in 2015.
- The physical condition of the water environment assessed as at good or better condition was found in 90% of Scottish waters.

The condition of rivers in the Scotland River Basin District remains a concern, however, with 42% rated below 'good condition' in 2020.[25]

Pressures from human interference continue to hinder the ability of the water environment to remain resilient under climate change.

- **Improvements in the condition of some groundwaters in the Scotland.**† The proportion of monitored groundwaters classified as good rose from 76% in 2012 to 84% in 2020. Groundwater stocks are a key support to the water environment; when fully stocked they overflow to help replenish and maintain surface water levels. [26]

- **Numbers of Scotland's wintering waterbirds have seen long-term declines, although different species are exhibiting different trends**. Overall waterbird numbers decreased 10% from the 1975/76 to 2019/20 period, with increases in goose species (up 263%) and ducks and swan species (up 3%), contrasted by declines in waders (down 55%).‡ This could partly be due to some species shifting their distribution in response to environmental change.[27]

- **Rural diffuse pollution (RDP) affected the highest number of water bodies in Scotland in 2020.**§ The number of surface waters affected by RDP in 2020 was 257, up from 246 in 2015. There were declines in the two other most prevalent pressures faced by Scotland's water environment; between 2015 and 2020, the number of surface waters affected by man-made barriers to fish migration fell from 306 to 247, while the number facing pressures from modifications to physical condition declined from 255 to 208.[28]

- **Increases in freshwater temperatures recorded in the short-term.** New research shows that between 2015 and 2019, 97% of monitored Scottish lochs and reservoirs have increased in water temperature. While most

* Analysis as at 2020.

† Data relates to Scotland area only of the Scotland and Solway Tweed river basin district.

‡ 41 species surveyed in total of which seven were goose, 16 were ducks and swans, and 14 were waders.

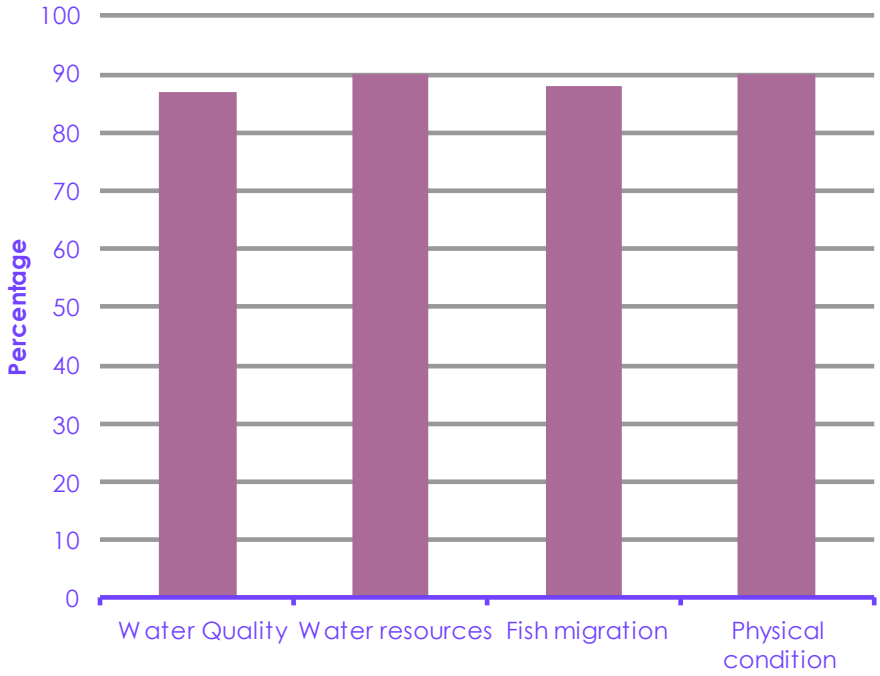
§ Rural diffuse pollution includes the use of fertiliser in agriculture and forestry, and pesticides from a wide range of land uses.

warmed by up to 1.0°C per year over this period, 9% increased by more than that – some by up to 1.3°C per year.[29]

Data gaps limit the CCC's ability to assess the use and effectiveness of nature-based solutions to manage flood risk.

- **The use of land for natural flood management (NFM) is poorly recorded.** More resources should be allocated to measure the extent and effectiveness of nature-based solutions (NbS) to manage flood risk.

Figure 2.3 Condition of the Scottish water environment



Source: SEPA (2021) *The River Basin Management Plan for Scotland 2021 – 2027*.

(ii) Policy and planning progress

The assessment found there to be 'limited policies and plans' in place to ensure freshwater habitats are in good ecological health.

Assessment of this outcome has found there to be **limited policies and plans** in place to ensure freshwater habitats are in good ecological health. Funding is available to support a range of NbS projects that aim to restore and regenerate freshwater habitats. However, clearer link up is needed between how the specific actions and the areas targeted, via the various environmental and agricultural schemes, will support the Scottish Government's high-level goals for the freshwater environment.

- **Ambitious new plans to improve Scotland's water environment, but more details are needed on how targets will be achieved.** The draft Scottish Biodiversity Strategy (SBS) includes the commitment to restore and regenerate biodiversity in freshwater habitats by 2045.[30] The accompanying SBS Delivery Plan includes proposals on the actions that will be taken to achieve the 2025 commitment, many of which will be delivered through the latest River Basin Management Plans (RBMP). The forthcoming Agricultural Payments Scheme should also support efforts to improve rural rivers, including riparian planting. However, current information, particularly for the proposed Agricultural Payments Scheme, as yet lacks sufficient detail on the specific actions that will be taken and the areas that will be targeted to achieve the RBMP outcomes. Furthermore, while risks from

climate change are referred to in the range of plans, it is not clear how shifting climate conditions will be considered and the appropriate actions developed.

Proposals under the draft Scottish Biodiversity Strategy include targets and actions that if delivered effectively will build the resilience of freshwater habitats.

- **Online resources have been made available to support land managers to sustainably manage the water environment.** The Water Environment Hub provides information on the health, impacts, action to be taken and planned future condition for Scotland's water environment including rivers.[31] Land managers can view relevant data at the individual river, catchment, local authority or national park levels, as well as information on the pressure, appropriate measures and the objectives set by SEPA.

- **Government funding has been provided to bring Scotland's freshwater environments back to good health, but some adaptive measures are not eligible for financial support**:

  – The Water Environment Fund provides £1 million annually to projects that help restore Scotland's rivers, lochs, floodplains and estuaries.[32] Grants are prioritised for actions that improve river corridors and remove barriers to fish migration, however, funding is currently unavailable for actions to eradicate invasive non-native species.

  – Freshwater restoration, including restoration of natural flows in rural catchments, is one of the five priority themes under the Nature Restoration Fund. The £65 million fund provides grants of up to £250,000 for eligible projects.[33]

  – NatureScot's Biodiversity Challenge Fund has invested £3.7 million in 27 freshwater and river restoration projects across Scotland, using innovative, NbS to help reverse biodiversity loss and mitigate against the effects of climate change.*,[34]

2.1.3 Outcome 3: Marine and coastal habitats are in good ecological health

(i) Delivery and implementation progress

Indicators for this outcome support a score of **mixed progress** in the delivery and implementation of actions to reduce vulnerability and exposure of marine and coastal habitats to climate change. The extent of protected marine areas is unchanged since our last assessment but remains above target. Abundance indicators show mixed trends across species, while new research reports that the sea floor of almost half of marine regions are in poor condition.

Indicators suggest there has been 'mixed progress' in the delivery and implementation of actions to reduce vulnerability and exposure of marine and coastal habitats to climate change.

- **The extent of Marine Protected Areas (MPAs) in Scotland is unchanged since our last assessment, but levels remain above target**. Scotland's MPA network covers 37% of the Scottish marine environment across 247 sites. This exceeds the commitment made by Scottish Government in its 2020 Statement of Intent on Biodiversity to protect at least 30% of our land and sea for nature by 2030. Data on the breeding success of seabirds (the number of chicks produced) was more positive, although again, there was a mixed picture across all species assessed.[35]

* As at 1st April 2022.

Seabird population have stabilised in the short-term, but remain only half the number recorded in the mid-1980s.

- **Data on the abundance of marine species presents a mixed picture.** Populations of most Scottish breeding seabird species' surveyed show they have declined by over half (down 51%) since 1986, although overall abundances have been largely stable since 2008 (Figure 2.4). Despite this, there is considerable variation within categories, with different species exhibiting different trends.[36] There has been some progress in mean breeding success with data showing 2019 as being 6% above the long-term average (75%), although again, there is significant variation between seabird species.* Abundance data for other marine species show more positive signs of progress, with four of the five taxonomic groups surveyed recording a significant increase in average abundance over the 1998 to 2020 period (see also Chapter 3).† The 'other fish group', sharks and relatives (Elasmobranchii), increased by 301% over the same period, whereas cephalopods (e.g. squid, octopus) and a small grouping of other invertebrates increased by 398% and 99% respectively.[37]

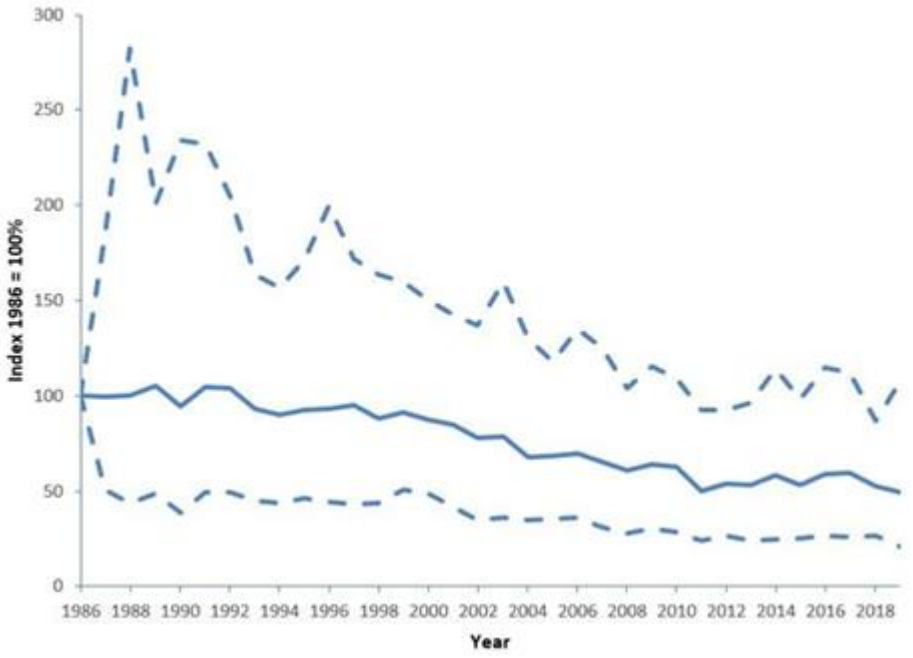
- **Marine litter remains a significant threat to the health of Scotland's marine species.** Research by Marine Scotland has found microplastics to be present in all Scottish sea areas surveyed.[38] The analysis surveyed 372 sites within the 11 Scottish Marine Areas and 26 within off-shore marine regions, over the 2013/14 to 2019/20 period.† Marine pollution from anthropogenic inputs of hazardous substances across the UK more generally has declined sharply in the long-term; down 78% between 1990 and 2019.[39]

- **Long-term upward trend in water temperatures in Scotland's marine environment.** All Scottish Marine Regions show an increasing trend in sea surface temperature from 1893 - 2018, with increasing trends for each region between 0.05 °C and 0.07 °C per decade.[40]

* Breeding success measures the number of chicks surviving to fledging.

† Other marine species relates to non-sea bird species.

Figure 2.4 Index of breeding seabird numbers



Source: NatureScot (2020) *Scottish Biodiversity Indicator – The Numbers and Breeding Success of Seabirds (1986 to 2019).*
Notes. (1) Index set to 100 at start of period. Blue dashed line shows average index level from 2011 to 2019. (2) The dashed line shows the 95% confidence limits.

(ii) Policy and planning progress

Our assessment of this outcome has found there are **partial policies and plans** in place to ensure marine and coastal habitats are in good ecological health. Initial plans for the next National Marine Plan suggest an increased focus on managing changing climatic conditions. Plans for highly protected marine areas have been withdrawn following consultation with stakeholders.

There are 'partial policies and plans' in place to ensure marine and coastal habitats are in good ecological health.

- **Update to the National Marine Plan (NMP) will be delivered in 2025**. The Scottish Government has commenced the development of the second NMP. Scottish Ministers have committed to publishing and beginning the implementation of the new NMP by 2026.[41] The programme of work includes a public consultation on the draft Plan and assessments in summer 2024. The Plan will aim to address the climate and nature crises, including supporting the delivery of Scottish Government's legal commitment to reach Net Zero by 2045, by carefully managing increased competition for space and resources in the marine environment.* The revised Plan will look to incorporate findings from the 2021 review of NMP1, which concluded climate change to be the most critical factor affecting Scotland's marine environment and that climate impacts are already being seen across the Scottish marine ecosystem.[42] Scotland's Marine Assessment 2020 (SMA2020) will act as the primary evidence base for the development and assessment of NMP2, providing an overview of the state of Scotland's seas, and of the main activities and pressures within our marine area.[43]

* The National Marine Plan sets out strategic policies for the sustainable development of Scotland's marine resources out to 200 nautical miles.

Our 2022 report concluded that while the Plan's 11 objectives were appropriately specific, achievable and relevant, they are largely not measurable or time bound making it difficult to assess progress in implementation.* Work to address this should be reflected in the next NMP.

The draft Scotland Biodiversity Strategy (SBS) - Delivery Plan includes new actions to build resilience in coastal and marine systems.

- **The draft Scottish Biodiversity Strategy (SBS) - Delivery Plan includes new actions to build resilience in coastal and marine systems**. This includes proposals to develop Coastal Change Adaptation Plans and to publish a plan for marine and coastal ecosystem restoration by 2025. These will be supported by a framework for statutory nature restoration targets within the forthcoming Natural Environment bill. All new targets, including those relating to marine and coastal habitats, must be SMART (specific, measurable, attainable, relevant and time-bound) and supported by outcomes that are appropriate in the context of climate change.

- **Regional Marine Plans are being developed in three of the eleven Scottish Marine Regions.** This is being led by the Marine Planning Partnerships that have delegated functions to develop these plans. The eleven marine regions are defined in the Scottish Marine Regions Order 2015 and cover the Scottish Marine Area from mean high water spring tide out to a maximum 12 nautical miles. The three Regional Marine Plans in development are in the Shetland, Clyde and Orkney marine regions. National marine planning sets the wider context for marine planning in Scotland whereas regional marine planning creates more locally tailored plans and more local ownership. Regional Marine Plans must be in conformity with other policy including the National Marine Plan and UK-wide Policy statement. The Scottish Government published the formal response to the final report of the Environment, Climate Change and Land Reform Committee Inquiry into the Development and Implementation of Regional Marine Plans in Scotland, in August 2023. As part of this response the Scottish Government has made a range of commitments and provided details on its approach to regional marine planning with the position that no further Marine Planning Partnerships (MMP) should be established until after the adoption of the National Marine Plan 2 with the exception of the Western Isles where early work on developing an MPP had commenced.†

Scottish Government has committed to developing a new pathway and timetable for enhancing marine protection.

- **Initial proposals to place enhanced protections on one-tenth of the Scottish marine environment have been withdrawn.** Scottish Government had previously committed to ensuring at least 10% of Scotland's seas would be designated as Highly Protected Marine Areas (HPMAs) by 2026.[44] However, following initial analysis of consultation responses and engagement with stakeholders, Scottish Government has committed to developing a new pathway and timetable for enhancing marine protection. A consultation report will be published in autumn 2023. It is understood the revised pathway will be in line with draft Biodiversity Strategy ambition for Scotland to be nature-positive by 2030.

- **Plans are underway to improve progress in monitoring marine and coastal habitats, but gaps remain.** NatureScot has conducted marine survey and monitoring work to inform the designation and management of MPAs. Scottish Government will also develop a new approach to marine biodiversity monitoring, including testing through pilots, covering both state

* Objectives include those for biological diversity, invasive species and the integrity of seafloor ecosystems.

† Western Isles relates to the Scottish Marine Region for the Outer Hebrides.

and pressure work. This will include a review of the Scottish MPA Monitoring Strategy. It responds to the 2021 review of the NMP, which found there to be too few ecosystem monitoring sites and insufficient data to allow detailed assessment at scale. Our 2022 report noted Scotland was the only UK nation that is yet to commit to a funded coastal monitoring strategy. It is not clear if funding has been allocated since our last assessment.

Scottish Government plan to develop a new approach to marine biodiversity monitoring.

- **New initiative to leverage public and private investment towards projects that enhance marine environments.** The Scottish Marine Environmental Enhancement Fund (SMEEF) is supported by Scottish Government, Crown Estate Scotland and NatureScot to leverage public and private investment towards projects that recover, restore, or enhance the health of marine and coastal habitats and species across Scotland. Since 2021, SMEEF has distributed £3.3 million to 50 projects around Scotland's coasts and seas. Many of these projects are new or in early stages of development, demonstrating that the Fund acts as a key pipeline investor for the emerging marine restoration sector. Alongside grant funding, SMEEF also provides guidance, and has recently published a new toolkit to help communities and groups wishing to undertake marine restoration projects understand best practice as well as regulatory requirements.

2.2 Recommendations

Table 2.2
Recommendations

Primary responsibility	Recommendation	Timing
Environment and Forestry Directorate	Identify barriers to achieving current peatland targets and consider financial incentives or facilitating private investment in peatland restoration.	2024
Agriculture and Rural Economy Directorate	Scottish Government should publish full details on how the new Agricultural Payments Scheme will support the delivery of outcomes outlined in the draft Biodiversity Strategy and latest River Basin Management Plan. This should include clear guidance on which actions that reduce vulnerability to climate change will be eligible for payments under the scheme.	2024
Environment and Forestry Directorate	A replacement to the Scottish Invasive Species Initiative (SISI) should be established immediately after the current initiative expires in 2023.	2023
Environment and Forestry Directorate	Risks to freshwater environments from higher water temperatures should be better managed through adopting an integrated catchment-based approach for setting water quality targets and planning interventions in Scotland's lochs and reservoirs.	2025
Marine Directorate	The forthcoming update to the National Marine Plan for Scotland should ensure the objectives it contains are measurable and timebound.	2024

Endnotes

[1] NatureScot (2023) *The proportion of Scotland's Protected Sites in Favourable Condition,* https://www.nature.scot/doc/proportion-scotlands-protected-sites-favourable-condition-2023.

[2] Scottish Government (2023) *Climate change monitoring report 2023,* https://www.gov.scot/publications/climate-change-monitoring-report-2023/pages/8/#:~:text=In%202022%2D23%2C%20an%20estimated,2023%2C%20following%20quality%20assurance%20processes.

[3] Scottish Government (2020) Securing a green recovery on a path to net zero: climate change plan 2018–2032 – update, https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages/12/.

[4] NatureScot (2022) *Scotland's indicators - Terrestrial Insect Abundance – Butterflies,* https://www.nature.scot/doc/scotlands-indicators-terrestrial-insect-abundance-butterflies.

[5] Comont, R., Luker, S., Dickinson, H. (2021) *BeeWalk Annual Report*, https://www.bumblebeeconservation.org/wp-content/uploads/2021/10/BeeWalk-annual-report-2021-FINAL-BBCT190.pdf.

[6] NatureScot (2023) *Pollinator Strategy - 2022 Progress Report, https://www.nature.scot/doc/pollinator-strategy-2022-progress-report.*

[7] Scottish Government (2023) *Tackling the Nature Emergency - Scottish biodiversity strategy to 2045,* https://www.gov.scot/publications/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland-2/pages/4/.

[8] Forestry Commission (2016) *NFI preliminary estimates of the presence and extent of rhododendron in British woodlands*, https://cdn.forestresearch.gov.uk/2022/02/presence_of_rhododendron_in_british_woodlands.pdf.

[9] NatureScot (2023) *Scotland's Nature*, https://scotlandsnature.blog/2023/10/02/get-involved-in-the-fifth-annual-great-scottish-squirrel-survey/.

[10] Forest Research (2022) *Forestry Statistics 2022,* https://cdn.forestresearch.gov.uk/2022/09/Ch1_Woodland_2022.pdf.

[11] Scottish Government (2022) *Biodiversity strategy to 2045: tackling the nature emergency,* https://www.gov.scot/publications/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland/.

[12] Scottish Government (2023) *Tackling the Nature Emergency - strategic framework for biodiversity: consultation,* https://www.gov.scot/publications/tackling-nature-emergency-consultation-scotlands-strategic-framework-biodiversity/.

[13] Scottish Government (2023) *Agriculture Bill: consultation analysis*, https://www.gov.scot/publications/agriculture-bill-analysis-consultation-responses/.

[14] Scottish Government (2023) *Tackling the Nature Emergency - strategic framework for biodiversity: consultation,* https://www.gov.scot/publications/tackling-nature-emergency-consultation-scotlands-strategic-framework-biodiversity/.

[15] Scottish Government (2022) *Land reform in a Net Zero Nation: consultation paper*, https://www.gov.scot/publications/land-reform-net-zero-nation-consultation-paper/pages/7/.

[16] NatureScot (2023) *Advising on peatland, carbon-rich soils and priority peatland habitats in development management,* https://www.nature.scot/doc/advising-peatland-carbon-rich-soils-and-priority-peatland-habitats-development-management.

[17] Scottish Government (2023) *Agriculture and Rural Communities (Scotland) Bill, part 4, section 26. Code of Practice on Sustainable and Regenerative Agriculture,* https://www.parliament.scot/-/media/files/legislation/bills/s6-bills/agriculture-and-rural-communities-scotland-bill/introduction/bill-as-introduced.pdf.

[18] Scottish Government (2023) *New Rural Support Scheme development - evidence: outputs summary,* https://www.gov.scot/publications/evidence-support-development-new-rural-support-scheme-scotland-summary-written-outputs/pages/11/.

[19] Green Finance Institute (2021) *Finance Gap for UK Nature report*, https://www.greenfinanceinstitute.co.uk/news-and-insights/finance-gap-for-uk-nature-report/.

[20] Scottish Government (2023) *Interim Principles for Responsible Investment in Natural Capital,* https://www.gov.scot/publications/interim-principles-for-responsible-investment-in-natural-capital/#:~:text=The%20Scottish%20Government%20is%20committed,and%20supports%20a%20Just%20Transition.

[21] Scottish Fire and Rescue Service (2023) *Wild Strategy (update),* https://external-doc-library.s3.eu-west-2.amazonaws.com/PROD/wildfirestrategy-final01-update-gg.pdf.

[22] Scottish Environment Protection Agency (2021) *The River Basin Management Plan for Scotland 2021 – 2027*, https://www.sepa.org.uk/media/594088/211222-final-rbmp3-scotland.pdf.

[23] Environmental Standards Scotland(2023) *Baseline Evidence Review – Water (Strategy and Analysis),* https://www.environmentalstandards.scot/wp-content/uploads/2023/04/Baseline-Evidence-Review-Water-DRAFT-2022-08v2-1.pdf.

[24] Environmental Standards Scotland (2023) *Baseline Evidence Review – Water (Strategy and Analysis),* https://www.environmentalstandards.scot/wp-content/uploads/2023/04/Baseline-Evidence-Review-Water-DRAFT-2022-08v2-1.pdf.

[25] Environmental Standards Scotland (2023) *Baseline Evidence Review – Water (Strategy and Analysis),* https://www.environmentalstandards.scot/wp-content/uploads/2023/04/Baseline-Evidence-Review-Water-DRAFT-2022-08v2-1.pdf.

[26] Environmental Standards Scotland (2023) *Baseline Evidence Review – Water (Strategy and Analysis),* https://www.environmentalstandards.scot/wp-content/uploads/2023/04/Baseline-Evidence-Review-Water-DRAFT-2022-08v2-1.pdf.

[27] NatureScot (2023) *Scotland's Indicators- Wintering Waterbird Indicator,* https://www.nature.scot/doc/scotlands-indicators-wintering-waterbird-indicator#:~:text=Overall%20waterbird%20numbers%20(41%20species,lower%20than%20in%201975%2F76.

[28] Environmental Standards Scotland (2023) *Baseline Evidence Review – Water (Strategy and Analysis),* https://www.environmentalstandards.scot/wp-content/uploads/2023/04/Baseline-Evidence-Review-Water-DRAFT-2022-08v2-1.pdf.

[29] Centre of Expertise for Waters (2022) *Assessing climate change impacts on the water quality of Scottish standing waters,* https://www.crew.ac.uk/sites/www.crew.ac.uk/files/publication/CREW%20%E2%80%93%20Assessing%20climate%20change%20impacts%20on%20the%20water%20quality%20of%20Scottish%20standing%20waters_1%2Blink3_0.pdf.

[30] Scottish Government (2022) *Biodiversity strategy to 2045: tackling the nature emergency,* https://www.gov.scot/publications/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland/.

[31] Scottish Environment Protection Agency (2023), *The Water Environment Hub,* https://www.sepa.org.uk/data-visualisation/water-environment-hub.

[32] Scottish Environment Protection Agency (2022) *The Water Environment Fund,* https://www.farmingandwaterscotland.org/funding-grants-and-resources/sepa-water-environment-fund/.

[33] Scottish Government (2022) *Nature Restoration Fund,* https://www.nature.scot/funding-and-projects/scottish-government-nature-restoration-fund-nrf.

[34] NatureScot (2022) *Scotland's rivers in recovery after £3.7m investment,* https://www.nature.scot/scotlands-rivers-recovery-after-ps37m-investment.

[35] NatureScot (2023) Marine Protected Areas (MPAs), https://www.nature.scot/professional-advice/protected-areas-and-species/protected-areas/marine-protected-areas-mpas.

[36] NatureScot (2020 *Scottish Biodiversity Indicator – The Numbers and Breeding Success of Seabirds (1986 to 2019),* https://www.nature.scot/doc/scottish-biodiversity-indicator-numbers-and-breeding-success-seabirds-1986-2019#:~:text=The%20mean%20numbers%20of%2011,%2Dterm%20average%20of%2075%25.

[37] NatureScot (2022), *Official Statistics - Marine and Terrestrial Species Indicators: Experimental Statistic,* https://www.nature.scot/doc/official-statistics-marine-and-terrestrial-species-indicators-experimental-statistic.

[38] Marine Scotland Assessment (2020) *Microplastics in surface water,* https://marine.gov.scot/sma/assessment/microplastics-surface-water#background.

[39] JNCC, (2022), *UK biodiversity indicators*, https://jncc.gov.uk/our-work/ukbi-b5b-marine-pollution/#:~:text=Levels%20of%20all%20six%20substances%20declined%20over%20the,respectively.%20The%20organic%20compound%20lindane%20decreased%20by%2086%25.

[40] Marine Scotland Assessment, (2020), *Physical characteristics and ocean acidification Temperature,* https://marine.gov.scot/sma/assessment/temperature#:~:text=Scottish%20Marine%20Regions,region%20was%20not%20statistically%20significant.

[41] Scottish Government (2023) *First Minister's Policy Prospectus, Equality, opportunity, community: New leadership - A fresh start, https://www.gov.scot/news/a-fresh-start-for-scotland/.*

[42] National Marine Plan Review, (2021), *Three Year Report on the effectiveness of Scotland's National Marine Plan,* https://marine.gov.scot/sites/default/files/national_marine_plan_review_2021.pdf#:~:text=The%20National%20Marine%20Plan%20%28NMP%20or%20%E2%80%9Cthe%20Plan%E2%80%9D%29,and%20report%20on%20the%20implementation%20of%20the%20Plan.

[43] Scottish Government (2020) *Scotland's Marine Assessment 2020 (SMA2020),* https://marine.gov.scot/sma/.

[44] Scottish Government (2022) *Highly protect marine areas: Policy framework,* https://www.gov.scot/publications/highly-protected-marine-areas-policy-framework/.

Chapter 3: Working lands and seas

Table 3.1
Progress summary – Working lands and seas (mostly devolved)

	Delivery and implementation	Policies and plans	Summary
Outcome 1: Agricultural productivity	Mixed progress	Limited policies and plans	• Indicators suggest some progress in building Scotland's agricultural resilience. However, thorough datasets are lacking. • There are limited policies and plans that improve the resilience of agriculture to climate change, with large gaps including no SMART* objectives for monitoring progress.
Outcome 2: Commercial forestry	Mixed progress	Credible policies and plans	• The percentage area of certified forestry has remained stable since 2020. Most newly planted trees are non-native and pests and wildfires continue to impact on the sector. • There are credible policies and plans to help build commercial forestry resilience to climate risks. Minor policy gaps remain which can be closed by ongoing work.
Outcome 3: Fisheries and aquaculture	Mixed progress	Partial policies and plans	• Novel warm water fish species are now migrating into Scottish marine areas, supporting fisheries, but some native cold-water fish populations are declining. Invasive non-native species and pests/diseases continue to affect the sector. • Some new policies/plans including climate adaptation actions have been put in place, but do not contain SMART objectives.

Relevant risks from CCRA3: Risks to soils. Urgency (N4); Risks and opportunities for natural carbon stores, carbon sequestration and GHG emissions (N5); Risks to agriculture and forestry (N6, N7, N8); Opportunities to agriculture and forestry (N9); Risks to aquifers agricultural land (N10); Risks to marine habitats and species, and fisheries (N14, N16); Opportunities to marine habitats and species, and fisheries (N15).

Working lands and seas are part of a complex system and are susceptible to climate risks that impact all ecosystems.

This chapter considers how climate change could affect the productivity of Scotland's working lands and seas (WLS), which includes agriculture, commercial forestry, fisheries, and aquaculture. These sectors provide jobs, vital products and inputs to other sectors, and bolster food, feed, fibre, timber, and resource security.

Climate risks to WLS are dependent both on risks to the underlying natural systems that these services depend on and the management practices used in the sectors (Box 3.1 – and Chapter 2). Other anthropogenic drivers, such as water pollution, soil degradation and policy-driven risks to economic resilience, can also impact the sectors and undermine resilience of natural resources to climate change, as well as the ability of these sectors to take advantage of any potential benefits from climate change.

* SMART objectives: In order for policy objectives to be considered SMART, they must be Specific, progress towards them must be Measurable, they must be Achievable, Realistic (or Relevant) for the outcome needed and Time-bound (achieved within an agreed date).

Climate risks to working lands and seas can be highly localised, but building resilience is strongly linked to action in other sectors covered in this report.

Climate hazards, such as impacts from floods, storms, drought and average temperature rise are already affecting agriculture, timber production and fisheries; these impacts are projected to increase.[1] The impacts of climate change will vary depending on region, with Scotland facing localised droughts, unpredictable and heavier precipitation, flooding and other weather events that will likely significantly impact the quality of land and agricultural production, as well fish stocks and the sustainability of the fishing sector. Scotland needs robust planning to manage these risks (Box 3.2).

Box 3.1
Resilience of WLS is a systemic issue

Climate resilience in agriculture, forestry, fisheries and aquaculture is strongly linked to resilience across several other sectors. Key interactions include:

- **Nature.** Healthy ecosystems deliver resources (e.g. food, timber, and fibre) that are fundamental to economic activities in WLS. Healthy ecosystems also provide regulating services (e.g. water filtration, erosion control and flood mitigation) that can protect WLS from the impacts of climate change, and supporting services (e.g. pest control and pollination) that support the production of many crops.
- **Food**. Effective adaptation by agricultural and fisheries industries will support a climate-resilient food system, producing sustainable, nutritious, high-quality food.
- **Water supply**. The agriculture and aquaculture sectors take freshwater from the environment to support production. Actions to use water more efficiently and sustainably in WLS are needed for the water system to be resilient to periods of future drought.

Box 3.2
Key findings from the 2022 Scottish adaptation progress report assessment

In March 2022, the Committee published its first independent assessment of Scotland's progress in adapting to climate change and implementing the second Scottish Climate Change Adaptation Programme (SCCAP2). The report found that, despite medium to good progress made in planning for and managing the risks to commercial forestry, the Scottish Government had made little to no progress in ensuring that agricultural productivity and commercial fisheries and aquaculture are adapting to climate change.

Key recommendations of the Committee's 2022 report included:

- Adding indicators on pests and pathogens to the monitoring of the Forestry Strategy Implementation Plan.
- Developing a long-term strategy to replace the EU Common Agriculture Policy that would incorporate the risks and opportunities to the sector of climate change.
- Increasing awareness of climate change risks to agricultural production and providing a mechanism to landowners to use the information.
- Updating all plans for fisheries and aquaculture with specific adaptation actions, SMART objectives and monitoring and evaluation plans.

Source: Climate Change Committee (2022) *Is Scotland climate-ready?*

3.1.1 Outcome 1: Climate-resilient agricultural production

(i) Delivery and implementation progress

Despite some positive developments, there has been mixed overall progress in reducing the vulnerability and exposure of agricultural production to the impacts of climate change.

There has been **mixed progress** in reducing the vulnerability and exposure of agricultural production to climate change. Some indicators show some of the agricultural sector is not yet experiencing significant negative impacts of climate change. However, as previously noted in the 2022 Progress Report, most datasets are still insufficient or old, meaning it has not been possible to undertake a comprehensive assessment.

- **More and newer data are needed to understand the full effects of climate change on agriculture.** This includes the impacts of increased risks of drought and wetness, as well as those posed by climate-sensitive pests and diseases. Key available indicators suggest:
  - Prime agricultural land coverage* increased by 4% between 1961 and 2010 due to increasing temperatures, especially in the east of Scotland.[2]
  - The most recent data indicate that average drought risk conditions and wetness risk to agricultural soil between 1981–2000 did not significantly change compared with 1961–1980.[3,4] There is, however, some spatial variability, particularly for wetness risk, with the east of Scotland showing a slight increase in drought risk due to higher soil moisture deficits and a projected decrease in soil wetness risk.†[,4]
  - Climate change is also expected to affect crop yields and diversity (both positively and negatively) due to warmer, drier summers and less severe winters. Between 2003-2022, total cereal production increased by 9%,[5] but this may be due to other factors alongside or instead of climate change, such as increased inputs. Evidence also suggests a long-term reduction in crop diversity since 1988.[6]
  - Some monitored agricultural pests and diseases are increasing, whereas others show no clear trend. Available data for the period 1993–2013 shows an increase of liver fluke cases by 13% for cattle and 16% for sheep.[7] Conversely, potato blight showed no clear trend between 2003-2014.[8]

There are signs that farming practices are adapting to some extent.

- **Increases in diversification of livelihood income and covered horticulture indicate that farming practices are adapting.** The area of covered horticulture increased from 80 hectares in 2003 to 1,122 hectares in 2014.[9] Growing horticultural products under glass or plastic can help protect agriculture against some of the effects of climate change and extend growing seasons, but energy requirements can affect profits. Average

* Defined as land capable of producing a wide range of crops or high-yielding moderate range of crops.

† Depending on the climate change scenario used for the projection.

income from livelihood diversification also increased by 37% between 2013-14 and 2018-19.[10] Livelihood diversification can improve agriculture resilience as it spreads the risk of potential income losses from climate change.

- **Pollinating insect populations are changing though data are lacking for a full assessment**. Of the monitored bee species between 2010–2020, eight had population increases of an average 1%, while 13 had population decreases that ranged from 1% to 18%.[11] There was a moderate shift towards a slightly earlier annual peak of the colony cycles.[12] Much of Scotland's crop production relies on pollination including from butterflies, but pollinators are sensitive to changes in climate.

(ii) Policy and planning process

There are limited policies and plans in place to support the agricultural sector in adapting to climate change.

There are **limited policies and plans** in place to ensure Scottish agricultural production is adapting to changes in climatic conditions and remaining resilient against further change.

- **The Scottish Government has made some progress on supporting farmers and crofters to adapt to climate change.** The Agriculture Bill and accompanying framework are the first steps towards implementing Scottish Government's 2022 'Vision for Scottish Agriculture', which is underpinned by the adaptation of the sector to climate change. As part of the developing Bill, direct payments are expected be retained, but additional payments will likely be tied to delivering wider environmental outcomes, including for climate adaptation. Aims and objectives to build climate resilience in agricultural production and ensure it is carried out sustainably are included in both the 2023 Just Transition Plan for Land and Agriculture and the 2023 draft Biodiversity Strategy delivery plan. Recent announcements suggest the Farm Advisory Service will be expanded to better support farmers in their transition to well-adapted agricultural practices.

- **There is a lack of SMART goals and related objectives to track whether agriculture is resilient to the effects of climate change**. This, along with a robust monitoring or evaluation plan to track delivery, will only be put in place after the Agriculture Bill comes into force; however, this is not expected until 2024. Scottish Government is currently consulting on the Strategic Framework for Biodiversity, the first Delivery Plan of which takes into account the needs of agriculture and other sectors and will put in place plans for INNS management. Control of INNS is also a priority theme for the £65 million Nature Restoration Fund, which awarded multi-year funding for the Scottish Invasive Species Initiative (SISI) in 2022.

Scottish Government has put some structures in place to upskill farmers to monitor and adapt to climate change impacts, but they need to be developed further.

Scottish Government has some funds and structures in place to enable farmers and crofters to monitor adaptation on their farms and find practical ways to build climate resilience.* ClimateXChange has carried out work measuring the vulnerability of Scottish soils to climate change and assessed the risk of future climate change to agriculture in Scotland, including options and indicators for adaptation.[12,13] While these actions set the foundation for the sector response to

* These include the Farming Advisory Service, Preparing for Sustainable Farming, National Test Programme, Farming for a Better Climate, Monitor Farm Scotland and a range of programmes focusing on specific issues, such as Farming with Nature, Farming and Water Scotland, and the Soil and Nutrient Network

climate risks, a more coherent approach is needed to enable farmers to understand and mitigate climate risks.

3.1.2 Outcome 2: Climate-resilient commercial forestry

(i) Delivery and implementation progress

There has been mixed progress in building resilience in the Scottish commercial forestry sector.

Indicators for this outcome show **mixed progress** in reducing vulnerability and exposure of Scotland's commercial forestry sector to climate change. Scotland has the largest area of forests under certification* in the UK and progress has been continuous in implementing the Forestry Strategy. However, there are still knowledge and data gaps on resilience metrics, 40% of Scottish woodland is still not under established standards of sustainable management, tree planting favours non-native species and the work to manage pests and diseases is ongoing.

- **Sixty one percent of Scottish woodland was certified in 2023, up by 36% since 2004.**[14] In 2023, woodland occupied 1.49 million hectares of land in Scotland, of which approximately 0.91 million hectares were certified; the percentage of certified woodland has increased since 2004, but this increase has slowed since 2012. In recent years, the certified area has remained around 60% of total woodland, with minor changes since 2021 (Figure 3.1). Sustainable management of woodland† helps increase resilience to pests and weather-related risks and provide healthy habitats for biodiversity.

Tree planting in Scotland has favoured non-native conifers over the past few years due to commercial profitability.

- **Tree planting in Scotland has favoured non-native conifers over native conifers and broadleaves.** In 2022, conifers made up approximately 60% of new trees planted, compared to 40% for broadleaves; down by five percentage points on the previous year. The most planted conifer species was the commercially profitable but non-native Sitka spruce, followed by the native Scots pine. Native species support woodland resilience to climate change through providing habitats for biodiversity and wider ecosystem services, but non-native species can also offer benefits, if managed sustainably (see Nature chapter). Of the non-native conifer species, less than 5% of these were affected by invasive non-native species in 2020.[15]

The data currently collected are not sufficient to effectively monitor the impact of wildfire risk on commercial plantations.

- **There is no clear trend in wildfire occurrence or severity over time.** Between 2009-2020, 493 wildfires occurred in broadleaved woodland compared with 103 in conifer forests.[16] However, there were 83 wildfires reported that each damaged more than 1,000 m^2 of conifer forests between 2009-2020 compared with 48 in broadleaved woods during the same timeframe.‡ Data on wildfire incidents are mainly collected by the Scottish Fire and Rescue Service, which does not currently record in detail the amount of area impacted by each wildfire; collecting similar data would give a better

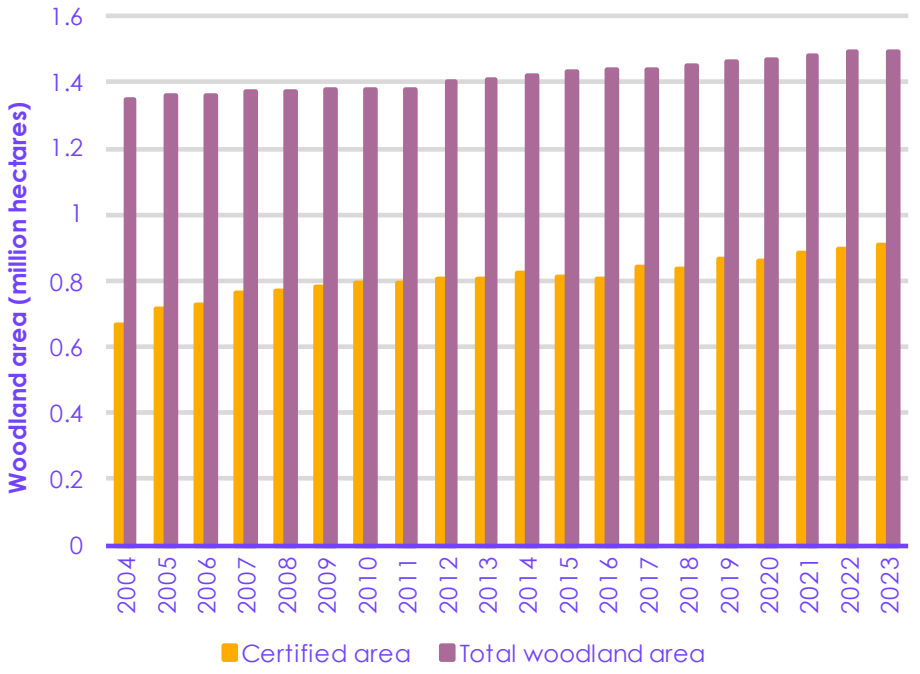
* Forestry certification schemes are overseen by the Forest Stewardship Council scheme, the Grown in Britain scheme and the Programme for the Endorsement of Forest Certifications, which certify wood and products from well-managed forests. Certified woodland areas are often used as an indicator of sustainable forest management. Certification in the UK is carried out based on the UK Woodland Assurance Standard, which in turn complies by the requirements of the UK Forestry Standard. While the UK Forestry Standard was recently updated, however, there is room for further development of the definition of and the guidance on building woodland resilience, including determining the appropriate amount of single species in a plantation.

† The definition of sustainable management used in this report refers to Scottish woodland under certification.

‡ It is unclear the area of commercial forestry affected by these wildfires compared with non-commercial woodland.

understanding of wildfire-related damage and risks across different woodlands.

Figure 3.1 Certified woodland area in Scotland, 2023



Source: Forestry Commission (2023) *Forestry Statistics*; CCC analysis.

(ii) Policy and planning progress

There are credible policies and plans in place to ensure that commercial forestry adapts effectively to climate risks, but there is room for further improvement.

There are **credible policies and plans** in place to ensure the resilience of commercial forestry in the face of climate change. The Committee's 2022 recommendations have now been largely enacted.

- **Progress is being made in delivering the objectives of the 2019-2029 Forestry Strategy.** A 2022 progress report found general progress across most areas of implementation, including those relevant for improved climate resilience.[17] The Forestry Strategy Implementation Plan 2022-2025 was published in March 2022 and included an objective of improving the resilience of Scottish forests and woodlands through continued research, monitoring and developing good practice guides for forestry managers on mitigating threats from pests, diseases and weather events.[18]

- **Scotland is constantly improving relevant plans and monitoring in place to protect timber from some future climate risks.** Scottish Forestry is using remote sensing and satellite imagery to monitor forests for a number of risks including the spread of pests and diseases, wind throw and storm damage. There is also an array of tools available to help assess the climatic suitability and risks of planting sites. Forestry and Land Scotland aims at selecting tree species for publicly managed forests are climatically suitable for current conditions. It is also working towards improving its decision processes to address the impacts of future climate change, while working with partners to ensure that forests offer wider environmental benefits, such as flood risk mitigation. Scotland has extensive plans in place and follows UK-wide

guidance on managing storm damage, tree health and INNS-related risks, which include action plans, biosecurity regulations and guidance on addressing affected trees.[19] Scottish Forestry has also launched a programme of work to build the resilience of Scottish forests, which is looking at cross-sectoral issues such as tree species choice and planning for wildfire risks.[20]

- **Scotland continues to update its legal framework and to follow UK standards on assessing climate risks and building resilience**. The 2022 UK Forestry Standard was recently updated to reduce the appropriate amount of single species in a plantation from 75% to 65%.[21] The 2019 Scottish Felling Regulations also introduced the requirement for a separate felling permission to clear storm-impacted sites.[22] Associated climate change fact sheets and an online Climate Change Hub, developed by Forest Research and Scottish Forestry, are also available, but their effectiveness relies on uptake by commercial forestry managers.

Despite the progress, more work needs to be done to address significant future risks, such wildfires and climate-related pests and diseases.

While existing plans and policy are credible in terms of scope and delivery, there remain significant policy and knowledge gaps that need to be urgently addressed. Scottish Forestry should focus on clarifying its concept of commercial woodland resilience, particularly on issues such as the species and genetic make-up of commercial forests, wildfire and the management of climate-related pests and diseases. It should also introduce measurable targets for resilience to ensure the delivery of relevant plans and policy.

3.1.3 Outcome 3: Fisheries and aquaculture

(i) Delivery and implementation progress

Available data suggest that there has been mixed progress in building resilience in commercial fisheries and aquaculture.

Indicators for this outcome show **mixed progress** in reducing the vulnerability and exposure of Scottish fisheries and aquaculture to climate change.* Some key datasets to assess risks are missing, while available datasets show heterogeneity in how climate change is affecting the sector.

- **Climate change is affecting species' ranges and populations of fish in Scottish waters.** Populations of some warmwater species (such as squid and European anchovy) have increased, whereas some cold-water species' populations have declined due to warming sea temperatures.[23] For example, the number of Atlantic salmon returning to Scottish freshwaters has been declining since the 1970s;† in 2018, numbers were 44% lower than in 2011.[24] To remain resilient to the effects of climate change, fishermen could capitalise on harvesting the new warm-water species now appearing in Scottish waters.

- **Data on the sustainability of fish harvests show a mixed picture.** The percentage of fish harvested sustainably in Scotland has increased from 29% in 1991 to 69% in 2020.[25] However, the percentage of large fish‡ caught in the North Sea§ between 1983 to 2019 has shown long-term declines,

* Please also refer to the Nature chapter's marine and coastal section as many of those indicators also apply to commercial fisheries and aquaculture.

† It is not clear to what extent climate change is contributing to this decline.

‡ Equal to or larger than 50 cm.

§ This includes the sea around eastern England and Scotland.

falling steeply between 2016-2019.[26] Sustainable harvesting of fish will help fish populations remain resilient to future shocks, including climate impacts. However, as of 2019, 23% of stocks remain in an unknown status.[27]

Marine pollution across the UK has been decreasing.

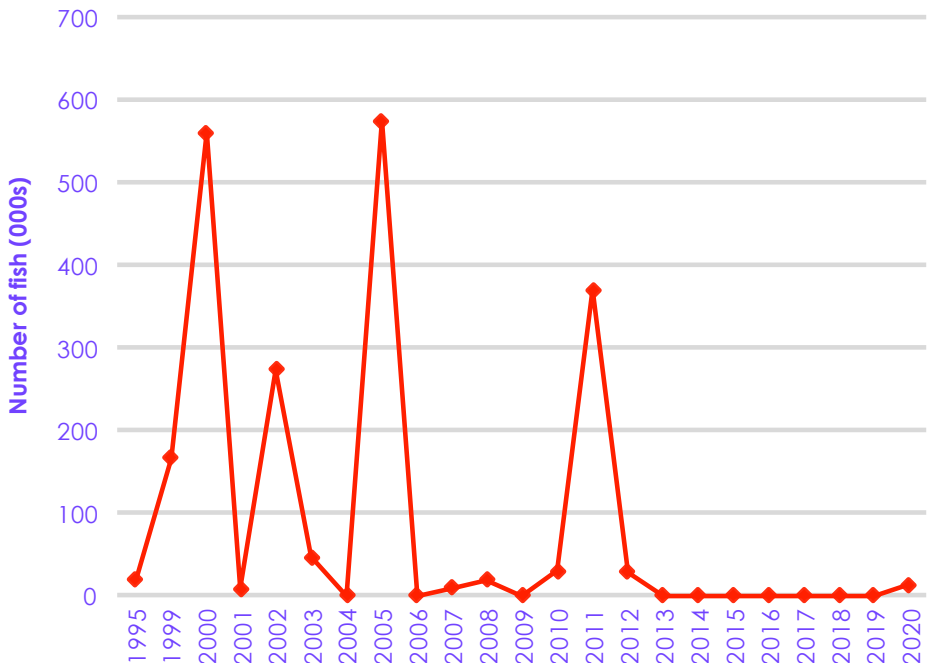
- **Marine pollution across the UK has been declining.**[*,28] Of the six pollutants monitored,[†] there has been an 78% decline in pollution levels between 1990-2019 across the UK. Reducing marine pollution is important for reducing negative impacts to fish populations thereby improving resilience to climate change.

- **The frequency of fish escaping aquaculture sites due to weather events declined in recent years and aquaculture sites are not shifting north as a result of climate change**.[29] Between 1995-2015, 19% of escapes were due to weather, but this resulted in 61% of the total escaped fish. This suggests that, whilst weather-related events are rare, the effect on fish farms can be large, but it has been better managed in recent years (Figure 3.2).[30]

There is a lack of data to allow for the monitoring of harmful algal blooms, invasive non-native species and pests and diseases in Scottish seas.

- **Comprehensive data to help assess the trends in harmful algal and jellyfish blooms, invasive non-native species, pests and diseases are lacking**. However, monitored fish gill health has declined, partly due to new pathogens such as amoebic gill disease from the pathogen Paramoeba perurans, which is associated with high salinities and temperatures.[31] Didemnum vexillum, an invasive species, is beginning to show up in Scottish waters and negatively affects fish populations. The harmful algae, Karenia mikimotoi, has occurred in Scottish waters since the 1980s, but the effects of climate change on blooms from these algae is hard to predict.

Figure 3.2 Fish escaped from fisheries due to weather-related events



Source: Scottish Government (2023) *Scotland's Aquaculture*; CCC analysis.
Notes: Based on escape events the final reason of which is recorded on the dataset as weather-related.

* Data specifically related to Scotland were not freely available at the time of publication.

† Mercury, cadmium, lead, copper, zinc and lindane.

(ii) Policy and planning progress

There are partial policies and plans in place to ensure the future sustainability of fisheries and aquaculture in the face of climate risks.

There are **partial policies and plans** in place to ensure fishing and aquaculture adapt to climate change, though the recommendations from the last Progress Report have yet to be enacted.

- **Scotland, along with the other UK administrations, published the first Joint Fisheries Statement in 2022.** The Statement recognised the need for sustainable management of UK fisheries and to mitigate risks from and adapt to climate change. Delivering its objectives is fundamental to ensuring a resilient seafood sector and restoring the marine environment. While the Statement sets out the policies in place for the fisheries' policy authorities, it lacks detail on the extent to which the supporting actions will be delivered.

- **Various policy announcements have been made recently to support the industry to adapt and remain resilient to the effects of climate change**. The Scottish Government published 'A Blue Economy Vision for Scotland' in March 2022, which includes an outcome on making fisheries and aquaculture resilient to climate change. A review of the state of this strategy was published in 2023, identifying climate change is the most critical factor affecting Scotland's marine environment. A Vision for Sustainable Aquaculture was published in July 2023 and includes a focus on adapting to climate change.[32] In 2022, the Scottish Government announced it would create a second National Marine Plan that will include actions to address climate risks. The Scottish Government also published its 2022 Wild Salmon Strategy, accompanied by an implementation plan, that include wide-ranging actions to improve the habitat and populations of wild Atlantic salmon in Scotland. At the time of writing this report, however, the Committee has not been made aware of any SMART goals and objectives associated with these policies; these are essential to track whether commercial fisheries and aquaculture are remaining resilient. The Farmed Fish Health Framework has also been used throughout 2022-23 to address climate impacts on farmed fish.

- **The 2022 'Fisheries Management Strategy 2020 to 2030: Delivery Plan' is a missed opportunity to fully embed climate adaptation into the sector's plans**.[33] The focus of the plan is on keeping Scotland's fisheries sector productive and, whilst there is an objective on climate change, this primarily focuses on Net Zero rather than adaptation.

Scottish Government needs to focus its efforts on streamlining the currently available strategies and frameworks to have a clear and coherent path for helping the sector adapt.

While the Scottish Government has begun building an evidence basis for the impact of climate change on UK wild capture fish populations,[34,35] the published plans are fragmented and lack a coherent strategy that will bring them together towards delivering a more sustainable Scottish fishing sector. The Scottish Government should use the opportunity provided by the Blue Economy Vision to design a clear and comprehensive strategy for fishing and aquaculture, with measurable targets and a clear monitoring framework that will aim at collecting and using data across the different subsectors to ensure the sector's future economic viability and ability to mitigate climate impacts.

3.2 Recommendations

Table 3.2
Recommendations to improve the resilience of working land and seas

Primary responsibility	Recommendation	Timing
Marine Directorate (MS); Agriculture and Rural Economy Directorate (ARE); Environment and Forestry Directorate (ENFOR); Scottish Forestry; Forestry and Land Scotland	Address data gaps across agriculture, forestry and fisheries, including collecting more recent, relevant and frequent data for monitoring purposes. Use existing or upcoming legislation to create consistent methods of collecting robust data to effectively track progress in adapting to climate change risks for agriculture and fisheries. Where there are solid frameworks in place (commercial forestry), expand data collection to include highly relevant metrics, such as on pests, pathogens and the impact of wildfires and wind damage.	2025
Agriculture and Rural Economy Directorate (ARE); Land Use Transformation (LUT) Board; Environment and Forestry Directorate (ENFOR)	Ensure the developing Agriculture Bill and associated policies fully integrate and support adapting to climate change and building climate resilience for the agricultural sector.	2024
Agriculture and Rural Economy Directorate (ARE); Environment and Forestry Directorate (ENFOR)	Tie any Government-funded payment schemes to delivering adaptation and wider environmental benefits. Ensure any basic payment scheme includes cross-compliance stipulations to carry out actions to build resilience to climate change.	2024
Marine Directorate (MS)	Use the Blue Economy Vision to design a strategy for fisheries and aquaculture that integrates adaptation of the sector to climate change as a central outcome and brings together already existing legislation and frameworks into one coherent strategy for the fishing and aquaculture sectors. Ensure that policies are updated with specific adaptation actions, SMART climate resilience objectives and appropriate monitoring and evaluation to support the sector to adapt to a changing climate and ocean acidification.	2025
Agriculture and Rural Economy Directorate (ARE); Environment and Forestry Directorate (ENFOR); Marine Directorate (MS) LUT Board	Introduce sector plans for benefitting from any opportunities that might arise from climate change, including the commercial exploitation of new warmwater species that are migrating to Scottish waters and the profitability of shifting to the cultivation of crops and commercial forestry that thrive in expected new climate conditions.	2025

Endnotes

[1] Climate Change Committee (2021) *Third UK Climate Change Risk Assessment*, https://www.theccc.org.uk/publication/independent-assessment-of-uk-climate-risk/.

[2] ClimateXChange (2015) *Indicators and trends: NA2 Area of Prime Agricultural Land (Land Capability)*, https://www.climatexchange.org.uk/research/indicators-and-trends/indicators/na2-area-of-prime-agricultural-land-land-capability/.

[3] ClimateXChange (2015) *Indicators and trends: NA29 Drought risk to agricultural land*, https://www.climatexchange.org.uk/research/indicators-and-trends/indicators/na29-drought-risk-to-agricultural-land/.

[4] ClimateXChange (2015) *Indicators and trends: NA28 Wetness risk for agriculture*, https://www.climatexchange.org.uk/research/indicators-and-trends/indicators/na28-wetness-risk-for-agriculture/.

[5] Scottish Government. https://scotland.shinyapps.io/sg-cereal-oilseed-rape-harvest/.

[6] ClimateXChange (2015) *Indicators and trends: NA6 National agricultural crop portfolio and diversity index*, https://www.climatexchange.org.uk/media/2555/na6_agriculture_crop_portfolio_v04_branded_template.pdf.

[7] ClimateXChange (2015) *Indicators and trends: NA26 \prevalence of liver fluke (Fasciola hepatica) in cattle and sheep*, https://www.climatexchange.org.uk/research/indicators-and-trends/indicators/na26-prevalence-of-liver-fluke-fasciola-hepatica-in-cattle-and-sheep/.

[8] ClimateXChange (2015) *Indicators and trends: NA25 Range and prevalence of climate marker pests and diseases in crops: Number of potato blight outbreaks*, https://www.climatexchange.org.uk/media/2575/na25_prevalence_potato_blight_branded_template.pdf.

[9] ClimateXChange (2015) *Indicators and trends: NA22 Area of cultivation under glass or plastic structures*, https://www.climatexchange.org.uk/research/indicators-and-trends/indicators/na22-area-of-cultivation-under-glass-or-plastic-structures/.

[10] Scottish Government (2020) *Scottish agriculture tables – economic report: 2020 edition*, https://www.gov.scot/publications/economic-report-on-scottish-agriculture-tables-2020-edition/.

[11] Comont, R., Luker, S., Dickinson, H. (2021) *BeeWalk Annual Report*, https://www.bumblebeeconservation.org/wp-content/uploads/2021/10/BeeWalk-annual-report-2021-FINAL-BBCT190.pdf.

[12] Neilson, R., Lilly, A., Aitkenhead, M., Artz, R., Baggaley, N., Giles, M. E., Holland, J., Loades, K., Ovando Pol, P., Rivington, M., Roberts, M., Yeluripati, J., James Hutton Institute (2020) *Measuring the vulnerability of Scottish soils to a changing climate*, https://www.climatexchange.org.uk/research/projects/measuring-the-vulnerability-of-scottish-soils-to-a-changing-climate/.

[13] Jenkins, B., Avis, K., Willcocks, J., Martin, G., Wiltshire, J., Peters, E. (2022) *Adapting Scottish agriculture to a changing climate – assessing options for action*, https://www.climatexchange.org.uk/research/projects/adapting-scottish-agriculture-to-a-changing-climate/.

[14] Forest Research (2023) *Forestry Statistics 2023,* https://www.forestresearch.gov.uk/tools-and-resources/statistics/data-downloads/.

[15] Forest Research (2020) *National Forest Inventory: Woodland Ecological Condition*, https://www.forestresearch.gov.uk/tools-and-resources/national-forest-inventory/what-our-woodlands-and-tree-cover-outside-woodlands-are-like-today-nfi-inventory-reports-and-woodland-map-reports/nfi-woodland-ecological-condition/.

[16] Scottish Government, Scottish Fire and Rescue Service (SFRS) (2022) *Wildfire: incident reporting system – data analyses*, https://www.gov.scot/publications/provision-analyses-scottish-fire-rescue-service-sfrs-incident-reporting-system-irs-data-relation-wildfire-incidents/pages/6/.

[17] Scottish Government (2022) *Scotland's Forestry Strategy 2019-2029: Parliamentary Progress Report 1 April 2019 to 31 March 2022*, https://forestry.gov.scot/publications/1443-scotlands-forestry-strategy-progress-report-2019-2022/viewdocument/1443.

[18] Scottish Government (2022) *Scotland's Forestry Strategy Implementation Plan 2022-2025*, https://forestry.gov.scot/publications/1413-scotland-s-forestry-strategy-implementation-plan-2022-2025.

[19] Scottish Forestry (accessed 2023) *Tree Pests and Disease,* https://forestry.gov.scot/sustainable-forestry/tree-health/tree-pests-and-diseases.

[20] Scottish Government (2023) Climate adaptation: letter to UK Climate Change Committee, https://www.gov.scot/publications/climate-adaptation-letter-to-uk-climate-change-committee/

[21] Forestry Commission (2023) The UK Forestry Standard 5th edition, https://www.gov.uk/government/publications/the-uk-forestry-standard.

[22] Scottish Parliament (2019) *The Felling (Scotland) Regulations 2019,* https://www.legislation.gov.uk/ssi/2019/49/made

[23] ClimateXChange (2016) *Indicators and trends: NM21 Occurrence of warmwater species in fish stocks exploited by Scottish fisherman: European anchovy; Squid; (red mullet; John Dory; European sea bass)*, https://www.climatexchange.org.uk/media/2616/nm21_warm_water_species.pdf.

[24] Scottish Government (2023*) Scotland's Blue Economy: current status review*, https://www.gov.scot/publications/scotlands-blue-economy-review-current-status/pages/2/.

[25] Scottish Government (2023) *National Performance Framework*, https://statistics.gov.scot/resource?uri=http%3A%2F%2Fstatistics.gov.scot%2Fdata%2Fnational-performance-framework.

[26] JNCC (2020*) D1a. Fish size classes in the North Sea,* https://jncc.gov.uk/our-work/ukbi-d1a-fish-size-classes/.

[27] JNCC (2021*) B2. Sustainable fisheries,* https://jncc.gov.uk/our-work/ukbi-b2-sustainable-fisheries/#key-results-figure-b2a-percentage-of-marine-fish-quota-stocks-of-uk-interest-harvested-sustainably-1990-to-2019.

[28] JNCC (2021*) B5b. Marine pollution,* https://jncc.gov.uk/our-work/ukbi-b5b-marine-pollution/.

[29] Scottish Government (2023) *Scotland's Aquaculture*, http://aquaculture.scotland.gov.uk/data/fish_escapes.aspx.

[30] ClimateXChange (2016) *Indicators and trends: NM46 Change in the latitudinal distribution of industry sectors in response to shifting optimal conditions for species specific growth: aquaculture,* https://www.climatexchange.org.uk/research/indicators-and-trends/indicators/nm46-change-in-the-latitudinal-distribution-of-industry-sectors-in-response-to-shifting-optimal-conditions-for-species-specific-growth-aquaculture/.

[31] Murray, A., Falconer, L., Clarke, D., Kennerley, A. (2022) *Climate Change Impacts on marine aquaculture relevant to the UK and Ireland*, https://www.mccip.org.uk/aquaculture.

[32] Scottish Government (2023) *Vision for Sustainable Aquaculture*, https://www.gov.scot/news/vision-for-sustainable-aquaculture/.

[33] Scottish Government (2022) *Fisheries management strategy 2020 to 2030: delivery plan*, https://www.gov.scot/publications/scotlands-fisheries-management-strategy-2020-2030-delivery-plan/documents/.

[34] Garrett, A., Pinnegar, J. (2022) *Climate change adaptation in the UK (wild capture) seafood industry – watching brief 2020-21*, https://www.seafish.org/document/?id=0f08da6f-54be-4d38-a788-fee919778f59.

[35] Winne, S., Pritchard, A., Kennedy, S., O'Gorman, S. (2022) *Review of climate vulnerability assessment of Scotland's marine environment and marine economy,* https://www.climatexchange.org.uk/research/projects/review-of-climate-vulnerability-assessment-of-scotland-s-marine-environment-and-marine-economy/.

Chapter 4: Food security

Table 4.1
Progress summary – Food security

	Delivery and implementation	Policies and plans	Summary
Outcome 1: Food and feed import supply chains are well managed, and quality assured against climate hazards	Unable to evaluate	Reserved policies and plans	• Private sector reporting is minimal, preventing evaluation of progress in reducing vulnerability and exposure of food and feed import supply chains to climate change. • Most of the policy levers for this area are reserved. The CCC's 2023 UK progress report score for this outcome was insufficient policies and plans.
Outcome 2: Vulnerability to food price shocks is reduced	Insufficient progress	Partial policies and plans	• Indicators demonstrate household level vulnerabilities to food price shocks and marked increases in food insecurity. • Committed funding is in place to support food insecure households. Vulnerability to price shocks should be monitored to gauge how effectively funding meets the level of need.

Relevant risks from CCRA3: ID1 Risks to UK food availability, safety, and quality from climate change overseas; ID2 Opportunities for UK food availability and exports from climate impacts overseas; ID6 Opportunities from climate change on international trade routes; ID7 Risks associated with international trade routes; H9 Risks to food safety and food security; B6 Risks to business from disruption to supply chains and distribution networks; N4 Risk to soils from changing climatic conditions, including seasonal aridity and wetness; N10 Risks to aquifers and agricultural land from sea level rise, saltwater intrusion.

This chapter covers Scotland's progress in addressing risks to food security. Industries within the food system rely on agriculture, which is particularly exposed to climate and long distribution networks.[1,*,†] The Internal Market Act governs UK food trade, including Scotland, and local diets are shaped by imported food from 180 different countries. The food supply chain in Scotland is more complex than other UK nations because a larger fraction of the population live in more rural or isolated areas, including the Scottish Islands, with dependence on a limited number of transport hubs. Variability of weather patterns in different regions globally can have direct and indirect implications on access to nutritious, high-quality, and reasonably priced food locally, while also altering the level of risk in foodborne disease. Opportunities from changes in climate conditions will also arise for Scotland.

Supporting food supply chain resilience will require multi-stakeholder collaboration between key policy actors in Scotland, and coordination with UK government.

Supporting supply chain resilience in the food system requires cohesive policies. Large scale events in recent years, such as the pandemic and international conflict, have triggered impacts on food supply and highlighted the need for building resilience into the supply chain. As global climate impacts increase, preparedness for food system disruption needs to be monitored at scale. The UK Government has policy control over international trade, which is a reserved policy area across the UK.

* Implications on domestic food production is covered in Chapter 3 on Working lands and seas.

† The distribution network refers to the overall supply chain and the flow of goods from a producer or supplier to the consumer.

Scotland adheres to Free Trade Agreements and World Trade Organisation (WTO) regulations ratified by the UK Government. Given the distributed policy responsibilities, ensuring resilience and security of food supply in Scotland requires a coordinated effort by the governments of the UK and Scotland. The responsibility to reduce vulnerability arising from shortage or availability lies with the Scottish Government's Food Security Unit, and the responsibility for the quality and food safety standards with the Food Standards Scotland.

Climate resilience in food is strongly linked to resilience across several other sectors. Key interactions include:

- **Working lands and seas** (Chapter 3)**.** Effective adaptation by the agriculture and fisheries industries will support a climate-resilient food system, providing sustainable, nutritious, and high-quality food.

- **Telecoms and ICT** (Chapter 7)**.** Most business functions of the food industry rely on reliable digital connectivity to manage the food supply chain and distribution networks.

- **Transport** (Chapter 8)**.** Preparedness of all-transport modes against climate-related disruptions and adequate adaptation planning is needed for delivery of adequate and safe food to populations. This is particularly important in Scotland, where connectivity of the Scottish Islands depends on multiple interconnected transport modes.

- **Business** (Chapter 13)**.** Adaptation actions taken by individual food sector businesses to strengthen their supply chain preparedness will be essential in ensuring a climate-resilient food supply.

The CCC's previous assessment of the Scottish Climate Change Adaptation Programme (SCCAP2) in March 2022 included some findings and recommendations that are relevant to food security (Box 4.1).

This progress assessment includes more in-depth analysis of food security in the context of climate change for Scotland, which was only minimally considered in the previous 2022 assessment.

Box 4.1
Key findings in our previous assessment of adaptation progress in Scotland

This is the first round of progress assessment with a dedicated adaptation analysis on food security, exploring evidence of supply chain preparedness and reduced vulnerability of consumers to price shocks. The last assessment on Scotland captured a few indicators that were related to food security through intersections with priority areas on health (resilience of people to pathogens) and business (supply chain disruptions).

- On resilience of people to pathogens, in relation to risks to food safety and security, a low planning score was given because reference to climate change in the food-borne illness strategy was limited. Data on pathogens affected by climate change were limited therefore, a low-risk management score was given.
- On supply chain disruptions, in relation to risks to food availability, safety and quality from climate change overseas, a low planning score was given because there was no overarching policy to address climate risks to Scottish businesses' supply chains. This priority area received a low-risk management score because data on Scottish businesses impacted by supply chain disruptions were not available.

The 2022 assessment included a recommendation to set out measures to ensure the resilience of the food supply chain, including to the risks of extreme weather in Scotland and internationally. For adapting to supply chain disruptions, we recommended that adaptation should be integrated into major upcoming policies in the next two years on risks to supply of food, goods, and vital services due to climate-related collapse of the supply chain.

Source: CCC (2022) *Is Scotland Climate Ready? 2022 Report to Scottish Parliament.*

4.1.1 Outcome 1: Disruption to food and feed import supply chains due to climate change is minimised

(i) Delivery and implementation progress

Monitoring of import supply chains for food is largely the onus of individual businesses and sector-wide reporting for food supply is not streamlined.

Indicators for this outcome are very limited. Data on Scotland's adaptation preparedness for climate-related supply chain disruptions are not available. Monitoring of import supply chains for food and feed is largely the onus of individual businesses and sector-wide reporting for food supply is not yet streamlined. This means it is difficult to assess whether the system is well-adapted in Scotland and the UK more broadly. We are therefore **unable to evaluate** the progress in minimising the disruption to food supply chains due to climate change.

- **Potential shocks in the UK food supply chain are factored into resilience building, helping supply chains to be more responsive and adaptable to problems.** Interdependency risks to the food supply chains are considered in the UK Food Security Report.[2] This includes risks to food supply chains stemming from dependence on other critical sectors, including energy, transportation, orders, labour, key components, and data communications. The Task Force on Climate-Related Financial Disclosures (TCFD) reporting does not currently include large supermarkets, which remains a key data gap on measures being taken to make the supply chain more resilient.

- **Safety standards of imported foods have remained stable.** Estimates of cases in microbiological food-borne illnesses monitored by Food Standards Scotland (FSS), around 43,000 annually, were reported in the strategy for reducing foodborne illness in Scotland from 2017.[3] However, these data can be impacted by under-reporting because direct causation between consumed food and illness is not always established by consumers. Consistent reporting on any changes to the number of foodborne illnesses reported annually will help to monitor how climate change impacts food safety.

- **Immediate supplies for food and feed are secure for Scotland, but there is greater strain on the food supply chain.** Recent external shocks, such as international conflict, prompted the establishment of a taskforce to review any potential disruptions to food security and supply because of the shocks. Findings from a Food Security and Supply Taskforce report found that while disruptions are unlikely in the immediate term, longer-term preparedness of the supply chain against such shocks is necessary.[4]

(ii) Policy and planning progress

Progress in policy and planning is **not scored** because key policy levers fall outside the Scottish Government's devolved arrangements. Scotland's advocacy to UK Government for ensuring adaptation measures and necessary environmental standards are upheld in all trade agreements will be pertinent to delivering a resilient food supply.

Scottish Government has affirmed its commitment to advocate for measures that support adaptation to be included in the environmental clauses for UK's free trade agreements.

- **Free trade agreements signed by UK Government are applicable to Scotland and are reserved powers within international trade-related matters.** Common rules apply to all imported food and feed in Scotland as across the UK, with additional requirements specifically for any high-risk products. Minimum standards for agri-food trade and mechanisms to protect these standards are led by UK Government, though consistent advocacy to represent Scotland's interests in safety of supply and quality is needed. The Scottish Government has affirmed its commitment to advocate for measures that support adaptation to be included in the environmental clauses for UK's free trade agreements.[5]

Lack of transparency on climate-related risks to food supply can increase vulnerabilities to disruption and quality of imports.

- **No climate-related financial disclosures were available from food and feed companies in Scotland under the TCFD framework.** Limited private sector reporting limits the overview of climate-related planning across individual businesses. Small and Medium Enterprises (SMEs) account for 53% of turnover in Scotland, a slightly larger share than in England.[6,*] Within the food sector, small enterprises account for 98.8% of businesses.[†] Whereas large food sector enterprises constitute only 0.4% of Scottish businesses.[‡] Most food enterprises are, therefore, outside the scope of TCFD reporting as they are small enterprises. Large food enterprises, such as supermarkets, are not presently required to report under the TCFD framework across the UK. This contributes to a lack of transparency, increasing exposure to climate-related risks to UK food supply.

- **An existing strategy for reducing food-borne illnesses has limited references to climate change.**[7] This strategy has minimal consideration of climate-related risks, though climate change is identified as a potential driver of future food-borne illnesses. No plans are in place for vector-borne diseases.

- **The Good Food Nation (Scotland) Act 2022 requires the food business sector to have a resilient supply chain and contribute to resilient local economies in Scotland.**[8] The Act recognises that the food system and supply chain and requires relevant authorities to factor in climate change considerations into the good food nation plans. The Scottish Food Commission is expected to scrutinise and make recommendations for progress towards good food nation plans.

Adaptation actions are included in the public body reporting, which also factors procurement processes, but food sector reporting on resilience is currently interpreted too broadly as actions towards sustainability.

- **Public sector procurement rules to buy healthy and sustainable food are in place.**[9] The Scottish Government's sustainable public procurement tools include indicators and guidance to support Scottish public sector buyers to consider and act on climate change. Building a sustainable supply base by prioritising resilient and robust supply chains is substantively considered, alongside ensuring a Just Transition and promoting a circular economy.[10] Specific duty is placed on public bodies to report on how procurement can support progress in delivering the SCCAP. However, reporting on resilience is at times interpreted too broadly as actions towards sustainability.[11]

- **Food Standards Scotland (FFS) produces an annual climate change report under the public body climate change reporting framework, though this falls short of setting meaningful adaptation priorities for the next cycle.**[12]

* Food and drink enterprises constitute 10% of all registered businesses in Scotland.

† Registered businesses with between 0 – 49 employees are considered small enterprises, which form most of the registered enterprises in the Food and Drink sector for Scotland and account for 52.4% of employment in this sector.

‡ Large businesses typically have 250 or more employees, these form a small percentage of Scottish enterprises in the Food and Drink sector and account for 34.1% of employment in this sector.

Some progress is seen on improving understanding on food safety risks arising from climate change across consumers and food businesses. The FSS Horizon Risk Scanning Group also assesses emerging risks due to weather or climate change, that may impact the food and feed supply chain.

- **Targeted risk assessment on food safety has been developed in 2021 – 2022.** In the annual climate change reporting, FSS detailed that the relevant risk assessment for a major contamination incident was developed in 2021 – 2022 for the first iteration of the classified Scottish Risk Assessment (SRA) with the purpose to help the resilience community in Scotland.[12]

4.1.2 Outcome 2: Vulnerability to food price shocks is reduced

(i) Delivery and implementation progress

Indicators for this outcome show **insufficient progress** in reducing vulnerability to food price shocks. External shocks in recent years led to rapid food price inflation and some periods of unavailability for essential food items, which has contributed to increased concern amongst consumers. There were disproportionate impacts on already vulnerable groups, such as the poorest 20% and the elderly, persons with disabilities, mothers, and children.[13] Climate-related shocks can heighten these vulnerabilities, causing more disproportionate impacts.

External shocks have recently contributed to food price inflation, causing disproportionate impacts on already vulnerable groups.

- **More than eight in ten people are concerned about food prices in Scotland and possibility of food supply shortages, according to a recent survey.** The July 2022 Food Standards Scotland survey identified rising concerns over increasing food prices, with 85% of people concerned, up 5% since December 2021. 70% of respondents expressed concern on food supply shortages, up 7% since December 2021.[14]

- **More adults in Scotland have experienced food insecurity compared to pre-pandemic levels with increased reliance on emergency food banks, although this was already on the rise.**[15] Even though current trends in food insecurity are not driven by climate change, household food insecurity still provides an indication of vulnerability of households to food price shocks, including from climate-related disruption.

- **The poorest 20% of UK households spend a higher proportion of their income on food.**[16] Incomes for the poorest 20% of UK households have also decreased since 2017, as reported in the 2021 UK Food Security Report. This increases their exposure to more food price shocks that can at times be attributed to climate change impacts. Defra's 2021 Food Security Report found that 8-9% of adults in Scotland were food insecure in 2020.[17] Recent analysis by Trussell Trust, in their 2023 annual report on hunger in Scotland, found that 17% of people in Scotland have experienced some food insecurity in the 12 months to mid-2022,* 8% of these had very low food security and 9% with low food security levels.[15,†]

* Trussell Trust's definition of food insecurity is based on the same measure as the Department for Work and Pension's Family Resources Survey, but uses a different time frame: 12 months instead of 3 months.

† This indicator includes any experience of running out of food, inability to afford food, reduced meal size, eating less, reduced weight due to lack of money.

(ii) Policy and planning progress

There are **partial policies and plans** in place to reduce vulnerability to food price shocks. Food price shocks can result from a range of factors, including climate-related impacts. The policy support available is not specifically targeted to climate change, however reducing underlying causes of vulnerability to food price shocks also strengthens progress on resilience towards climate-related shocks.

Some financial instruments to support organisations targeting food support for low-income households were introduced, the impacts of these to address the scale of the challenge need to be monitored.

- **Some financial instruments are in place to support low-income households.** The recently established Cash-First Programme builds on the Flexible Food Fund, which provided two discretionary payments over a 4-to-6-week period, to build local partnerships between public sector and third sector organisations to reduce the need on emergency foodbanks. The £1.8 million programme will provide area-based funding and practical assistance to respond to financial hardship and help reduce the need for emergency food parcels.[18] The Best Start Foods scheme also provides support through food vouchers for people on low income to increase access to healthy food for young children in Scotland from 2019 onwards.[19]

- **The Investing in Communities (ICF) fund will invest £10 million each year to support communities between 2023-2026, including for tackling food insecurity.**[20] The fund supports place-based, and community led approaches to support learning and sharing of good practice in delivering cash-first schemes. Thirty-one local organisations whose activities specifically include tackling food insecurity will receive this funding. The fund aims to support those facing poverty and inequality, addressing the linkages between just transition and Net Zero. The targeted three-year funding should enable greater understanding of vulnerabilities across Scotland, including on the population's access to nutritious food.

4.2 Recommendations

Table 4.2
Recommendations

Primary responsibility	Recommendation	Timing
Agriculture and Rural Economy Directorate	Ensure the Food Security Unit's remit covers risks from climate change and set out measures to ensure resilience of food supply from extreme weather in Scotland and internationally, while safeguarding against impacts from climate-related disruption of supply chains.	2024
Food Standards Scotland	Embed monitoring of current food safety risks posed by climate change into the existing risk monitoring process.	Ongoing

Endnotes

[1] Sniffer (2021) *Evidence for the third UK Climate Change Risk Assessment (CCRA3): Summary for Scotland.*

[2] Department for Environment, Food and Rural Affairs (2021) *United Kingdom Food Security Report 2021.*

[3] Food Standards Scotland (2017) *A strategy for reducing foodborne illness in Scotland. A refreshed approach for preventing transmission of contaminants through the Scottish food chain.*

[4] Agriculture and Rural Economy Directorate (2022) *Short Life Food Security and Supply Taskforce: report.*

[5] Energy and Climate Change Directorate (2023) *Climate adaptation: letter to UK Climate Change Committee*.

[6] Department for Energy Security and Net Zero (2022) *Business population estimates 2022.*

[7] Food Standards Scotland (2021) *A strategy for reducing foodborne illness in Scotland*,

[8] Acts of Scottish Parliament (2022) *Good Food Nation (Scotland) Act 2022.*

[9] Section 8 (2) *'Sustainable procurement duty'*, Procurement Reform (Scotland) Act 2014; The Climate Change (Duties of Public Bodies: Reporting Requirements) (Scotland) Amendment Order 2020.

[10] Scottish Government (2023) *Public Procurement Strategy for Scotland 2023 to 2028*.

[11] Article 2, section 4 (d), The Climate Change (Duties of Public Bodies: Reporting Requirements) (Scotland) Amendment Order 2020.

[12] Sustainable Scotland Network (2022) *Food Standards Scotland Climate Change Report 2021-22.*

[13] Department for Environment, Food and Rural Affairs (2021) *United Kingdom Food Security Report 2021*.

[14] The Research Consortium. *Food in Scotland Consumer Tracking Survey Wave 14*.

[15] Trussell Trust (2023) *2023 Hunger in Scotland Report.*

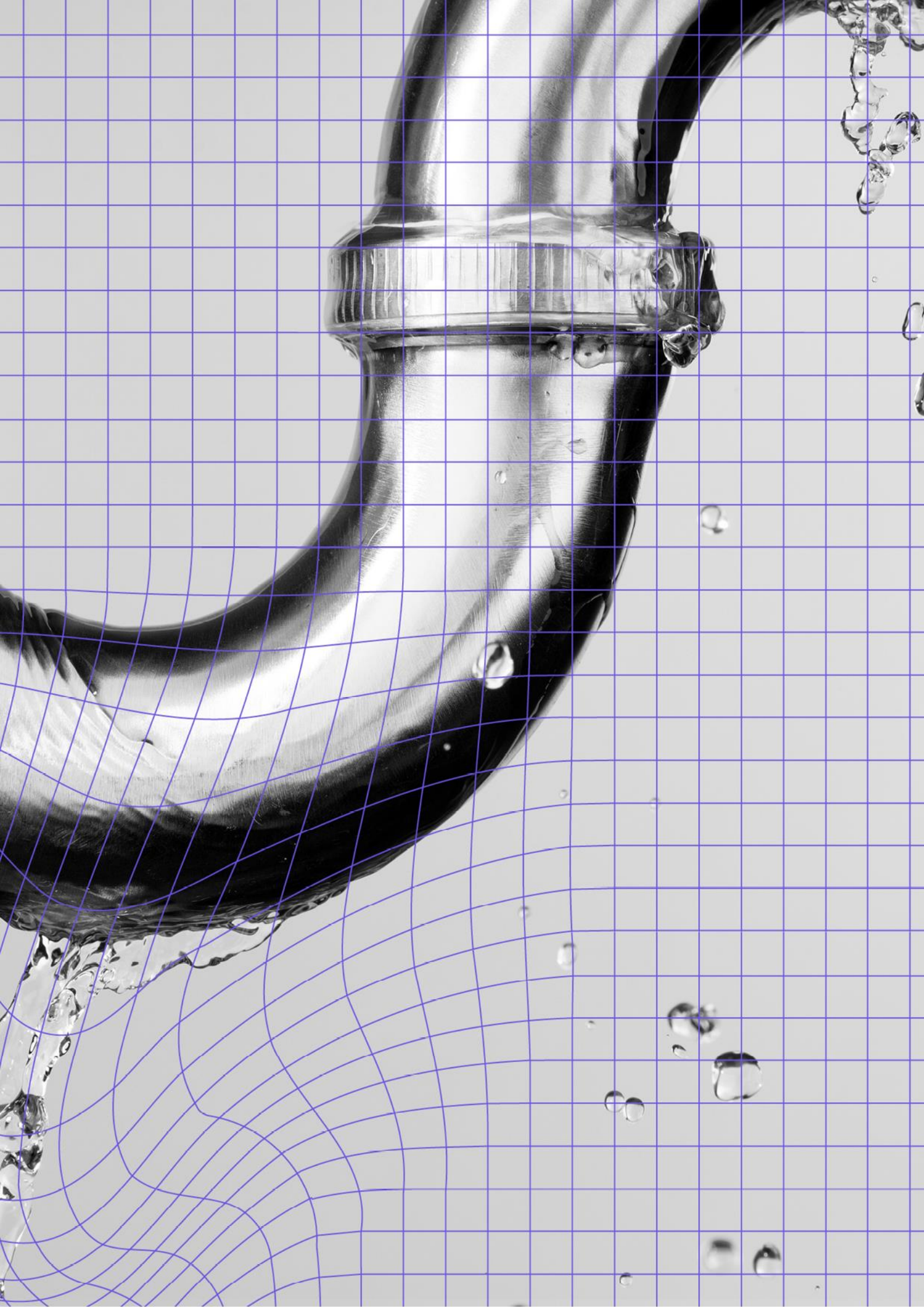
[16] Department for Environment, Food and Rural Affairs (2021) *United Kingdom Food Security Report 2021*.

[17] Department for Environment, Food and Rural Affairs (2021) *United Kingdom Food Security Report 2021: Theme 4: Food Security at Household Level*.

[18] Cabinet Secretary for Social Justice, *Cash-First- Towards ending the need for food banks in Scotland: Plan*.

[19] Scottish Government. *Best Start Grant and Best Start Foods.*

[20] Cabinet Secretary for Social Justice, *Cash-First- Towards ending the need for food banks in Scotland: Plan*.



Chapter 5: Water supply

Table 5.1
Progress summary – Water supply

	Delivery and implementation	Policies and plans	Summary
Outcome 1: Reduced demand	Insufficient progress	Insufficient policies and plans	• Water consumption per person increased by 13% between 2019/20 and 2020/21 and has not yet returned to pre-pandemic levels, despite reductions in the past two years. • Scottish Government's commitment to bring forward legislation to modernise the water industry, coupled with upcoming reports from Scottish Water (including an adaptation action plan) may improve this score. There is not yet enough detail on these to incorporate them into our assessment.
Outcome 2: Improved system performance	Mixed progress	Insufficient policies and plans	• There was a small reduction (1%) in leakage in the latest data and fewer unplanned interruptions to supply than in the previous year. • There has been no progress on revising leakage targets, which are set on an economic, rather than climate risk, basis. Scottish Government's upcoming consultation should consider this.
Outcome 3: Increased supply	Insufficient progress	Insufficient policies and plans	• Water deficits are projected for some water resource zones in Scotland as early as 2050, but there are not yet plans for new water supply infrastructure to address these projected deficits. • As with demand and system performance, forthcoming plans from Scottish Government and Scottish Water should address this and improve this score.
Outcome 4: Interdependencies identified and managed	Unable to evaluate	Insufficient policies and plans	• Cascading impacts are already presenting challenges to the water system in Scotland, with Scottish Water reporting delays in fixing burst pipes due to wintry road conditions last year. There is no data to systematically track progress on this. • There is no consideration of interdependency risks in existing policies and plans from Scottish Government, the regulator or Scottish Water.

Relevant risks from CCRA3: Risks to infrastructure networks (water, energy, transport, ICT) from cascading failures (I1); Risks to infrastructure services from river, surface water and groundwater flooding (I2); Risks to infrastructure services from coastal flooding and erosion (I3); Risks to subterranean and surface infrastructure from subsidence (I7); Risks to public water supplies from reduced water availability (I8); Risks to health from poor water quality and household supply interruptions (H10).

This chapter covers adaptation to climate change for public and private water supplies. Public water supplies most of the population in Scotland. Private water supplies are more common in Scotland than in other parts of the UK – there are over 22,800 private water supplies in Scotland, supplying nearly 190,000 people or 3.5% of the population, originating from sources such as lochs, burns or boreholes.[1]

Assessment scores are given for public water supply outcomes, with consideration of policies in place for private supplies.

Water scarcity is already a risk in Scotland. Projections point to concerns around water availability by mid-century in several Scottish water resource zones.

Water scarcity is already a risk in Scotland, with several areas in the east of Scotland on alert for water scarcity in September 2023.[2] Future projections of more frequent and intense dry periods combined with expected population growth lead to concerns around future availability of water supplies in several water resource zones by mid-century.[*,3] There are also likely to be increases in leakage and burst frequency due to increased flooding risk, and increased risk of subsidence and soil shrink-swell damage.[4]

Successful adaptation to climate change within the water system means ensuring a plentiful supply of water despite future climate change. This requires ensuring sufficient water for public supply and private water use. At the same time, there must also be sufficient water for sustainable abstraction by energy, industry and agriculture (see Chapter 6 on energy, Chapter 13 on business and Chapter 3 on working lands and seas), as well as sufficient water to support the natural environment (see Chapter 2 on nature).

Water policy is fully devolved to Scottish Government, except for product efficiency labelling. Organisations with a role in the resilience of public water supply infrastructure are:

- **Scottish Water**: operates the public water supply system.
- **Scottish Government**: sets objectives for Scottish Water.
- **Water Industry Commission for Scotland (WICS)**: regulates the water sector, including setting leakage reduction targets.
- **Scottish Environment Protection Agency (SEPA)**: responsible for environmental protection and improvement.
- **Drinking Water Quality Regulator for Scotland:** ensures that drinking water from public and private supplies in Scotland is safe to drink.

* Refers to supply-demand balance at the water resource zone scale in the mid-century, in a 2°C world, under central population projections and assuming no additional adaptation action.

While there have been no new water sector policies in the past year, Scotland's National Planning Framework 4 (NPF4), which will impact infrastructure and the wider built environment, was published in February 2023.[5] This included positive steps towards enhancing the resilience of the water system, by prioritising new development proposals that can connect to the public water mains. However, the Framework missed an opportunity to ensure that the location of new infrastructure considers wider climate change impacts, as we had recommended in our March 2022 Progress Report to Scottish Parliament.[6]

Scottish Government and Scottish Water are developing policies and plans to enhance the resilience of the public water supply system in Scotland.

There are forthcoming policies by Scottish Government and adaptation plans by Scottish Water, which had not yet been published at the time of drafting this report:

- **Scottish Government is planning to consult on new policies and legislation on water industry adaptation**. Scottish Government has committed to consult on policies in autumn 2023 with an aim of bringing forward new legislation "to modernise and update the water industry to adapt to the extremes of climate change".[7] There are no further details on what this consultation will include.

- **Scottish Water is due to publish an updated climate change risk assessment and an adaptation plan**. Scottish Water is updating its climate change risk assessment to plan for between 2 – 4°C of warming by the 2080s and is developing scenarios for risk and response assessments.[8] This will inform its Strategic Investment Plan to 2050 and a high-level adaptation action plan, which will be published in 2023.

These plans should set out proposals for setting drought resilience standards under a changing climate in Scotland, to inform the balance of necessary action across the adaptation outcomes of reduced demand, improved system performance and increased supply. These documents, once published, should improve Scotland's planning scores for the water system. We reference these proposals across most outcomes, and the recommendations at the end of this chapter set out our expectations for these plans in greater detail.

5.1.1 Outcome 1: Reduced demand

(i) Delivery and implementation progress

Indicators for this outcome show **insufficient progress** in reducing household water demand:

Household water consumption in Scotland has not yet fallen to pre-pandemic levels.

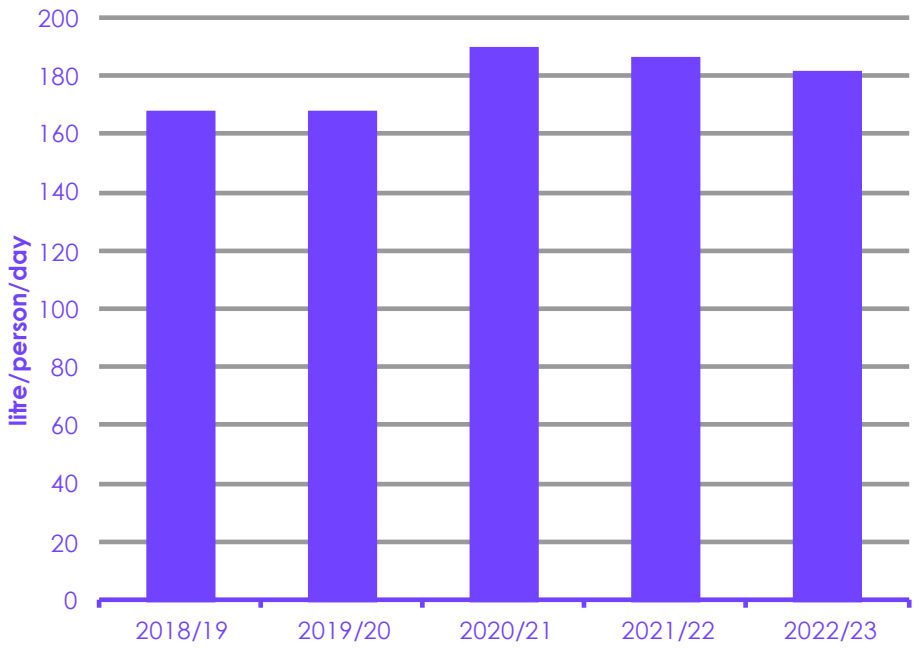
- **Household water consumption fell in 2022/23 and 2021/22, following a large increase in 2020/21, likely driven by the COVID-19 pandemic.** An increase in per capita consumption was seen in Scotland, and across the rest of the UK, in 2020/21 when people spent more time and consumed more water at home (Figure 5.1). Non-household water consumption in Scotland declined over this period, albeit by less than the increase in household consumption, following a longer-term declining trend (see Chapter 13 on business). Although 2021/22 and 2022/23 saw small reductions in per capita consumption, levels are still 8.4% higher than before the pandemic.

- **Scottish Water has made efforts to inform households on the need to conserve water.** Scottish Water has distributed 'water saving packs' to households since 2017, and an online and television campaign on saving water was launched in 2022.[9] There is not yet evidence that this is having an impact on demand.

There has been a slight increase in private water supplies between 2021 and 2022. Private supplies do not have to be risk assessed.

- **The number of private water supplies, and the population supplied by them, increased slightly in 2022.** There were nearly 189,500 people supplied by private water supplies in 2022,[1] compared to close to 185,900 in 2021.[10] A recent study looking at climate impacts on private water supplies found that almost half of private water supplies in Scotland are in areas of high or very high risk.*,[11] Current regulation means that small non-commercial private water supplies – which correspond to 80% of private water supplies – don't have to be risk assessed or tested, unless a grant is being requested from Scottish Government.[1] Increases in demand from private supplies could therefore present a risk to the resilience of the system as a whole.

Figure 5.1 Per capita water consumption



Source: Scottish Water (unpublished).

* Risk is defined based on a 'Meteorological Drought Risk Indicator' developed for this project, constructed based on combining indices of hydrological drought with projections of future climate based on UKCP09. The risk classes are the sum of the number of years (0 - 31) in the future projections where the annual total rainfall falls below the 20th percentile threshold of the observed years multiplied by the number of private water supplies in a given 5 km cell.

(ii) Policy and planning progress

There are no new policies to increase the resilience of the water sector in Scotland, but Scottish Government intend to consult on this.

There are **insufficient policies and plans** in place to reduce household water demand:

- **There are no new policies to encourage a reduction in household consumption**. There are no targets for the reduction of water consumption in Scotland. We expect consideration of this, alongside other policies to address water demand, to be included in Scottish Government's consultation later in the year.

- **The final NPF4 should help to limit growth in private water supplies in water-scarce areas**. NPF4 states that new developments will only be supported if they can be connected to the public water mains. Where that is not possible developers must demonstrate that drinking water can be sourced from a sustainable source, resilient to periods of water scarcity. While this is welcome, it will only ensure that private supplies do not increase further, as it will only apply to new developments.

5.1.2 Outcome 2: Improved system performance

(i) Delivery and implementation progress

Indicators for this outcome show **mixed progress** in improving the performance of the system in a changing climate:

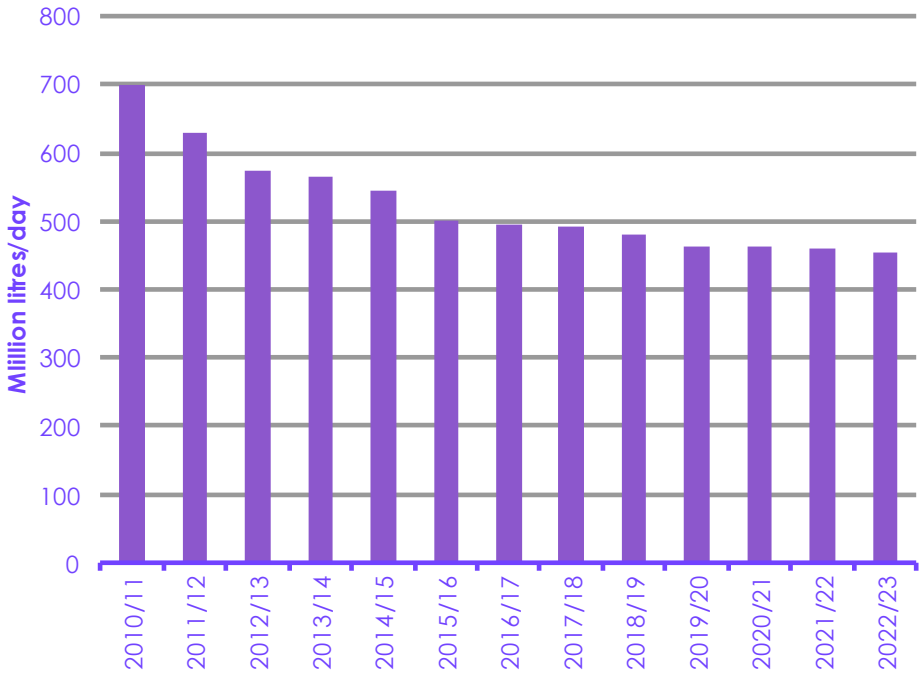
- **While leakage rates are in line with current targets, these targets have not been determined with consideration of potential climate change risks to future water availability.** The average annual leakage rate only fell by around 1% in the last year (Figure 5.2). Although leakage rates meet current targets, the approach to setting them should be reviewed (see section on policies and plans below).

Leakage fell by 1% in the latest data. Weather hazards have led to unplanned interruptions to supply.

- **Lengthy interruptions to water supplies continue to occur, in particular due to extreme weather events such as winter storms**. There were over 5,700 unplanned interruptions to water supply lasting more than six hours in 2022/23 (Figure 5.3). While not all unplanned interruptions are caused by weather, Scottish Water state that a lot of disruptions in 2021/22 and 2022/23 occurred during severe weather events which stretched their normal response capability.[12] Scottish Water responded to these events by rezoning the network or using tankers to bring supplies back while repairs were underway.

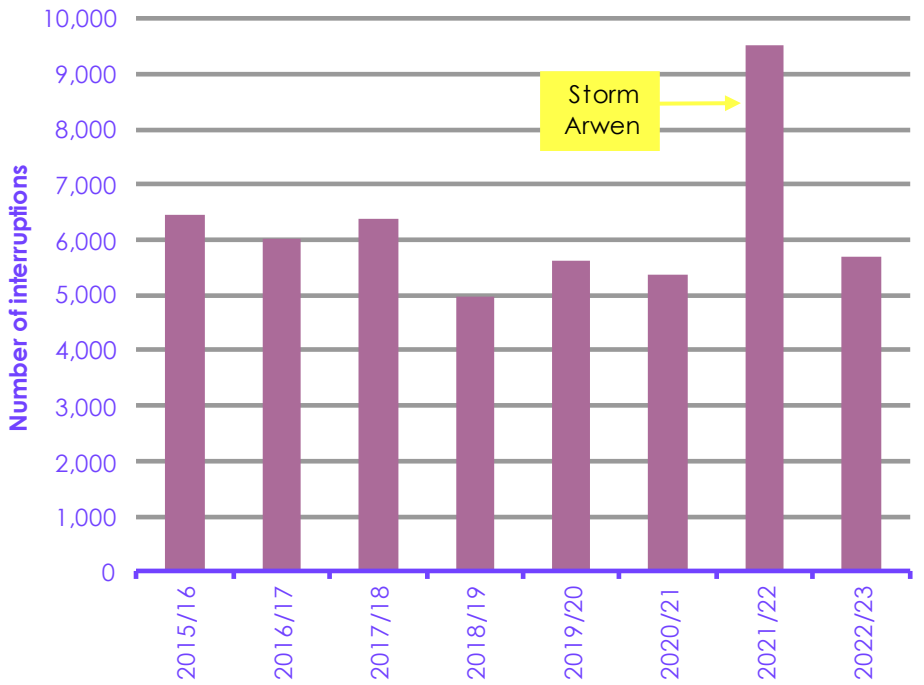
- **Water supply infrastructure is already being affected by climate hazards, with flooding of water treatment works occurring last year.** Ballater Water Treatment Works in Aberdeenshire flooded due to high river flows, when customers supplies had to be maintained through tankers.[12] There is no data on the number of sites at risk of flooding or other hazards.

Figure 5.2 Leakage from the public supply system



Source: Scottish Water (2010-2023) *Annual Reports*.

Figure 5.3 Unplanned interruptions to supply lasting more than six hours



Source: Scottish Water (2022) 2020-21 Annual Return; Scottish Water (2023) Scottish Water Annual Report 2022/23.

(ii) Policy and planning progress

There are **insufficient policies and plans** in place to improve the performance of the system in a changing climate:

Leakage targets are currently set on an entirely economic basis and do not take climate resilience into account.

- **Leakage targets have still not been updated**. While Scottish Water does have targets for leakage, which are set and monitored by WICS, the level of acceptable leakage is determined on an economic basis, and does not take a long-term approach to identifying the leakage reduction rates that may be needed to ensure adequate water supplies are maintained despite climate change.* Actual leakage reductions have already exceeded these targets, which have not changed in seven years. We expect this to be considered in Scottish Government's consultation later in the year.

- **The planned increase in investment in the public water supply system out to 2027 may reduce leakage**. WICS determined in its Strategic Review of Charges 2021-27 that Scottish Water should be allowed an increase in investment of 30% compared to the previous regulatory control period (2015 – 2021), recognising that investment would need to increase if current service levels are to be maintained in a changing climate.[13] There is currently no information on the breakdown of future investment and how much of this will relate to leakage reduction. Furthermore, WICS' latest assessment concluded that delivery of Scottish Water's investment programme was slipping.[14]

5.1.3 Outcome 3: Increased supply

(i) Delivery and implementation progress

Indicators for this outcome show **insufficient progress** in increasing water supply:

- **Water scarcity is already affecting Scotland**. Water scarcity alerts have been reported by SEPA regularly in the last few years, in particular in the east of Scotland.[15]

Scotland's challenging terrain may make transfers between some water resource zones prohibitively expensive.

- **Water deficits are projected for some water resource zones in Scotland by the 2050s but there are not yet plans for additional supply.** The projections of future water availability from the third Climate Change Risk Assessment suggest that Scotland will have an overall supply-demand balance surplus by both the mid and late-century, but several Scottish water resource zones will be in deficit.*,[3] There is an assumption that deficits can be resolved by transferring water between regions, but this may be prohibitively expensive due to challenging terrain in many cases. Scottish Water's adaptation plans will need to set out plans for additional capacity to address these deficits.

* Refers to supply-demand balance at the water resource zone scale in the mid-century, in a 2°C world, under central population projections and assuming no additional adaptation action.

(ii) Policy and planning progress

There are **insufficient policies and plans** in place to increase water supply:

The planned consultation on water system adaptation should consider a resilience standard for Scotland.

- **Scottish Government does not specify a level of resilience for system supply.** Companies in England must plan for resilience to a 1 in 500-year drought, while in Scotland a resilience standard has not been set. We expect this to be considered in Scottish Government's consultation later in the year.

- **Scottish Government is exploring opportunities to extend public water networks to households reliant on private supplies.** With the help of Scottish Water, Aberdeenshire Council and Consumer Scotland, Scottish Government is investing £20 million to support a pilot project looking at opportunities to connect households reliant on private supplies to the public network.[16] Given lack of regulation over private supplies, bringing these into the public network would be a positive step in enhancing resilience.

5.1.4 Outcome 4: Interdependencies identified and managed

(i) Delivery and implementation progress

We are **unable to evaluate** progress against managing interdependencies:

Cascading impacts across infrastructure systems are already affecting water supplies in Scotland.

- **While there is no evidence to comprehensively assess the exposure of water supply to interdependent infrastructure in Scotland, cascading impacts across infrastructure systems are already affecting the resilience of the water system.** In 2021, Storm Arwen led to power outages which affected water treatment works, disrupting water supply to customers.[17] Scottish Water also reported difficulties in accessing burst pipes for repair in 2022/23 due to wintry road conditions.[12]

(ii) Policy and planning progress

There are **insufficient policies and plans** in place to identify and manage interdependencies:

- **There is no national, systemic view of cascading impacts from climate risks to infrastructure systems in Scotland**:

  - The Scottish National Adaptation Plan should include a national assessment of the scale of current and future risks from weather-related cascading infrastructure failures due to interdependencies, with specific policies and/or actions to plan for, and manage, risks from interdependent infrastructure.

  - Scottish Government's consultation on the water industry should factor in interdependencies explicitly, as should Scottish Water's adaptation action plan and other upcoming assessments.

5.1.5 Enablers

Progress is needed on data and monitoring, funding and investment, public engagement and governance to deliver a well-adapted water system.

Further progress is also needed on key enablers to deliver a well-adapted water system:

- **Data and monitoring**. Scottish Water publish data in their annual reports including on leakage, consumption and unplanned supply disruptions. There is also ad hoc information on flooding incidents affecting assets. There is no publicly available data on assets at risk of various climate hazards. We welcome Scottish Government's commitment to develop a monitoring and evaluation framework to track progress against the Scottish National Adaptation Plan – they should work with Scottish Water to ensure that data that is already tracked can be made publicly available in an accessible format.

- **Funding and investment**. While it is positive that WICS has recognised the need for greater investment in the water system due to climate change, Scottish Government and Scottish Water's plans should make clear what level of resilience will be achieved with this investment and how it will be delivered, including breakdowns of planned investment in reducing demand, improving leakage, increasing supply and protecting assets from hazards.

- **Engagement and education**. Scottish Water distributes water saving packs annually and has launched an information campaign to increase awareness on the need to save water. It would be useful to assess the impact of these measures.

- **Governance**. Drought resilience standards, set by Scottish Government and regulated by WICS, are needed to inform Scottish Water's leakage and per capita consumption targets and water supply infrastructure needs. Scottish Water's plans will need to be transparent on how they intend to achieve these standards.

5.2 Recommendations

Table 5.2
Recommendations

Primary responsibility	Recommendation	Timing
Energy and Climate Change Directorate; Performance, Delivery and Resilience Directorate	Include a national assessment of the scale of current and future risks from weather-related cascading infrastructure failures in the Scottish National Adaptation Plan, as well as specific policies and/or actions to plan for, and manage, risks from interdependent infrastructure.*	2024
Local Government and Housing Directorate	Explore policy opportunities to ensure decisions around the location of new infrastructure consider future climate change impacts, before the next National Planning Framework, as this was not explicitly considered in NPF4.*	2024
Energy and Climate Change Directorate	The consultation on water sector policies planned for 2023 should include proposals for setting clear drought resilience standards under a changing climate, to inform leakage reduction and per capita consumption targets and future water supply needs.	2023

* A cross-cutting infrastructure recommendation.

Endnotes

[1] Drinking Water Quality Regulator for Scotland (2022) *Private Water Supplies: Drinking Water Quality in Scotland 2022*, https://dwqr.scot/information/annual-report/2022-annual-reports/

[2] Scottish Environmental Protection Agency (2023) *Water Scarcity Report – 14th September 2023,* https://www.sepa.org.uk/environment/water/water-scarcity/

[3] HR Wallingford (2020) *Updated projections of future water availability for the third UK Climate Change Risk Assessment: Technical Report*, https://www.ukclimaterisk.org/independent-assessment-ccra3/research-supporting-analysis/

[4] Jaroszweski, D., Wood, R., and Chapman, L. (2021) *Infrastructure*. In: The Third UK Climate Change Risk Assessment Technical Report. [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)] Prepared for the Climate Change Committee, London

[5] Scottish Government (2023) *National Planning Framework 4*, https://www.gov.scot/publications/national-planning-framework-4/

[6] Climate Change Committee (2022) *Is Scotland Climate Ready?*, https://www.theccc.org.uk/publication/is-scotland-climate-ready-2022-report-to-scottish-parliament/

[7] Scottish Government (2023) *Climate adaptation: letter to UK Climate Change Committee*, https://www.gov.scot/publications/climate-adaptation-letter-to-uk-climate-change-committee/

[8] Sustainable Scotland Network (2022) *Scottish Water Climate Change Report 2021-22*, https://sustainablescotlandnetwork.org/reports/scottish-water

[9] Scottish Government (2023) *Your water your life*, https://www.yourwateryourlife.co.uk/campaign/water-is-always-worth-saving/

[10] Drinking Water Quality Regulator for Scotland (2021) *Private Water Supplies: Drinking Water Quality in Scotland 2021*, https://dwqr.scot/information/annual-report/2021-annual-reports/

[11] M.Rivington, I. Akoumianaki and M. Coull (2020) *Private Water Supplies and Climate Change The likely impacts of climate change (amount, frequency and distribution of precipitation), and the resilience of private water supplies*. CRW2018_05. Scotland's Centre of Expertise for Waters (CREW).

[12] Scottish Water (2023) 2022/23 *Annual Report and Accounts: Performance and Prospects*, https://www.scottishwater.co.uk/help-and-resources/document-hub/key-publications/annual-reports

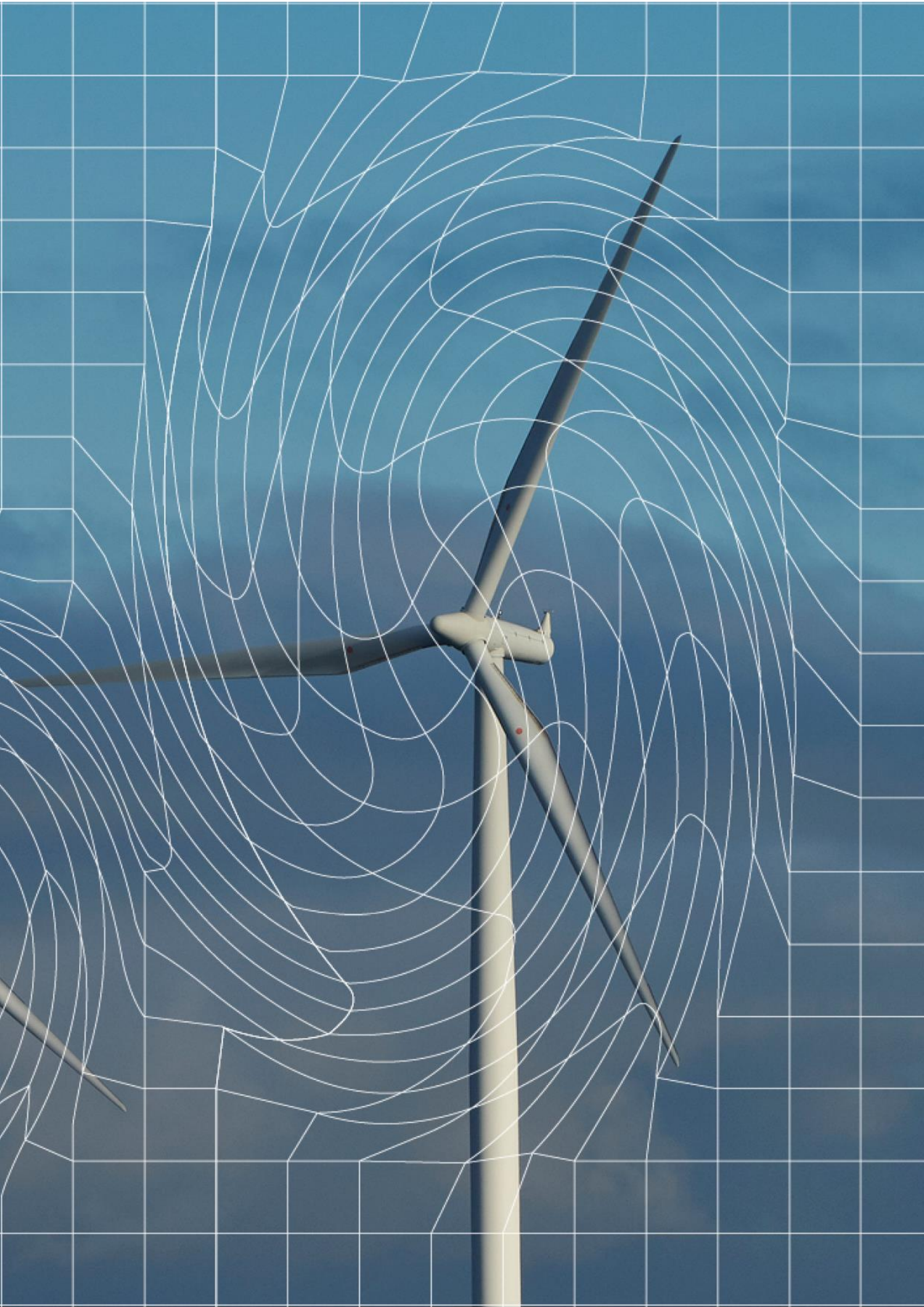
[13] Water Industry Commission for Scotland (2021) *Final Determination: Strategic Review of Charges 2021-27*, https://wics.scot/publications/price-setting/strategic-review-charges-2021-27/determinations/2021-27-final-determination

[14] Water Industry Commission for Scotland (2023) *Scottish Water Performance Report 2021-22*, https://wics.scot/publications/scottish-water/performance/scottish-water-performance-report-2021-22

[15] Scottish Environmental Protection Agency (2023) *Water Scarcity Alert,* https://www.sepa.org.uk/environment/water/water-scarcity/

[16] Scottish Government (2022) *Adapting to climate change and water scarcity*, https://www.gov.scot/news/adapting-to-climate-change-and-water-scarcity/

[17] Scottish Water (2021) *Impact on customers – Storm Arwen*, https://www.scottishwater.co.uk/about-us/news-and-views/2021/12/281121stormarwen



Chapter 6: Energy

Table 6.1
Progress summary - Energy

	Delivery and implementation	Policies and plans	Summary
Outcome 1: Reduced vulnerability of energy assets to extreme weather	Unable to evaluate	Mostly reserved	• There is insufficient evidence to comprehensively assess risks to energy assets from climate change. • Scottish Government has published a draft Energy Strategy and Just Transition Plan, which aims to reduce the vulnerability of power assets to the impacts of climate change. • Much of this policy area is reserved to UK Government. The latest CCC 2023 Adaptation Progress Report to Parliament score for this outcome was 'partial policies and plans'.[1]
Outcome 2: System-level security of supply	Mixed progress	Mostly reserved	• Plans are in place for further progress on hydrogen and carbon capture and storage (CCS) in Scotland, which are critical to supporting security of supply. While there is progress on system-level security of supply through renewable capacity growth in Scotland, it remains unclear to what extent geographical diversity of assets or other system-level adaptation strategies are being factored into planning decisions. • More research is needed to understand possible climate impacts on the energy system, and this must be integrated into system design and investment processes. • The majority of policy milestones for this outcome are reserved to UK Government. Our March 2023 Progress Report score for this outcome was 'limited policies and plans'.
Outcome 3: Interdependencies known and managed	Insufficient progress	Mostly reserved	• Operators are starting to consider their interdependencies with other infrastructure systems but there are limited actions in place to quantify or manage risks. • Scottish Government has produced a high-level mapping of energy system interdependencies for the 2020s and 2030s. • The majority of policy milestones for this outcome are reserved to UK Government. Our March 2023 Progress Report score for this outcome was 'insufficient policies and plans'.

Relevant risks from CCRA3: I1 Risks to infrastructure networks (water, energy, transport, ICT) from cascading failures; I2 Risks to infrastructure services from river, surface water and groundwater flooding; I3 Risks to infrastructure services from coastal flooding and erosion; I4 Risks to bridges and pipelines from flooding and erosion; I6 Risks to hydroelectric generation from low or high river flows; I7 Risks to subterranean and surface infrastructure from subsidence; I9 Risks to energy generation from reduced water availability; I10 Risks to energy from high and low temperatures, high winds, lightning; I11 Risks to offshore infrastructure from storms and high waves; H6 Risks and opportunities from summer and winter household energy demand.

This chapter covers adaptation to climate change for the energy system in Scotland. This includes the generation of electricity and the production of gas and hydrogen, and the operation of the networks to distribute energy to end users.

Careful system-level and asset-level planning and design is needed from the outset to deliver a reliable and resilient decarbonised energy system.

The energy system is already undergoing a transformation to achieve Net Zero. Careful system-level and asset-level planning and design is needed from the outset to ensure that a decarbonised energy system, with a higher degree of weather dependence, can be made reliable and resilient. If future climate risks are not considered and reflected in energy system planning and operation, there is a significant risk that energy assets and systems may not be well-adapted to the climate and weather hazards expected over their lifetime, creating additional costs in retrofitting later and/or locking in increased climate vulnerability.

All energy related infrastructure is at risk from the impacts of climate change. More frequent and intense weather events such as heatwaves, droughts and floods must be anticipated alongside other likely changes to weather. These include possible changes to wind conditions, which are increasingly critical to the functioning of the whole energy system.*

Climate resilience in energy is strongly linked to resilience across several other sectors, including health, telecoms and ICT, transport and water supply, which are already dependent on the functioning of the energy system. The cascading impacts of electricity failure will continue to grow as the economy becomes increasingly electrified and as extreme weather events become more common and severe.

While policy levers in relation to energy are largely reserved, Scottish Government retains an important role.

Policy levers in relation to energy are largely reserved. However, Scottish Government works closely with UK Government and electricity network operators and owners. Emergency response to electricity system failures is largely devolved in practice.

Box 6.1 sets out the key findings from our last assessment in 2022.

Box 6.1
Key findings from our March 2022 Report to Scottish Parliament

Plan score: Medium

- Electricity transmission and distribution companies and gas network operators have submitted updated adaptation plans under the third round of the Adaptation Reporting Power (ARP3). A summary report is available for the generation sector.
- Current and upcoming Scottish Government policy documents do not consider adaptation or resilience of energy networks.

Risk management score: Low

- Indicators are not available for Scotland.

Recommendations:

- Urgently include adaptation and increased resilience to climate risks as a key priority in the upcoming Energy Strategy. Identify actions which can be taken within Scotland and to influence UK Government policy, which would respond to the multiple climate risks affecting energy generation, transmission and distribution in Scotland.

Source: CCC (2022) *Is Scotland climate ready? 2022 Report to Scottish Parliament.*

* Further information on climate risks can be found in the latest Independent Assessment of UK Climate Risk (CCRA3).

To ensure a reliable energy supply in a Net Zero economy, a range of outcomes need to be delivered to effectively manage risks:

- Reducing the vulnerability of energy assets to extreme weather
- Increasing system-level security of supply
- Identifying and managing interdependencies

6.1.1 Outcome 1: Reduced vulnerability of energy assets to extreme weather

(i) Delivery and implementation progress

Insufficient data means we are unable to comprehensively evaluate progress in reducing vulnerability and exposure of energy assets to climate change.

Insufficient data on indicators across the range of climate hazards and electricity and gas assets relating to this outcome means we are **unable to evaluate** progress in reducing vulnerability and exposure of energy assets to climate change.

- **Across Scotland, the majority of critical electricity substations are flood-proofed, and plans are in place to deliver the rest by 2028.** Electricity network operators in Scotland have set out their plans to undertake flood mitigation works for at-risk substations as part of their RIIO-2 business plan submissions to Ofgem.[*,2,3,4,5] Transmission-level works are planned for delivery by 2026 and distribution-level works are planned for delivery by 2028. Ofgem collects data annually from electricity network operators on the number of flood site surveys and mitigation schemes undertaken, however they do not compile or report on these data.

- **The age and poor condition of overhead poles have contributed to recent weather-related electricity network damage.** Ofgem found that the age and condition of overhead poles were contributing factors to the power network damage caused by Storm Arwen, which impacted almost 200,000 energy consumers in Scotland.[6,7] The average age of damaged poles in Scottish & Southern Electricity Network's distribution network was 51 years.[†] In SP Energy Network's distribution network, 80% of damaged poles were over 40 years old.[‡] Ofgem's final report identifies the need for further work to understand the correlation between pole age and damage, and to identify improvements in pole condition reporting.

[*] Ofgem set price controls for the gas and electricity network companies of Great Britain. RIIO-2 is the second set of price controls implemented under the RIIO (Revenue = Incentives + Innovation + Outputs) model.

[†] This data includes Scottish & Southern Electricity Network's Northern Scotland distribution network and Southern England distribution network. Disaggregated data for Scotland was not available.

[‡] This data includes SP Energy Network's Southern Scotland distribution network and its Merseyside and North Wales distribution network. Disaggregated data for Scotland was not available.

- **Data on abstraction restrictions imposed on power generators, ground conditions (subsidence, landslides and erosion) and heatwave risk to energy assets in Scotland were not available.** There is a need to address national data gaps on asset resilience.

(ii) Policy and planning process

Key policy milestones for reduced vulnerability of energy assets to extreme weather are largely outside of Scottish Government's direct control. This outcome is therefore not scored.

Key policy milestones for this outcome are largely outside of Scottish Government's direct control. This outcome is therefore **not scored**.

At a UK-wide level for reserved policies, our March 2023 Progress Report assessed this outcome as 'partial policies and plans'.[1] Some of the key policy milestones required to ensure generation and network assets are resilient to extreme weather are not in place. Climate change is a consideration in statutory planning applications for new infrastructure, and reports submitted under ARP3 demonstrate progress in some areas, but there is a need for minimum resilience standards and a clearer climate resilience remit for regulators.

Relevant developments in Scotland include the following:

- **Scottish Government has published a draft Energy Strategy and Just Transition Plan, which aims to reduce the vulnerability of power assets to the impacts of climate change.** This reflects the recommendation from our 2022 Report to Scottish Parliament, Is Scotland climate ready? to urgently include adaptation and increased resilience to climate risks as a key priority in the energy strategy.[8] However, no detail is provided in the draft plan on how this outcome will be achieved, either through action which can be taken within Scotland or to influence UK Government policy. The finalised Energy Strategy and Just Transition Plan is due to be published by summer 2024.

- **Scotland's fourth National Planning Framework (NPF4) is a key lever for considering major infrastructure but has limited consideration of future climate risks for energy assets.** While NPF4 considers climate resilience generally, policies focusing on renewable energy developments do not consider the resilience of these energy assets to future climate risks explicitly.[9] It is important that resilience to future climate risks is considered from the outset for new energy assets to avoid creating additional costs in retrofitting later and/or locking in increased climate vulnerability. It is not yet clear how effectively this national framework will be translated into Local Development Plans.

6.1.2 Outcome 2: System-level security of supply

(i) Delivery and implementation progress

Indicators for this outcome show mixed progress in reducing vulnerability and exposure of the energy system to climate change.

Indicators for this outcome show **mixed progress** in reducing vulnerability and exposure of the energy system to climate change.

System-level security of supply is reserved to UK Government and needs to be considered at a UK-wide level. To ensure a reliable energy supply that is resilient to changing weather conditions, system-level security of supply needs to consider a range of factors, including generation capacity, flexibility and redundancy; generation mix and location; network resilience and redundancy; and water needs for Net Zero compatible generation.

Relevant developments in Scotland include the following:

- **Plans are in place for further progress on hydrogen and carbon capture and storage (CCS) in Scotland, critical to supporting security of supply during extreme weather.** Sufficient levels of storage and low-carbon dispatchable generation are needed in addition to renewables, for instance through hydrogen-fired turbines or gas CCS. Scottish Government has set an ambition of 5 GW of renewable and low-carbon hydrogen production by 2030 and 25 GW by 2045.[10] The Acorn cluster, which includes CO_2 transport and storage and blue hydrogen production in Scotland, also recently progressed to negotiations under Track-2 of UK Government's CCUS cluster sequencing process.[11]

- **Progress on renewable capacity growth in Scotland is improving security of supply, but it remains unclear what adaptation measures, such as geographical diversity of assets, are being factored into planning decisions at a system level.** In 2022, an additional 1.5 GW of wind capacity was installed in Scotland.[12] A sufficient level of renewables capacity is an important component in supporting system-level security of supply. However, variable renewable generation can also create greater weather dependence (particularly wind dependence) and increased exposure to outages due to weather extremes. Improving the geographical diversity of assets can support resilience. We have not been able to establish the extent to which geographical diversity is currently being considered in locating wind. This remains an area of continued importance, particularly at the UK scale.

(ii) Policy and planning progress

Key policy milestones for system-level security of supply are largely outside of Scottish Government's direct control. This outcome is therefore not scored.

Key policy milestones for this outcome are largely outside of Scottish Government's direct control. This outcome is therefore **not scored**.

UK Government has committed to fully decarbonise energy supply by 2035 and ensure its resilience, but has not set out a coherent plan for delivering system-level climate resilience (which was largely missing from the Third National Adaptation Programme). The UK Government needs to implement integrated policy in this area which addresses both mitigation and adaptation challenges together.

Relevant developments in Scotland include the following:

- **Scottish Government continues to urge UK Government to take action to ensure energy security and resilience.** The draft Energy Strategy and Just Transition Plan sets out Scottish Government's aims to influence UK Government's energy security policy, including on reforms around electricity system restoration and ancillary service markets, to support low-carbon flexibility sources. The draft plan also sets out Scottish Government's aims of exploring the potential for a fully interconnected North Sea grid, and urging UK Government to support the development of pumped hydro storage through an appropriate market mechanism.[10]

- **Scotland's NPF4 includes three significant energy developments that support ambitions for a reliable, decarbonised energy system.** These energy developments aim to support renewable energy generation, covering additional hydropower capacity, green hydrogen production and investment in electricity network infrastructure.[9]

6.1.3 Outcome 3: Interdependencies known and managed

(i) Delivery and implementation progress

Indicators show insufficient progress in identifying and managing interdependencies.

Indicators for this outcome show **insufficient progress** in identifying and managing interdependencies.

- **Operators are starting to consider their interdependencies with other infrastructure systems but there are limited actions in place to quantify or manage risks.** Electricity transmission and distribution companies and gas network operators within Scotland provided some information in ARP3, but often the assessment of interdependent risks lacked quantification and actions for management (Table 6.2).

- **Energy producers and network operators will update their climate risk assessments and adaptation actions in late 2024.** The fourth round of the Adaptation Reporting Power (ARP4) will close in late 2024. Reporting will be invited from energy generators, electricity transmission and distribution companies, gas network operators and Ofgem. However, reporting on interdependencies will remain voluntary.

Table 6.2
Summary of ARP3 evaluation of interdependent risk in energy sector reporting

Reporting organisation	Interdependent risks identified?	Interdependent risks quantified?
Energy Networks Association	Yes	No
Energy UK	Yes	No
National Gas Transmission (formerly National Grid Gas)	Yes	Yes
SGN	Yes	Yes
SP Energy Networks	Yes	No
Scottish & Southern Electricity Networks	No	No

Source: CCC analysis of ARP3 submissions.

(ii) Policy and planning progress

Key policy milestones around the management of interdependencies are largely outside of Scottish Government's direct control. This outcome is therefore not scored.

Key policy milestones for this outcome are largely outside of Scottish Government's direct control. This outcome is therefore **not scored**.

Coverage of interdependency risks improved in adaptation plans submitted for ARP3 but more needs to be done to consistently identify, quantify and manage interdependent risks. Scottish Government has produced a high-level mapping of energy system interdependencies for the 2020s and 2030s. These maps illustrate how energy supply, networks and end-use energy demand relate and interact with each other; finding that the future energy system in Scotland is likely to become more complex and interdependent.[10]

6.2 Recommendations

Table 6.3
Recommendations

Primary responsibility	Recommendation	Timing
Energy and Climate Change Directorate; Performance, Delivery and Resilience Directorate	Include a national assessment of the scale of current and future risks from weather-related cascading infrastructure failures in the Scottish National Adaptation Plan, as well as specific policies and/or actions to plan for, and manage, risks from interdependent infrastructure.*	2024
Local Government and Housing Directorate	Explore policy opportunities to ensure decisions around the location of new infrastructure consider future climate change impacts, before the next National Planning Framework, as this was not explicitly considered in NPF4.*	2024
Energy and Climate Change Directorate	Engage with UK Government to ensure that regulators are given consistent climate resilience remits across the UK, including all devolved administrations.*	2024
Energy and Climate Change Directorate	Work with UK Government and key energy system stakeholders, building on CCC recommendations, to understand what is required to ensure a resilient energy system in Scotland, identify resilience gaps and prepare a plan for addressing these. This plan should identify actions that can be taken within Scotland, as well as opportunities to influence UK Government policy, to respond to the multiple climate risks affecting energy generation, transmission and distribution in Scotland.	2024
Energy and Climate Change Directorate	Address national data gaps on asset resilience. This should include monitoring the vulnerability of energy assets (including flood resilience, condition of power system infrastructure, heat resilience, ground conditions and abstraction restrictions) and monitoring weather-related outages (including the frequency and duration of the outage and the number of properties and businesses affected).	2024

* A cross-cutting infrastructure recommendation.

Endnotes

[1] Climate Change Committee (2023) *Progress in Adapting to Climate Change: 2023 Report to Parliament*, https://www.theccc.org.uk/publication/progress-in-adapting-to-climate-change-2023-report-to-parliament/.

[2] SP Energy Networks (SPEN) (2021) *Enabling the path to Net Zero – Our RIIO-ED2 Business Plan for 2023-28*, https://www.spenergynetworks.co.uk/pages/our_riio_ed2_business_plan.aspx.

[3] SP Energy Networks (2019) *RIIO-T2 Business Plan – Annex 7: Environmental Action Plan*, https://www.spenergynetworks.co.uk/pages/riio_t2_business_plan_annexes.aspx.

[4] Scottish & Southern Electricity Networks (2021) *SSEN Distribution RIIO-ED2 Environmental Action Plan*, https://www.ssen.co.uk/about-ssen/stakeholder-engagement/reports-and-publications/?filterTerm=95#docLib.

[5] Scottish & Southern Electricity Networks (2019) *RIIO-T2 Business Plan – Regulatory Framework Uncertainty Mechanisms*, https://www.ssen-transmission.co.uk/information-centre/riio-t2-plan-and-uncertainty-mechanisms/.

[6] Ofgem (2022) *GHD - Storm Arwen Review Main Report*, https://www.ofgem.gov.uk/sites/default/files/2022-06/GHD%20-%20Storm%20Arwen%20Review%20Main%20Report.pdf.

[7] Scottish Government (2022) *Storm Arwen Review*, https://www.gov.scot/publications/storm-arwen-review/.

[8] Climate Change Committee (2022) *Is Scotland climate ready? – 2022 Report to Scottish Parliament*, https://www.theccc.org.uk/publication/is-scotland-climate-ready-2022-report-to-scottish-parliament/.

[9] Scottish Government (2023) *National Planning Framework 4*, https://www.gov.scot/publications/national-planning-framework-4/pages/1/.

[10] Scottish Government (2023) *Draft Energy Strategy and Just Transition Plan*, https://www.gov.scot/publications/draft-energy-strategy-transition-plan/.

[11] Department for Energy Security & Net Zero (2023) *Update to industry on conclusion of the CCUS Cluster Sequencing Track-2 expression of interest*, https://www.gov.uk/government/publications/cluster-sequencing-for-carbon-capture-usage-and-storage-ccus-track-2/update-to-industry-on-conclusion-of-the-ccus-cluster-sequencing-track-2-expression-of-interest.

[12] Scottish Government (2023) *Scottish Energy Statistics Hub – Renewable Electricity Capacity*, https://scotland.shinyapps.io/Energy/?Section=RenLowCarbon&Subsection=RenElec&Chart=RenElecCapacity.

Chapter 7: Telecommunications and ICT

Table 7.1
Progress summary – Telecommunications and ICT networks

	Delivery and implementation	Policies and plans	Summary
Outcome 1: Vulnerability of assets reduced	Unable to evaluate	Mostly reserved	• There is insufficient evidence to comprehensively assess risks to telecoms and ICT assets from climate change. • Telecoms and ICT networks adaptation policy is mainly reserved to UK Government, so policy scores are not given to Scotland. For the UK, the latest CCC 2023 adaptation progress report to Parliament scored this outcome as 'limited policies and plans.'
Outcome 2: System level resilience	Unable to evaluate	Mostly reserved	• There is insufficient evidence to comprehensively assess climate change risks to the system. There are examples of system resilience being considered in the delivery of Scottish Government-led programmes – some mobile masts installed in rural locations through the 4G Infill Programme included back-up diesel generators that can provide service in the event of a power outage. • Telecoms and ICT networks adaptation policy is mainly reserved to the UK Government, so policy scores are not given to Scotland. For the UK, the latest CCC 2023 adaptation progress report to Parliament scored this outcome as 'insufficient policies and plans.'
Outcome 3: Interdependencies identified and managed	Unable to evaluate	Insufficient policies and plans	• There is insufficient evidence to comprehensively assess risks to telecoms and ICT networks arising from interdependencies. • There has been no progress in developing a systemic view of cascading impacts from climate risks to infrastructure systems.

Relevant risks from CCRA3: Risks to infrastructure networks (water, energy, transport, ICT) from cascading failures (I1); Risks to infrastructure services from river, surface water and groundwater flooding (I2); Risks to infrastructure services from coastal flooding and erosion (I3); Risks to bridges and pipelines from flooding and erosion (I4); Risks to subterranean and surface infrastructure from subsidence (I7); Risks to digital from high and low temperatures, high winds, and lightning (I13).

This chapter covers adaptation to climate change for telecommunications (telecoms) and information and communications technology (ICT) network infrastructure. This is infrastructure for the provision of telephone, mobile communications and internet services, including data centres and extensive networks of optical fibres, cables and masts.

Telecoms and ICT infrastructure will be affected by a range of climate hazards including flooding, increased temperatures and storm and winds.

Telecoms and ICT infrastructure will be affected by increased temperatures and more frequent flooding, heatwave events, storms and winds, increasing disruption to these systems.[1]

Telecommunications policy is not devolved to Scotland. The UK Government Department for Science, Innovation and Technology (DSIT) is responsible for Government regulation related to the telecoms and ICT sector, although Scottish Government funds digital initiatives, such as supporting digital transformation or offering digital support for businesses. Ofcom regulates operations in the sector but has no statutory remit for climate resilience.

All other infrastructure systems depend on telecoms and ICT to operate effectively (see Chapter 5 on water supply, Chapter 6 on energy and Chapter 8 on transport). Increased prevalence of ICT in 'smart' infrastructure is rapidly increasing the exposure of ICT assets to climate risks. Telecoms and ICT networks also depend on the energy system to function, and on the transport network to access assets for installation, maintenance and repair.

7.1.1 Outcome 1: Vulnerability of assets reduced

(i) Delivery and implementation progress

We are **unable to evaluate** progress in reducing the vulnerability of telecoms and ICT assets to climate change:

Indicators are needed to monitor the vulnerability of telecoms and ICT assets, including on flooding risk, condition of assets and operating thresholds.

- **Indicators are needed to monitor the vulnerability of telecoms and ICT assets**. Scottish Government should look to develop indicators that can be used in the Scottish National Adaptation Plan's monitoring and evaluation framework. Indicators that could be useful include:
  - Assets at risk of flooding
  - Condition of cables and other network infrastructure
  - Datacentre clusters developed in areas of flood risk
  - Heat protection/operating thresholds of datacentres and other network infrastructure

(ii) Policy and planning progress

We have not formally scored progress on policies and plans to reduce the vulnerability of telecoms and ICT assets, as this is **mostly reserved** to UK Government. Where there are policies or plans within Scottish Government's control, we have highlighted opportunities for considering climate risks:

Scottish Government should consider climate resilience in any policies it develops which result in the roll-out of new telecoms and ICT assets.

- **Policy to incentivise datacentres to locate in Scotland should consider resilience as well as decarbonisation when defining what a 'green' datacentre is**. Scottish Government's Green datacentres and digital connectivity: vision and action plan for Scotland looks to establish Scotland as an attractive location for green datacentres.[2] The programme is now at the design phase, with Scottish Government identifying potential locations for datacentres based on criteria including access to renewable energy.[3] There is an opportunity to incorporate resilience into the design phase of this project by considering the vulnerability of potential locations to climate hazards, such as flood risk, and requiring any new datacentres and accompanying infrastructure to be built to specified climate resilience standards.
- **There is still no policy to ensure the location of new infrastructure takes into account climate hazards.** Scotland's National Planning Framework 4 (NPF4), published in February 2023, missed an opportunity to ensure that the location of new infrastructure considers future climate change impacts, as we had recommended in our March 2022 Progress Report to Scottish Parliament.[4,5]

7.1.2 Outcome 2: System level resilience

(i) Delivery and implementation progress

We are **unable to evaluate** progress in reducing the vulnerability of the system to climate change:

Indicators are needed to monitor the vulnerability of telecoms and ICT systems, including on system redundancy and contingency plans.

- **Indicators are needed to monitor the resilience of telecoms and ICT systems**. Scottish Government should look to develop indicators that can be used in the Scottish National Adaptation Plan's monitoring and evaluation framework. Indicators that could be useful include:
  - Level of redundancy in system design and operation for power supply, emergency generation, comms, cooling
  - Extent of contingency plans for weather-related outages
  - Diversity of technologies (mobile, copper lines, digital, satellite)
- **Despite challenges in systematically tracking progress, there are examples of programmes led by Scottish Government which incorporate resilience into their delivery**. The Scottish 4G Infill Programme is increasing Scotland's digital connectivity by rolling out mobile masts to rural locations, and is on track to be completed this year.[6] There has been some consideration of the resilience of the system in the delivery of the programme, where back-up generators have been installed alongside some mobile masts, providing resilience against power outages.

(ii) Policy and planning progress

We have not formally scored progress on policies and plans to reduce the vulnerability of the system, as this is **mostly reserved** to UK Government:

Scottish Government should work with UK Government to enhance the resilience of telecoms and ICT networks, including by ensuring Ofcom is given a climate resilience remit.

- **Scottish Government should seek opportunities to work with UK Government on enhancing the resilience of telecoms and ICT networks to climate change**. This should include ensuring that Ofcom is given a climate resilience remit across the UK.

7.1.3 Outcome 3: Interdependencies identified and managed

(i) Delivery and implementation progress

We are **unable to evaluate** progress in identifying and managing interdependencies between telecoms and ICT and other infrastructure systems.

- **Metrics are needed to assess interdependencies between telecoms and ICT and other infrastructure systems**. Scottish Government should look to develop indicators that can be used in the Scottish National Adaptation Plan's monitoring and evaluation framework.

(ii) Policy and planning progress

There are **insufficient policies and plans** in place to identify and manage interdependencies between telecoms and ICT and other infrastructure systems:

There is no systemic view of cascading impacts from climate risks to infrastructure systems in Scotland.

- **There is no national, systemic view of cascading impacts from climate risks to infrastructure systems in Scotland**. The Scottish National Adaptation Plan should include a national assessment of the scale of current and future risks from weather-related cascading infrastructure failures as well as specific policies and/or actions to plan for, and manage, risks from interdependent infrastructure.

7.1.4 Enablers

Further progress is also needed on key enablers to deliver well-adapted telecoms and ICT systems:

- **Data and monitoring**. We welcome Scottish Government's commitment to develop a monitoring and evaluation framework to track progress against the Scottish National Adaptation Plan. As set out in each of the outcomes above, there is still a lack of evidence on climate risks to telecoms and ICT. Scottish Government should look to develop indicators on assets at risk, the resilience of the telecoms and ICT system as a whole, and on interdependencies with other infrastructure sectors.

- **Governance**. As set out above, there is still no resilience remit for Ofcom – Scottish Government should work with the UK Government on establishing this.

7.2 Recommendations

Table 7.2
Recommendations

Primary responsibility	Recommendation	Timing
Energy and Climate Change Directorate; Performance, Delivery and Resilience Directorate	Include a national assessment of the scale of current and future risks from weather-related cascading infrastructure failures in the Scottish National Adaptation Plan, as well as specific policies and/or actions to plan for, and manage, risks from interdependent infrastructure.*	2024
Local Government and Housing Directorate	Explore policy opportunities to ensure decisions around the location of new infrastructure consider future climate change impacts, before the next National Planning Framework, as this was not explicitly considered in NPF4.*	2024
Energy and Climate Change Directorate	Engage with UK Government to ensure that regulators are given consistent climate resilience remits across the UK, including all devolved administrations.*	2024
Energy and Climate Change Directorate; Digital Directorate	Address data gaps for telecoms and ICT as part of the Scottish National Adaptation Plan monitoring and evaluation framework. Develop a research programme to collect data against these indicators where none is available.	2024

* A cross-cutting infrastructure recommendation.

Endnotes

[1] Jaroszweski, D., Wood, R., and Chapman, L. (2021) Infrastructure. In: The Third UK Climate Change Risk Assessment Technical Report. [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)] Prepared for the Climate Change Committee, London

[2] Scottish Government (2021) *Green datacentres and digital connectivity: vision and action plan for Scotland*, https://www.gov.scot/publications/green-datacentres-and-digital-connectivity-vision-and-action-plan-for-scotland/

[3] Scottish Government (2023) *Infrastructure Investment Plan 2021-22 to 2025-26: progress report 2022 to 2023*, https://www.gov.scot/publications/infrastructure-investment-plan-2021-22-2025-26-progress-report-2022-2023/pages/7/

[4] Scottish Government (2023) *National Planning Framework 4*, https://www.gov.scot/publications/national-planning-framework-4/

[5] Climate Change Committee (2022) *Is Scotland Climate Ready?*, https://www.theccc.org.uk/publication/is-scotland-climate-ready-2022-report-to-scottish-parliament/

[6] Scottish Government (2023) *Scottish 4G Infill Programme: progress update*, https://www.gov.scot/publications/scottish-4g-infill-programme-progress-update/

Chapter 8: Transport

Table 8.1
Progress summary - Transport

	Delivery and implementation	Policies and plans	Summary
Outcome 1: Asset and system level reliability of rail network	Mixed progress	Credible policies and plans	• Average annual weather-related rail delays over the last five years were more than twice as high as the preceding five years. Network Rail continues to monitor and manage bridge sites at risk of structural damage or failure. • Network Rail has a range of standards, minimum requirements and guidance, including on drainage and weather management. It is updating its adaptation plan for Scotland with the latest climate projections.
Outcome 2: Asset and system level reliability of strategic road network	Mixed progress	Partial policies and plans	• There has been an improvement in the condition of motorways in the latest data, but slightly worsened conditions for dual and single carriageways. Transport Scotland has identified sites at risk of landslides along the trunk road network and taken action to mitigate risks. • This score should improve following planned updates to a range of policies and plans, including on scour management, flooding and high winds.
Outcome 3: Asset and system level reliability of local roads	Mixed progress	Insufficient policies and plans	• The proportion of local roads which may need repair has seen an improvement in the latest data, but is still more than a third of the network. • Scottish Government should provide guidance to local areas on how to consider climate adaptation and resilience in their transport strategies and plans.
Outcome 4: Asset and system level reliability of airport operations	Unable to evaluate	Limited policies and plans	• There is insufficient available evidence to track progress on the reliability of airport operations in Scotland. • Commitments to monitor and act on risks from flooding and high temperatures in Highlands and Islands airports would improve this score if delivered.
Outcome 5: Asset and system level reliability of port operations	Insufficient progress	Limited policies and plans	• Weather is the most common cause of ferry cancellations in Scotland, and the share of cancellations due to weather has increased in the last five years. • The draft Long-Term Plan for Vessels and Ports commits to placing a high priority on vessel and port designs that consider the need to adapt to climate change, but investment pathways do not explicitly factor in a changing climate.

Outcome 6: Interdependencies identified and managed	Unable to evaluate	Insufficient policies and plans	• There is insufficient available evidence to assess risks arising from interdependencies between transport modes and across transport and other infrastructure systems. • Some infrastructure operators consider interdependencies in their submissions to the Third Adaptation Reporting Power. Transport Scotland's Approach to Climate Change Adaptation and Resilience was a missed opportunity to consider interactions between modes and other sectors.
Relevant risks from CCRA3: Risks to infrastructure networks (water, energy, transport, ICT) from cascading failures (I1); risks to infrastructure services from river, surface water and groundwater flooding (I2); risks to infrastructure services from coastal flooding and erosion (I3); risks to bridges and pipelines from flooding and erosion (I4); risks to transport networks from slope and embankment failure (I5); risks to subterranean and surface infrastructure from subsidence (I7); risks to transport from high and low temperatures, high winds and lightning (I12).			

This chapter covers adaptation to climate change for transport networks in Scotland. This includes infrastructure networks for strategic and local roads, rail, ports, and airports. Functioning transport networks are necessary for personal mobility and public services, as well as business supply chains.

A range of climate hazards will affect transport systems, caused by changes in rainfall and higher temperatures.

A range of climate hazards will affect transport systems, including flooding and earthworks failures from changes in rainfall intensity and frequency; risks of asphalt melting, rail buckling and failure of overhead power lines on the railways from extreme heat; and risks to coastal transport infrastructure, in particular ports, from sea level rise.[1] Weather conditions can also lead to the safety of transport system users being compromised.

Several organisations are responsible for policy across the Scottish transport system:

- **Road.** All policy related to the trunk road network is devolved to Scottish Government and managed by Transport Scotland. Local councils are responsible for the maintenance of most roads and pavements.
- **Rail.** Scottish Government manages the ScotRail and Caledonian Sleeper franchises and is responsible for the operation of rail services. Network Rail Scotland manages rail infrastructure assets across Scotland.
- **Airports**. Aviation policy remains reserved. The Civil Aviation Authority regulates all airports, regardless of ownership. The 11 Highlands and Islands airports are owned by Scottish Government and operated by Highland and Islands Airports Limited (HIAL). Glasgow Prestwick Airport is also owned by Scottish Government but operated on a commercial basis.
- **Ports**. Scottish Government has devolved responsibility for some ports-related activities, such as harbour orders to accommodate infrastructure works. Ferry services are devolved. Caledonian Maritime Assets Limited, which owns ferries, ports and harbours and infrastructure for vital ferry services, is wholly owned by Scottish Government.

Infrastructure services are increasingly linked and dependent upon one another, and all transport modes rely on energy (Chapter 6) and telecommunications and ICT (Chapter 7) infrastructure to varying degrees.

8.1 Progress towards a well-adapted transport network

Transport Scotland's ACCAR set out a high-level vision for well-adapted trunk roads, rail, aviation and maritime networks.

Transport Scotland published its adaptation strategy in August 2023. The strategy – Transport Scotland's Approach to Climate Change Adaptation and Resilience (ACCAR) – sets out a vision for a well-adapted transport system, along with four strategic outcomes linked to that vision for trunk roads, rail, aviation and maritime networks.[2] Our assessment of the ACCAR is provided below under the relevant outcomes.

Scotland's National Planning Framework 4 (NPF4), which will impact infrastructure and the wider built environment, was published in February 2023.[3] The framework missed an opportunity to ensure that the location of new infrastructure considers future climate change impacts, as recommended in our 2022 Progress Report to Scottish Parliament.[4]

8.1.1 Outcome 1: Asset and system reliability of rail network

(i) Delivery and implementation progress

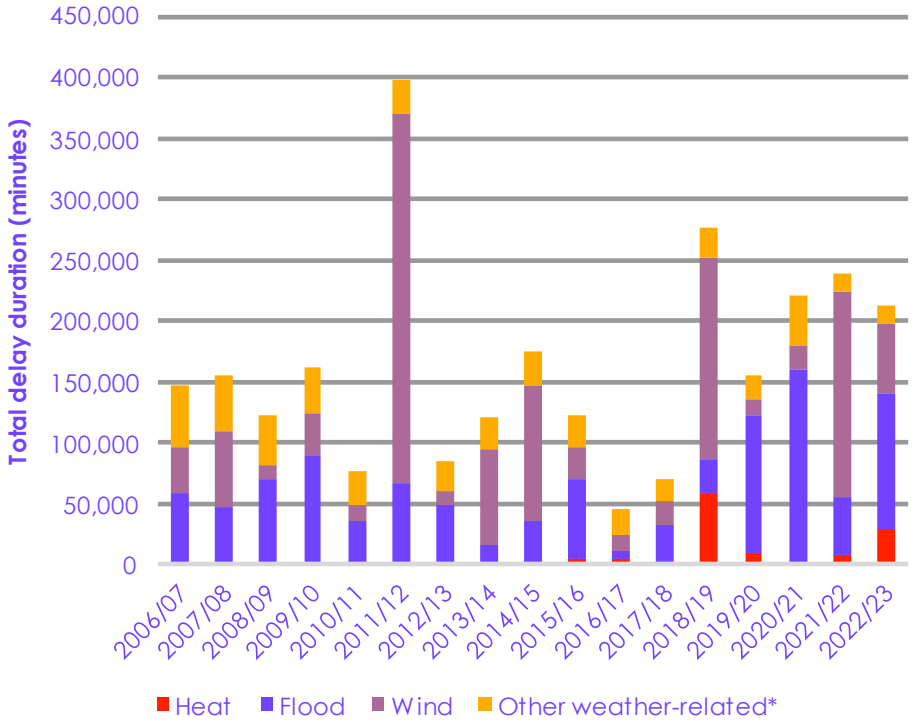
Indicators for this outcome show **mixed progress** in improving the reliability of the rail network to climate change:

Weather-related delays to the rail network in Scotland have increased in the last five years, with floods and wind the biggest causes.

- **There is an increasing trend in the number of weather-related delays to the rail network, with average annual weather-related delays over the 2018 – 2022 period more than twice as high as the preceding five years.** Floods and wind continue to be the biggest causes of weather-related delays since 2015/16, with heat coming in third in 2022/23 (Figure 8.1). Weather-related incidents caused over a quarter of all minutes of delay in Scotland in 2022/23. Annual variability in weather events means it is not possible to attribute this as evidence of the quality of risk management, but it does provide a clear indication that the system is already vulnerable to climate hazards, which are expected to increase in future.

- **Network Rail continues to manage bridge sites at risk of structural damage or failure due to scour**. The Train Accident Risk Reduction (TARR) measures whether planned risk reduction activities have been achieved. In Control Period 6 (2019-2024), Network Rail committed to remediate 50 sites at higher risk of scour in Scotland, and report that these have been completed.[5] They report that they have also remediated some emerging risk sites, which are additional to the TARR targets.

Figure 8.1 Weather-related rail delays



Source: Network Rail (unpublished).
Notes: Data does not include long-term closures as a result of severe weather. While this is recorded, Network Rail report that the data collection is not consistent enough to give reliable data on longer term closures.
*Other weather events causing delays correspond to adhesion, cold, fog, lightning, snow and subsidence.

(ii) Policy and planning progress

There are **credible policies and plans** in place to ensure the rail network is reliable under a changing climate:

There are a range of standards, minimum requirements and guidance in place on rail network resilience, and updates to some of these are underway.

- **Network Rail already has a range of standards, minimum requirements and guidance in place and is updating its climate resilience and adaptation plans:**
  - A strategic framework for climate resilience will be published in the first quarter of 2024, to update the 2017 strategy.[6] This will include consideration of day-to-day as well as long-term resilience.
  - A Climate Ready Plan for Scotland's Railway, that merges both Network Rail's and ScotRail's adaptation and resilience efforts into one plan, is being prepared for Control Period 7 (2024 – 2029) and due to be published by March 2024.
  - The national risk assessments undertaken for the third round of the Adaptation Reporting Power (ARP) are being reviewed at the regional level to be submitted to the fourth round ARP (ARP4) in 2024.[7] Although the adaptation reporting power was only directed in England, Network Rail chooses to submit reports covering Wales and Scotland.
  - Long-term adaptation pathways and investment strategies are being developed for all regions in Great Britain by 2029.

8.1.2 Outcome 2: Asset and system level reliability of strategic road networks

(i) Delivery and implementation progress

Indicators for this outcome show **mixed progress** in reducing the vulnerability and exposure of the strategic road network to climate change:

There has been mixed progress in improving the condition of trunk roads. Roads in good condition should be better able to withstand extreme weather impacts.

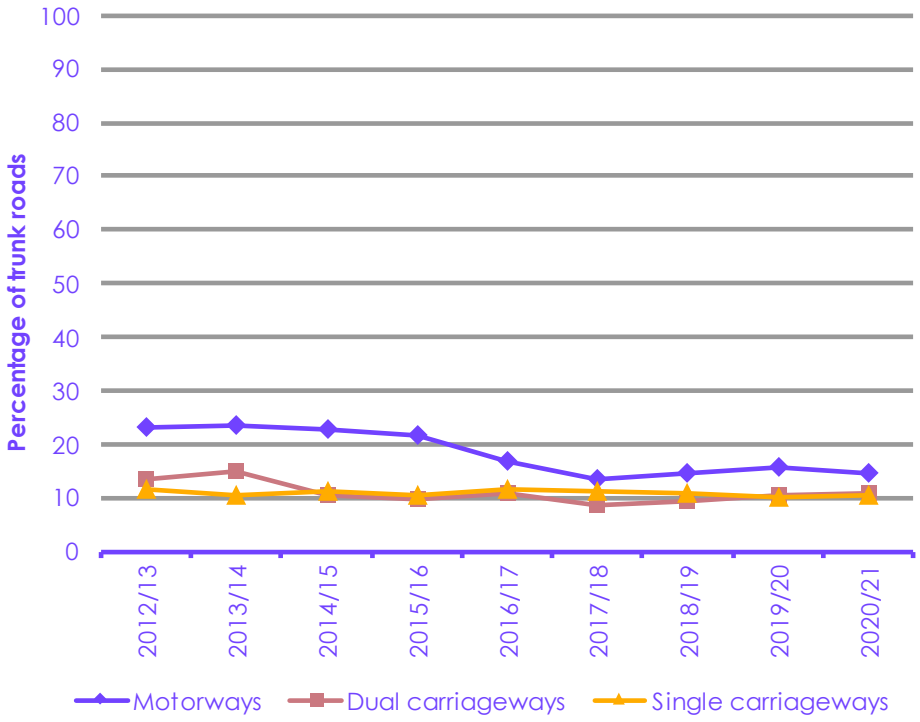
- **There has been an improvement in the condition of motorways in the latest data, but slightly worsened conditions for dual and single carriageways.** Roads in better condition should be better able to withstand extreme weather impacts. The Scottish trunk road network includes motorways, dual carriageways and single carriageways. There has been a 1.2 percentage point reduction in the proportion of Scottish motorways which require close monitoring between 2019/20 and 2021/22, following a 1.2 percentage point increase in the previous year (Figure 8.2). Overall, there is a marked improvement from conditions at the start of the period (2012/13). There has been less improvement for dual and single carriageways, although the proportion of these roads which require close monitoring was marginally lower in 2020/21 than 2012/13.

- **There is no up-to-date published data on weather-related disruptions to the trunk road network or on bridges at risk of scour in Scotland**. Research undertaken by ClimateXChange in 2015 pointed to flooding as the fourth most common recorded cause of trunk road incidents between January 2014 and March 2015.[8] The same research identified 3.5% of trunk road bridges as highly susceptible to scour.[9] This research was undertaken based on unpublished data from Transport Scotland and other sources.

Transport Scotland has acted to reduce landslide risk on the trunk road network and is identifying further sites for action over the next three years.

- **Transport Scotland is taking action to reduce landslide risk on hazard-prone sites of the trunk road network, following landslide events in 2020**. It has also outlined known at-risk sites on the Scottish Trunk Road Network and proposed a first tranche of sites for further investigation of hazards and risks. Seven sites are provisionally identified for action over the next three years and a number of other sites will be the subject of consultation during 2022 – 2023.[10]

Figure 8.2 Proportion of the trunk road network which requires close monitoring



Source: Transport Scotland (2021) *Transport Statistics 2021: Chapter 04 – Road Lengths*.
Notes: The part of the network that requires close monitoring is that which has a residual life of less than zero. Residual life represents the number of years to elapse before the pavement reaches the stage when it may be necessary to undertake relatively more expensive reconstruction rather than strengthening to restore its full life. Figures for 2019/20 and 2020/21 are provisional.

(ii) Policy and planning progress

There are **partial policies and plans** in place to ensure a well-adapted and resilient strategic road network:

- **A Vulnerable Locations Group has been established to help understand how the changing climate will affect the trunk road network and drive forward adaptation**. The group is part of a commitment made in the Delivery Plan for 2022-2023 for Scotland's Road Safety Framework to 2030, published in 2021.[11] The group is running a pilot project over 2022 – 2023, looking to go beyond maintenance towards adapting the network to future impacts of climate change.[10] We look forward to reviewing the results of this pilot programme and the potential for it to result in plans for the wider network.

The Strategic Transport Projects Review includes resilience as a key investment priority, but is not a funded plan.

- **The Strategic Transport Projects Review includes the resilience of the strategic transport network as a key investment priority**. The final Strategic Transport Projects Review 2 was published in December 2022, following on from the consultation in early 2022.[12] It will inform transport investment in Scotland over 2022 – 2042, delivering priorities such as increasing the safety and resilience of the strategic transport network. The Review recommends building on existing evidence around vulnerable locations to identify, prioritise and implement improvements to the motorway and trunk road network at risk of disruption due to weather events. However, the Review is not a funded plan – funding allocations are agreed by Parliament through the annual budget process.

Transport Scotland has set out an objective for trunk roads which are well-adapted and resilient and will update a range of plans and standards to achieve this.

- **Transport Scotland's ACCAR sets out an objective for Scottish trunk roads which are well-adapted and resilient to the current, projected and unexpected impacts of climate change and commits to update plans and standards to achieve this by 2030**:
  - The ACCAR recognises the need to understand expected risks to the network using the most up-to-date climate projections and includes a commitment to develop a Trunk Roads Adaptation Plan based on UK Climate Projections 2018, although no timelines for the publication of this plan are set.
  - The ACCAR also commits to reviewing and updating several further strategies and plans, including a Scour Management Strategy (linked to updates to scour standards), a Flood Emergency Plan and a High Wind Strategy. Specific timelines are not set for most of these commitments.

8.1.3 Outcome 3: Asset and system level reliability of local roads

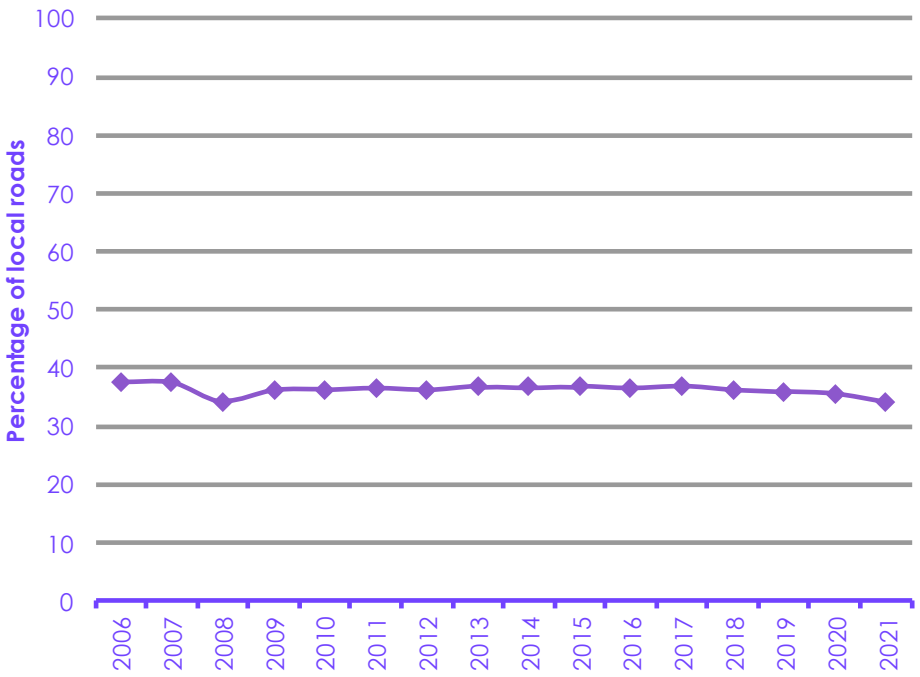
(i) Delivery and implementation progress

Indicators for this outcome show **mixed progress** in improving the reliability of local roads to climate change:

The proportion of local roads which may require maintenance has decreased in the past four years.

- **After a decade of minimal change, the proportion of local roads which may require maintenance has decreased over the past four years, but still accounts for more than a third of the local road network**. Across the whole of the local authority network (all road categories), 34% of roads have been classified as 'amber' or 'red', which means they may require some kind of maintenance (Figure 8.3).

Figure 8.3 Proportion of the local authority road network which may require maintenance



Source: Scottish Government Statistics (2023) *Road Network and Traffic: a data cube spreadsheet*.
Notes: Amber: further investigation should be undertaken to establish if treatment is required. Red: the road has deteriorated to the point at which it is likely repairs to prolong its future life should be undertaken. There was no data available for 2010 – the 2010 data point is the average of 2009 and 2011.

(ii) Policy and planning progress

There are **insufficient policies and plans** in place to ensure the reliability of local roads in a changing climate:

Local areas need guidance on how to consider climate adaptation and resilience in their transport plans and in road management.

- **Local areas need guidance on how to consider climate adaptation and resilience in their transport strategies and plans**. Transport Scotland's ACCAR does not consider local roads. While many local transport plans mention climate resilience and adaptation, there is no consistency in whether and how these plans outline preparations for future climate impacts.

8.1.4 Outcome 4: Asset and system level reliability of airport operations

(i) Delivery and implementation progress

We are **unable to evaluate** progress on increasing the reliability of airport operations in a changing climate:

Data is needed to monitor progress in ensuring the resilience of airport operations.

- **Indicators are needed to monitor the resilience of airport operations**. Scottish Government should look to develop indicators that can be used in the Scottish National Adaptation Plan's monitoring and evaluation framework. Indicators that could be useful include:
  - Airports at risk of flooding

- Asphalt condition
- Weather-related delays and incidents
- Freight tonnage disrupted by weather

(ii) Policy and planning progress

There are **limited policies and plans** in place to ensure the reliability of airport operations in the control of Scottish Government:

There are not yet plans to meet the commitment for Highlands and Islands Airports to monitor and act on climate risks at its airports.

- **Transport Scotland set out a commitment for Highlands and Islands Airports Limited to monitor and act on climate risks at its airports.** This includes monitoring and acting on flood risks and high temperatures.[2] No timelines or details on how that will be achieved are included in the ACCAR. The forthcoming elements of the Islands Connectivity Plan that relate to aviation should also be aligned with this objective.

8.1.5 Outcome 5: Asset and system level reliability of port operations

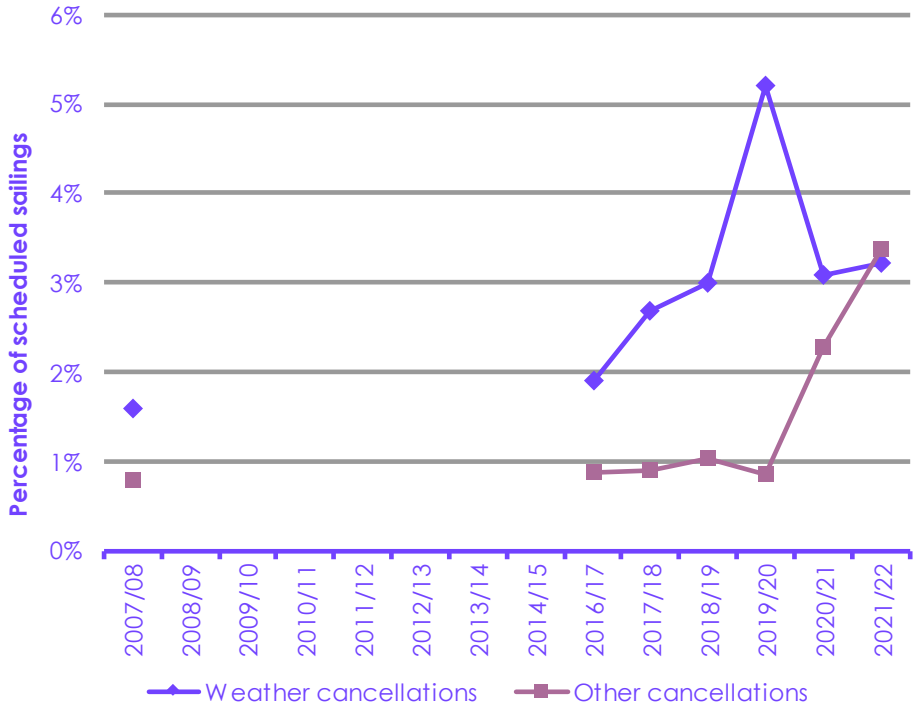
(i) Delivery and implementation progress

Indicators for this outcome show **insufficient progress** in improving the reliability of port and ferry operations in a changing climate:

The majority of ferry service cancellations are due to weather. The number of cancellations due to severe weather has increased in recent years.

- **The reliability of ferry services has declined, with weather the main cause of cancellations.** Ferry service cancellations caused by the weather have been higher in the past six years than in 2007/08, the first year for which there is data (Figure 8.4). Nearly half of all cancellations in 2021/22 occurred due to weather. Ferry services are particularly important for Scotland's islands, providing connectivity to local communities. More than two-thirds of Scotland's ferry passengers are on 'lifeline services' serving the Clyde, West Coast and Northern Isles.[4] Disruption to infrastructure services can leave these communities isolated.

Figure 8.4 Ferry service cancellations



Source: Transport Scotland (unpublished).
Notes: Corresponds to Clyde & Hebrides Ferry Services (CHFS) and Northern Isles Ferry Services (NIFS) only. Other cancellations are higher in 2020/21 and 2021/22 than previous years due to the COVID-19 pandemic.

(ii) Policy and planning progress

There are **limited policies and plans** in place to ensure the reliability of port and ferry services:

- **The draft Long-Term Plan for Vessels and Ports takes first steps towards increasing the reliability of ferry services and ports in Scotland over the medium- to long-term.** The draft Plan was published for consultation in December 2022 and is the first part of the Islands Connectivity Plan.[13] It set out investment priorities to improve ferry services and ports over the long term, following the commitment to invest £580 million for Phase 1 of the programme (2021 – 2026) made in Scottish Government's Infrastructure Investment Plan.[14] The draft Long-Term Plan for Vessels and Ports states that it will place a high priority on vessel and port designs with improved weather reliability, including the need to adapt to the effects of climate change. However, it is not clear whether the investment needs identified in either the 'baseline' or 'service / asset enhancement' scenarios explicitly factor in climate change when determining asset renewal requirements.

Next steps towards ensuring ferry and port asset owners and operators factor climate adaptation into their policies are needed.

- **Transport Scotland should set out steps to achieve its objective for ferry and port asset owners and operators to factor climate adaptation into their policies**. Transport Scotland's ACCAR includes an objective to contribute to safeguarding lifeline services, ports, harbours and canals in response to climate change. As part of this, they set out an aim to collaborate with Caledonian Maritime Assets Limited and ferry operators to help ensure that climate science is considered in developing policy and interventions.

8.1.6 Outcome 6: Interdependencies identified and managed

(i) Delivery and implementation progress

We are **unable to evaluate** progress in identifying and managing interdependencies across transport networks, and between transport and other infrastructure systems:

Data is needed to monitor progress in identifying and managing interdependencies in the transport sector and between transport and other infrastructure sectors.

- **Indicators are needed to assess interdependencies across transport networks and between transport and other infrastructure systems**. Scottish Government should look to develop indicators that can be used in the Scottish National Adaptation Plan's monitoring and evaluation framework.

(ii) Policy and planning progress

There are **insufficient policies and plans** in place to identify and manage interdependencies:

Some operators consider interdependencies between sectors at a high level but there is no systemic view of cascading impacts from climate risks to infrastructure in Scotland.

- **Some infrastructure operators consider interdependencies between infrastructure sectors in their ARP3 submissions.** Glasgow and Edinburgh airports identify interdependencies with other sectors and set out an intent to work collaboratively with stakeholders to tackle these. Network Rail go a step further and categorise interdependencies based on climate risk. No detailed plans for dealing with these interdependencies are set out.[15]

- **It is positive that the ACCAR includes rail, roads, ports and ferries and airports, but the plan missed an opportunity to consider interactions between modes**. This is particularly important in Scotland, where the connectivity of the Scottish Isles depends on multiple interconnected transport modes.

- **There is no national, systemic view of cascading impacts from climate risks to infrastructure systems in Scotland**. The Scottish National Adaptation Plan should include a national assessment of the scale of current and future risks from weather-related cascading infrastructure failures due to interdependencies, with specific policies and/or actions to plan for, and manage, risks from interdependent infrastructure.

8.1.7 Enablers

Further progress is also needed on key enablers to deliver a well-adapted transport system:

Progress is needed on funding and investment, data and monitoring and governance to deliver a well-adapted transport system.

- **Funding and investment.** As set out above, Network Rail is now developing estimates of additional investment need for a climate-resilient rail network, as part of its long-term adaptation pathways and investment strategies, which are expected to be developed for all regions in Great Britain by 2029. There are investment commitments to improve the reliability of ferry services, but it is not clear whether these explicitly factor in climate change.

- **Data and monitoring**. While there are indicators against most of the outcomes for the transport sector in Scotland, these only present a partial picture of progress, and further indicators are needed. Scottish Government should develop additional indicators across all transport modes as part of its monitoring and evaluation framework for the Scottish National Adaptation Plan. This will require working with bodies which should already hold much

of the relevant data (e.g. Network Rail, Highlands and Islands Airport Limited, Caledonian Maritime Assets Limited), but will also mean commissioning research in areas where data is not available.

- **Governance**. Scottish Ministers provide the Office for Road and Rail (ORR) – the regulator for strategic roads and rail – with separate High-Level Output Specifications for Scotland. These specifications set out expectations for network resilience and include the impacts of climate change. Although climate impacts are cited in the high level output specification (HLOS) for England and Wales, it is embedded in the Scottish HLOS as a strategic priority. Climate resilience is still not within the remit of the Civil Aviation Authority (CAA), the aviation regulator.

8.2 Recommendations

Table 8.2
Recommendations

Primary responsibility	Recommendation	Timing
Energy and Climate Change Directorate; Performance, Delivery and Resilience Directorate	Include a national assessment of the scale of current and future risks from weather-related cascading infrastructure failures in the Scottish National Adaptation Plan, as well as specific policies and/or actions to plan for, and manage, risks from interdependent infrastructure.*	2024
Local Government and Housing Directorate	Explore policy opportunities to ensure decisions around the location of new infrastructure consider future climate change impacts, before the next National Planning Framework, as this was not explicitly considered in NPF4.*	2024
Energy and Climate Change Directorate	Engage with UK Government to ensure that regulators are given consistent climate resilience remits across the UK, including all devolved administrations.*	2024
Transport Scotland	Commit to timelines for publishing the Trunk Roads Adaptation Plan, Scour Management Strategy, Flood Emergency Plan and High Wind Strategy.	2023
Transport Scotland	Develop guidance for local authorities on developing climate change risk assessments (based on UK Climate Projections 2018) and climate change resilience and adaptation plans for local roads.	2025
Transport Scotland	The final Long-Term plan for vessels and ports on the Clyde & Hebrides and Northern Isles networks should explicitly consider investment needs under a changing climate.	2024

* A cross-cutting infrastructure recommendation.

Endnotes

[1] Jaroszweski, D., Wood, R., and Chapman, L. (2021) Infrastructure. In: The Third UK Climate Change Risk Assessment Technical Report. [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)] Prepared for the Climate Change Committee, London

[2] Transport Scotland (2023) *Approach to Climate Change Adaptation and Resilience*, https://www.transport.gov.scot/media/53779/ts-approach-to-climate-change-adaptation-and-resilience-accar.pdf

[3] Scottish Government (2023) *National Planning Framework 4*, https://www.gov.scot/publications/national-planning-framework-4/

[4] Climate Change Committee (2022) *Is Scotland Climate Ready?*, https://www.theccc.org.uk/publication/is-scotland-climate-ready-2022-report-to-scottish-parliament/

[5] Network Rail (2023) *Network Rail delivers £34m investment of bridge protection works*, https://www.networkrailmediacentre.co.uk/news/network-rail-delivers-gbp-38m-investment-of-bridge-protection-works

[6] Network Rail (2023) *Climate change adaptation*, https://www.networkrail.co.uk/sustainability/climate-change/climate-change-adaptation/

[7] Network Rail (2021) *Network Rail Third Adaptation Report*, https://www.networkrail.co.uk/wp-content/uploads/2022/01/Network-Rail-Third-Adaptation-Report-December-2021.pdf

[8] ClimateXChange (2016) *Indicators and trends: BT4 Flood events affecting the trunk road network*, https://www.climatexchange.org.uk/research/indicators-and-trends/indicators/bt4-flood-events-affecting-the-trunk-road-network/

[9] ClimateXChange (2016) *Indicators and trends: BT26 Road and rail bridges vulnerable to scour*, https://www.climatexchange.org.uk/research/indicators-and-trends/indicators/bt26-road-and-rail-bridges-vulnerable-to-scour/

[10] Scottish Government (2023) *Scottish Climate Change Adaptation Programme Progress Report 2023*, https://www.gov.scot/publications/scottish-climate-change-adaptation-programme-progress-report-2023/

[11] Transport Scotland (2022) *Road Safety Framework 2030: Delivery Plan 2022-2023*, https://www.transport.gov.scot/media/52955/road-safety-framework-2030-delivery-plan-2022-2023.pdf

[12] Transport Scotland (2022) *Strategic Transport Projects Review*, https://consult.gov.scot/transport-scotland/strategic-transport-projects-review/

[13] Transport Scotland (2022) *Islands Connectivity Plan: Long term plan for vessels and ports on the Clyde, Hebrides and Northern Isles Networks 2023-2045 – Draft for Consultation*, https://www.transport.gov.scot/media/52720/draft-for-consultation-long-term-plan-for-vessels-and-ports-on-the-clyde-hebrides-and-northern-isles-networks-2023-2045-islands-connectivity-plan.pdf

[14] Scottish Government (2021) *A National Mission with Local Impact: Infrastructure Investment Plan for Scotland 2021-22 to 2025-26*, https://www.gov.scot/publications/national-mission-local-impact-infrastructure-investment-plan-scotland-2021-22-2025-26/documents/

[15] Department for Environment, Food & Rural Affairs (2022) *Climate change adaptation reporting: third round reports*, https://www.gov.uk/government/collections/climate-change-adaptation-reporting-third-round-reports

Chapter 9: Towns and cities

Table 9.1
Progress summary – Towns and cities

	Delivery and implementation	Policies and plans	Summary
Outcome 1: Towns and cities are prepared for and resilient to river and coastal flooding	Mixed progress	Partial policies and plans	• Local authorities have carried out most of the actions set out in their last flood risk management plans. However, delivery of large schemes has been inconsistent and indicators to evaluate wider resilience measures are lacking. • Updated flood risk management plans have been published and include monitoring and evaluation. Gaps remain for funding broader schemes which could improve resilience overall.
Outcome 2: Towns and cities are prepared for and resilient to surface water and groundwater flooding	Unable to evaluate	Limited policies and plans	• Indicators for adaptation to surface water flooding, such as the extent of impermeable surfaces or deployment of Sustainable Drainage Systems (SuDS), are not fully available. • Updates to planning policy will help limit runoff from new developments into the sewer but plans to support retrofit adaptation are limited.
Outcome 3: Sustainable and long-term coastal erosion management plans	Mixed progress	Limited policies and plans	• Data shows that more local authorities with a coastline are developing long-term plans and more central government funding is being allocated for coastal management. • Recent guidance on Coastal Change Adaptation Plans is important for enabling local authorities to make coastal plans which consider climate change, but these are not mandatory.
Outcome 4: Urban heat risks to towns and cities are managed	Unable to evaluate	Limited policies and plans	• There are no comprehensive national datasets which show trends in urban heat adaptation, such as green infrastructure installed over time. • Cross-sector plans on open space enhancement and monitoring are positive, but SCCAP2 lacks a vision for how Scotland should manage urban heat risks.
Outcome 5: A planning system which prioritises future climate resilience	Unable to evaluate	Partial policies and plans	• Indicators for resilience in new developments are unavailable, including the number of new developments built in flood risk areas. • The fourth National Planning Framework addresses past CCC recommendations, with climate-relevant criteria for new developments such as for green-blue infrastructure and flood risk areas. It is too early to evaluate the policy and the monitoring and evaluation framework is planned but not yet in place.

Relevant risks from CCRA3: Risks to health and wellbeing from high temperatures (H1); Risks to people, communities and buildings from flooding (H3); Risks to coastal communities from sea level rise (H4).

People and assets in Scotland's built environment are exposed to climate risks such as flooding and high temperatures.

This chapter covers adaptation in Scotland's built environment – covering towns, cities and villages. In mid-2020, around 91% of Scotland's population lived in settlements with populations over 500, with the five most populated areas containing 38% of the population.*,1 These areas have more people, buildings and businesses exposed to the risks from changes in Scotland's climate, such as warmer temperatures and flooding from rivers and rain. Coastal settlements may also be at risk of erosion and flooding from the sea. The impacts of these risks will vary in different places and different adaptation actions may be more suited to some locations than others.

Spatial planning, public health and flood and coastal erosion risk management are the key areas of policy which can influence adaptation to climate change in the urban and rural built environment. All are devolved to Scottish Government. Other policy goals, such as meeting housing demands, reducing greenhouse gas emissions and making places safer and more pleasant, may have co-benefits or trade-offs with adaptation.

Well-adapted towns and cities are prepared for climate change risk, as well as being well-provisioned, safe and pleasant places to live.

The Scottish Government sets the framework and objectives in the key policy areas for towns and cities. Local authorities are responsible for much of the implementation and delivery. Other bodies are also involved, such as the Scottish Environment Protection Agency (SEPA), which produces Scotland's flood risk management plans.

Some of the key risks to towns and cities overlap with risks in other chapters in this report (Box 9.1) and adaptation requires a cross-cutting approach.†

Creating resilient towns and cities requires a cross-cutting approach, which includes nature, communities and infrastructure.

Box 9.1
Interactions with other chapters in this report

This chapter has important interactions with other parts of this report:

- **Energy, telecoms, transport and water infrastructure.** Infrastructure systems should be built in ways which increase resilience in nearby settlements. Well-adapted drainage and sewer infrastructure can increase resilience to flooding, while poorly maintained drainage systems can exacerbate impacts.
- **Buildings and health.** Buildings, their contents, and occupant's health and wellbeing will be impacted by heat and flooding. Adaptation of individual buildings and healthcare systems can reduce vulnerability in settlements.
- **Nature.** Risks to urban and rural nature will have knock-on impacts for built-up areas. Nature can help to build resilience and improve health in towns and cities, for example through nature-based solutions.
- **Community preparedness and response.** Preparedness and capacity to respond contributes to overall resilience of the people who live in towns and cities.

* For comparison, in England, the proportion of people living in 'built up areas' identified by satellite imagery was 94.9%.

† This chapter excludes risks and policies related to large-scale infrastructure, individual buildings and urban habitats in towns and cities.

Our last report found some good plans to manage flooding but a lack of sufficient risk management for most built environment priorities.

The summary of our last assessment related to adaptation in Scotland's towns and cities is provided in Box 9.2.

Box 9.2
Summary from our last report

In 2022, our report found some good plans were in place for river and coastal flood management. However, surface water flood alleviation, development in flood risk, coastal erosion risk management and recovery from flooding all received low scores for planning. All priority areas received low scores for risk management. Key recommendations included:

- Measurable objectives for reducing flood risk in Local Flood Risk Management plans and ring-fenced funding at the local level.
- A commitment to ensure new developments avoid future risk by ensuring they do not overload sewers and are not built in areas at high risk.
- Data collection on SuDS and surface water flood risk, and new developments in flood risk areas.
- A review of outdated legislation on coastal change (1949 Coast Protection Act) to consider the impacts of climate change.

Good progress has been made through updated planning policy, which has introduced clearer criteria for where new developments can be built and measures to ensure they don't increase surface water flood risk. Our assessment finds some key data gaps remain.

Source: CCC (2022) *Is Scotland Climate Ready? 2022 Report to Scottish Parliament.*

9.1.1 Outcome 1: Towns and cities are prepared for and resilient to river and coastal flooding

(i) Delivery and implementation progress

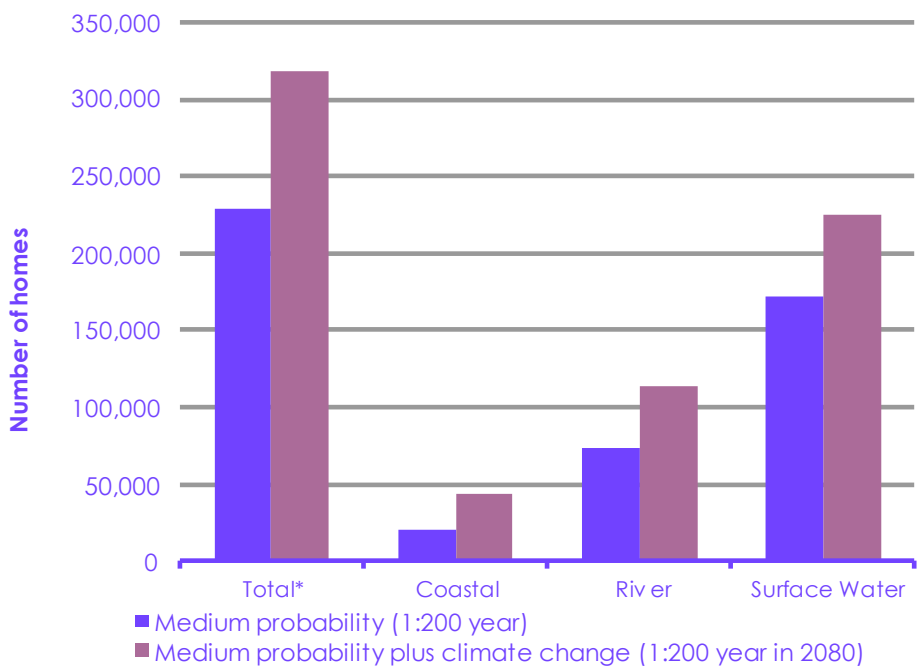
Available indicators show mixed progress in preparing towns and cities for flooding.

Indicators for this outcome show **mixed progress** in preparing towns and cities to river and coastal flood risk in Scotland.

- **The risk of flooding to the built environment in Scotland is predicted to increase in the future.** The National Flood Risk Assessment (NFRA 2018) identifies 283,400 properties, including 228,700 homes, currently at medium risk of flooding (Figure 9.1).* Of these homes, 21,000 are at risk of coastal flooding and 73,200 at risk of river flooding. This is more than twice as many identified in the 2011 assessment, mainly the result of improved methodology. Around 90% of the risk is contained in 235 identified 'Potentially Vulnerable Areas' (PVAs).† By 2080, under a high emission scenario, the numbers of homes at risk of coastal and river flooding are expected to increase by 111% and 56% respectively.[2]

The number of homes at risk of flooding in Scotland is expected to increase under future climate conditions.

Figure 9.1 Homes at risk of flooding in Scotland



Source: SEPA (2018) *National Flood Risk Assessment.*
Notes: * Total number at risk is without double counting. Some homes may be at risk of flooding from more than one source. The medium probability plus climate change is based on UKCP09 projections high emission scenario in 2080.

* Homes at a medium probability of flooding lie in the 1 in 200-year indicative flood extent, and therefore have a 0.5% or greater chance of flooding each year.

† PVAs are areas where significant flood risk exists now or is likely to occur in the future.

Funding is allocated to local authorities to deliver flood risk management schemes.

- **Capital funding from the Scottish Government for local authorities to deliver flood risk management schemes has increased.** From 2016 to 2026, the Scottish Government guaranteed a minimum £42 million per year in flooding capital grant in the local government settlement.[3] Scottish Government has committed an additional £150 million in capital funding for flood risk management over the course of the current Parliament (2021-2026). As of March 2023, local authorities had been allocated £31 million of this funding.[4]

- **Local authorities are responsible for the delivery and development of flood schemes, and the majority of schemes identified in the last flood risk management plans are under construction.**[*,5] Forty schemes were prioritised from 42 identified for delivery between 2016-2021. Most of these (80%) cover river flooding. As of October 2023, 15 schemes are completed, four are under construction, 20 are confirmed or under development and one withdrawn. Schemes were projected to protect around 14,600 properties; completed or in construction schemes make up 5,900 of this total (40%).[6]

Most schemes planned for in the last flood risk management cycle are under construction and many of the actions are completed.

- **Progress has been made in delivering actions in flood risk management plans since 2015.** In the 2015-2021 (planning cycle 1) mid-cycle report, 90% of the actions to avoid increase in flood risk were ranked 'green' (completed), with the remaining 10% ongoing. 84% of actions described in strategies to reduce flood risk were ranked completed, with 12% ongoing and 4% not started.[7] Available data from the final reports of cycle 1 shows 88% of all actions completed, 10% ongoing and 2% not started.[†,8]

- **The condition of many flood defence assets is unknown and there is limited evidence on the delivery of upstream land management at national scale.** The Scottish Flood Defence Asset Database (SFDAD) provides a centralised database for local authorities to store asset information, but data inputs are inconsistent and maintenance status not included. There are no data on the number of schemes focusing on natural flood management or the uptake of upstream or wider-catchment land management.

- **The area covered by local flood warnings in Scotland has increased.** Regional flood alerts cover the whole of Scotland, with 76,800 houses and businesses also covered by local 'take action' flood warnings. These local warnings currently serve over 326 Flood Warning Areas, up from 269 in 2017.[9,10] Due to data loss during a cyber-attack on SEPA in 2020, there are no data showing change in coverage over time.

(ii) Policy and planning progress

There are **partial policies and plans** in place to build resilience to current and future river and coastal flood risk, although gaps remain in ensuring local delivery.

Updated local flood risk management plans were published in 2022.

- **SEPA published the second cycle of Flood Risk Management Plans (FRMP) for Scotland's Local Districts in 2021.** Plans for each of the 14 Local Plan Districts set out how and when actions for 2022-2028 will be delivered, including general actions for SEPA, as well as specific local actions to

[*] Flood risk management plans were called flood risk management strategies at the time of their publication in 2015. Flood risk management cycles are six years in Scotland. Cycle 1 flood risk management plans (for planning) ran from 2015-2021 and local flood risk management plans (for implementation) ran from 2016-2022. Cycle 2 plans run from 2021-2027 and 2022-2028 respectively.

[†] Not all cycle 1 final reports are published yet.

manage risk in PVAs. The lead local authority within each district is responsible for publishing a final report on cycle 1 and a new cycle 2 local plan by December 2022 (one plan is yet to be published). SEPA and local authorities report on meeting the plan's overarching objectives but because there are no specific local targets for different actions, such as defence maintenance standards, it is difficult for the organisations involved to monitor progress.

Capital funding programmes are currently more suited to supporting large projects than smaller-scale approaches.

- **Current flood risk management investment in Scotland prioritises large schemes and hard defences.** 80% of the capital funding is ring-fenced to support schemes. The remaining 20% of the capital funding is distributed pro-rata annually amongst local authorities; it not restricted to schemes and can be used for smaller projects, although it is not ring-fenced.[11] As funding is set-up for up-front capital investment, schemes which require long-term maintenance funding, such as nature-based solutions, are often less cost-effective for local authorities. There is a joint Scottish Government/COSLA (Convention of Scottish Local Authorities) working group looking at funding arrangements for flood risk management going forwards.

- **There are currently no specific targets for the use of Natural Flood Management (NFM).** Scottish Government's overarching policy advocates a whole catchment approach, as set out in statutory guidance for responsible authorities (Sustainable Flood Risk Management Guidance (2019)).[12] However, there is a need for more clarity on the types of NFM approaches, where they might be deployed, and how this links with nature and agriculture policy, with further guidance and clarity around regulation and funding for upstream land management required.

- **SEPA's flood risk mapping and the NFRA consider future climate impacts.** The 2018 NFRA and 2022 FRMPs consider flooding impacts associated with climate change using scenarios based on 2009 UK Climate Projections (UKCP09). Projections from 2018 (UKCP18) are now available. SEPA has started to account for these in flood mapping, but they are not yet embedded into the local plans.

The Scottish Government has committed to developing a new flood strategy which should place resilience at the core.

- **The Programme for Government 2022-23 committed Scottish Government to develop a new flood strategy.**[13] Stakeholder engagement is currently underway, and policy is expected to be consulted on in the next year.

(iii) Progress on enablers

Trends in enablers for adaptation to flood risk in the built environment in Scotland are mixed, with some increased funding but relatively low public awareness.

- **Scottish Government has provided increased funding to the Scottish Flood Forum (SFF).** The SFF works with at-risk communities and households (see Chapters 10 and 12). Annual grant funding from Scottish Government increased to £220,000 in 2022-23 from £193,000 in 2020-21.[14,15]

- **Skilled workers will be required to keep up with the requirement for risk management activities, as well as resilient construction and design**. This is not currently monitored or tracked at a national scale.

Despite experience of flooding, the number of people who perceive their homes to be at flood risk remains low.

- **Around 45% of people in Scotland have experienced flooding to their local area but risk perception is low.** Only 13% of respondents to the same survey perceived flooding posed a moderate-to-high risk to their home specifically. Fewer (11%) were already trying or very likely to try to persuade

friends or relatives to move away from flood risk areas; 2% had actually relocated due to flood or erosion risks, rising to 11% for respondents from Glasgow.[16]

9.1.2 Outcome 2: Towns and cities are prepared for and resilient to surface water and groundwater flooding

(i) Delivery and implementation progress

There are few indicators to assess progress towards adapting to surface water and groundwater flood risk in Scotland and we are **unable to evaluate** this outcome.

Surface water flooding is a major source of flood risk in Scotland, although trends over time have not been monitored.

- **Surface water flooding is the largest source of flood risk to homes in Scotland.** NFRA 2018 identified 432,000 homes at risk of surface water flooding in Scotland; 50% of which are currently considered to be at medium and high risk (i.e. greater than 0.5% annual probability).[2] More homes are therefore at risk of surface water flooding than flooding from other sources (Figure 9.1). Changes in the number of properties at risk of surface water flooding has not been previously routinely monitored.

- **The extent of impermeable surfaces in Scotland has not been recently monitored.** There was a 7.5% net increase in impermeable surface area in Scotland between 2008 and 2015 but no data have been collected since.[17] Estimates for urban green and grey area are variable depending on methodology. In 2017, NatureScot approximated that 54% of Scotland's urban area was green space.[18] Estimates from the ONS are lower, at 38%.[19]

There are limited data on the extent of impermeable surfaces and sustainable drainage systems installed.

- **The uptake, installation and quality of sustainable drainage systems (SuDS) in Scotland is unknown.** Local authorities in Scotland are required to map SuDS and prepare a maintenance schedule. However, monitoring is not regulated and does not account for maintenance status, meaning there are no national data to evaluate progress in delivery. Data collected in 2001 identified 3,900 SuDS systems, mostly permeable paving, soakaways and infiltration trenches, but this has not been updated.[20]

- **Scottish Water models the drainage network in Scotland and monitors key sites, as well as recording internal sewer flooding events from overloading**. In 2022/23, 364 properties were affected by internal sewer flooding, with 329 properties affected by blockages and collapses (up from 279 in 2021/22) and 48 by sewer overloading. The number of properties affected by internal sewer flooding was greater in 2021/22 (570 properties in total, 291 from sewer overloading) due to more intense summer storms.[21]

(ii) Policy and planning progress

There are **limited policies and plans** in place to prepare towns and cities in Scotland for surface water and groundwater flooding.

There are some plans in place to manage surface water flooding and encourage the use of blue-green infrastructure.

- **Local authorities are responsible for developing and implementing Surface Water Management Plans (SWMPs).** These plans set out objectives, actions and roles for managing surface water flood risk. SEPA identify areas where SWMPs are required and guidance on developing the plans was published in 2018.[22] The plans are non-statutory but should be reviewed and updated following the FRMP cycle, with local FRMPs reporting on delivery of surface water plans or studies in PVAs. Under the Flood Risk Management (Scotland) Act 2009, local authorities are also responsible for mapping SuDS

and preparing a maintenance schedule but data are inconsistently recorded, with most currently informal and ad-hoc.[23]

- **The Water-Resilient Places Policy Framework, published in 2021, recommends a vision for resilient places with green and blue infrastructure.**[24] The framework recommends clearer responsibilities for managing surface water and blue-green approaches. The framework is currently feeding into drainage services policy development but there has been no published response to its recommendations. The 2023 Programme for Government committed to building on the £170 million investment in water and sewerage services, including for adaptation.[25]

New planning policy requires new developments to reduce surface water runoff to the combined sewer.

- **Sustainable drainage systems are required in new developments and updates to planning policy include measures to manage surface water**. New developments are required to pass surface water discharges through SuDS and integrate these with blue-green infrastructure, with SEPA the statutory regulating agency. The fourth National Planning Framework (NPF4) addresses our past recommendation to control surface water connections to the combined sewer in development proposals and minimise impermeable surfaces.[26] However, there are no clear requirements for monitoring and evaluation of SuDS, with the most recent guidance for developers and planners published by the SuDS Working Party in 2016. Furthermore, there is no formal funding for maintenance works.

- **SEPA's Flood Warning Development Framework 2022-2028 includes a commitment to deliver a long-term approach to surface water flood forecasting.**[27] SEPA have produced updated national surface water hazard plans and are building on pilot testing to improve forecasting and maps.

Policy for surface water flooding does not yet fully address regulation, funding and monitoring.

- **There are several missing policy milestones including no mechanisms for addressing increases in unplanned impermeable surfaces or financial instruments for retrofit**. While policy exists for SuDS in new development, there is no policy to incentivise SuDS retrofit or funding streams for ongoing maintenance of drainage infrastructure.

(iii) Progress on enablers

Some governance enablers are in place for adapting to surface water flooding, but further research, data and monitoring are required.

- **Regional-level partnerships are delivering local sustainable drainage schemes.** The Metropolitan Glasgow Strategic Drainage Partnership received a City Deal investment of £45 million, allowing key stakeholders to work together to deliver drainage schemes.[28] Central Scotland Green Network's 10,000 Raingardens for Scotland programme, led by the Green Action Trust, received NatureScot funding. It has recorded around 1,000 rain gardens and engages with public and professional audiences.[29]

Adaptation to surface water and groundwater flooding will require improved data, monitoring and partnership working.

- **Data, monitoring and management of groundwater flood risk is lagging.** Groundwater flood mapping in Scotland does not show the extent of flood risk but highlights catchments where groundwater contributes to flooding from other sources. Further research and investment are required to understand the scale of future groundwater flood risk.

9.1.3 Outcome 3: Long-term and sustainable coastal erosion management plans

(i) Delivery and implementation progress

Available indicators demonstrate **mixed progress** in delivering adaptation to coastal change in Scotland.

Indicators show some positive trends in managing coastal change but data on adaptation delivery are inconsistently recorded.

- **Around £20 billion of assets lie within 50 m of the shoreline in Scotland and around £1.2 billion may be at risk of erosion by 2050.**[*,30] Research from the Dynamic Coast project found coastal erosion affects around 46% of Scotland's soft coast, up by 8% since 2017.[31] The Dynamic Coast project provides the strategic evidence base on coastal erosion in Scotland. Research is carried out by the University of Glasgow, led by Scottish Government and managed by NatureScot. By 2100, 84% of shorelines are predicted experience erosion under high emissions scenarios. By 2050, up to 647 residential properties and 55 km of road are likely be affected.[†,32]

- **Approximately £14.5 billion of building and infrastructure assets are protected by natural defences and £5 billion by artificial defences.**[30] Mapping from the Dynamic Coast project shows around 2,200 artificial defences, protecting around 600 km of coastline. More than half (58%) of these defences are sea walls or embankments.[33] Condition assessments of these structures are variable, inconsistent and not coordinated at a national level. Periodic monitoring of natural defences has been done via the Dynamic Coast project, rather than coordinated coastal monitoring.

More of Scotland's coastline is covered by coastal change plans.

- **The proportion of local authorities with a shoreline developing coastal change plans has increased due to new funding and guidance.** Prior to 2022, when the Scottish Government's Coastal Change Adaptation (CCA) Fund started, around 10% of the coastline was covered by a shoreline management plan (six local authorities). Following the CCA fund, five local authorities are undertaking full or partial Coastal Change Adaptation Plans (CCAP), covering 29% of the coastline. A further four authorities intend to undertake a plan, which would extend the coverage to 43%. It is too early to evaluate whether actions in CCAPs are being carried out.[34]

(ii) Policy and planning progress

There are **limited policies and plans** in place to prepare towns and cities to the risks of coastal change in Scotland.

New guidance and public funding for coastal change adaptation planning considers future climate risk.

- **Coastal Change Adaptation Plan (CCAP) guidance was published in February 2023 to accompany new central government funding**.[35] Guidance incorporates advances in shoreline planning and recommends a collaborative, adaptive pathway approach, based on an amended version of England and Wales's Shoreline Management Plan process. While not statutory, production of a CCAP would count towards public body reporting on adaptation. Clearer guidance for local authorities is good progress and the guidance will be updated with new scientific evidence and following feedback from stakeholders.

[*] Assets include roads, rail and residential properties within 50 m of mean high water spring.

[†] Under high emission scenarios, using RCP8.5 and 'do nothing' adaptation, where artificial and natural defences are not maintained.

CCAPs should account for climate change and should be considered in local development plans and planning decisions. However, they have no legislative backing for securing funding and it is not yet clear how the plans and their actions will be monitored.

There are positive plans in place for funding and monitoring coastal adaptation, but many projects are currently at case study scale.

- **Scottish Government have committed funding for coastal adaptation.** The Programme for Government 2021/22 allocated £11.7 million capital for coastal change adaptation to local authorities over four years from 2022/23.[14] In 2022/23, £1.6 million has been distributed to ten local authorities with the most assets at risk, identified by evidence from Dynamic Coast 2. For 2023/24, £1.85 million has been provisionally agreed for the remaining authorities and £550,000 shared in support of local case studies to improve understanding, which has supported eight case studies so far.[36] Local authorities can also fund coastal protection work through their capital grants, although this is not ring-fenced.

- **There are plans to continue to advance data and monitoring of coastal change in Scotland.** SEPA are progressing updates to coastal flood maps which will include taking account of wave action and activity. The Dynamic Coast project has been funded by the Centre of Expertise for Waters (CREW) using funds from Scottish Government, as well as NatureScot and St Andrews Links Trust and is advertising £1 million of case study funding for projects for 2024-25.

(iii) Progress on enablers

Enablers for awareness and research to deliver adaptation at the coast are partially in place.

Coastal erosion has been mapped alongside social vulnerability indicators.

- **The Dynamic Coast research provides a robust evidence base for policy and has included 'coastal erosion disadvantage' mapping.** The mapping found 39% of coastal data zones were classified as 'socially vulnerable', containing 37% of residential property at risk of coastal erosion under high emission scenarios, assuming no future maintenance of defences. Over half (67%) of socially vulnerable properties at risk are currently undefended.[37]

- **Public awareness of coastal erosion risks is high**. Around 69% of people in Scotland were aware of the risk of coastal erosion to the natural environment in Scotland. Risk awareness for the built environment is unknown.[16]

9.1.4 Outcome 4: Urban heat risks to towns and cities are managed

(i) Delivery and implementation progress

Data to evaluate trends in the risk of and adaptation to urban heat in Scotland are limited.

This outcome is scored as **unable to evaluate** because there are few available indicators to demonstrate progress adapting to urban heat risks.

- **Urban areas in Scotland are likely to be at risk of higher average and extreme temperatures in the future.** Past data on mean land surface temperatures found the urban core in Glasgow can be up to 4-6°C warmer than rural surroundings.[38] Edinburgh's average annual urban heat island effect is estimated at 1.3°C, comparable to London suburbs.[39]

Baseline data on the extent of urban green and blue space in Scotland suggests it may have a cooling effect in Glasgow and Edinburgh.

- **There are some baseline data for urban green and blue space and their cooling effects.** In 2021, ONS research found 11,300 ha of green and 1,700 ha of blue space in urban areas in Scotland. A large proportion, 68%, of this green space was publicly accessible, with the average distance to the nearest public park or garden from urban residential properties 900 m.[40] Due to changing methodologies, previous datasets are not comparable. The estimated annual average cooling effect of green and blue space in Glasgow and Edinburgh was -0.8°C between 2013-2018. Further data are required to assess trends in this effect over time.[41]

There are no timeseries data for canopy cover in urban areas but there is evidence of delivery of local green infrastructure projects.

- **There are some baseline data for urban canopy cover in Scotland, covering urban trees and hedgerows.** Average percentage canopy cover in urban ward areas in Scotland is around 16%.[42] There are approximately 12,700 ha of urban trees and 6,300 km of urban hedgerows.[40] This indicator should continue to be monitored over time, alongside indicators for managing anthropogenic heat.

- **There are examples of good practice in local projects for green infrastructure.** The Green Infrastructure Community Engagement Fund (GICEF) has funded nine projects which involve building green infrastructure and engaging local communities across Scotland.[43] The Central Scotland Green Network has supported tree planting and green infrastructure across 19 of Scotland's 32 local authorities.[44] The Clyde Climate Forest sits within the wider area of the network and has planted 1.2 million trees across Glasgow City region.[45]

(ii) Policy and planning progress

There are **limited policies and plans** in place to manage urban heat.

There are positive cross-sector policies for urban greening but SCCAP2 doesn't include a vision for managing urban heat.

- **Scottish Government has developed some cross-sector policy which focuses on green space and green infrastructure.** The Planning (Scotland) Act 2019 introduced a duty on planning authorities to prepare and publish an open space strategy, including an audit of existing open space provision and an assessment of current and future requirements.[46] Draft open space strategy regulations were consulted on in 2021-22 and the NPF4 Delivery Programme anticipates these will come into force in 2024.[47] NPF4 requires local development plans and spatial strategies to identify, enhance and expand blue-green infrastructure, providing support and protection for new and existing measures. The NPF4 Delivery Programme sets out the development of a monitoring approach which should read across to relevant data gathered in National Outcomes reporting. It is too early to assess whether this is sufficient to regulate consistent delivery and maintenance of green space and green infrastructure.

- **There is no national-level vision for monitoring and managing urban heat despite updates to planning policy and some promising local plans**. There are no objectives within SCCAP2 that consider how to manage urban heat at a local scale or within urban areas. Future plans should consider building fabric, place design and initiatives such as traffic management, as well as monitoring heat production. There are some promising local plans, such as the Clyde Climate Forest, which aims to plant 18 million trees and increase the average tree canopy cover in urban Glasgow to 20%.[48]

There are some funding schemes for green infrastructure but a lack of plans and funding for maintenance and monitoring.

- **There are some funding schemes for green infrastructure and green space, but these are not specifically linked to managing climate risks**. These include funding from the Central Scotland Green Network (CSGN), set out as a national development within NPF3.* The Green Infrastructure Strategic Intervention allocated £15 million of European Regional Development Fund money to green infrastructure projects. With matched funding, the programme delivered a total value of around £40 million of investment. Delivery began in 2016 and the scheme is due to come to an end in 2023.[49]

(iii) Progress on enablers

Data for enablers show evidence of household-level behaviour change but long-term monitoring is lacking.

- **Monitoring for urban heat impacts and adaptation uptake is not sufficiently included in current plans.** Mandatory monitoring and reporting of green infrastructure within urban areas would improve ability to track and understand cooling and other benefits.

- **Around half of people in Scotland have taken considered action to plant trees or re-landscape for more shade.** A 2021 survey found 9% of people had already taken these actions, with a further 52% very or fairly likely to do so. For comparison, 16% had already shaded south facing windows in their homes.[16]

9.1.5 Outcome 5: A planning system which prioritises future climate resilience

(i) Delivery and implementation progress

There are very limited data to evaluate whether the planning system in Scotland is facilitating climate resilience.

There are few available indicators for assessing this outcome in Scotland, so it is scored as **unable to evaluate**.

- **There are limited recent data for the number of new developments or planning permissions granted in flood risk zones.** SEPA collect data on their objections to planning applications for water and flood related reasons. Scottish Ministers are notified when a Planning Authority are minded to approve an application against SEPA's advice and then decide whether to call the application for independent scrutiny. A record of notified planning applications and the resulting decisions is kept by Scottish Government. Since 2018, 27 applications have been notified, 10 of which have been granted and 10 refused (37%), with the remainder live or deferred. The number of annual notified applications has increased slightly from four in 2019 to six in 2022, and four so far in 2023. All applications notified in 2023 are still live so it is difficult to assess trends over time. No notified applications from 2022 have been granted yet (67% have been refused), compared to 80% granted in 2021.[50] The data do not consistently show how many buildings or assets have been applied for or end up being constructed. No government agency or department currently collects nationally consistent data on the extent of new development in the floodplain.

* Funding is provided by Forestry Commission Scotland, NatureScot, Transport Scotland and the Scottish Government.

- **There is some evidence that local plans are accounting for adaptation.** There are 34 Planning Authorities in Scotland, comprising 32 Local Authorities and two National Park Authorities. In 2021, 53% of local climate plans were found to set out adaptation actions for planning and land use.[51]

There are no national-scale datasets on the prevalence of adaptation measures in new developments.

- **There are no national-scale datasets on developments built or retrofitted with adaptation measures, such as blue-green infrastructure**. There are no consistent data on adaptation retrofits in existing developments and new builds.

(ii) Policy and planning progress

There are **partial policies and plans** in place to embed adaptation and resilience in the planning system in Scotland.

- **Planning policy for development in flood risk areas has been updated to include appropriate allowances for climate change and strengthen flood resilience requirements**. Under NPF4, adopted in February 2023 and now forming part of the statutory development plan, new developments will now be restricted on land which lies within the 1-in-200-year flood extent plus an appropriate allowance for climate change. The allowance is a prediction of change in peak river flow, rainfall intensity or sea level rise due to climate change and will depend on the type of flooding and location being considered. For example, in the Argyll and Tweed River Basin regions, an additional 59% peak river flow allowance is required on top of the 1-in-200-year flow estimate to determine the developable area.[52] For 'vulnerable use' development, SEPA require higher sensitivity testing to be carried out (e.g. to the 90th percentile flow uplift).* SEPA is currently updating its guidance to align with NPF4 and published updated guidance for climate change allowances in April 2023.[52] NPF4 provides stronger policy for regulating new development in areas at current and future risk from all sources of flooding, stating that development proposals should not increase discharge to the public sewer network and should minimise impermeable surface areas.

Updates to planning policy in NPF4 include stronger requirements for flood and coastal resilience.

- **Planning policy now contains more thorough legislation for resilient development in the coastal zone and considers sea level change**. NPF4 policy now states proposals in developed coastal areas should not result in the need for further coastal protection considering climate change. Proposals in undeveloped areas will only be supported where they are necessary to support the economy and Net Zero. All coastal development must be 'supportable in the long-term', considering projected climate change. This aligns with Marine Planning Policy 8, which states development in the marine environment should be resilient to coastal change and flooding, and not adversely impact coastal processes.[53]

- **NPF4 includes policies which specifically focuses on climate mitigation and adaptation, nature-based solutions and retrofit.** Policy promotes development that is adaptive to current and future climate impacts. This includes supporting retrofit measures to existing developments. NPF4 also promotes natural flood management, coastal nature-based solutions and encourages blue-green infrastructure as integral to design and building. Importantly, NPF4 requires development proposals that include new or

* Vulnerable use cases of development include hospitals, schools, care homes and holiday sites.

enhanced blue-green infrastructure to provide effective management and maintenance plans covering the funding arrangements and responsibilities for their long-term delivery and upkeep.

Guidance for embedding climate change in planning are currently in development.

- **The NPF4 Delivery Programme commits Scottish Government to preparing 'planning and climate change guidance' in Autumn 2023.**[47] Open space and biodiversity guidance are also proposed. The Delivery Programme commits to scoping out a five-year monitoring framework for NPF4 with stakeholders by the end of 2023. Overarching or local targets for embedding adaptation in developments and monitoring towards these targets in annual reporting could strengthen the policy.

Public finance and mechanisms to leverage private finance will be required to deliver adaptation through planning.

- **Financial incentives and subsidies for delivering and maintaining adaptation measures, such as green infrastructure, are not fully in place.** There is no ring-fenced funding to support local authorities to include adaptation their development plans, other than for flood defences. Capital programmes such as the £325 million Place Based Investment Programme could be used to fund projects, but currently lack clear guidance or remit for adaptation. While NPF4 requires funding arrangements for blue-green infrastructure to be laid out, financial incentives for developers and landowners are limited. The Scottish Government will likely be required to provide subsidies and incentives for the cross-sector collaboration needed to bridge the adaptation gap.

9.2 Recommendations

Table 9.2
Recommendations

Primary responsibility	Recommendation	Timing
Environment and Forestry Directorate	The new national flood strategy must include a clear vision for managing future flood risk, with measurable targets informed by updates to the National Flood Risk Assessment and the most recent climate projections, accompanied by multi-year funding for local authorities for a wider range of resilience measures.	2025
Environment and Forestry Directorate	Consult on new legislation (e.g. to supersede the 1949 Coast Protection Act) to clarify roles and responsibilities for coastal management planning, as well as laying out responsibility for monitoring delivery of actions in Coastal Change Adaptation Plans.	2024
Local Government and Housing Directorate	Establish the five-year monitoring and evaluation programme for the fourth National Planning Framework to assess progress towards the framework's policy objectives. This should include data collection on new infrastructure and developments in flood risk areas and planning permitted against SEPA advice. Data must be collected from local authorities and developers on the location, type and condition of SuDS and blue-green infrastructure.	2024
Local Government and Housing Directorate	Review the funding mechanisms and update guidance on funding for local authorities, private sector and community actors for installing and maintaining blue-green infrastructure.	2024
Population Health Directorate; Energy and Climate Change Directorate; Local Government and Housing Directorate	Ensure the third Scottish National Adaptation Plan (SNAP3) incorporates urban heat risks and adaptation.	2024

Endnotes

[1] National Records of Scotland (2022) *Population Estimates for Settlements and Localities in Scotland, Mid-2020,* https://www.nrscotland.gov.uk/files//statistics/settlements-localities/set-loc-20/set-loc-2020-report.pdf.

[2] SEPA (2018) *National Flood Risk Assessment Data,* sepa.org.uk/data-visualisation/nfra2018/.

[3] Scottish Government (2021) *Local authority breakdown of flood and coastal funding schemes: EIR release,* https://www.gov.scot/publications/foi-202100137848/.

[4] Scottish Government (2023) *Infrastructure Investment Plan 2021-22 to 2025-26: programme pipeline update – March 2023,* https://www.gov.scot/publications/infrastructure-investment-plan-2021-22-2025-26-programme-pipeline-update-march-2023/pages/1/.

[5] SEPA (2021) *Flood Risk Management Plans. Frequently asked questions* (Table 1), https://www2.sepa.org.uk/frmplans/documents/frequently-asked-questions.pdf.

[6] Scottish Government (2023) *Data provided for CCC analysis*.

[7] SEPA (2021) *Flood Risk Management Plans: Highland and Argyll Local Plan District (LPD 1)* (page 4), https://www2.sepa.org.uk/frmplans/documents/lpd1-highland-and-argyll-frmp-2021.pdf.

[8] CCC (2023) *Analysis of available local flood risk management plan cycle 1 final reports*.

[9] SEPA (2023) *Data provided for CCC analysis.*

[10] SEPA (2017) *Flood Warning Development Framework 2017-2021,* https://www.sepa.org.uk/media/219818/sepa-flood-warning-development-framework-2017-2021.pdf.

[11] SEPA (2021) *Flood Risk Management Plans. Frequently asked questions* (page 10), https://www2.sepa.org.uk/frmplans/documents/frequently-asked-questions.pdf.

[12] Scottish Government (2019) *Delivering sustainable flood risk management: guidance (2019),* https://www.gov.scot/publications/flood-risk-management-scotland-act-2009-delivering-sustainable-flood-risk-management/pages/1/.

[13] Scottish Government (2022) *Programme for Government 2022 to 2023,* https://www.gov.scot/publications/stronger-more-resilient-scotland-programme-government-2022-23/.

[14] Scottish Government (2023) *Scottish Climate Change Adaptation Programme Progress Report 2023*, https://www.gov.scot/binaries/content/documents/govscot/.

[15] Scottish Government (2021). *Flood Risk Management (Scotland) Act 2008 implementation: report to the Scottish Parliament – 2020.* https://www.gov.scot/publications/implementation-flood-risk-management-scotland-act-2009-report-scottish-parliament-2020/pages/9/.

[16] Millar et al. (2022) *Public awareness of climate risks and opportunities in Scotland.* ClimateXChange, https://www.climatexchange.org.uk/media/5213/cxc-public-awareness-of-climate-risks-and-opportunities-in-scotland-january-2022.pdf.

[17] ClimateXChange (2016) *Indicators and trends: BB13 Proportion of local authority areas under impermeable surfaces; Change in impermeable surfacing in built-up areas,* https://www.climatexchange.org.uk/research/indicators-and-trends/indicators/bb13.

[18] NatureScot (2022) *Landscape Indicator: Extent of urban greenspace,* https://www.nature.scot/sites/default/files/2022-06/Landscape

[19] Office of National Statistics (2019) *UK natural capital: urban accounts,* https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/uknaturalcapital/urbanaccounts.

[20] Sniffer (2002) *SUDS in Scotland – the Scottish SUDS database,* https://www.sniffer.org.uk/sr0209-pdf.

[21] Scottish Water (2023) *Annual report and accounts. Performance and prospects,* https://www.scottishwater.co.uk/-/media/ScottishWater/Document-Hub/Key-Publications/Annual-Reports/SWAnnualReport2023.pdf.

[22] Scottish Government (2018) *Surface water management planning: guidance (2018),* https://www.gov.scot/publications/flood-risk-management-scotland-act-2009-surface-water-management-planning/documents/.

[23] Scottish Parliament (2009) *Flood Risk Management (Scotland) Act 2009,* https://www.legislation.gov.uk/asp/2009/6/contents.

[24] Scottish Government (2021) *Water-resilient places: A policy framework for surface water management and blue-green infrastructure,* https://www.gov.scot/publications/water-resilient-places-policy-framework-surface-water-management-blue-green-infrastructure/documents/.

[25] Scottish Government (2023) *Programme for Government 2023 to 2024,* https://www.gov.scot/publications/programme-government-2023-24/documents/.

[26] Scottish Government (2023) *National Planning Framework 4,* https://www.gov.scot/publications/national-planning-framework-4/documents/.

[27] SEPA (2022) *Flood Warning Development Framework,* https://www.sepa.org.uk/media/594489/sepa-flood-warning-dev-framework-2022-28.pdf.

[28] Metropolitan Glasgow Strategic Drainage Partnership (2023) *Projects,* https://www.mgsdp.org.

[29] Central Scotland Green Network (2021) *10,000 raingardens for Scotland case study,* https://centralscotlandgreennetwork.org/wp-content/uploads/2021/10/10000-Raingardens.

[30] F.M.E Muir, M.D. Hurst, A.F. Rennie & J.D. Hansom (2021) *Dynamic Coast: National Coastal Erosion Risk Assessment. CRW2017_08. Scotland's Centre of Expertise for Waters (CREW),* https://www.dynamiccoast.com/files/dc2/_DC2_WS2RA_NCERA_FINAL.pdf

[31] Dynamic Coast (2023), https://www.dynamiccoast.com/.

[32] A.F. Rennie, J.D. Hansom, M.D. Hurst, F.M.E Muir, L.A. Naylor, R.A. Dunkley, & C.J. MacDonell (2021). *Dynamic Coast: The National Overview (2021) CRW2017_08. Scotland's Centre of Expertise for Waters (CREW),* https://www.crew.ac.uk/dynamic-coast.

[33] Dynamic Coast (2023) *Artificial coastal defences dataset,* https://opendata.nature.scot/datasets/snh::dynamiccoast-artificial-coastal-defences/explore.

[34] Dynamic Coast (2023) *Data provided for CCC analysis*.

[35] Scottish Government (2023) *Coastal Change Adaptation Plan Guidance,* https://www.dynamiccoast.com/files/ccapg_2023feb.pdf.

[36] Dynamic Coast (2023) *Coastal Change Adaptation,* https://www.dynamiccoast.com/cca.

[37] R.A. Dunkley, C.J. MacDonell, L.A. Naylor, F.M.E Muir, J.M. Fitton (2021) *Dynamic Coast: Mapping Coastal Erosion Disadvantage in Scotland.* CRW2017_08. Scotland's Centre of Expertise for Waters (CREW), https://www.dynamiccoast.com/files/dc2/.

[38] Emmanuel, R. et al. (2021) *Climate proofing Glasgow. Adaptation strategies for urban overheating,* https://www.gcu.ac.uk/__data/assets/pdf_file/0015/35700/.

[39] Kershaw, T. et al. (2010) *Estimation of the urban heat island for UK climate change projections.* Building Services Engineering Research and Technology, 31(3), pp. 251-263, 10.1177/0143624410365033, https://journals.sagepub.com/doi/abs/10.1177/0143624410365033.

[40] ONS (2023) *Urban natural capital accounts, UK:2023,* https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/urbannaturalcapitalaccountsuk/2023#urban-natural-capital-accounts-uk-ecosystem-services-data.

[41] ONS (2023) *Urban natural capital accounts, UK:2023. Supplementary data: Table 8*, https://www.ons.gov.uk/economy/environmentalaccounts/datasets/urbannaturalcapitalaccountsuksupplementaryinformation.

[42] Forestry Commission (2023) *UK Ward Canopy Cove,* https://data-forestry.opendata.arcgis.com/datasets/ecba26cfaf9d4b61bddc0e3284348d79_0/explore.

[43] NatureScot (2023) *Green Infrastructure Community Engagement Fund,* https://www.nature.scot/sites/default/files.

[44] Central Scotland Green Network (2023) *About CSGN,* https://centralscotlandgreennetwork.org.

[45] Central Scotland Green Network (2023) *Clyde climate forest 'tree count' gets underway,* https://centralscotlandgreennetwork.org/clyde-climate-forest-tree-count/.

[46] Scottish Parliament (2019) *Planning (Scotland) Act 2019,* https://www.legislation.gov.uk/asp/2019/13/contents/enacted.

[47] Scottish Government (2023) *National Planning Framework 4 Delivery Programme v2: September 2023,* https://www.transformingplanning.scot/media/3194/npf4-delivery-programme-v2-september-2023-final.pdf.

[48] GCV Green Network (2023) *Clyde Climate Forest,* https://www.gcvgreennetwork.gov.uk/what-we-do/clyde-climate-forest.

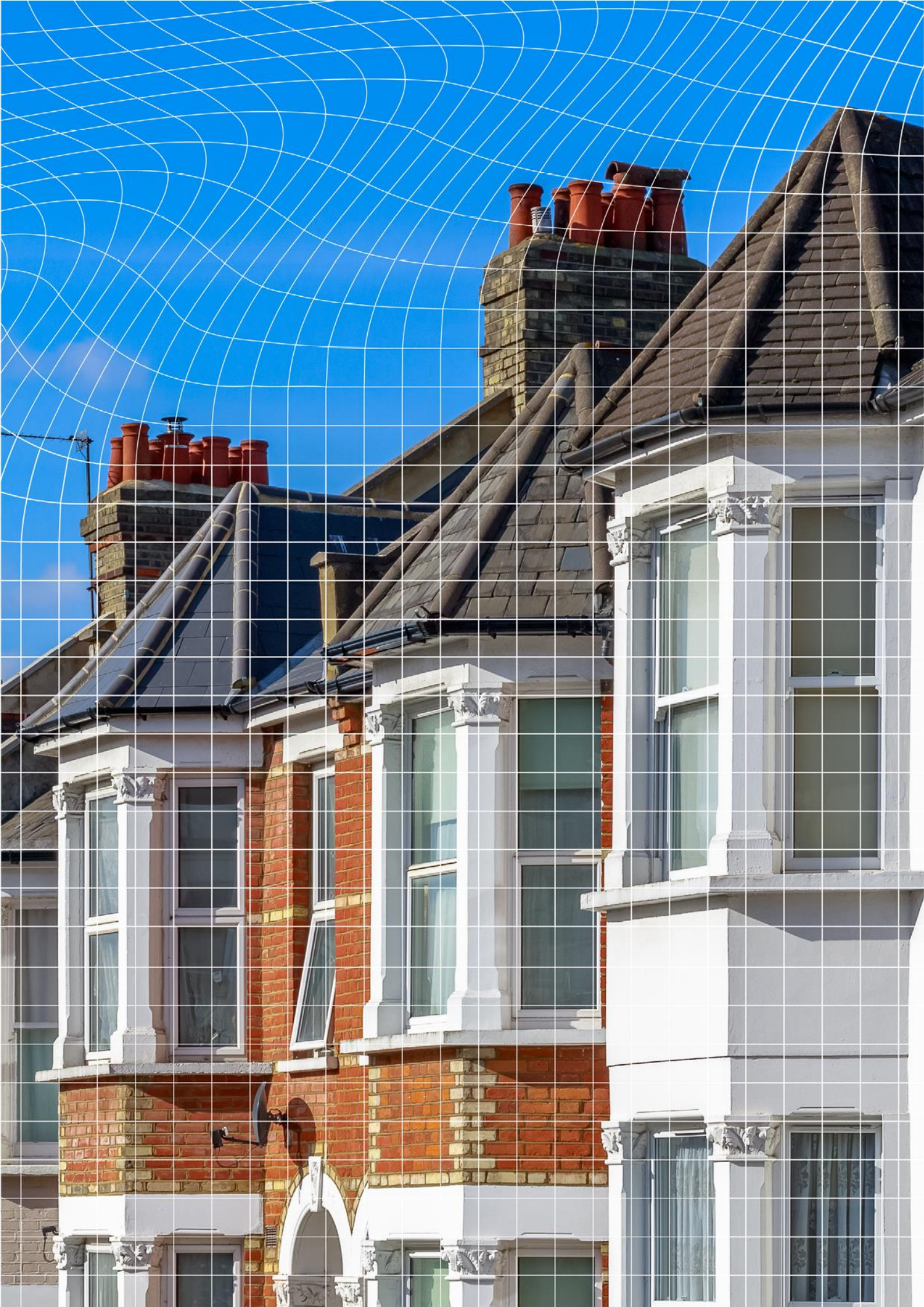
[49] Scottish Government (2020) *Quality greenspace,* https://www.gov.scot/binaries/content/documents/govscot/publications/

[50] Scottish Government (2023) *Data provided for CCC analysis*.

[51] Climate Emergency UK (2021) *Climate Emergency Scorecards,* https://councilclimatescorecards.uk/?

[52] SEPA (2023) *Climate change allowances for flood risk assessment in land use planning. Version 3,* https://www.sepa.org.uk/media/594168/climate-change-guidance.pdf

[53] Scottish Government (2015) *Scotland's National Marine Plan,* https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2015/03/scotlands-national-marine-plan.



Chapter 10: Buildings

Table 10.1
Progress summary - Buildings

	Delivery and implementation	Policies and plans	Summary
Outcome 1: Buildings do not overheat during heatwaves	Unable to evaluate	Limited policies and plans	• Available data on overheating in Scotland's building stock is limited. • There are no policies to directly support adapting the existing residential building stock to manage heat risk. Opportunities to fully include adaptation in key policies for existing buildings are often missed. • Updated building standards and updates to national planning policy will mitigate the risk of overheating in new residential buildings. New prisons are being designed to account for climate change. New and refurbished schools should take account of guidance for thermal comfort.
Outcome 2: Buildings are prepared for flooding	Mixed progress	Limited policies and plans	• There has been some increase in buildings with property level resilience, but delivery and uptake remain slow. • Updates to building and planning regulations include flood resilience. Policies and plans to increase the uptake of property-level resilience are more piecemeal, relying on local delivery, which lacks guidance and funding.

Relevant risks from CCRA3: Risks to health and wellbeing from high temperatures (H1); Risks to people, communities and buildings from flooding (H3); Risks to building fabric (H5); Risks and opportunities from summer and winter household energy demand (H6); Risks to health and social care delivery (H12); Risks to education and prison services (H13).

This chapter assesses progress in adapting Scotland's buildings (focussing mostly on residential and public) to a changing climate.* Buildings should be healthy and comfortable places to spend time in all year round. This means warm in winter, cool in summer and resilient to climate hazards such as flooding. This chapter focuses on adaptation at the level of building design and operation, particularly to heat and flood risks. For new and existing buildings, the key policy areas that can enable building-level adaptation (planning policy, building standards and provision of property-level flood protection) are devolved to the Scottish Government.

The efforts to adapt buildings to climate change have strong overlaps with adaptation actions in other chapters (Box 10.1).

* Adaptation of hospitals and care settings are covered in Chapter 11 (Health). Commercial buildings and the impacts to workers are largely captured in Chapter 13 (Business).

The efforts to adapt buildings to climate change have strong overlaps with adaptation actions in other chapters.

Box 10.1
Overlaps with other chapters

Overlaps with other chapters:

- **Towns and cities.** Urban areas (such as large towns and cities) can be significantly warmer than surrounding countryside – particularly overnight – meaning the indoor air temperatures are also higher.[1]
- **Health.** Overheating in buildings can result in increased deaths and increases in the prevalence and severity of some health conditions.
- **Water supply.** Homes and non-residential buildings consume water provided through the public water system. Reducing water demand within buildings is a key action to increase resilience to future drought extremes.
- **Business.** Climate change impacts on commercial buildings, such as extreme heat, can make it difficult for staff to conduct their roles. Without adaptation measures, there is a risk of resulting productivity losses.
- **Community preparedness and response.** This chapter covers ensuring local heritage, including different types of heritage buildings, is conserved under a changing climate.

There are two additional policy goals for buildings relevant to adaptation efforts:

- **Decarbonisation.** The decarbonisation of the building stock should be done in an integrated way, taking into consideration overheating and indoor air quality risk.
- **Building safety**. In the context of this chapter, this means ensuring that buildings do not overheat, have good levels of indoor air quality, meet fire safety standards, do not have indoor moisture problems such as mould and damp and are resilient to flooding.

Box 10.2 sets out the key findings from the Committee's March 2022 Progress Report to the Scottish Parliament on adaptation of Scotland's building stock.

Box 10.2
Key findings from the Committee's March 2022 Progress Report to the Scottish Parliament

- Current policies and regulations are not ensuring that homes built today are resilient to future warmer temperatures.
  - There is no evidence that energy efficiency, overheating and ventilation are being considered together at large scale when retrofitting or building new homes.
  - Availability of data to measure the level of risk remains limited.
- Current buildings standards do not consider future climate change scenarios. The new Housing to 2040 Strategy and the draft Heat in Buildings Strategy do not explicitly include climate change adaptation.

Source: CCC (2022) *Is Scotland climate ready?*

10.1.1 Outcome 1: Buildings do not overheat during heatwaves

There is considerable risk of lock-in* for dwellings and other buildings that are not adapted. While temperatures in Scotland may often be lower than elsewhere in the UK and current impacts may not be as widespread, heatwaves have been more frequent in Scotland in recent years.[2] Urban areas in particular are at risk of extreme heat now and under future climate change (see Chapter 9). A modelling study conducted by Arup for the CCC in 2022, found that instances of overheating in Scottish homes could increase later in the century under higher warming futures.[3] The third CCRA technical report concluded that climate change is projected to increase heat-related mortality in Scotland and that there is an adaptation shortfall in building policy to address the risks of overheating.[4]

(i) Delivery and implementation progress

Limited available indicators for this outcome mean that we are **unable to evaluate** the score in reducing vulnerability and exposure of buildings overheating due to current and future climate.

There are insufficient data on residential and non-residential overheating.

- **Data on overheating in buildings across Scotland are limited.** There is no regular data collection to monitor current overheating rates in residential or non-residential buildings. A recent survey on public awareness of climate risks and opportunities in Scotland found that 49% of respondents have experienced discomfort or being unable to sleep due to heatwaves in Scotland.[5] The survey also found that 12% of respondents have already shaded south facing windows to reduce heat, with a further 13% very likely to do so.

- **Several other key indicators are missing to monitor progress against this outcome.** Additional indicators for this outcome sit in the third row of the building's adaptation monitoring map in the CCC adaptation monitoring framework: the annual number of cooling measures installed in homes, area of green roofs, awareness amongst the public about how to manage internal temperatures, and the in-use performance of new-build homes passing the overheating requirement within Building Standards.

(ii) Policy and planning progress

There are **limited plans and policies** in place to help ensure that buildings do not overheat during current or more intense future heatwaves. Further targeted action to alleviate potential overheating in buildings is needed in Scotland, particularly for vulnerable people in existing buildings in the most at-risk locations. Joined up policy should mean that support for energy efficiency is required to consider overheating and ventilation together.

* Lock-in: Early actions or decisions that involve long lifetimes or path dependency, which will potentially increase future risk or vulnerability and that are difficult or costly to reverse later (quasi-irreversibility). This can be from an action or decision that is 'business-as-usual', from a lack of an action or decision, or from a mal-adaptative action or decision.

There remains no policy in place to incentivise adaptation in the existing building stock.

- **There are no policies to support adapting the existing residential building stock to manage heat risk and opportunities to include adaptation in key strategies are often missed**. The UK Green Building Council states that 80% of occupied buildings that will exist in 2050 are already built but there is no policy in place to incentivise adaptation in the existing residential building stock.[6]

  – The Housing to 2040 Strategy does not include any objectives relating to climate change adaptation, although the Heat in Building Strategy recognises the need for potential future cooling and possible use of passive measures.[7,8]

  – There are currently no financial mechanisms in place to directly support building-level adaptation investment. This is particularly important for vulnerable private households. Home resilience or adaptation plans could provide holistic guidance and help to unlock green finance, but these are not currently in use.

Updated buildings standards will mitigate the risk of overheating in new residential buildings. NPF4 also requires buildings and places to be adapted to extreme temperatures.

- **Updated Building Standards will mitigate the risk of overheating in new residential buildings.** Building Standard 3.28 for overheating risk includes a new provision to assess and mitigate against the risk of summertime overheating in all new dwellings* for specific designs and locations from February 2023.[9] Conversions from non-domestic to residential are included in the standard.

- **The Fourth National Planning Framework (NPF4)** is now adopted and includes a requirement for buildings and places to be adapted to more extreme temperatures.[10] Policy 2 within the NPF4 states that new development will be sited and designed to adapt to current and future risks from climate change; and that proposals to retrofit climate adaptation measures for existing developments will be supported. Proposals for buildings that will be occupied by people should be designed to promote sustainable temperature management, including where possible prioritising natural or passive solutions. NPF4 is now part of the statutory development plan, informing planning system decision making.

Some policies for public buildings provide an opportunity to incorporate adaptation measures.

- **There are some policies in place for Scottish public buildings that could play a role in supporting passive cooling measures and adaptation action**. The Scottish Green Public Sector Estate Decarbonisation Scheme acts as the main government-led capital funding mechanism to support leadership for decarbonisation of public buildings, and includes some cooling technologies.[11,12] The Net Zero Public Sector Buildings Standard is a voluntary standard, owned by the Scottish Government and applicable to public sector new build and major refurbishment projects.[13] The standard aims to ensure that buildings have good indoor air quality and avoid overheating.

New schools and prisons are taking account of climate change.

- **The Scottish Prison Service (SPS) does not currently have a strategy to mitigate climate-related risks in place, although new prisons are being designed to account for climate change**.[14] SPS has a programme to redevelop and replace older, less efficient prisons. HMP Highland will replace HMP Inverness in 2024 and has been designed to ensure resilience

* The standard applies to a) a unit of residential accommodation occupied by an individual, or individuals, living together as a family or as a single household, and b) a shared multi-occupancy residential building.

against predicted impacts of climate change (including flooding, overheating, sea level rise and severe weather events).

- **Schools within the Learning Estate Investment Programme are mandated to use Building Bulletin 101 when designing new schools or making refurbishments to existing schools.**[15] The bulletin includes guidelines on ventilation, thermal comfort and indoor air quality. Resources are also available to help designers, local authorities and teachers take a role in adapting school grounds. Climate Ready School Grounds guidance and action plans include six areas: heat, cold and wind stress, carbon management, water management, biodiversity ecosystems, air quality and learning, play and community.[16] Projects which require planning approval are also assessed for flood risk under NPF4.

10.1.2 Outcome 2: Buildings are prepared for flooding

(i) Delivery and implementation progress

There has been some progress in preparing buildings for flooding in Scotland, but further data are required.

Indicators for this outcome show **mixed progress** in reducing vulnerability and exposure of buildings to flooding in Scotland.

- **Flooding already impacts buildings in Scotland and this is expected to increase in the future**. Around 9% of residential property and 11% of non-residential property in Scotland is at medium risk (a 1 in 200 annual chance) of flooding. By 2080, the number of residential and non-residential buildings at a 1 in 200 risk of flooding are expected to increase by 39% and 35%.[17] Estimates of the cost of flood damages to property in Scotland vary, with present day estimates for expected annual damages at around £324 million.[18]

- **Estimates suggest that the uptake of property level flood resilience measures in Scotland has been slow.** A study in 2019 estimated that between 1,400-1,500 properties had property flood resilience (PFR) measures installed, an increase of around 300 since 2014.* The study estimated that 81,000 buildings would benefit from some type of PFR. Of this 81,000, all would benefit from resistance measures requiring manual deployment, 64,000 would benefit from automatic resistance measures and 40,000 from resilience measures.† Estimated uptake was therefore only around 2% of this total.[19]

Property flood resilience has mainly been delivered by local authorities but data on the uptake are piecemeal.

- **The majority of PFR has been delivered by local authorities with subsidy schemes but monitoring and evaluation is often poor.** PFR installation in Scotland has been mainly implemented by relatively few local authorities who have developed PFR subsidy schemes or installation projects. Some data for PFR installations are noted in five of the 12 published final reports from the cycle 1 Flood Risk Management Plans (2016-2021), highlighting local councils offering subsidies or installations in at-risk areas.‡,[20] A significant proportion of installations can be attributed to schemes in a few

* Estimates from ClimateXChange questionnaire issued to local authorities and flood groups.

† 'Resistance' measures are those installed to prevent floodwater from entering a property (e.g. air brick covers). 'Manual' resistance measures require deployment or fitting by the homeowner before a flood event, while 'automatic' do not. 'Resilience' measures are those which are designed to limit the damage caused when floodwater enters a property (e.g. waterproof plaster).

‡ There are 14 Local Plan Districts. Not all final cycle 1 reports have been published yet.

councils, such as Dumfries and Galloway (550 properties purchasing subsidised products) and Perth and Kinross (90 installations in council properties).[21,22] However, ongoing maintenance is often not included; around 63% of properties who have had PFR installed have not had a post-installation survey and only 8% had maintenance agreements in place.[19]

- **Scottish Water have invested in measures for properties at risk of internal sewer flooding during intense rainfall.** In 2022/23, Scottish Water invested £1.7 million installing measures at 236 properties in the first year of an enhanced service to customers at risk of internal flooding. There are currently 553 properties on the internal sewer flooding risk register with a 5% or greater annual chance of flooding. Of these properties, around 47% are protected by some form of mitigation, although 22% of customers rejected these measures.[23]

Further data are required to assess the extent of damages to buildings from flood events in Scotland.

- **There are no available data on successful insurance claims at the national scale which might enable better tracking of the risk and recovery of buildings.** Furthermore, there are no national data for the costs of damages to buildings from flooding. However, insurance is more accessible for households at flood risk. The proportion of at-risk households in the UK with recent flood claims (in the last five years) able to obtain more than 10 different quotes for insurance has steadily increased to over 90% since the introduction of Flood Re (which covers the whole of the UK, including Scotland).*,[24]

(ii) Policy and planning progress

There are some plans for addressing building level flood resilience but a lack of clear delivery mechanisms.

There are **limited policies and plans** in place to ensure that buildings in Scotland are protected from flooding.

- **The Living with Flooding action plan lays out ways to provide better information about preparing buildings for flooding.** As part of the plan, Scottish Government continues to work with stakeholders on the Property Flood Resilience Delivery Group (PFRDG).† However, plans and outcomes of actions from the group have yet to be published or feed into policy. There remain key gaps in addressing enablers for PFR delivery, such as funding, supply chains and workforce, as well as engaging the most vulnerable communities and helping business-owners understand PFR. There is limited guidance for local authorities on how to deliver and maintain PFR schemes, including addressing uncertainty around approvals from different parties and accessing small grants for small projects.

- **The NPF4 states that planning applications in areas of flood risk must use flood resistant and resilient materials and construction**. Where flood risk is managed at the site, proposals must ensure that the first occupied or used floors are above flood risk levels‡ and demonstrate safe access.

* Flood Re is a reinsurance scheme allowing insurers to pass the flood risk element of policy to Flood Re for a fixed price. Most homes and contents (for tenanted properties) built before 2009 in high flood risk areas are eligible.

† The group includes key actors for PFR delivery, community resilience and Scottish Government.

‡ Plus an allowance for freeboard and a separate allowance for climate change.

There are measures in updated planning and buildings policy to increase standards for buildings at flood risk.

- **Recent updates to the technical handbooks for domestic and non-domestic buildings in Scotland include mandatory standards for flooding.** Standard 3.3 covers design and construction to reduce risks to the building and occupants from flooding and groundwater.

- **Scottish Government has provided more grant funding to the Scottish Flood Forum (SFF).** The grant was increased to £220,000 in 2022/23, from £193,000 in 2020-21.[25,26] SFF can provide free surveys for households and community engagement. However, there is a backlog of property assessments. Multi-year funding will likely be required to support the awareness-raising, engagement and surveying needed.

There are some local grants for property flood resilience but no national-scale schemes.

- **There are local grants to accelerate the delivery and uptake of PFR but there are no national-scale schemes and limited options for resilient repairs**. The Scottish Borders Council and Dumfries and Galloway Council have subsidy schemes with discounted PFR products for at risk households.[27] Aberdeen City Council runs a 50% funded grant scheme for residential and commercial properties at risk of, or with previous damage from, internal flooding (up to a maximum threshold of £2500 for residential properties and commercial properties with less than 200 m^2 ground floor, and up to £5000 for larger commercial properties).[28] Flood Re's Build Back Better scheme was introduced in April 2022 and enables homeowners to install PFR measures up to the value of £10,000 over the cost of work to repair damage after a flood. * Schemes have mainly focused on supplying PFR products to homeowners and have not yet addressed wider systemic enablers, proactive installation and PFR maintenance.

- **Data and monitoring of property flood resilience are lacking.** The PFRDG recommended that the Scottish Government establish a baseline for PFR. Since the ClimateXChange research was published, there has been no further update on the outcome of this action and there are no current plans to update the data.

- **In the last year, Scottish Water have commenced an enhanced service to customers in all risk categories of internal flooding to ensure they are better protected**. This programme will deliver installations to properties at risk of flooding from sewers under intense rainfall.

(iii) Progress on enablers

Trends in enabling factors for preparing buildings for flooding are mixed, with risk awareness low despite positive community engagement.

The Scottish Flood Forum provides advice and information for homeowners and communities.

- **The Scottish Flood Forum provides information and advice to individuals on how to protect their home from flooding and help with recovery**. SFF's website hosts a 'Property Protection Advisor' tool which allows uses to estimate how much it might cost to provide property level protection for their home.

- **Most people in Scotland do not consider their homes to be at flood risk.** Survey research in 2022 found that 85% of respondents considered their

* Build Back Better is a Flood Re initiative introduced following the Flood Reinsurance (Amendment) Regulations in April 2022. Customers can access reimbursement costs over and above work to repair damage and loss from flooding. Grants are paid for via the same pool of money which covers flood claims. The first Build Back Better claims are now being processed. The scheme does not cover commercial or residential buildings.

homes to be at low or no risk of flooding. 20% were 'fairly' or 'very' likely to install flood resilience measures in their homes or business, although only 2% were already doing so. People who perceived their home to be at risk were more likely to want to install measures (50% compared to 16% of those not perceiving risk).[5]

Retrofit of adaptation measures in buildings will require sufficient numbers of trained workers to install measures.

- **The Living with Flooding action plan recognises that increasing PFR uptake will require sufficient skilled workers, but this has yet to be addressed**. The plan contains an action to investigate the skills gap, review current training and investigate future training needs. There is no published information on the outcome of this action yet.

10.1.3 Outcome 3: Buildings are resilient to other climate risks

In addition to overheating and flooding, there are other risks to both new and existing buildings in Scotland. Climate hazards which can damage building fabric include excessive moisture due to flooding, heavy rain (including wind-driven rain), structural damage due to high winds and impacts of cold.

There are other risks to both new and existing buildings in Scotland that can damage building fabric.

The impact of climate change on most of these specific hazards is not currently well understood and further research is required to understand how risks to building fabric will vary over time, and to form a policy response. As a result, we do not yet have an agreed outcome or indicators to fully assess progress.

However, there are some relevant recent announcements:

- **The Met Office and Department for Energy Security and Net Zero are currently reviewing wind driven rain maps.** Guidance within the Technical Handbooks for wind and rain in Scotland reference British and European standards. The review may therefore be relevant for Scotland.

- **The Scottish Government has committed to reduce vulnerability to cold and fuel poverty**. For example, the Home Energy Efficiency Programmes for Scotland area schemes target fuel-poor areas to provide measures to a large number of homes. Including 2021/22 allocations, the scheme has made available over £482 million to local authorities for measures and helped over 100,000 households since 2013.[29]

10.2 Recommendations

Table 10.2
Recommendations

Primary responsibility	Recommendation	Timing
Local Government and Housing Directorate; Directorate for Energy and Climate Change	Ensure that support for adaptation alongside decarbonisation is included in key building policies such as the Housing to 2040 Strategy and route map and the Scottish Green Public Sector Estate Decarbonisation Scheme.	Ongoing
Local Government and Housing Directorate; Environment and Forestry Directorate; Population Health Directorate	Address data gaps on impacts to buildings and adaptation actions by a) utilising already available data to track the resilience of the building stock (e.g. through the insurance sector) to monitor impacts on buildings from extreme weather, b) undertaking a programme of regular indoor temperature monitoring of samples of existing buildings in at-risk locations to better understand the extent of current overheating and c) consider introducing home resilience reporting that include assessments of flood and overheating resilience.	2025
Local Government and Housing Directorate; Environment and Forestry Directorate	Facilitate access to finance to install proactive adaptation measures for overheating and flood resilience in buildings. This could be via grant schemes or green finance for private owners, with public funding targeted at low-income households or buildings with vulnerable occupants, alongside energy efficiency retrofit.	2024
Environment and Forestry Directorate	Respond to the outcomes of the Living with Flooding action Plan and recommendations of the Property Flood Resilience Delivery Group to develop a vision for identifying at-risk buildings, awareness raising, training and engagement on property-level flood protection. Consider developing localised targets for property-level installations to accelerate uptake.	2024

Endnotes

[1] Lo, Y. T. E., Mitchell, D. M., Bohnenstengel, S. I., Collins, M., Hawkins, E., Hegerl, G. C., Joshi, M., & Stott, P. A. (2020) *UK Climate Projections: Summer daytime and night-time urban heat island changes in England's major cities,* Journal of Climate, 33(20), 9015-9030, https://journals.ametsoc.org/configurable/content/journals$002fclim$002f33$002f20$002fjcliD190961.xml?t:ac=journals%24002fclim%24002f33%24002f20%24002fjcliD190961.xml.

[2] Emmanuel, R. et al. (2021) *Climate proofing Glasgow. Adaptation strategies for urban overheating.* MUrCS project, www.gcu.ac.uk/__data/assets/pdf_file/0015/35700/beam_climate_proofing_glasgow.pdf.

[3] Arup (2022) *Addressing overheating risk in existing UK homes,* www.theccc.org.uk/publication/addressing-overheating-risk-in-existing-uk-homes-arup/.

[4] Kovats, S. and Brisley, R. (2021) *Health, communities and the built environment. In: The Third UK Climate Change Risk Assessment Technical Report* Betts, R.A., Haward, A.B., Pearson K.V. (eds). Prepared for the Climate Change Committee, London, www.ukclimaterisk.org/wp-content/uploads/2021/06/CCRA3-Chapter-5-FINAL.pdf.

[5] Millar, C. et al. (2022) *Public awareness of climate risks and opportunities in Scotland,* https://www.climatexchange.org.uk/media/5213/cxc-public-awareness-of-climate-risks-and-opportunities-in-scotland-january-2022.pdf.

[6] UK Green Building Council (2023) *Climate Change Mitigation,* https://ukgbc.org/our-work/climate-change-mitigation/.

[7] Scottish Government (2021) *Housing to 2040,* https://www.gov.scot/publications/housing-2040-2/.

[8] Scottish Government (2021) *Heat in Buildings Strategy,* https://www.gov.scot/publications/heat-buildings-strategy-achieving-net-zero-emissions-scotlands-buildings/.

[9] Scottish Government (2022) *Building standards technical handbooks 2022: summary of changes for 1 June 2022 and 1 December 2022,* www.gov.scot/publications/building-standards-technical-handbooks-2022-summary-of-changes-for-1-june-2022-and-1-december-2022/.

[10] Scottish Government (2023) *National Planning Framework 4,* www.gov.scot/publications/national-planning-framework-4/documents/.

[11] Scottish Government (2023) *Climate adaptation: letter to UK Climate Change Committee,* www.gov.scot/publications/climate-adaptation-letter-to-uk-climate-change-committee/.

[12] Scottish Government (2023) *Scottish Central Government Energy Efficiency Grants scheme: form and guidance,* www.gov.scot/publications/scottish-central-government-energy-efficiency-grant-scheme-form-and-guidance/pages/eligibility/.

[13] Scottish Futures and Scottish Government (2021) *Net Zero Public Sector Building Standard,* https://www.sustainabilityexchange.ac.uk/files/nzpsb_standard_22march2021.pdf

[14] Scottish Prison Service (2022) *The Scottish Prison Service Climate Change Report 2021-22,* https://sustainablescotlandnetwork.org/reports/the-scottish-prison-service.

[15] Education and Skills Funding Agency (2018) *Building Bulletin 101 Guidelines on ventilation, thermal comfort and indoor air quality in schools,* www.gov.uk/government/publications/building-bulletin-101-ventilation-for-school-buildings.

[16] Architecture & Design Scotland (2023) *Climate Ready School Grounds,* www.ads.org.uk/resource/climate-ready-school-grounds.

[17] SEPA (2023) *National Flood Risk Assessment 2018,* Data provided by SEPA for CCC analysis.

[18] Sayers, PB., Horritt, M, Carr, S, Kay, A, Mauz, J., Lamb R, and Penning-Rowsell E (2020) Third UK Climate Change Risk Assessment (CCRA3): *Future flood risk. Research undertaken by Sayers and Partners for the Committee on Climate Change*. Published by Committee on Climate Change, London.

[19] Pettit, A. and Kerr, H. (2020) *Property Flood Resilience – Scottish Baseline Study,* ClimateXChange, https://era.ed.ac.uk/bitstream/.

[20] CCC Analysis of Cycle 1 Flood Risk Management Final Reports.

[21] Dumfries and Galloway Council (2022) *Solway Local Plan District Local Flood Risk Management Plan Final Report,* https://www.dumgal.gov.uk/media/27018/Solway-Local-Flood-Risk-Management-Strategy-Final-Report-Cycle-1/pdf/Solway-Local-Flood-Risk-Management-Strategy-Final-Report-Cycle-I.pdf?m=638072139853600000 (pg. 9).

[22] Perth and Kinross Council (2022) *Final report: Local Flood Risk Management Plan Tay Local Plan District,* https://www.pkc.gov.uk/media/50690/Final-Report-Tay-LPD/pdf/S38_Final_Report_Tay_LPD_Final.pdf?m=638101525268300000 (pg. 8).

[23] Scottish Water (2023) *Annual report and accounts,* https://www.scottishwater.co.uk/-/media/ScottishWater/Document-Hub/Key-Publications/Annual-Reports/SWAnnualReport2023.pdf.

[24] Flood Re (2023) *Data provided for CCC analysis.*

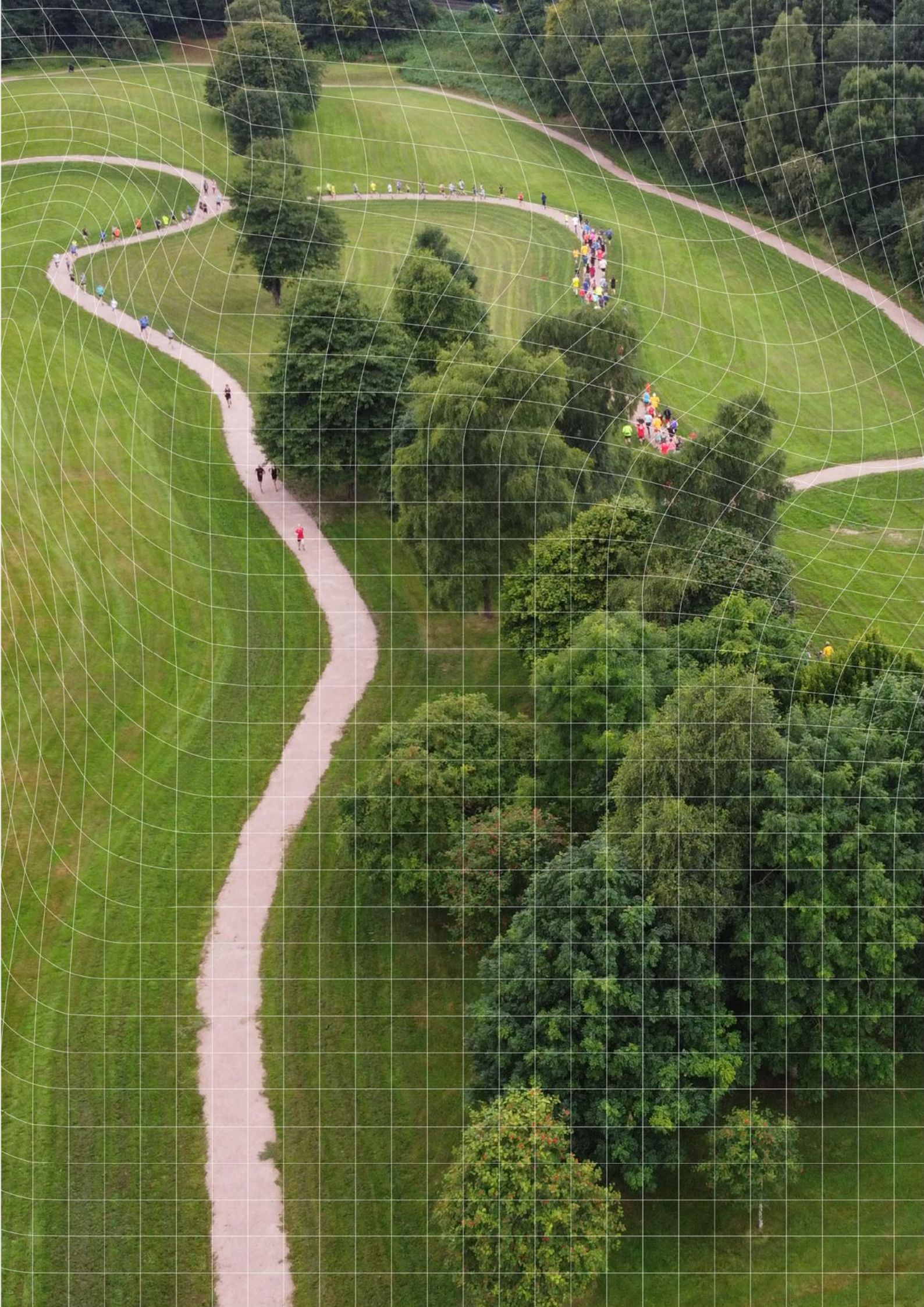
[25] Scottish Government (2023) *Scottish Climate Change Adaptation Programme Progress Report 2023,* https://www.gov.scot/binaries/content/documents/govscot/.

[26] Scottish Government (2021). *Flood Risk Management (Scotland) Act 2008 implementation: report to the Scottish Parliament – 2020,* https://www.gov.scot/publications/implementation-flood-risk-management-scotland-act-2009-report-scottish-parliament-2020/pages/9/.

[27] Dumfries and Galloway Council (2022) *Solway Local Plan District Local Flood Risk Management Plan: Final Report,* https://www.dumgal.gov.uk/article/15215/.

[28] Aberdeen City Council (2023) *Property Level Protection flood grant, https://www.aberdeencity.gov.uk/services/.*

[29] Scottish Government (2022) *Home energy and fuel poverty*, www.gov.scot/policies/home-energy-and-fuel-poverty/energy-saving-home-improvements/.



Chapter 11: Health

Table 11.1
Progress summary - Health

	Delivery and implementation	Policies and plans	Summary
Outcome 1: Protect population health from the impacts of climate change and utilise potential benefits	Insufficient progress	Limited policies and plans	• Data to track mortality and morbidity due to impacts from weather are not regularly recorded. Lyme disease cases have increased, although the association with climate change is unclear. • There is no long-term plan for managing heatwaves or extreme weather, however Public Health Scotland have published a strategic plan for climate change and sustainability, including commitments to develop an adverse weather and health plan. • There is some surveillance of vector-borne diseases (VBD) but there is no dedicated strategy and further assessment of future risks is needed. Ventilation guidance was updated in February 2023 to simplify options for ventilation strategies based on airtightness and to add guidance on purge ventilation.
Outcome 2: Quality and accessible healthcare delivery during extreme weather	Unable to evaluate	Partial policies and plans	• Data on disruption to health and social care services by heatwaves or floods is not available. • Recent commitments and tools, such as the NHS Scotland climate emergency and sustainability strategy: 2022-2026 are an important step in understanding climate risk across NHS Scotland and planning adaptation action. • More coordinated action is needed on understanding vulnerabilities across the care sector and how risks can be addressed.

Relevant risks from CCRA3: H1 Risks to health and wellbeing from high temperatures; H2 Opportunities for health and wellbeing from higher temperatures; H3 Risks to people, communities and buildings from flooding; H7 Risks to health and wellbeing from changes in air quality; H8 Risks to health from vector-borne diseases; H12 Risks to health and social care delivery.

Risks to people's health from climate change are affected by their vulnerability and exposure, including factors such as age.

This chapter covers the adaptation to ensure that the effects of climate change on population health and health and social care delivery are minimised. Population health, both physical and mental, may be affected by a range of climate hazards. Increased frequency and intensity of extreme heat can create physiological stress on the body, and weather extremes, such as flooding, can put health care delivery at risk. The risks to people's health from climate change are not only affected by the severity of the changes in weather hazards, but also by factors influencing vulnerability and exposure, such as an aging population and existing health inequalities. The key policy levers for adapting the health system are devolved to the Scottish Government.

Many health co-benefits, including reductions of health inequalities, can be achieved indirectly through focusing on the wider determinants of health that sit within other policy areas.

Reducing greenhouse gas emissions and creating resilience to respond to the impacts of a warming climate provide an opportunity to improve the health of the population. Whilst the health and social care systems are important to everyone's health, many things that affect health sit outside of these.[1] Therefore, many health co-benefits, including reductions of health inequalities, can be achieved indirectly through focusing on the wider determinants of health that sit within other policy areas (See Box 11.1 for interactions with other key sectors). The third Scottish National Adaptation Plan (SNAP3) should include the broader impacts of climate change on health by ensuring that actions across other relevant policy areas consider health, wellbeing and equity.

Box 11.1
Interactions with other sectors in this report

Key interactions include:

- **Buildings.** Overheating in buildings can result in increased deaths and increases in the prevalence and severity of some health conditions.
- **Food.** Continued food security and safety from climate-sensitive food-borne diseases under future climate conditions.
- **Towns and cities.** Urban design, new developments, planning and reducing the urban heat island effect.
- **Communities.** At local levels, ensuring that communities are prepared for and can respond to climate shocks, helping to minimise knock-on impacts on public health.
- **Business.** Productivity losses due to the impacts from overheating on workers, both arising directly in the workplace (including working from home) and indirectly from disrupted sleep.

Overall, health was rated as low for risk management and medium for plans in our previous assessment.

Box 11.2 describes the key findings from the Committee's March 2022 Progress Report to the Scottish Parliament.[2]

Box 11.2
Key findings from our March 2022 Progress Report to the Scottish Parliament

Health was rated as low for risk management and medium for plans. Key messages were:

- There was a lack of plans and policies for managing risks of more prevalent climate-sensitive diseases.
- Future climate conditions were being adequately considered in current outdoor air quality strategies but not in relation to indoor air quality.
- Availability of data to measure the level of risk was limited for most of the priority areas.

CCC (2022) *Is Scotland climate ready?*

11.1.1 Outcome 1: Protect population health from the impacts of climate change and utilise potential benefits

Health impacts from climate change in Scotland include heat and flood related mortality and morbidity, impacts from poor air quality and increased risks of vector-borne disease.

Flooding events can cause immediate dangers to physical health but can also greatly impact mental health.[3] High temperatures have the potential to affect a wide range of health and social outcomes. Whilst temperatures are often not as high across Scotland as elsewhere in the UK, evidence suggests that heat-related impacts on health can occur at cooler temperatures further north, and in 2022 temperature records were broken, with 34.8˚C recorded in the Borders.[4,5] As temperatures increase with climate change, it is very likely there will be an increase in the frequency and intensity of heatwave events and extreme high temperatures.[6] CCRA3 found that climate change is projected to increase heat-related mortality in Scotland from around 70 heat-related deaths per year to around 70 - 285 per year by 2050 and 140 - 390 per year by the 2080s.*[,7] However, estimates are uncertain as there is less confidence in projections for Scotland and very few observational studies on heat impacts.

(i) Delivery and implementation progress

Data to track impacts on mortality and morbidity due to impacts from weather are not regularly recorded.

Indicators for this outcome show **insufficient progress** towards ensuring good population health under current and future climate.

- **Data to track impacts on mortality and morbidity due to impacts from weather are not regularly recorded.** Public Health Scotland (PHS) have committed to undertake a feasibility study assessing the potential development of Scotland-specific climate-related indicators on population health and equity impacts of climate change. They are also investigating developing their surveillance capacity on the health effects of adverse weather and climate sensitive infectious disease.[8]

- **Despite a lack of regular data being recorded, there is evidence of impacts on health from weather events occurring in Scotland**. Weather-related incidents from Storm Babet in October 2022 led to the deaths of several people across the UK, including Scotland. A recent study on public awareness of climate risks in Scotland found that 49% of respondents have experienced discomfort or difficulties sleeping due to heatwaves, although only 9% reported that heatwaves have significantly affected their health.[9] 45% of respondents had experienced flooding in their local areas, although fewer had experienced flooding damage to their homes (5%) or relocation due to flood risk or erosion (2%).

* In a scenario of 4°C global warming at the end of the century, assuming no population growth.

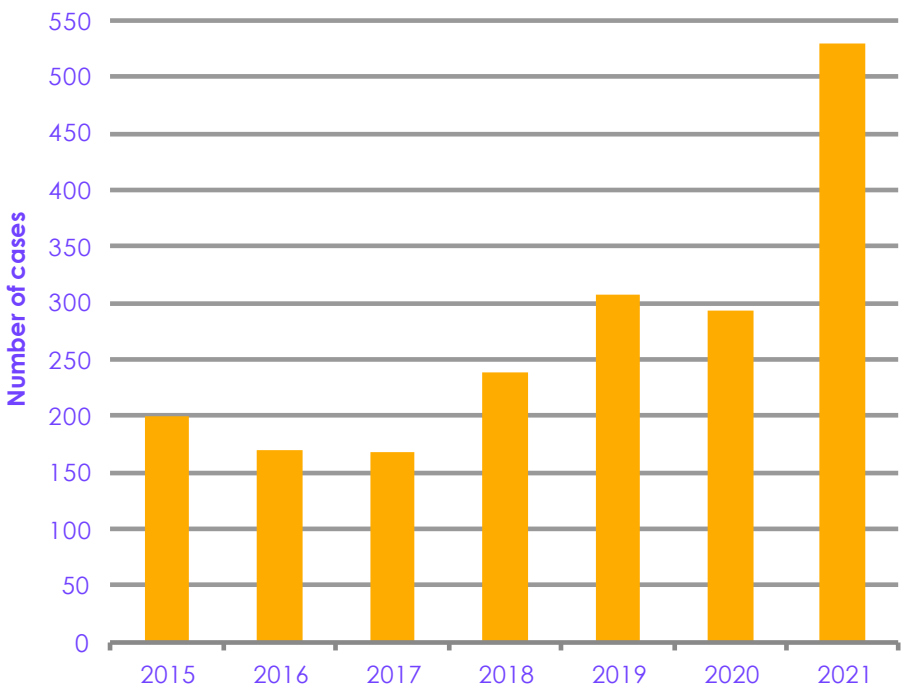
While cases of Lyme disease have increased, more research is needed to understand the links to climate change.

- **Confirmed laboratory cases of Lyme disease have been increasing, although these changes have not been attributed to climate change.**[10] Between 2020 and 2021 laboratory cases of Lyme disease, caused by tick bites, in Scotland increased by nearly 81% (Figure 11.1). This is reported as likely, in part, to be due to the introduction of additional screening tests in April 2020. However, there may have been a true underlying increase in cases due to increased tick activity and restrictions placed during the pandemic increasing people's leisure behaviours, potentially increasing the likelihood of tick exposure. Attribution of the different drivers, including climate change (from milder winters and warmer temperatures leading to increased tick-human contact patterns) is not possible, and more research is needed to understand the links. In 2022, there was a probable human case of tick-borne encephalitis likely to have been acquired in Scotland.[11]

Green space can provide important benefits including urban cooling in heatwaves, as well as improvements to air quality and mental and physical health.

- **In 2021, 70% of adults lived within a five-minute walk of their nearest area of green or blue space (such as parks, woods, rivers or coasts), around the same proportion as 2020 (68%).**[12] While not directly comparable, Great Britain figures show 52% of people live within a five-minute walk (300 m as the crow flies) of a public park or playing field.[13] Green space can provide important benefits including urban cooling in heatwaves, as well improvements to air quality and mental and physical health.

Figure 11.1 Laboratory confirmed cases of Lyme disease in Scotland



Source: Public Health Scotland (2023) *Gastrointestinal & Zoonoses Biennial Report 2020/2021*.

(ii) Policy and planning progress

There are **limited policies and plans** in place to ensure good population health under current and future climate.

PHS have published a strategic approach to climate change and sustainability setting out 41 high-level actions.

- **There is no longer-term plan for managing heatwaves and extreme weather in Scotland. However, PHS have recently published a strategic approach to climate change and sustainability setting out future priorities, including developing an adverse weather and health plan.**[14,15] The strategic approach sets out 41 high-level actions PHS will take between 2023 and 2026 and longer-term outcomes to beyond 2026**,** including: working with partners and stakeholders to ensure that opportunities to deliver population health, wellbeing and equity co-benefits from climate action are realised, embedding climate in all of PHS's work to protect and improve health, and supporting ambitions of NHS Scotland (through delivery of NHS Scotland's Climate Emergency and Sustainability Strategy) and social care partners. A detailed, time-bound action plan will sit beneath this which will use several public health approaches.

- **Adaptation Scotland, Public Health Scotland and the Improvement Service have set out principles for addressing health inequalities as an integral part of adaptation planning and decision making.**[16] This is a positive step in acknowledging the wider determinants of health and opportunities for public bodies to address these when designing, delivering and evaluating climate change adaptation plans.

Research is assessing the impact of climate and land-use change on mosquito emergence in Scotland but there is no dedicated strategy and further assessment of future risks is needed.

- **There is some surveillance of vector-borne diseases (VBD) but there is no dedicated strategy and further assessment of future risks is needed.** Lyme disease is monitored via lab confirmed cases, which underestimate the true burden of the disease.[17] PHS also collates data on mosquito-borne disease cases. The University of Glasgow is leading a project to assess the impact of climate and land use change on the risk of mosquito VBD emergence in Scotland which will help guide longer-term surveillance, however further assessment of future risks of VBD from ticks is also needed.[18]

- **Ventilation guidance was updated in February 2023 to simplify options for ventilation strategies based on airtightness levels and to add guidance on purge ventilation.**[19] Scottish Government intend to undertake a fuller review of ventilation provision for domestic and non-domestic buildings from 2023.

The score for this outcome may be revised to 'partial' upon publication of forthcoming plans.

The score for this outcome may be revised to 'partial' upon publication of the adverse weather and health plan and PHS' strategic approach time-bound action plan.

(iii) Enablers

- **Public health communications around extreme heat were issued in 2022.** The heatwave in July 2022 saw a proactive information campaign using social media and the ReadyScot website to promote behaviours to minimise the negative impacts of extreme heat, reaching over 1.2 million people across southern Scotland.[20] PHS will evaluate its public communications on climate, population health and equity by 2026.[21]

- **The public in Scotland are aware of impacts from climate change, although the level of perceived seriousness varies.** 51% of respondents of a study looking at public awareness of climate risks and opportunities in Scotland

felt that flooding was already a serious problem.[22] Findings also suggested an apparent disparity between personal experience and perceived seriousness of heatwaves. Discomfort or difficulties sleeping due to heatwaves was the second most common weather-related impact, after disruptions from snow. However, heatwaves were viewed as comparatively less serious problems for Scotland, or for respondents' local areas than other weather events.

11.1.2 Outcome 2: Quality and accessible healthcare delivery during extreme weather

Care homes, GP surgeries and hospitals are projected to be at significant risk of flooding by the 2050s and it is likely that healthcare buildings will overheat more frequently. CCRA3's flood projections show that across Scotland, the number of care homes, GP surgeries and hospitals projected to be at risk of significant river, surface water or coastal flooding by 2050s will increase by 4%, 31% and 33% respectively* (see Chapter 9, towns and cities for further analysis on flooding).[23] Modelling studies indicate that unshaded, well-insulated and thermally lightweight hospital buildings are inherently at risk of overheating, even in a cool UK summer.[24] As temperatures increase, it is very likely there will be an increase in the frequency and intensity of heatwave events and extreme high temperatures, and healthcare buildings will overheat more frequently.[25] Acute services will also need to address the increases in demand during heatwave events.

(i) Delivery and implementation progress

The Committee have been **unable to evaluate** progress in reducing vulnerability and exposure of extreme weather impacts on health and social care delivery.

There are no data available to show the extent to which health and social care services have been disrupted by heatwaves or flooding.

- **Data on disruption to health and social care services by heatwaves or floods are not available.** There are no regularly collected data available to show the extent to which health and social care services have been disrupted by heatwaves or flooding over recent years, or the extent to which health and care sites are well protected against climate risks.

(ii) Policy and planning progress

There are **partial policies and plans** in place to help ensure quality and accessible healthcare delivery during extreme weather.

The NHS Scotland climate emergency and sustainability strategy: 2022-2026 sets out plans to adapt to climate change.

- **Recent commitments and tools are an important step in understanding climate risk across NHS Scotland and planning adaptation action.** The NHS Scotland climate emergency and sustainability strategy: 2022-2026 was published in August 2022.[26] The strategy sets out plans to adapt to climate change, review progress annually (both at Health Board and wider NHS Scotland level) and includes the following commitments:
  - Conduct climate change risk assessments covering all areas of the service, ensuring integration with other strategies, risk assessments and business continuity plans and work towards the requirements of ISO 14090: Adaptation to climate change.

* Under a low population growth, 2°C warming scenario.

- Assess the risk of flooding for all sites, key transport and access routes, supporting infrastructure and workforce, based on current and future projected climate conditions.

- Prepare and implement climate change adaptation plans to ensure the resilience of service under changing climate conditions and input into the development of wider adaptation strategies and related activity, including local authority open space strategies.

- Prioritise passive cooling measures over mechanical cooling where possible; and establish a monitoring programme to capture data that will enable a robust assessment of the nature of and severity of overheating at in-patient facilities.

- Incorporate water saving measures wherever possible.

- Develop and manage green space and other green infrastructure such as green roofs and rain gardens to mitigate flood and overheating risks.

- Raise awareness of the potential for flooding and overheating, and actions that can be taken by staff, patients, visitors and contractors.

All NHS Boards are working towards creating full adaptation plans.

- **Work is now in progress across all NHS Boards to create full adaptation plans and utilise the NHS Scotland Climate Change Risk Assessment and Adaptation Planning Tool for Healthcare Assets.**[27] Flooding and overheating are identified as the climate risks most likely to have the biggest effect on the estate and operations of NHS Scotland, as well as increasing patient demand. It is not known how many Health Boards have completed plans at the time of writing. NHS Scotland must ensure that plans are adequately resourced, are good quality - including SMART actions – and that they are implemented fully to minimise risks.

More coordinated action on understanding vulnerabilities and how risks can be addressed across the social care is needed.

- **Although there are some commitments in place to begin to support the social care sector to respond to climate change, more coordinated action on understanding vulnerabilities and how risks can be addressed is needed.** The National Care Service (Scotland) Bill 2022 establishes the National Care Service in Scotland (NCS).[28] If enacted, the NCS will create opportunities to enhance services, including on climate resilience, and there will be scope to ensure that the Scottish Government's work on climate and environmental priorities (including biodiversity and green space) are incorporated. The Scottish Government and local government in Scotland have committed to developing ethical commissioning and procurement approaches in social care which will aim to take account of the impacts of climate change.[29] PHS have also committed to collaborate with the Scottish Government and COSLA to understand how they can support the social care sector to respond to the climate emergency.[*,30]

* COSLA are a councillor-led, cross-party organisation for Local Government in Scotland.

11.2 Recommendations

Table 11.2
Recommendations

Primary responsibility	Recommendation	Timing
Population Health Directorate; Public Health Scotland; Directorate General Health and Social Care	Address data gaps on adaptation for health and social care, including conducting or commissioning time series analyses of temperature-related mortality data and establishing monitoring programmes to gather data on disruptions to healthcare due to flooding and overheating.	2025
Energy and Climate Change Directorate	The third Scottish National Adaptation Plan should include the broader impacts of climate change on health by ensuring that actions across other relevant policy areas consider health, wellbeing and equity.	2024
Directorate General Health and Social Care	Assess vulnerability to existing and future climate risks across the social care sector. Following this develop a long-term, cross-sector approach on how risks in the social care sector can be addressed.	2024
Population Health Directorate; Public Health Scotland	Assess the changing risks to vector-borne diseases from climate change (including those from both mosquitos and ticks). This should consider areas for future monitoring and surveillance and whether a dedicated strategy is needed.	2024

Notes: Some recommendations within Chapter 10 (Buildings) are also relevant, for example facilitating access to finance to install adaptation measures in buildings.

Endnotes

[1] Institute of Health Equity (2020) *Sustainable Health Equity: Achieving a Net-Zero UK,* http://www.theccc.org.uk/publication/ucl-sustainable-health-equity-achieving-a-net-zero-uk/.

[2] Climate Change Committee (2022) *Is Scotland Climate Ready? 2022 report to Scottish Parliament,* https://www.theccc.org.uk/publication/is-scotland-climate-ready-2022-report-to-scottish-parliament/.

[3] Kovats, S. and Brisley, R. (2011) *Health, communities and the built environment. In: The Third UK Climate Change Risk Assessment Technical Report* [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)]. Prepared for the Climate Change Committee, London.

[4] Met Office *UK climate extremes,* www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-extremes

[5] Climate Change Committee (2014) *Managing climate risks to well-being and the economy,* www.theccc.org.uk/publication/managing-climate-risks-to-well-being-and-the-economy-asc-progress-report-2014/.

[6] Kovats, S. and Brisley, R. (2011) *Health, communities and the built environment. In: The Third UK Climate Change Risk Assessment Technical Report* [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)]. Prepared for the Climate Change Committee, London.

[7] Kovats, S. and Brisley, R. (2011) *Health, communities and the built environment. In: The Third UK Climate Change Risk Assessment Technical Report* [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)]. Prepared for the Climate Change Committee, London.

[8] Public Health Scotland (2023) *PHS climate change and sustainability strategic plan,* www.publichealthscotland.scot/media/22286/phs-climate-change-and-sustainability-strategic-plan_english_sep2023.pdf.

[9] ClimateXChange (2022) *Public awareness of climate risks and opportunities in Scotland*, www.climatexchange.org.uk/media/5213/cxc-public-awareness-of-climate-risks-and-opportunities-in-scotland-january-2022.pdf.

[10] Public Health Scotland (2023) *Gastrointestinal & Zoonoses Biennial Report 2020/2021,* https://publichealthscotland.scot/media/18212/giz-annual-report-2020-2021_final_revisions.pdf.

[11] Public Health Scotland (2023) *Tick awareness,* www.publichealthscotland.scot/news/2023/april/tick-awareness/.

[12] Scottish Government (2023) *Scottish Household Survey 2021,* www.gov.scot/news/scottish-household-survey-2021-results-published/.

[13] ONS (2020) *One in eight British households has no garden,* www.ons.gov.uk/economy/environmentalaccounts/articles/oneineightbritishhouseholdshasnogarden/2020-05-14.

[14] Public Health Scotland (2023) *PHS climate change and sustainability strategic plan,* www.publichealthscotland.scot/publications/phs-climate-change-and-sustainability.

[15] Scottish Government (2023) *Climate adaptation: letter to UK Climate Change Committee,* www.gov.scot/publications/climate-adaptation-letter-to-uk-climate-change-committee/.

[16] Adaptation Scotland, Improvement Service and Public Health Scotland, *Working together to build climate-resilient, healthy and equitable place,* www.publichealthscotland.scot/news/2023/july/join-us-in-building-a-climate-resilient-scotland/.

[17] Public Health Scotland (2023) *Gastrointestinal & Zoonoses Biennial Report 2020/2021,* https://publichealthscotland.scot/media/18212/giz-annual-report-2020-2021_final_revisions.pdf.

[18] University of Glasgow (2023) *Ongoing research: Assessing the impact of climate and land use change on the risk of mosquito vector-borne disease emergence in Scotland*, www.gla.ac.uk/colleges/mvls/graduateschool/wellcomephd/.

[19] Scottish Government (2023) *Building Scotland (Amendment)Regulations 2022 – ventilation and overheating: presentation,* www.gov.scot/publications/building-scotland-amendment-regulations-2022-ventilation-and-overheating-presentation/.

[20] Scottish Government (2023) *Climate adaptation: letter to UK Climate Change Committee,* www.gov.scot/publications/climate-adaptation-letter-to-uk-climate-change-committee/.

[21] Public Health Scotland (2023) *PHS climate change and sustainability strategic plan,* www.publichealthscotland.scot/publications/phs-climate-change-and-sustainability.

[22] ClimateXChange (2022) *Public awareness of climate risks and opportunities in Scotland*, www.climatexchange.org.uk/media/5213/cxc-public-awareness-of-climate-risks-and-opportunities-in-scotland-january-2022.pdf.

[23] Sayers PB, Horritt M, Carr S, Kay A, Mauz J, Lamb R, and Penning-Rowsell E (2020) *Third UK Climate Change Risk Assessment (CCRA3): Future flood risk,* https://www.ukclimaterisk.org/independent-assessment-ccra3/research-supporting-analysis/.

[24] Kovats, S. and Brisley, R. (2011) *Health, communities and the built environment. In: The Third UK Climate Change Risk Assessment Technical Report* [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)]. Prepared for the Climate Change Committee, London.

[25] Kovats, S. and Brisley, R. (2011) *Health, communities and the built environment. In: The Third UK Climate Change Risk Assessment Technical Report* [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)]. Prepared for the Climate Change Committee, London.

[26] NHS Scotland (2022) *Climate Emergency & Sustainability Strategy 2022-2026,* www.gov.scot/publications/nhs-scotland-climate-emergency-sustainability-strategy-2022-2026/documents/.

[27] Scottish Government (2023) *Climate adaptation: letter to UK Climate Change Committee,* www.gov.scot/publications/climate-adaptation-letter-to-uk-climate-change-committee/.

[28] Scottish Parliament (2022) *National Care Service (Scotland) Bill Policy Memorandum,* www.parliament.scot/-/media/files/legislation/bills/s6-bills/national-care-service-scotland-bill/introduced/policy-memorandum-accessible.pdf .

[29] Scottish Government (2022) *Joint Statement of Intent and Next Steps for Adult Social Care 2022-23,* www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2022/12/joint-statement-intent-next-steps-adult-social-care-2022-23/documents/joint-statement-intent-next-steps-adult-social-care-2022-23/joint-statement-intent-next-steps-adult-social-care-2022-23/govscot%3Adocument/joint-statement-intent-next-steps-adult-social-care-2022-23.pdf.

[30] Public Health Scotland (2023) *PHS climate change and sustainability strategic plan,* www.publichealthscotland.scot/publications/phs-climate-change-and-sustainability.

Chapter 12: Community preparedness and response

Introduction

Table 12.1
Progress summary – Community preparedness and response

	Delivery and implementation	Policies and plans	Summary
Outcome 1: Communities are prepared for climate shocks	Good progress	Credible policies and plans	• All local authorities in Scotland have carried out some adaptation action and there is increasing prevalence of partnership and community-led projects. • Adaptation Scotland has facilitated a positive place-based programme and there is increased support and funding for community-led action.
Outcome 2: Communities can respond to climate shocks	Mixed progress	Credible policies and plans	• Emergency responders have slightly increased capability to deal with weather events. Emergency alerts have relatively good coverage but data on the links to response are lacking. • Long-term plans for incident response and community resilience exist but they are not accompanied by multi-year funding and evaluation is inconsistent.
Outcome 3: Local cultural heritage is conserved	Mixed progress	Partial policies and plans	• Climate risk to cultural heritage is increasingly understood, but available evidence to assess progress to date on addressing risks is mixed. • National Trust Scotland is identifying their most at-risk sites along the coast. A collaborative strategy for the historic environment in Scotland was launched in April 2023 including adaptation.

Relevant risks from CCRA3: H1 Risks to health and wellbeing from high temperatures; H2 Opportunity for health and wellbeing from warmer summers and winters; H3 Risks to people, communities and buildings from flooding; H4 Risks to viability of coastal communities from sea level rise; H11 Risks to cultural heritage; N18 Risks and opportunities from climate change to landscape character H1 Risks to health and wellbeing from high temperatures; H2 Opportunity for health and wellbeing from warmer summers and winters; H3 Risks to people, communities and buildings from flooding; H4 Risks to viability of coastal communities from sea level rise; H11 Risks to cultural heritage; N18 Risks and opportunities from climate change to landscape character.

This chapter covers local-level awareness, planning and response to weather and climate impacts, as well as the protection and resilience of cultural heritage. Local communities and services in Scotland will be affected by all climate hazards for the UK, including extreme heat and flooding. Well-adapted communities are those that are adequately prepared for current and future climate and weather extremes and can respond to emergencies when they occur, minimising the impacts. Maintaining thriving communities also requires conservation of cultural heritage under future climate conditions. Key findings from our previous report in March 2022 are highlighted in Box 12.1.[1]

Resilient communities are prepared for and able to effectively respond to current and future climate events.

Policy areas for resilient communities and cultural heritage are fully devolved from UK Government to Scottish Government. In many cases, adaptation actions are delivered at the local level, often via collaboration with actors from the national or local public, private and voluntary sectors (Box 12.2). Scottish Government can provide funding, and legislative and policy support for community-led actions and local authority resilience.

A mixture of community-led, partnership, local authority and national-level approaches can contribute to community resilience.

SCCAP2 provides an overarching policy framework for resilient communities, supported by cross-cutting policies and initiatives, including the Adaptation Scotland programme. The Civil Contingencies Act (2004) Contingency Planning (Scotland) Regulations (2005) is the legislation for Scotland's resilience frameworks, outlining the basis for emergency preparedness and local arrangements for civil protection, including roles and responsibilities for local responders.[2] The Historic Environment Scotland Act (2014) is the main piece of legislation in Scotland for the designation of monuments and buildings and for consents relating to scheduled monuments, listed buildings and conservation areas.[3] Adaptation in communities and cultural heritage sectors overlaps with other policy goals, such as embedding the Place Principle, improving health outcomes and achieving Net Zero.*

Our last report gave high scores to emergency planning and response and medium-to-low scores for other relevant areas.

Box 12.1
Summary from our last report

In 2022, our assessment gave emergency planning and response a high planning score and a medium risk management score. All other relevant priority areas under the SCCAP2 outcome 'our communities are inclusive, empowered, resilient and safe in response to the changing climate' received low risk management and planning scores, including resilience of the population to changes in temperature and recovery from flooding. Beyond these priority areas, we found that Historic Environment Scotland had published a good quality adaptation plan.

Key recommendations for community response were: a review of the funding model for the Scottish Fire and Rescue Service, with a view to providing multi-year funding; and national guidance for local authorities on recovery from flooding (other hazards were not assessed).

Some areas, such as cultural heritage and adaptation planning, are covered in more detail in this assessment than in our 2022 assessment due to updates to our monitoring framework.

Source: CCC (2022) *Is Scotland Climate Ready? 2022 Report to Scottish Parliament.*

There are a range of organisations and actors who may be involved in delivering adaptation in communities and cultural heritage sectors.

Box 12.2
Adaptation Scotland and community adaptation delivery

Multiple organisations are key to the delivery of community level adaptation in Scotland:

- **Adaptation Scotland** is an adaptation programme funded by Scottish Government, delivered by the sustainability charity **Sniffer**. The programme provides advice and support to public sector, businesses and communities to help prepare for and build resilience to climate impacts.
- There are 32 **local authorities** in Scotland, responsible for delivering a range of public services, including roads and transport, housing and planning, and environmental protection.
- **COSLA (Convention of Scottish Local Authorities)** is a councillor-led, cross-party organisation which helps to build capacity in local councils. The **Improvement Service** is the national organisation for local government in Scotland, providing support, research and data.
- **SEPA (Scottish Environment Protection Agency)** is a non-departmental public body with responsibilities as an environmental regulator. They monitor the environment and regulate compliance with environmental responsibilities and deliver Scotland's flood warning system.

* The 'Place Principle' was developed by Scottish Government with partner organisations to promote a shared understanding and develop clear visions of place, helping to achieve better outcomes for people and communities.

- **NatureScot** is the lead public body responsible for advising Scottish Ministers, local government and public, private and voluntary bodies on matters relating to natural heritage.
- **Historic Scotland** is the lead public body established to investigate, care for and promote Scotland's historic environment, leading on Scotland's historic environment strategy.
- The **Scottish Fire and Rescue Service** responds to emergency incidents in the community, including extreme weather events, such as flooding and wildfire.
- Scottish Government has grant-funded the **Scottish Flood Forum** since 2009. The forum supports individuals and communities at risk of flooding, providing immediate support, resilience and awareness raising.

12.1.1 Outcome 1: Communities are prepared for climate shocks

(i) Delivery and implementation progress

There has been good progress in preparing communities, with an increase in adaptation actions and plans.

Indicators for this outcome show **good progress** in planning for adaptation and preparing communities for future climate change in Scotland. Adaptation actions and climate risk feature increasingly in place-based plans and community-led projects, although it is too early to assess the impact of many of these plans and projects.

- **Local authorities in Scotland are required to report on adaptation annually via the public bodies' legal reporting duties and all are taking some action**. In the most recent published reporting in 2021/22, all local authorities had completed some form of risk assessment, with 53% of assessments considered 'limited' and 44% 'comprehensive'.* All authorities reported taking some form of adaptation action; 53% are taking 'good' action and 16% 'advanced' action.[4]

- **It is not yet clear whether local adaptation plans and action are improving preparedness.** Despite a degree of risk assessment, less than half of local council plans (12 out of 32, 38%) consider how to prepare residents for these climate risks. Some plans cover adaptation in specific sectors, with 53% setting out adaptation actions for planning and land use, and 38% for housing, buildings, and infrastructure. Only four of Scotland's plans identified specific vulnerable groups in the community, although six plans featured focused resources for vulnerable groups.[5]

Most local authorities are considering climate risk and adaptation actions.

- **Adaptation Scotland has helped to deliver multiple adaptation partnership projects.** These partnerships have enabled place-based adaptation plans. Since our last report, there has been continued development on projects supported by Adaptation Scotland. For example, Aberdeen Adapts (for which Adaptation Scotland supported the initial development) was refreshed in 2022, aligning it with Net Zero Aberdeen, and Edinburgh Adapts is also in the process of being refreshed. Adaptation Scotland supported the business case development for a major new adaptation initiative (including a climate risk and opportunity assessment) for Edinburgh and the South East Scotland City Region, which has now secured funding. Many projects have included monitoring and evaluation, such as the independent assessment of progress currently being commissioned for the Climate Ready Clyde Glasgow City Region Adaptation Strategy and Action Plan.

* Public body reporting is self-reported. A 'limited' risk assessment focuses on a single climate issue or corporate risk register/business plan. A 'comprehensive' assessment addresses a range of climate hazards or risks. 'Good' adaptation action means the public body lays out actions addressing multiple risks, but these are not target-based. 'Advanced' action means there are comprehensive actions and targets to address risk and measure progress.

There is evidence for increased place-based and community-led actions to prepare for climate risks.

- **The Scottish Government has created tools and networks to support place-based and community-led climate action.** The 'Place Standard with a climate lens' toolkit and resources were launched in September 2022.[6] The Scottish Government also sponsor Architecture and Design Scotland, who are currently working with nine towns to explore place-based actions communities can take to deliver adaptation at the town-scale, through the Climate Action Towns project.[7]

Surveys suggest that public engagement around adaptation to climate change risk is relatively high.

- **Public engagement around adaptation in Scotland is high but has not consistently led to individuals taking action to prepare.** Most respondents to a 2021 survey had personal experience of extreme weather events (86%) and agreed that Scotland needed to adapt to climate change impacts immediately (78%).* Nearly half (49%) recorded discomfort or being unable to sleep because of heatwaves and had been impacted by flooding in the local area (45%). Most (88%) respondents intended to or had already taken some actions to prepare for impacts, with 66% willing to give up some time to help their local community prepare for climate impacts. Over three quarters (78%) were confident that people in the local community would act together if faced with severe events. Scottish Government was seen as most responsible for carrying out action (74%), with individuals (36%) and local communities (7%) ranked lower.[8] However, more recent surveys suggest the Scottish public has become less worried about the impact of climate change; with 63% of people polled in July 2023 worried in the last 12 months, down from 72% recorded in October 2022.[9]

- **There are examples of community engagement projects to enhance nature and green infrastructure.** The Green Infrastructure Community Engagement Fund, led by NatureScot, was designed to fund bespoke community nature projects. The fund was part of the Scottish Government's European Regional Development Fund Programme which runs through to the end of this year. Nine projects have been completed, including citizen wildlife monitoring and creating community rain gardens.[10]

Scotland is covered by flood warnings, with an increased area able to access 'take-action' alerts.

- **More Flood Warning Areas have been established in Scotland but the uptake of warnings is relatively low.** SEPA's flood warnings are messages for community-scale areas, with 'take action' messaging. The service currently serves 326 Flood Warning Areas (up from 269 in 2017), which cover around 76,800 properties.[11,12] Uptake of flood warning messages as of August 2023 was 22,400, around 30% of those covered.† Regional flood alerts cover the whole of Scotland and indicate possible flooding. The number of customers signed up to these Regional Flood Alerts was 24,100.[11] Previous years of data for uptake are not comparable due to data lost during a cyber-attack in December 2020.

* ClimateXChange conducted a survey of 967 adults over 16 in November and December 2021. Data was weighted by factors including age, gender and region to reflect the profile of the population.

† Uptake is measured per customer, so there may be more than one customer associated with each property in the coverage dataset.

(ii) Policy and planning progress

There are **credible policies and plans** in place for ensuring community preparedness to current and future climate change impacts and weather extremes.

There are credible plans for community preparedness, including the Scottish Government funded Adaptation Scotland programme.

- **Scottish Government has continued to fund the Adaptation Scotland programme which supports capacity building and action on adaptation**. The programme has a focus on supporting locally led adaptation. In 2023, the programme published a Community Climate Adaptation Routemap with practical actions for community preparedness.[13] Training on the Routemap has been delivered to leads for the two pathfinder Community Climate Action hubs. Scottish Government has allocated £4.3 million for 2023-2024 to expand the hub network further by around 20 hubs, typically run through community anchor organisations.[14]

Place-based adaptation plans are being delivered through partnership approaches.

- **Place-based adaptation plans for community preparedness are being delivered through long-term multi-sector partnerships.** There are examples of successful long-term partnership working for adaptation in Scotland. These include city-based and regional projects, which involve multiple local authorities, delivery bodies and the private sector – for example, Highlands and Islands Enterprise are a key partner in Highlands Adapts. The mechanisms for enabling partnerships may be different in different places and for different adaptation actions. In some cases, new adaptation-focused partnerships are having a positive impact, while in other cases, adaptation can be delivered through established initiatives, with local partners supported to identify the best options. The Adaptation Scotland programme has worked with local community-led initiatives to codevelop new approaches to involving communities in climate adaptation, such as the community interest company Climate Hebrides, which is piloting community involvement processes in the islands.

Local authorities and public sector bodies are required to report on adaptation and reporting is now analysed.

- **Local authorities are required to report on adaptation through mandatory public sector bodies reporting.** Since 2015, all public bodies and local councils in Scotland are required to report annually on compliance with climate change duties. Analysis of this adaptation reporting has featured in Sustainable Scotland Network's high-level reports since 2020/21.[4]

- **Scottish Government's adaptation programme includes an outcome on addressing vulnerability and climate justice.**[15] As part of the work on this policy area, Scottish Government previously mapped out flood disadvantaged neighbourhoods and created a risk screening tool for NHS boards. Ongoing work must ensure these tools continue to be updated.

- **The National Flood Risk Assessment identifies areas where the greatest overall impact of flooding on communities might be through socio-economic data.**[16] There were 235 'Potentially Vulnerable Areas' (PVAs) identified in 2018 based on flood extents and data on people, economic activity and the environment.[17] SEPA's hazard and risk maps, and local authorities' Local Flood Risk Management Plans must specifically address each PVA.

SEPA has updated plans to improve flood warnings and deliver new services.

- **There has been some recent progress in policy for warning and alerting for flooding.** SEPA has updated the Flood Warning Development Framework, which sets out how they will improve existing and deliver new flood warning services and capabilities, such as the Future Flood and Incident Messaging Service (FFIMS), which will consider multi-hazards.[18]

Scottish Government is also funding Rivertrack, a local flood alert tool for communities, through the CivTech programme.[15] Messages for heat are delivered via the UK Met Office and the Climate Ready Scotland platforms.

- **There is public funding for community empowerment which can support adaptation.** The Empowering Communities Programme includes multi-year communities funding through the Investing in Communities Fund (ICF).[19] Projects approved for 2023-2026 address place-based approaches, community-led regeneration, inequality and just transition, focusing on areas such as food, health and wellbeing and sustainable urban places.

12.1.2 Outcome 2: Communities can respond to climate shocks

(i) Delivery and implementation progress

Indicators show **mixed progress** in delivering actions to improve response to climate shocks in communities, with some increase in response capabilities. Further evidence is required to link responses with impacts and damages from shocks.

- **The annual number of flood warnings and flood alerts issued by SEPA varies depending on weather conditions but is generally increasing**. As of August 2023, the number of warnings was the highest in the past 6 years in 2020; when due to severe storms, 430 flood alerts (early indication of potential flooding for larger areas) and 814 flood warnings (warning that flooding is imminent with immediate action required) were issued.* Improvements in warning coverage and accuracy are likely to have also contributed to an increasing trend, with the average annual number of alerts and warnings increasing by 77% and 50% respectively from 2016-2018 to 2021-2022.[5] A daily Scottish flood forecast was also introduced in May 2022.

Information about flooding and heatwaves has been distributed through alerts and online.

- **In the July 2022 heatwave, information about minimising the impact from extreme heat reached over one fifth of the population.** Ready Scotland provides an online platform for advice and learning on extreme event response and preparedness. A coordinated online and social media information campaign reached over 1.2 million people in southern Scotland in July 2022.[20]

- **The Scottish Fire and Rescue Service (SFRS) has carried out more flood incident actions in the last few years.** The annual number of SFRS advice actions on flooding (which includes flooding from burst pipes in domestic and business premises, as well as weather events) was 525 in 2021/22, up from 411 in 2019/20. The total number of flood incident responses also shows an increasing trend, although fewer evacuation and pumping responses were carried out in 2021/22 than in previous years (Figure 12.1).[21] Data may reflect increased focus on partnership working, possibly resulting in the service responding to more incidents in general.

The Scottish Fire and Rescue Service has increased capabilities to deal with flooding.

- **SFRS has increasing capabilities to deal with extreme weather events**. The number of SFRS fire stations with flood response capability increased from 83 to 91 in 2022/23.[22] Eighteen stations have tactical ability for water pumping for wildfires, down by one since 2020/21. A 2023 report from HM Fire Service Inspectorate concluded SFRS has good capabilities to deal with

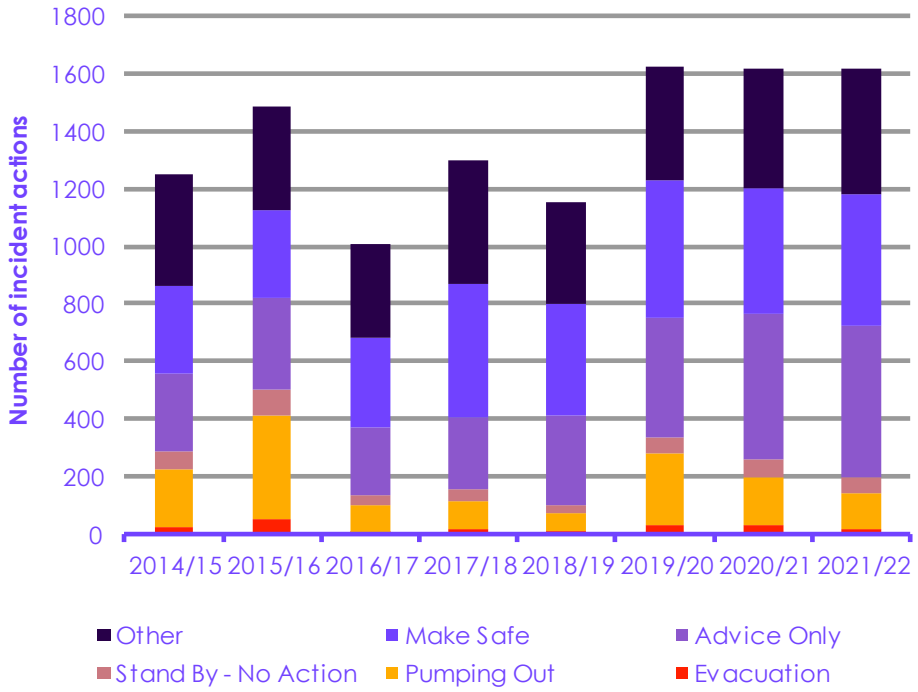
* Since August 2023, there have been several high impact rainfall events in Scotland (see Chapter 1) for which SEPA issued numerous flood warnings.

flooding and a positive strategy for wildfire.[23] The total number of national fire resilience capabilities has increased by 9% since 2019/20, although the number of all SFRS staff has decreased by 1.1% in the last year, with a 4% decline in volunteers.*,[24]

Recommendations were made to Scottish Government after Storm Arwen in 2021 to improve winter readiness.

- **In response to previous storm events, Local Resilience Partnerships have conducted winter readiness exercises.** Storm Arwen, in November 2021, caused widespread disruption to communities, impacting energy and water supply, telecoms, transport and nature. Scottish Government has responded to recommendations made in a review after Storm Arwen. For example, as recommended, all 12 Local Resilience Partnerships in Scotland have since conducted full 'winter readiness' exercises.[25]

Figure 12.1 Number of flooding incident actions carried out by the Scottish Fire and Rescue Service



Source: Scottish Fire and Rescue Service (2023) *Fire and Rescue Incident Statistics 2021-22.*
Notes: Flooding incidents includes surface and groundwater flooding and flooding through other causes, such as: burst pipes in homes and domestic business premises.

* National Fire Resilience Capabilities includes capabilities such as swift water response, high volume pumps and enhanced logistical support.

(ii) Policy and planning progress

Plans to ensure communities can respond to and recover from weather events are credible.

There are **credible policies and plans** in place to ensure communities can respond to and recover from current and future climate and weather events.

- **A set of national guidance documents for planning, responding and recovering from emergencies are published and hosted on the Ready Scotland website**. Preparing Scotland is made up of guidance on key principles and detailed specific advice, including a guidance document for 'Building Resilient Communities'.[26] Ready Scotland publishes advice for local government, communities, individuals and organisations on emergency preparedness and response, including for extreme weather. Alerts are published on the Ready Scotland social media accounts.

- **The Scottish Fire and Rescue Service (SFRS) has a Long-Term Vision for the service for the next 10 years which is delivered through strategic plans**.[27] The Vision considers resilience under future climate conditions and the Strategic Plan for 2022-2025 highlights planning and training for responding to climate change incidents and placing specialist resources in areas at greater flood risk.[28] SFRS are also developing a spatial risk model to inform plans. This provides a response to the Fire and Rescue Framework for Scotland 2022, which set out Scottish Ministers' expectations of SFRS, including a strategic priority for climate change.[29] As recommended by HM Fire Service Inspectorate, SFRS should ensure that plans cover weather-related incident reporting, data capturing and analyses.[23]

The Scottish Fire and Rescue Service has developed long-term, strategic plans which include climate change and a new wildfire strategy.

- **SFRS is implementing a new wildfire strategy.**[30] The new strategy considers the increased risk of wildfire in the context of climate change and the latest technology in monitoring, management and response. SFRS will implement a tiered classification of fire stations to respond to wildfires.

- **Climate change impacts and extreme weather form key aspects of civil contingency planning.** The current Scottish Risk Assessment, developed by Scottish Government, includes assessments themed around major impacts of climate change. This feeds into local risk assessments produced by regional partnerships. In winter 2022, the Scottish Resilience Partnership (high-level cross sector responders) coordinated a 'Winter Preparedness Programme', which has involved winter readiness exercises with local incident responders. As part of the response to the review into Storm Arwen, Local Resilience Partnerships should have developed understanding of radio networks and capabilities for instances where telecoms networks are impacted, although there are no recent updates.

There are some promising plans which would support local authorities to identify and help vulnerable groups.

- **Scottish Government is facilitating a local authority roll-out of software to identify vulnerable individuals in an emergency, but the scheme is yet to be tested**. The Persons at Risk Distribution system is being rolled out across local authorities and NHS Scotland, aiming to help identify vulnerable individuals during an emergency for targeted public communication and checks. Public Health Scotland is also developing an Adverse Weather Health Protection Response Plan, with the aim to improve public health messaging. Scottish Government has committed to reviewing national 'Care for People' guidance, which should help responders roll out measures to check on vulnerable households.

- **SFRS maintains a Community Asset Register (CAR) which can be used in emergencies.** SFRS manages and hosts the CAR, which is a Scotland-wide database map of volunteers and equipment assets (such as boats and

vehicles) for managing risk. SFRS is working on initiatives to develop and expand the register, such as through a digital platform. The 2023 HM Fire Service Inspectorate report found the CAR was under-utilised and recommended that the SFRS should review improving awareness and accessibility of the database.[23]

It is not clear when central government funding might be made available to local authorities in extreme events.

- **Central government funding streams for emergency response and resilient repairs are not clear.** Although there is no duty on councils to supply emergency response equipment such as sandbags, some do, maintaining equipment banks or 'flood pods' for households to access, however there are no clear criteria for when or how much funding might be made available from central government for response and recovery.

12.1.3 Outcome 3: Local cultural heritage is conserved

(i) Delivery and implementation progress

Evidence for this outcome in Scotland is somewhat limited and progress in adaptation in the cultural heritage sector was scored as **mixed progress**.

Available evidence for adaptation in the cultural heritage sector is mixed, despite increased understanding of the risks.

Climate risk to cultural heritage is increasingly understood and well mapped.*,[31] However, while there are some positive trends, more is needed to track and monitor progress to date on addressing risks.

- **Four out of six World Heritage Sites in Scotland have been assessed under the Climate Vulnerability Index (CVI) with most scoring moderate or high for vulnerability assessments**.[32] The CVI is a tool developed to assess climate change vulnerability for all types of World Heritage. The assessment includes interested stakeholders and local communities. Results feed into World Heritage Site and monument management plans and are used to target action and identify knowledge gaps. For example, the CVI for the Old and New Towns of Edinburgh found that there is a need for flood mapping, which is now underway.

Historic Environment Scotland have funding available for projects which include resilience.

- **Historic Environment Scotland (HES) have approximately £14 million available in grants for funding projects and activities, including for mitigation and adaptation**.[33] HES refreshed its grants programme in 2022. Priorities for grants include strengthening the resilience of Scotland's historic environment and using the historic environment as a catalyst for climate action.

- **There is annual climate change reporting from cultural heritage organisations which includes adaptation, although the level of detail on adaptation action is mixed**. Examples of actions for 2021/22 include HES co-designing extreme rainfall impact assessment tools for adaptation for the heritage sector, and the Royal Botanic Gardens increasing drainage in areas prone to flooding.[34,35]

There are over 100 coastal archaeology sites at risk from climate change.

- **A recent project by National Trust Scotland (NTS), 'Archaeology on the Edge' is identifying coastal sites that are most at risk from climate change**.[36] The initial phase revealed more than 116 of such sites across Scotland, all

* For example, the UK Heritage Adaptation Network programme seeks to address climate change challenges by bringing together UK heritage agencies, the national heritage collections and the National Trusts. The first output of the group was the development of a climate hazard map.

within 50 m of the coast, lakes or riverbanks.[37] Using a range of modelling tools, NTS have created a shortlist of properties identified as being particularly vulnerable to coastal erosion, flood, landslide and sea level rise.[35] The collection of this data will be used to help put in place strategies to respond to the climate emergency at these sites.

- **NTS is exploring ways to adapt to climate change through condition surveys and future proofing new builds.**[35] They are undertaking external condition surveys of the more than 1,500 structures in their care (including castles, historic houses, bridges, monuments, ice houses, gates, and sculptures).

(ii) Policy and planning progress

Climate resilience has been embedded in the new historic environment strategy.

There are **partial policies and plans** in place to conserve local cultural heritage in Scotland with reference to climate change. Since March 2022:

- **A collaborative strategy for the historic environment in Scotland was launched in April 2023.**[38] 'Delivering the transition to Net Zero' is one of the three priorities of the strategy over the next five years, including a specific outcome that the historic environment is more climate resilient. Actions include providing advice, support and guidance and ensuring heritage grant programmes can fund adaptation measures.

Historic Environment Policy guidance is being reviewed with reference to climate change.

- **HES is reviewing Historic Environment Policy for Scotland (HEPS) guidance, including looking at themes arising from National Planning Framework 4 and other updated policy areas such as forestry and agriculture.**[15,39] The review will identify areas where management of the historic environment will support and enable positive action to tackle the twin nature and climate crises.

- **Creative Scotland published a climate emergency and sustainability plan in 2022.**[40] The plan includes actions to develop carbon budgets and better understand and support adaptation capabilities. In 2023, Creative Scotland updated their funding requirements so that environmental sustainability is a strategic priority of their funding programmes.

Buildings guidance for historic buildings include consideration of climate change.

- **Current building standards apply to traditional and historic buildings and include resilience.** There are also several guidance documents on making improvements specifically to these types of buildings. These include for climate change adaptation, energy efficiency and flood damage.[41,42,43,44,45]

12.1.4 Progress on enablers

Some enablers to deliver well-adapted communities are in place.

Scottish Government has increased public funding for community networks, including via the Scottish Flood Forum.

- **The Scottish Government has increased funding to local authorities and organisations to raise community awareness.** This includes funding awarded to the Scottish Flood Forum (see Chapters 9 and 10) and grant funding to organisations such as the Conservation Volunteers Scotland for citizen science projects.

- **Community Risk Registers are in place across the whole of Scotland, split into north, east and west regions.** These set out risks and preparedness action measures taken in the area for severe weather and flooding, based on risk assessments carried out by multiple agencies.

12.2 Recommendations

Table 12.2
Recommendations

Primary responsibility	Recommendation	Timing
Energy and Climate Change Directorate	Scottish Government should continue to support the implementation and evaluation of the Adaptation Scotland programme, upscaling the delivery of initiatives for place-based and cross-sectoral adaptation and including support for vulnerable areas and sectors.	Ongoing
Safer Communities Directorate	Scottish Government should review the funding model for the Scottish Fire and Rescue Service and other major incident responders to provide multi-year funding for long-term planning, including monitoring of weather-related incident response.	2024
Local Government and Housing Directorate	Scottish Government should provide clear criteria for when central government funding will be made available to local authorities after severe weather events and include emergency funding for resilient repairs.	2024
Safer Communities Directorate; Performance, Resilience and Delivery Directorate	Scottish Government should evaluate measures rolled-out in response to the Storm Arwen review, including the impact of Ready Scot alerts and the winter preparedness programme, and roll-out of collection of vulnerability data.	2024
Historic Environment Scotland and National Trust Scotland	Address data gaps on adapting heritage assets to climate change. For example, by monitoring grant money used for adaptation and tracking how many at risk sites or buildings have been adapted for climate change.	Ongoing

Endnotes

[1] CCC (2022) *Is Scotland climate ready? 2022 Report to Scottish Parliament,* https://www.theccc.org.uk/publication/is-scotland-climate-ready-2022-report-to-scottish-parliament/.

[2] Scottish Parliament (2004) *The Civil Contingencies Act 2004 (Contingency Planning) (Scotland) 2005,* https://www.legislation.gov.uk/ssi/2005/494/contents/made.

[3] Scottish Parliament (2014) *Historic Environment Scotland Act 2014,* https://www.legislation.gov.uk/asp/2014/19/contents/enacted.

[4] Sustainable Scotland Network (2022) *Public Bodies Climate Change Reporting 2021/22,* https://sustainablescotlandnetwork.org/uploads/store/mediaupload/2141/file/SSN_AnalysisReport_21-22.pdf.

[5] Climate Emergency UK (2021) *Climate Emergency Scorecards,* https://councilclimatescorecards.uk/?.

[6] Scottish Government (2022) *Place Standard with a Climate Lens,* https://www.ourplace.scot/Place-Standard-Climate.

[7] Architecture & Design Scotland (2023) *Climate Action Towns,* https://www.ads.org.uk/resource/climate-action-towns.

[8] Millar et al. (2022) *Public awareness of climate risks and opportunities in Scotland,* ClimateXChange. https://www.climatexchange.org.uk/media/5213/cxc-public-awareness-

[9] Office of National Statistics (2023) *Climate change insights, families and households, UK: worries about climate change and changes to lifestyle to help tackle it, Great Britain, 14 June to 9 July 2023*, https://www.ons.gov.uk/economy/environmentalaccounts/datasets/.

[10] NatureScot (2023) *Green Infrastructure Community Engagement Fund,* https://www.nature.scot/sites/default/files/2023-01/GI.

[11] SEPA (2023) *Floodline data provided by SEPA for CCC analysis.*

[12] SEPA (2017) *Flood Warning Development Framework 2017-2021,* https://www.sepa.org.uk/media/219818/sepa-flood-warning-development-framework.

[13] Adaptation Scotland (2023) *Community Climate Adaptation Routemap,* https://adaptationscotland.org.uk/how-adapt/tools-and-resources/community-climate-adaptation-routemap.

[14] Scottish Government (2023) *Climate action hubs,* https://www.gov.scot/climate-action-hubs/.

[15] Scottish Government (2023) *Scottish climate change adaptation programme: Progress Report 2023,* www.gov.scot/publications/scottish-climate-change-adaptation-programme-progress-report-2023/.

[16] SEPA (2018) *National Flood Risk Assessment Data,* sepa.org.uk/data-visualisation/nfra2018/.

[17] SEPA (2018) *2018 Publication of NFRA and PVAs FAQ's,* https://www.sepa.org.uk/media/399172/nfra-faq.pdf.

[18] SEPA (2022) *Flood Warning Development Framework,* https://www.sepa.org.uk/media/594489/sepa-flood-warning-dev-framework-2022-28.pdf.

[19] Scottish Government (2023) *Empowering Communities Programme,* https://www.gov.scot/policies/community-empowerment/empowering-communities-fund/.

[20] Cabinet Secretary for Transport, Net Zero and Just Transition (2023) *Climate adaptation: letter to UK Climate Change Committee. Interim Policy Package*, https://www.gov.scot/publications/climate-adaptation-letter-to-uk-climate-change-committee/.

[21] Scottish Fire and Rescue Service (2023) *Fire and Rescue Incident Statistics 2021-22, Table INF_RTC1,* https://www.firescotland.gov.uk/publications/document/?id=445.

[22] Scottish Fire and Rescue Service (2023) *Fire Safety and Organisational Statistics 2022-23,* https://www.firescotland.gov.uk/publications/document/?id=431.

[23] HM Fire Service Inspectorate Scotland (2023) *Climate change: managing the operational impact on fires and other weather-related emergencies,* https://www.hmfsi.scot/media/x1zisyju/climate-change-managing-the-operational-impact.

[24] Scottish Fire and Rescue Service (2023) *Fire Safety and Organisational Statistics 2022-23. Table WF_STH1,* https://www.firescotland.gov.uk/about-us/who-we-are/statistics/.

[25] Scottish Government (2022) *Storm Arwen review recommendations update: October 2022,* https://www.gov.scot/publications/storm-arwen-review-recommendations-update-october-2022/pages/progress-update/.

[26] Scottish Government (2023) *Ready Scotland: Preparing Scotland Guidance,* https://ready.scot/how-scotland-prepares/preparing-scotland-guidance.

[27] Scottish Fire and Rescue Service (2021) *Long Term Vision,* https://www.firescotland.gov.uk/publications/document/?id=513.

[28] Scottish Fire and Rescue Service (2022) *Strategic Plan 2022-2025,* https://www.firescotland.gov.uk/publications/document/?id=655.

[29] Scottish Government (2022) *Fire and rescue framework for Scotland 2022,* https://www.gov.scot/publications/fire-rescue-framework-scotland-2022/.

[30] Scottish Fire and Rescue Service (2023) *Wildfire Strategy Update,* https://www.firescotland.gov.uk/publications/document/?id=688.

[31] National Trust (2023) *Hazard Mapping Tool*, https://national-trust.maps.arcgis.com/apps/webappviewer/index.html?id=a44672bb34c4491a909034d0eed76583

[32] Historic Environment Scotland (2023) *Scotland's world heritage and climate change,* www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=d1038cc9-27b7-4be0-9003-afe800ddb6f2.

[33] Historic Environment Scotland (2023) *Historic Environment Scotland Written Submission to Inquiry into Budget Scrutiny 2023-2024,* www.parliament.scot/-/media/files/committees/constitution-europe-external-affairs-and-culture-committee/7-hes.pdf.

[34] Royall Botanic Garden Edinburgh (2022) *The Royal Botanic Garden Edinburgh Climate Change Report 2021-22,* www.sustainablescotlandnetwork.org/reports/the-royal-botanic-garden-edinburgh.

[35] Historic Environment Scotland (2022) *Historic Environment Scotland Climate Change Report 2021-22,* www.sustainablescotlandnetwork.org/reports/historic-environment-scotland.

[36] National Trust Scotland (2022) *Evolving in the era of climate change,* www.nts.org.uk/stories/evolving-in-the-era-of-climate-change.

[37] National Trust Scotland (2023) *Data provided for CCC analysis.*

[38] Historic Environment Scotland (2023) *Our Past, Our Future,* www.historicenvironment.scot/our-past-our-future/.

[39] HES (2022) *Managing Change in the Historic Environment,* www.historicenvironment.scot/advice-and-support/planning-and-guidance/legislation-and-guidance/managing-change-in-the-historic-environment-guidance-notes/.

[40] Creative Scotland (2022) *Climate Emergency and Sustainability Plan,* www.creativescotland.com/__data/assets/pdf_file/0003/90444/Climate-Emergency-and-Sustainability-Plan.pdf.

[41] Historic Environment Scotland (2021) *Guide to Energy Retrofit of Traditional Buildings,* www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=47c9f2eb-1ade-4a76-a775-add0008972f3.

[42] Historic Environment Scotland (2022) *Technical Paper 36; Architecture and Health in Traditional Buildings,* www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=d24bfc38-efcf-4b95-848d-ae8500873eb7

[43] Historic Environment Scotland (2017) *Short Guide: Climate Change Adaptation for Traditional Buildings,* www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=a0138f5b-c173-4e09-818f-a7ac00ad04fb

[44] Historic Environment Scotland (2013) *Short Guide: Fabric Improvements for Energy Efficiency;* www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=179c1909-3679-4486-9583-a59100fa98c1

[45] Historic Environment Scotland (2014) *Inform Guide: Flood Damage to Traditional Buildings,* www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=13349883-20bf-48ec-afd9-a59500e9a44e.

Chapter 13: Business

Table 13.1
Progress summary - Business

	Delivery and implementation	Policies and plans	Summary
Outcome 1: Public and private adaptation measures are implemented to minimise risks to business sites	Unable to evaluate	Limited policies and plans	• There is limited time series data on the share of Scottish businesses assessing and adapting to climate risks, and a lack of data on impacts to business assets from extreme weather events. • Guidance and information are available for businesses to prepare for flooding, however there is no water reduction target.
Outcome 2: Businesses have access to insurance and capital including for adaptation	Unable to evaluate	Limited policies and plans	• There are no Scotland specific assessments of insurance challenges for businesses or availability of capital for adaptation. • There are limited policies to lever adaptation finance. The Scottish Government has not integrated incentives for businesses to implement adaptation measures into its economic development or Net Zero strategies.
Outcome 3: Productivity losses due to physical climate risks are minimised	Unable to evaluate	Partial policies and plans	• There are no data on the labour productivity impacts on Scottish businesses from climate hazards. • Guidance is available for businesses on protecting workers from the impacts of extreme weather but the level of uptake is unknown.
Outcome 4: Supply chain risks are identified and managed	Unable to evaluate	Partial policies and plans	• There is a lack of data on the exposure of Scotland's major supply chains to climate risks. The creation of a Food Security Unit can improve monitoring of climate risks. • Some progress had been made in integrating supply chain risks into public procurement guidance.
Outcome 5: Risks and actions are disclosed and managed by businesses	Mixed progress	Limited policies and plans	• Disclosure coverage is growing but gaps exist on reporting adaptation action and risk management. • UK-wide reporting schemes are driving climate-risk reporting, however there is room to improve the quality of adaptation disclosures.

Relevant risks from CCRA3: B1 Risks to business from flooding; B2 Risks to businesses and infrastructure from coastal change; B3 Risks to businesses from water scarcity; B5 Risks to business from reduced employee productivity due to infrastructure disruption and higher temperatures in working environments; B6 Risks to business from disruption to supply chains and distribution networks; B7 Opportunities for business from changes in demand for goods and services.

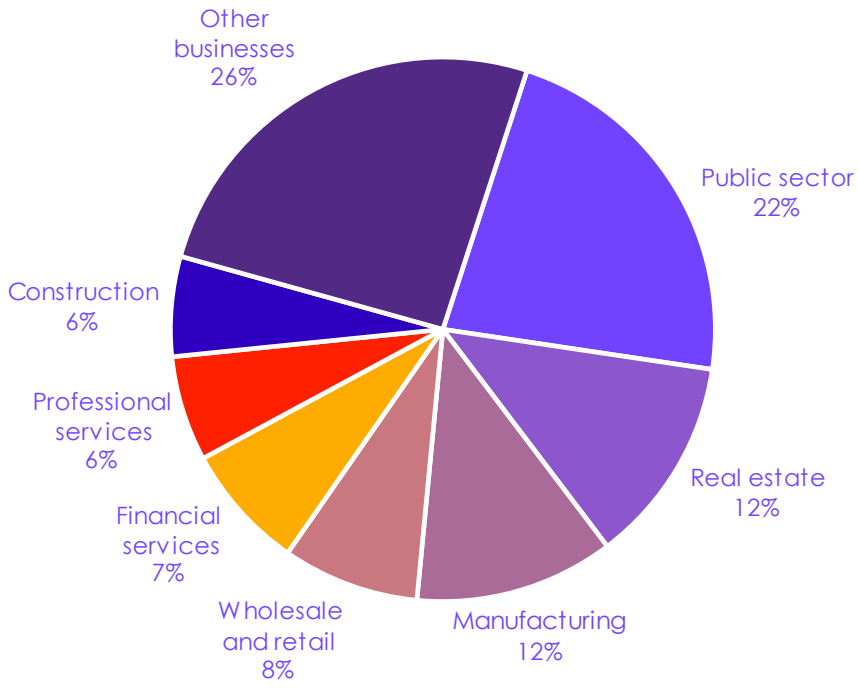
This chapter covers adaptation to climate change by businesses in Scotland and the role of the Scottish Government in supporting businesses to adapt. Scottish businesses are already impacted by climate change; business activities can be disrupted by flooding, storms and coastal erosion, and are at risk from reduced

water availability and higher temperatures in working environments. Businesses are also exposed to infrastructure failure as a result of extreme weather, and supply chain disruptions both domestically and abroad. Some business sectors will also have opportunities resulting from climate change, for example, the availability of new forms of agricultural production for farmers and business opportunities in the construction industry to maintain and retrofit infrastructure and buildings.

The largest business sectors in Scotland are real estate, manufacturing and retail.

The business sectors with the largest contributions to Scotland's economy are real estate (12%), manufacturing (12%), retail (8%) and financial services (7%) (Figure 13.1).[1] A number of key business sectors are covered elsewhere in this report, including agriculture, forestry and fishing (Box 13.1). Small and Medium Enterprises (SMEs) account for 53% of turnover in Scotland, a slightly larger share than in England.[2]

Figure 13.1 Business sector contribution to GVA in Scotland, 2021



Source: ONS (2023) *Regional Gross Value Added (balanced) by Industry*
Notes: 'Other businesses' include administration and support services, information and communication services, accommodation and food services, arts, entertainment and recreation services and mining and quarrying. Public sector includes health and social work, public administration and education services.

Box 13.1
Interactions with other sectors

Key interactions between business adaptation and other chapters of this report include:

- **Nature and working lands and seas** (Chapters 1 and 2): Changes in the natural environment impact natural capital and economic output in the agriculture, forestry and fisheries sectors (which currently account for 2% of GVA in Scotland).
- **Infrastructure** (Chapters 5 - 8): Most business functions depend on reliable infrastructure, with disruptions posing a key risk for site operations, access to markets, supply chain and distribution networks, and employee productivity.

- **Buildings** (Chapter 10): Overheating of buildings poses risks to employee well-being and productivity. The state of the built environment and adaptation responses depend on business action, including investment and construction procedures.
- **Finance** (Chapter 14): Global exposure of the UK financial sector to climate risks around the world.

Relevant policy in this area is largely devolved, including economic development policy and the environmental regulation of businesses in Scotland. However, macro-economic policy and climate-related reporting and disclosure schemes for large businesses and financial institutions are controlled by the UK Government. The Scottish Government's strategy for preparing businesses for climate change is largely detailed in the Economy chapter of the Second Scottish Climate Change Adaptation Programme.[3]

13.1.1 Outcome 1: Public and private adaptation measures are implemented to minimise risks to business sites

Physical climate impacts, such as extreme weather events, pose a risk to business sites and operations. In Scotland, the costliest physical hazard to businesses is flooding.[4] Coastal change and water scarcity also pose a risk to some businesses. Adaptation to these will require actions from business themselves supported by effective guidance and wider public-led adaptation of infrastructure and the built environment.

(i) Delivery and implementation progress

More businesses are assessing climate risks in Scotland than the rest of the UK, but overall the share of businesses taking action is low.

Key gaps in available data make this outcome **unable to evaluate.** There is a lack of recent time-series data on climate risks and damages to business assets.

- **A higher share of surveyed businesses in Scotland have assessed flood and coastal erosion risk compared to the rest of the UK, however overall, the share of businesses assessing climate risks and taking action is low**. In 2023 the Office for National Statistics' Business Insights and Conditions Survey (BICS) collected data on the number of businesses assessing and responding to climate risks. 7% of surveyed Scottish businesses have assessed their flood risk, 2% have assessed the risk of coastal erosion, and 3% have assessed the risk of water scarcity, with similar numbers reporting to have taken actions to adapt (Table 13.2).[5] Over half of businesses have not assessed risks for any of the specified climate impacts.

- **Non-household water consumption is declining, however reductions in water abstracted from freshwater sources by industry have stalled**. There have been consistent reductions in water delivered to businesses by Scottish Water, with a 7% reduction from 2020-2021 (Figure 13.2).[6] There is a lack of evidence to show whether this is a result of improved efficiency measures, with business shutdowns over COVID-19 likely a contributing factor to the 2020 reductions. Consumptive abstractions from freshwater sources peaked in 2011, followed by a downward trend until 2015, with a small increase from 2016-2018. Abstraction data for 2019-2022 is not available.

- **A significant number of commercial buildings in Scotland are at risk of flooding and risks are expected to increase with climate change**.[7] Scotland's 2018 National Flood Risk Assessment (NFRA) showed 10,000 commercial buildings in Scotland face a high level of flood risk (4%), and 30,000 face a medium level of risk (13%), with estimated annual damages at from flooding £114 million.[8] However, more recent assessments of flood risk are not available, with the next assessment due in 2024, making it challenging to assess the effectiveness of flood risk adaptation measures.[3]

There is limited data to assess the impacts of climate hazards on Scottish businesses and therefore understand the effectiveness of adaptation measures.

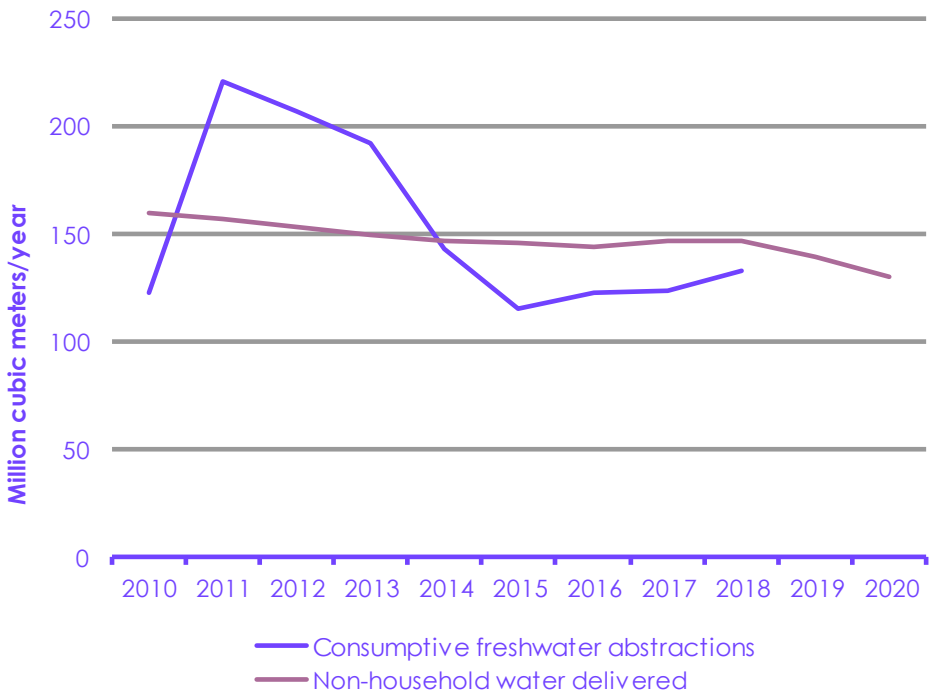
- **There is a lack of data to track annual financial damage to business sites from climate hazards such as flooding.** Alongside up to date flood risk assessments, annual assessments of damage to commercial buildings from flooding events would enable better monitoring of the effectiveness of business adaptation.

Table 13.2
Scottish and UK businesses climate risks and taking action to adapt

	Share of businesses assessing climate risks		Share of businesses taking action to adapt	
	Scotland	UK	Scotland	UK
Coastal erosion	1.8%	<1%*	1.3%	<1%*
Increased flooding	7.2%	5.3%	8.0%	7.8%
Supply chain disruption and distribution	15.3%	13.8%	22.1%	21.4%
Temperature increases	5.6%	6.3%	7.1%	10.9%
Water scarcity	3.1%	3.1%	4.0%	4.9%
Not sure	27.5%	20.9%	55.4%	47.3%
None of the above	52.5%	59.8%	14.7%	18.8%

Source: ONS (2023) *Business insights and impact on the UK economy, Wave 88 August 2023.*
Notes: <1%* indicates data that the ONS has removed for confidentiality reasons, representing an unspecific percentage of less than 1% or a response rate of less than 10.

Figure 13.2 Total water delivered to non-household users and consumptive freshwater abstractions for industry



Source: Water Industry Commission for Scotland (2022) *Scottish Water's Annual Returns*, SEPA; CCC analysis.
Notes: Sources of consumptive freshwater abstractions include agriculture, industrial processes, mining and quarrying and non-agricultural irrigation. Abstractions for hydropower and fish farming are classed as non-consumptive and have been removed. Annual rates of non-household water delivered have been calculated by multiplying the daily rate by 365. Data for non-household water delivered represent a financial year and the chart uses the first year of the financial year.

(ii) Policy and planning progress

The policy score for this outcome is **limited.** Guidance and information are available for businesses to prepare for flooding, however there is no water reduction target in place for businesses.

- **Flood risk management policy offers some protection to commercial buildings in Scotland.** The second cycle of Local Flood Risk Management Plans detail local government's approach to managing flood risk which covers commercial buildings, however there have been some gaps in ensuring local delivery (see the Towns and Cities chapter for further details). Smaller businesses may require additional financial support to adapt and ensure that they can access insurance in the future as the risk of flooding is projected to increase with climate change.

Guidance on how to prepare for flooding is available for businesses, but the level of business engagement with these resources is unknown.

- **Guidance and information are available for businesses to prepare for flooding.** SEPA has introduced a daily flood forecast tool alongside its existing Floodline alert warning system, which can be used by businesses and the public to monitor the likelihood of flooding over the next three days. The Floodline website also provides advice for businesses on actions to take in the event of a flood, however the extent to which at risk businesses are engaging with and utilising these resources is not clear.

- **There is currently no water reduction target in place for businesses.** The National Planning Framework 4 includes a policy outcome for the efficient and sustainable use of water, however the focus of policy for this outcome is on flood risk rather than improving the efficiency of water use.[9]

13.1.2 Outcome 2: Businesses have access to capital and insurance including for adaptation

(i) Delivery and implementation progress

The delivery and implementation of this outcome is **unable to evaluate**.

There is a lack of Scotland specific data on adaptation finance gaps or access to insurance.

- **There is a lack of Scotland specific analysis of adaptation finance flows and investment gaps.** Tracking the availability of adaptation finance is challenging as adaptation is rarely financed through distinct flows of finance. UK wide analysis shows that investment needs for adaptation are increasing and an additional £10 billion worth of investment may be needed a year to address climate change risks across the economy.[10]

- **There is limited data on the extent to which businesses have access to the necessary capital for adaptation, however recent survey data suggests that costs are not the primary barrier**. Only 6% of surveyed Scottish businesses identified costs as a factor preventing them from taking action to mitigate climate risks.[11] A further 7% cited a lack of information or guidance, whilst over half of businesses were unsure of the barriers preventing them from taking action. More evidence is needed to better understand the extent to which businesses can access the necessary capital for effective adaptation.

- **There is no publicly available data on insurance coverage and premiums for businesses relating to climate risks**. This means it is not possible to assess the extent to which climate hazards are impacting businesses' ability to access insurance in Scotland.

(ii) Policy and planning progress

There are **limited policies and plans** for this outcome.

There are limited policies to lever adaptation finance for businesses in Scotland.

- **The vast majority of policies to lever finance for climate change target mitigation rather than adaptation; it is not clear if this is due to an informed assessment that access to finance for adaptation is currently sufficient**. The Second Scottish Climate Change Adaptation Programme (2019-24) lacks specific policies to help businesses access finance for adaptation, and adaptation finance has not been included in Scotland's major economic development strategies.[3,12] Some projects with adaptation benefits can be funded through public funding of nature restoration, for example the Facility for Investment Ready Nature in Scotland (FIRNS) fund, through which £1.8 million is available for nature restoration projects.[13] However, there is a need for a better assessment of the gaps in access to capital and insurance for businesses, and the development of appropriate incentives where necessary, for example to ensure continued affordable access to flood insurance for small businesses.

- **Adaptation Scotland convened a Climate Finance Working Group in 2021 to develop guidance for businesses on accessing adaptation finance.**[14] Case studies and information on developing adaptation business cases are available on their website, which identify the need for a diverse use of finance instruments due to the context specific nature of adaptation and highlight a number of challenges businesses face in delivering additional revenue streams for adaptation.

- **Some funding for adaptation projects is available through regional development funds.** For example, the Glasgow Business Growth Programme has £1.9 million available for SMEs for a range of business growth activities, including climate resilience and adaptation as one category.[15]

13.1.3 Outcome 3: Productivity losses due to physical climate risks are minimised

Climate change impacts, such as extreme heat or weather-related travel disruption, can make it difficult for employees to conduct their roles. Without adaptation measures, there is a risk of resulting labour productivity losses, ultimately impacting on business output and profitability.

(i) Delivery and implementation progress

This outcome is **unable to evaluate.** There is limited regional analysis of the impacts of extreme heat on labour productivity and no assessments of the labour productivity impacts from infrastructure disruption during extreme weather events.

There is limited evidence on the labour productivity risks to businesses from infrastructure disruption or extreme heat.

- **There is a lack of monitoring of the labour productivity risks to businesses from infrastructure disruption caused by extreme weather**. CCRA3 found the risks to employee productivity as a result of extreme heat or infrastructure disruption in Scotland as in need of further investigation.[8] No data was available on the labour productivity impacts of disruption caused by extreme weather events including flooding and windstorms. However, Adaptation Scotland found that in 2021, only 17% of trade union representatives felt their workplace was significantly resilient to weather related risks.[16]

- **There is limited evidence on the labour productivity impacts of extreme heat, but regional assessment suggests it may not be a priority risk**. National data on overheating of non-residential buildings is not available. Highland Adapts have undertaken a regional assessment of the impacts of extreme heat on labour productivity in the Highland region. Their assessment estimates negligible impacts with effective adaptation, and impacts of £120,000 per year by the 2050s without adaptation measures (less than 0.001% of regional GVA), without factoring in potential productivity benefits from reduced low winter temperatures.[17] This suggests that extreme heat is not a priority risk to labour productivity in the region.

(ii) Policy and planning progress

There are **partial policies and plans** in place to ensure productivity losses due to physical climate risks are minimised. A range of guidance is available for businesses, but the level of uptake and engagement is unknown, and wider policy to ensure the resilience of infrastructure and commercial buildings is mixed.

Guidance for businesses on how to protect employees from the impacts of extreme weather is available, however the level of uptake is unknown.

- **In 2018 the Scottish Government published a Fair Work Charter for Severe Weather, providing guiding principles for businesses to manage impacts of severe weather on workers.**[18] The Charter recommends all employers have a Severe Weather Policy which details the range of actions it will take to consider worker safety during severe weather events. However, the extent to which businesses have taken up government guidance is unknown.

- **Adaptation Scotland provide guidance and resources created alongside trade unions to identify climate hazards and solutions in different types of workplaces.**[16] This includes guidance on protecting workers from extreme heat and flooding, which is currently being updated to target SMEs. Guidance for businesses on managing extreme temperatures is also provided at a UK level by the Health and Safety Executive (HSE).[19] However, there are no laws defining maximum work premise temperatures.

- **There are no regulations in place to prevent the overheating of commercial buildings.** Updated building regulations to address overheating risk only apply to residential buildings (see Chapter 10, buildings for further details).

13.1.4 Outcome 4: Supply chain risks are identified and managed

Scottish businesses rely on well-functioning supply chains, both domestically and internationally, to deliver goods and services, including for adaptation actions. There are many risks to supply chains from climate change. These include transport disruption and loss of production overseas. Transport disruption may be particularly significant in Scotland due to dependence on a limited number of transport hubs.

(i) Delivery and implementation progress

This outcome is **unable to evaluate** due to a lack of data on exposure of major supply chains to climate risks.

Assessments of the exposure of Scotland key supply chains to climate risks are not available.

- **There is limited understanding of the resilience of Scotland's major supply chains to climate risks.** Scotland's largest imports are gas from Norway and the United States, and machinery and equipment from China, the United Stated, and Poland. [20] Its largest food imports come from Ireland, the Netherlands and France. Whilst evidence is available on the exposure of these regions and sectors to climate change, there are limited assessments of the implications of these climate risks in these regions to the overall resilience of Scotland's supply chains. A significant number of Scottish businesses have recently reported supply chain difficulties, however there is limited evidence on climate risks to supply chains specifically.[21,15]

- **15% of surveyed Scottish businesses have reported assessing climate related supply chain risks to their businesses and 22% report taking action to adapt to the effects of supply chain disruption (Table 13.2).**[5] This is slightly higher than the UK average, however it is not yet clear if this is an increasing trend. Without better data on the extent of Scottish business supply chain exposure to climate hazards, it is difficult to assess whether businesses with at risk supply chains are taking appropriate action to adapt.

(ii) Policy and planning progress

There are **partial policies and plans** in place for this outcome.

- **Scotland Economy and Fair Work Committee held an inquiry in 2022 exploring how Scotland's supply chains can be developed.**[22] The inquiry mentions the significant threats to supply chains from extreme weather events. Their report notes the absence of focus on resilience of supply chains to climate hazards in the current Supply Chain Development Programme, and recommended the Scottish Government establish a process to engage businesses and enterprise agencies to develop contingency planning to improve supply chain resilience.

Updated public procurement guidance integrates supply chain risks from climate change.

- **Updated public procurement guidance for taking account of climate and circular economy considerations (SPPN 3/2022) now includes specific guidance for considering climate change adaptation and supply chain risks in public contracts.**[23] The new guidance enables procurers to require contractors to detail whether they have assessed supply chain risks and undertaken any actions to mitigate them.

- **A new Food Security Unit within the Scottish Government was recently announced to monitor and address food system resilience, including against climate related risks**.[24] Increased evidence is needed to assess the climate risks to Scotland's food imports. Food supply chains are covered in more detail in Chapter 4.

13.1.5 Outcome 5: Risks and actions are disclosed and managed by businesses

Businesses need to undertake robust climate risk assessments to identify the necessary adaptation actions they will have to take. Government should coordinate with businesses to create a transparent information disclosure regime, which can in turn deliver benefits for those businesses that are taking effective action.

(i) Delivery and implementation progress

Indicators for this outcome demonstrate **mixed progress**.

- **Monitoring and disclosure of climate-risks by large businesses in Scotland is being stimulated by UK-wide reporting schemes, but disclosures on risk management and adaptation actions remain low.** 11% of surveyed Scottish businesses report that they are monitoring physical climate related risks (Figure 13.3).[25] This figure has increased since 2022, which may be linked to the growth of UK-wide reporting schemes. Data from TCFD show that large businesses are monitoring the actual and potential impacts of climate risks, but only a minority disclose how these risks will be addressed.

There is a lack of evidence on the management of risks by SMEs, which account for over half of turnover in Scotland.

- **There is little consolidated information available to assess the management of climate risks by SMEs.** SMEs are not in scope for the mandatory disclosure schemes, which would require significant and potentially impractical resource demands on SMEs to comply with. However, as a result there is limited data on the extent to which SMEs, which account for over half of total turnover in Scotland, are monitoring and managing climate risk.

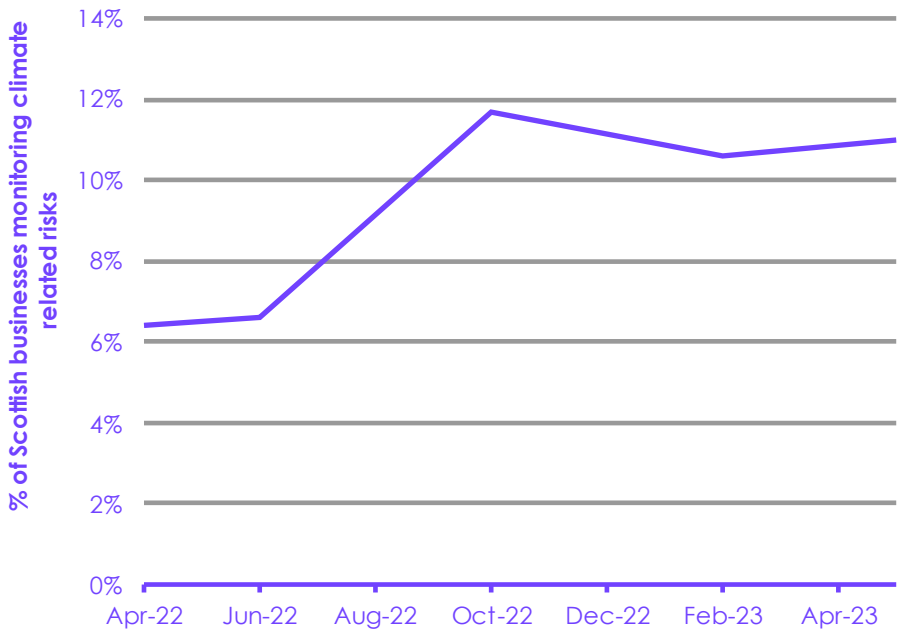
- **Some Scottish businesses are disclosing their climate risks and progress towards adaptation under the Adaptation Reporting Power (ARP).** However, the robustness of assessment of climate risks and the comprehensiveness of adaptation measures presented vary in quality (Table 13.3). For example, Glasgow Airport has provided a thorough risk assessment and comprehensive programme of measures to address climate risks. Other ARP disclosures have not looked at different timeframes or warming scenarios in their risk assessments, have lacked time frames and senior oversight for adaptation actions, or have unclear approaches to monitoring and evaluation.

Table 13.3
High-level summary of quality of Adaptation Reporting Power Third Round responses by businesses in Scotland

	Robust assessment of current and future risks to the organisation?	Comprehensive programme of measures presented, both current and future?
Glasgow Airport	Yes	Yes
SGN	Partial	Partial
Scottish Power Energy Networks	Yes	No
Scottish and Southern Electricity Networks (SSEN)	No	No

Source: CCC (2022) *Understanding climate risks to UK infrastructure: Evaluation of the third round of the Adaptation Reporting Power.*

Figure 13.3 Share of Scottish businesses monitoring climate related risks



Source: ONS (2022-2023) *Business insights and impact on the UK economy.*

(ii) Policy and planning progress

There are **limited policies and plans** in place for this outcome.

Large businesses are now required to disclosure climate risks under the new Sustainability Disclosure Regulation, but the quality of disclosures on adaptation could be improved.

- **The largest businesses in Scotland are now required to disclose climate risks as part of the UK's Sustainability Disclosure Requirements.** The regulations apply to the 245 Scottish businesses with over 500 employees, which accounts for 39% of total turnover.[5] Assessments of the quality of disclosures under TCFD suggest that further work is needed to improve disclosures on risk management and adaptation actions.[26] A full review of the regulations at the UK level can be found in the March 2023 Progress Report on adaptation to climate change in England.[27]

- **The Scottish Investment Bank is developing its own risk reporting framework for businesses across its investment portfolio.** The framework will require businesses funded by the bank to assess climate risks based on risks to businesses identified in CCRA3.

- **A number of UK wide policy developments are increasing the focus on adaptation in reporting frameworks.** The second phase of work under the Transition Plan Taskforce will look into how climate adaptation can be incorporated into transition plans for large businesses. Similarly, development of the UK Green Taxonomy provides an opportunity to integrate adaptation considerations.

13.1.6 Progress on enablers

Key enablers to deliver a well-adapted business sector are:

- **Engagement and education:** Adaptation Scotland provide a range of educational tools and resources for businesses on climate adaptation.[28] They are currently developing a business support tool with the University of Edinburgh to help SMEs understand their climate risks and the actions they can take to address them. The tool uses simplified data inputs from SMEs to generate an 'archetype' of their climate risk profile. SEPA also provide some other resources for climate risk monitoring, for example a tool to monitor drought risk.[29]

Improving the availability of data relating to business adaptation actions and effectiveness is a key enabler.

- **Data and monitoring:** Several outcomes for this chapter have been classified 'unable to evaluate' due to a lack of data, particularly on delivery and implementation. New questions in the ONS BICS survey will enable better tracking of key adaptation actions by businesses. However, significant data gaps remain to understand the effectiveness of business adaptation. Data gaps identified in this chapter include:

  - Financial damage to business sites from flooding
  - Updated data on flood risk to commercial buildings
  - Data on adaptation investment gaps
  - Data on businesses' access to insurance
  - Assessments of labour productivity impacts from extreme weather events
  - Monitoring of exposure of key supply chains to climate risks

– Monitoring uptake and engagement with government policies and resources.

13.2 Recommendations

Table 13.4
Recommendations

Primary responsibility	Recommendation	Timing
Economic Development Directorate	Address data gaps on Scottish business preparedness, availability of capital and insurance for adaptation, and the effectiveness of business adaptation actions. Integrate adaptation into Government's business engagement plans to improve awareness of data for business to monitor climate risk.	2024
Energy and Climate Change Directorate; Environment and Forestry Directorate	Set out targets and supporting measures for reducing water use by business. Publish data collected by SEPA on water abstractions annually.	2024
Economic Development Directorate	Integrate supply chain resilience to climate hazards into the Supply Chain Development Programme, including funding research to assess and monitor resilience of essential supply chains to climate shocks and establishing a process to engage businesses and enterprise agencies to develop contingency planning.	2024
Economic Development Directorate	Engage with UK Government to strengthen adaptation reporting requirements across the UK Sustainability Disclosure Requirements.	2024

Endnotes

[1] Office for National Statistics (2023) *Regional gross value added (balanced) by industry,* https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/nominalandrealregionalgrossvalueaddedbalancedbyindustry.

[2] DESNZ (2022) *Business population estimates 2022, https://www.gov.uk/government/statistics/business-population-estimates-2022*

[3] Scottish Government (2019) *Climate Ready Scotland: Second Scottish Climate Change Adaptation Programme, 2019-2024,* https://www.gov.scot/publications/climate-ready-scotland-second-scottish-climate-change-adaptation-programme-2019-2024/documents/

4 Surminski, S. (2021) *Business and industry*. In: The Third UK Climate Change Risk Assessment Technical Report [Betts, R.A., Haward, A.B. and Pearson, K.V. (eds.)]. Prepared for the Climate Change Committee, London

[5] Office for National Statistics (2023) *Business insights and impact on the UK economy, Wave 88 August 2023, https://www.ons.gov.uk/economy/economicoutputandproductivity/output/datasets/businessinsightsandimpactontheukeconomy*

[6] Water Industry Commission for Scotland (2021) *Scottish Water's Annual Returns, https://wics.scot/publications/scottish-water/annual-return-regulatory-accounts*

[7] Sayers, PB., Horritt, M, Carr, S, Kay, A, Mauz, J., Lamb R, and Penning-Rowsell E (2020) *Third UK Climate Change Risk Assessment (CCRA3): Future flood risk.* Research undertaken by Sayers and Partners for the Committee on Climate Change. Published by Committee on Climate Change, London.

[8] CCC (2021) *Third UK Climate Change Risk Assessment Technical Report: Summary for Scotland, https://www.ukclimaterisk.org/wp-content/uploads/2021/06/CCRA-Evidence-Report-Scotland-Summary-Final-1.pdf*

[9] Scottish Government (2023) *National Planning Framework 4, https://www.gov.scot/publications/national-planning-framework-4/*

[10] CCC (2023) *Investment for a well-adapted UK, https://www.theccc.org.uk/wp-content/uploads/2023/01/Investment-for-a-well-adapted-UK-CCC.pdf*

[11] Office for National Statistics (2023) *Business Insights and Impact on the UK Economy - BICS Wave 88 Edition of This Dataset 10 August 2023*, https://www.ons.gov.uk/economy/economicoutputandproductivity/output/datasets/businessinsightsandimpactontheukeconomy.

[12] Scottish Government (2022) *Scotland's National Strategy for Economic Transformation, https://www.gov.scot/publications/scotlands-national-strategy-economic-transformation/*

[13] Scottish Government (2023) *Funding to help nature projects grow*, https://www.gov.scot/news/funding-to-help-nature-projects-grow/#:~:text=Supporting%20and%20scaling%20up%20responsible,help%20grow%20their%20nature%20projects.

[14] Adaptation Scotland (2021) *Climate Finance Working Group,* https://www.adaptationscotland.org.uk/get-involved/our-projects/climate-finance-working-group#:~:text=The%20Climate%20Finance%20Expert%20Working,policy%20and%20finance%20landscape%20development

[15] Glasgow City Council (2023) *Glasgow Business Growth Programme,* https://glasgow.gov.uk/index.aspx?articleid=30153

[16] Adaptation Scotland (2021) *Climate Hazards and Resilience in the Workplace: Making the Case,* https://www.adaptationscotland.org.uk/application/files/4716/5582/5461/WEB_5089_CHRW_Handbook.pdf

[17] Highland Adapts (2023) *Economic assessment of climate change risks and opportunities in the Highlands: Report by Paul Watkiss Associates.* [Forthcoming].

[18] Scottish Government (2018) *Severe Weather: Fair Work Charter,* https://www.gov.scot/publications/severe-weather-charter/

[19] Health and Safety Executive (2023) *Temperature in the Workplace,* https://www.hse.gov.uk/temperature/employer/managing.htm#:~:text=Provide%20air%2Dcooling%20or%20air,sunlight%20or%20sources%20of%20heat

[20] UK Trade Info (2023) *Trade Data*, https://www.uktradeinfo.com/trade-data

[21] IPSOS (2022) *Highland and Islands Business Panel*, *Wave 22,* https://www.hie.co.uk/media/12880/hie-business-panel-june_july-2022-report.pdf

[22] Scottish Government (2022) *Economy and Fair Work Committee, Scotland's Supply Chain, https://sp-bpr-en-prod-cdnep.azureedge.net/published/EFW/2022/4/28/2cc174e8-a91a-4025-83f8-4f30bf4a2f23/EFWS062022R5.pdf*

[23] Scottish Government (2022) *Public Procurement – taking account of climate and circular economy considerations: SPPN 3/2022, https://www.gov.scot/publications/public-procurement-taking-account-of-climate-and-circular-economy-considerations-3-2022/*

[24] Scottish Government (2023) *Protecting Food Security*, https://www.gov.scot/news/dedicated-food-security-established/

[25] Office for National Statistics (2023) *Business impacts and insight on the UK economy, Wave 82 May 2023, https://www.ons.gov.uk/economy/economicoutputandproductivity/output/datasets/businessinsightsandimpactontheukeconomy*

[26] Financial Conduct Authority (2022) TCFD-aligned disclosures by premium listed commercial companies, https://www.fca.org.uk/publications/multi-firm-reviews/tcfd-aligned-disclosurespremium-listed-commercial-companies

[27] CCC (2023) *Progress in adapting to climate change: 2023 Report to Parliament*, https://www.theccc.org.uk/publication/progress-in-adapting-to-climate-change-2023-report-to-parliament/

[28] Adaptation Scotland (2023) *Businesses, https://www.adaptationscotland.org.uk/how-adapt/your-sector/businesses*

[29] SEPA (2023) *Drought Risk Assessment Tool, https://www2.sepa.org.uk/drought-risk-assessment-tool*

Chapter 14: Finance

Table 14.1
Progress summary - Finance

	Delivery and implementation	Policies and plans	Summary
Outcome 1: All financial institutions incorporate physical risks into financial decision-making	Unable to evaluate	Mostly reserved	• There is a lack of reliable data on how risk information is used in financial decision-making. • For the UK, the latest progress report scored policies and plans as limited.
Outcome 2: UK financial services are a global leader in adaptation	Unable to evaluate	Mostly reserved	• There is a lack of publicly accessibly financial indices data to assess Scotland's exports of adaptation goods and services. • For the UK, the latest progress report scored policies and plans as insufficient.
Outcome 3: No viable adaptation project fails for lack of finance	Unable to evaluate	Limited policies and plans	• There is a lack of estimates of the overall need for adaptation investment in Scotland or reliable estimates of financing gaps. • The Scottish National Investment Bank is helping to improve access to finance for some small and medium-sized enterprises (SMEs), but it is currently focused on decarbonisation.
Outcome 4: Risks and actions are disclosed and managed by financial institutions	Mixed progress	Mostly reserved	• Large companies engaged in Financial Conduct Authority (FCA) regulated activities have a high degree of alignment with the Task Force for Climate-Related Financial Disclosures (TCFD). • For the UK, the latest progress report scored policies and plans as limited.

Relevant risks from CCRA3: B4: Risks to finance, investment and insurance including access to capital for businesses. ID8: Risks to the UK financial sector from climate change risks overseas.

This chapter covers adaptation to climate change for the financial system. The financial system is a highly connected network of financial institutions – such as corporate and retail banks, insurers, pension funds, asset managers, and exchanges – that work together to exchange and transfer capital from one place to another. The functionality and stability of the financial sector is essential to the functioning of the economy (see Box 14.1).

Scotland has a significant presence in the financial services industry.

Scotland has a significant presence in the financial services industry, with financial services representing 7% of Gross Value Added (GVA) in 2021 and around 80,000 people directly employed in the sector.[1,2] Edinburgh is recognised as the second largest financial hub in the UK. Banking and insurance dominate, representing 49% and 25% of total employment in the financial sector, while accounting respectively for 59% and 20% of the sector GVA.[3]

Box 14.1
Interactions with other sectors

Climate adaptation finance is strongly linked to resilience across several other sectors. Key interactions include:

- **Business** (Chapter 13): Financial institutions have the capacity to assist businesses in evaluating and handling climate-related risks.
- **Nature and working lands and seas** (Chapters 1 and 2): Adaptation finance can help finance nature-based solutions to reduce the impact of extreme weather events.
- **Infrastructure** (Chapters 5 – 8)**:** Financial institutions can help finance measures to build resilient infrastructure and reduce the impact of extreme weather events such as floods and heatwaves.
- **Buildings** (Chapter 10)**:** Adaptation finance can reduce the vulnerability of buildings, for example investing in seawalls to protect coastal communities.

The Second Scottish Climate Change Adaptation Programme (SCCAP2) identifies finance as a cross-cutting area.

The Second Scottish Climate Change Adaptation Programme (SCCAP2) identifies finance as a cross-cutting area. However, while some climate change risks are specific to the Scottish financial sector (see Box 14.2), financial regulation such as the UK Green Taxonomy is a reserved policy for the UK Government.

Box 14.2
Climate change hazards and the Scottish financial sector

Physical climate threats can affect the different financial risks that financial institutions face, such as credit, liability, operational risks, and ultimately, structural macroeconomic failures.[4] There are three main risks for the Scottish financial sector:

- **Availability and affordability of insurance:** Flooding is one of the most significant risks with financial impacts on insurance, mortgages, and investment.[5] The National Flood Risk Assessment for Scotland estimates 284,000 properties are at risk of flooding, while direct and indirect damages could lead to an estimated £200 – 250 million of damages per year.[6] The storms of early 2016 were estimated to have cost the Scottish economy £700 million.[7] The insurance sector could be particularly affected, as it will have to pay out claims for damages while increasing insurance premiums.
- **Increased costs of capital:** Future impacts from extreme weather events are expected to increase capital costs in Scotland.[8] For example, damage to fixed assets may necessitate costly repairs or replacements, alongside increasing insurance prices. Unsuitable sites may force the purchase of new locations and delayed retrofitting of existing structures for climate resilience could lead to further increased costs. Additionally, businesses and industries in Scotland may face inventory write-downs as a result of climate-related disruptions.
- **Stranded assets.** Oil and gas, a large component of the Scottish economy, could become stranded leaving the financial sector exposed.[9,10] The ongoing growth of fossil fuel infrastructure along with a lack of transparency in the valuation of these assets raises concerns that such risks are being mispriced by financial institutions.[11] The stranding of these assets could have a significant impact on Scotland's economy and have second and third order effects on the financial system.[12,13]

Source: Sniffer (2021) *Evidence for the third UK Climate Change Risk Assessment Summary for Scotland;* Sniffer (2021) *Climate Adaptation Finance: Insights and Opportunities for Scotland;* Grantham Research Institute *(2022) What are stranded assets.*

Adaptation initiatives frequently rely on co-benefits for revenue. This can help to raise finance, but adaptation projects will face a higher degree of complexity.

Adaptation initiatives frequently rely on co-benefits for revenue, such as carbon sequestration or carbon credits.[14] This can help to raise finance, but adaptation projects will face a higher degree of complexity, with multiple goals and beneficiaries, potentially creating trade-offs and conflicts between objectives. Private entities will struggle to invest in adaptation if revenue streams for adaptation outcomes do not exist or are insufficient.[15]

14.1.1 Outcome 1: All financial institutions incorporate physical risks into financial decision-making

(i) Delivery and implementation progress

Lack of available indicators for Scotland makes progress on this outcome **unable to evaluate.**

Large financial institutions report information on their climate risks through the Task Force on Climate-Related Financial Disclosures (TCFD), However, TCFDs are often high-level and insufficiently detailed.

- **There is limited data on how risk information is used in financial decisions in Scotland, and whether financial exposure to climate hazards is reducing.**[16] Whilst the Financial Conduct Authority (FCA) requires large financial institutions to report information on their climate risks through the Task Force on Climate-Related Financial Disclosures (TCFD), how these institutions report incorporating physical risks into financial decision-making is often high-level and insufficiently detailed. It is unclear whether increased reporting of climate risks is translating into reduced exposure. To enable evaluation of this outcome, publicly available data would be required on investment asset losses due to physical risks.

- **Anecdotal evidence suggests some Scottish financial institutions are progressing towards incorporating physical risks into financial decision-making.** For example, the Scottish National Investment Bank has been developing its own climate risk reporting framework, to incorporate climate risks into their decision-making process.*[17]

(ii) Policy and planning progress

Key policy milestones for this outcome are largely outside of the Scottish Government's direct control, as this is a reserved policy area. This outcome is therefore **not scored.** In the March 2023 Progress Report on adaptation to climate change in the UK, policy and plans for this outcome were scored as limited. There is progress to embed adaptation in financial regulators' activity, although it is still nascent.

14.1.2 Outcome 2: UK financial services are a global leader in adaptation

(i) Delivery and implementation progress

A lack of available indicators for Scotland makes progress on this outcome **unable to evaluate.**

- **Data on the exports of adaptation financial services are not available.** Whilst Scotland's total international export of financial and insurance

* In relation to disclosure of climate risks, see also outcome 4 below.

activities stood at £2.5 billion in 2019, there is a lack of data on how much of this is related to climate change adaptation.[18]

Edinburgh is ranked among the top 15 financial centres for green finance.

- **Edinburgh is ranked among the top 15 financial centres for green finance.** The Global Green Finance Index is a yearly assessment that ranks financial hubs based on their support for green finance. Although the index focuses on mitigation, it also considers adaptation finance. The report emphasises the progress of Edinburgh (ranked 14th worldwide with an increase of 8 positions) and Glasgow (ranked among the top 50).[19] However, it is unclear if this progress was linked specifically to adaptation finance.

(ii) Policy and planning progress

Key policy milestones for this outcome are largely outside of the Scottish Government's direct control, as this is a reserved policy area. This outcome is therefore **not scored**. For the UK, the latest CCC 2023 adaptation progress report to Parliament score is insufficient policies and plans.

14.1.3 Outcome 3: No viable adaptation project fails for lack of finance

(i) Delivery and implementation progress

A lack of data means progress on this outcome was **unable to evaluate.**

- **There is a lack of Scotland specific analysis of adaptation finance flows and investment gaps.** Tracking the availability of adaptation finance is challenging as adaptation is rarely financed through distinct flows of finance. UK wide analysis shows that investment needs for adaptation are increasing and an additional £10 billion per year of investment may be needed this decade to address climate change risks across the economy.[20]

Only 6% of surveyed Scottish businesses identified costs as a factor preventing them from taking action while over half were unsure of the barriers.

- **There is limited data on the extent to which businesses have access to the necessary capital for adaptation, however recent survey data suggests that costs may not be the primary barrier**. Only 6% of surveyed Scottish businesses identified costs as a factor preventing them from taking action to mitigate climate risks.[21] A further 7% cited a lack of information or guidance, whilst over half of businesses were unsure of the barriers preventing them from taking action.[22] More evidence is needed to better understand the extent to which businesses can access the necessary capital for effective adaptation.*

- **There is no systematic data on the use of adaptation linked financial instruments, however there are some regional examples**. Some regional adaptation projects have mapped several options for the blended finance solutions available to them, such as the Glasgow City Region Adaptation Strategy and Action Plan.[23] A survey from Adaptation Scotland's Climate Finance Working Group members revealed that the greatest barriers for adaptation finance were: uncertainty or lack of awareness about the future benefits of adaptation, low commercial attractiveness of adaptation

* See Chapter 13 (business) for more detail.

due to the inability to quantify revenue streams from adaptation for value capture, and no standard set of adaptation business models.[24]

(ii) Policy and planning progress

There are **limited policies and plans** in place to ensure no viable adaptation project fails for lack of finance.

The vast majority of policies to lever finance for climate change target mitigation rather than adaptation.

- **The vast majority of policies to lever finance for climate change target mitigation rather than adaptation**. It is not clear if this is due to an informed assessment that access to finance for adaptation is currently sufficient. There is a need for a better assessment of the gaps in access to capital and insurance. This is discussed in more detail in the business chapter.

- **The establishment of the Scottish National Investment Bank (SNIB) is helping to improve access to finance for some SMEs in Scotland, but it is currently focused more on decarbonisation**.[25] Whilst they have made significant progress in understanding and managing climate related impacts across their portfolio, their most recent impact report is focused mainly on decarbonisation projects. While not legally required, SNIB has committed to publish the TCFD as their climate risk and reporting framework.[26]

- **Regionally, some programmes in Scotland have shown progress in financing climate change adaptation.** Examples of successful initiatives in which regional programmes identified and obtained funding for adaptation projects include:

  - **TreesAI:** While not being a traditional financial institution per-se, TreesAI helps public and private entities to co-invest in Nature-based Solutions that strategically provide Natural Flood Management (NFM) and Sustainable Drainage Systems (SuDS).[27]

  - **The Glasgow City Region Adaptation Strategy and Action Plan** is a comprehensive and innovative plan to help the region adapt to climate change. It sets out 11 interventions to enhance climate resilience and increase the resilience of over 140,000 people to the impact of climate change (Box 14.3).[28,29]

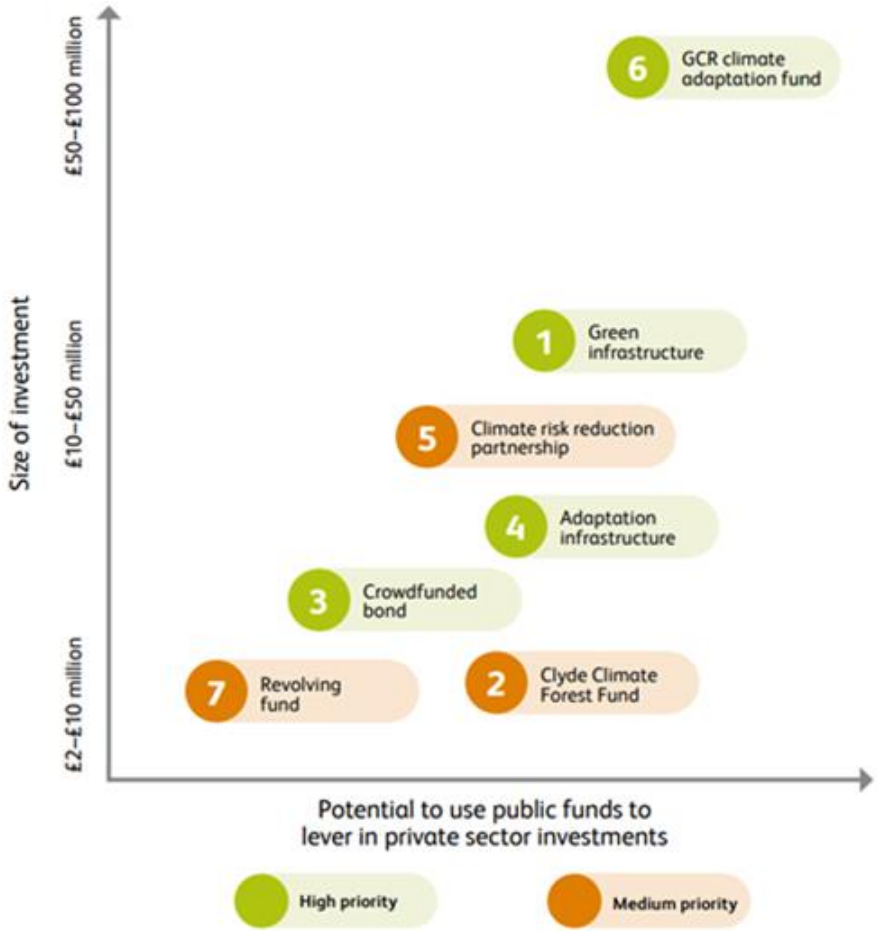
The Glasgow City Region Adaptation Strategy and Action Plan is a comprehensive and innovative plan to help the region adapt to climate change.

Box 14.3
Case study: Financing transformative adaptation in Glasgow City Region

The Glasgow City Region Adaptation Strategy and Action Plan maps gaps in conventional finance for adaptation, estimating that an additional £184 million per year in public finance is needed. They recognise that private sector finance could be mobilised to bridge that gap for adaptation if the right mechanisms are put in place and illustrate options for blended finance solutions (see Figure B14.3). For example:

- **Glasgow City Region Climate Adaptation Innovation Fund:** A platform through which private sector investments can be strengthened with public funds.
- **Green Infrastructure Blended Finance Lending Facility**: Loans to projects that deliver green infrastructure to mitigate and adapt to climate change.
- **Adaptation infrastructure including green and sustainable urban drainage systems:** For the Glasgow City Region, this requires public, water and insurance companies to invest in infrastructure that can reduce flood risk.[30]
- **Climate Risk Reduction Public Private Partnership (PPP):** Adaptation projects to transfer risk management knowledge to SMEs and municipalities and increase climate change resilience.[31]

Figure B14.3 Approximate investment sizes and leverage potential of financing options



Source: Climate Ready Clyde (2021) *Glasgow City Region's first Adaptation Strategy and Action Plan. Annex 3.*

14.1.4 Outcome 4: Risks and actions are disclosed and managed by financial institutions

(i) Delivery and implementation progress

Scottish financial institutions must comply with UK financial regulations, but these are currently not strong on adaptation.

There is **mixed progress** on the disclosure and management of risks by financial institutions. Scottish financial institutions must comply with UK financial regulations, but these are currently not strong on adaptation.

- **Large financial institutions in Scotland disclose in line with TCFD, however there are shortcomings in TCFD requirements**. The Bank of Scotland (part of the Lloyds Bank Group), Virgin Money plc, and The Royal Bank of Scotland (part of the NatWest Group plc) all publicly pledged their support for Taskforce on Climate-related Financial Disclosures (TCFD), and produced reports, as part of their respective groups, aligned to the TCFD in 2022.[32,33,34] All three included climate risk management information in their latest disclosures for 'Pillar 3' of TCFD.*[,35,36,37] The same is true for life insurance and pensions companies, such as Scottish Widows and Standard Life.[38,39] However, TCFD and in general other reporting schemes are currently weak on adaptation disclosures and data.

(ii) Policy and planning progress

Key policy milestones for this outcome are largely outside of the Scottish Government's direct control. This outcome is therefore **not scored.**

For the UK, the latest CCC 2023 adaptation progress report to Parliament score is limited policies and plans. While work has progressed on TCFD, the UK's Sustainability Disclosure Requirements, including Net Zero transition plans, and on developing a UK Green Taxonomy, it is only just beginning on adaptation plans and adaptation plan-related disclosures.

* Pillar 3 of the UK Capital Requirements Regulation (CRR) specifies disclosures regarding risk management policies, procedures, and performance.

14.2 Recommendations

Table 14.2
Recommendations

Primary responsibility	Recommendation	Timing
Energy and Climate Change Directorate	Undertake research, engagement, and consultation with business and financial institutions to assess the extent to which improved access to finance for adaptation is needed in Scotland. Based on this, integrate appropriate adaptation finance policy into major economic development strategies where needed, and include finance more prominently in the next Scotland national adaptation plan next Scotland climate change adaptation programme.	2024
Economic Development Directorate	Include adaptation in investment frameworks used for major development strategies and long-term strategic approaches to improving regional economies, such as the Regional Growth Deals.	Ongoing
Economic Development Directorate	Engage with UK public financial institutions (such as the UK Infrastructure Bank, British Business Bank, UK Export Finance, and British International Investment) and Scotland's financial services representatives (Scottish Financial Enterprise) to create adaptation finance strategies, setting out how they will independently and collectively ensure that no viable climate adaptation project fails for lack of finance or insurance.	2024
Economic Development Directorate	Engage with the UK Government to strengthen adaptation reporting requirements across the Sustainability Disclosure Requirements.	2024

Endnotes

[1] Office for National Statistics (2023) *Regional Gross Value Added (Balanced) By Industry, Chained Volume Measures in 2019 Money Value, Pounds Million,* https://www.ons.gov.uk/economy/grossvalueaddedgva/datasets/nominalandrealregionalgrossvalueaddedbalancedbyindustry

[2] TheCityUK (2022) *Enabling Growth Across the UK 2022*, https://www.thecityuk.com/media/ca5kcnbk/enabling-growth-across-the-uk-2022-uk-based-financial-and-related-professional-services.pdf

[3] TheCityUK (2022) *Enabling Growth Across the UK 2022,* https://www.thecityuk.com/media/ca5kcnbk/enabling-growth-across-the-uk-2022-uk-based-financial-and-related-professional-services.pdf

[4] United Nations Environment Programme Finance Initiative (2019) *Driving Finance Today for the Climate Resilient Society of Tomorrow*, https://www.unepfi.org/wordpress/wp-content/uploads/2019/07/GCA-Adaptation-Finance.pdf.

[5] Bank of England (2019) *Climate Change: What Are the Risks to Financial Stability?*, https://www.bankofengland.co.uk/explainers/climate-change-what-are-the-risks-to-financial-stability

[6] Sniffer (2022) *Evidence for the Third UK Climate Change Risk Assessment (CCRA3). Summary for Scotland. 2021 p.83*, https://www.ukclimaterisk.org/wp-content/uploads/2021/06/CCRA-Evidence-Report-Scotland-Summary-Final-1.pdf

[7] Sniffer (2022). *Evidence for the Third UK Climate Change Risk Assessment (CCRA3). Summary for Scotland. 2021 p.83*, https://www.ukclimaterisk.org/wp-content/uploads/2021/06/CCRA-Evidence-Report-Scotland-Summary-Final-1.pdf

[8] Murtagh, Ellie; Watkiss, Paul; Khosla, Sumalee; Beswick, Anna; England, Kit; Connor, Ben; Martel, Patrick Jean; Gale, Alan; Faichney, David; Fraser, Leigh; Robinson, Peter (2022) *A Guide to Adaptation Climate Finance*, https://www.adaptationscotland.org.uk/application/files/9016/6255/4638/A_Guide_to_Adaptation_Climate_Finance.pdf.

[9] Scottish Government (2023) *Scottish Natural Capital Accounts: 2023 - 8. Asset values*, https://www.gov.scot/publications/scottish-natural-capital-accounts-2023/pages/9/

[10] Caldecott, B., Clark, A., Koskelo, K., Mulholland, E., & Hickey, C. (2021). *Stranded Assets: Environmental Drivers, Societal Challenges, and Supervisory Responses. Annual Review of Environment and Resources, 46, pp. 417-447*, https://www.annualreviews.org/doi/abs/10.1146/annurev-environ-012220-101430

[11] Grantham Research Institute on Climate Change and the Environment (2022) *What Are Stranded Assets?*, https://www.lse.ac.uk/granthaminstitute/explainers/what-are-stranded-assets/

[12] Phillips, D. (2023) *Lower Oil and Gas Prices Set to Hit Scotland's Underlying Public Finances*, https://ifs.org.uk/articles/lower-oil-and-gas-prices-set-hit-scotlands-underlying-public-finances

[13] Mccully, P. (2023) *Throwing Fuel on the Fire: GFANZ Financing of Fossil Fuel Expansion*, https://reclaimfinance.org/site/wp-content/uploads/2023/01/Throwing-fuel-on-the-fire-GFANZ-financing-of-fossil-fuel-expansion.pdf

[14] Masters, H. (2022) *Barriers To Financing Adaptation Actions in the UK - An evidence report p.16*, https://www.theccc.org.uk/wp-content/uploads/2023/01/Barriers-to-financing-adaptation-actions-in-the-UK-Frontier-Economics-Paul-Watkiss-Associates.pdf

[15] Masters, H. (2022). *Barriers To Financing Adaptation Actions in the UK - An evidence report p.16*, https://www.theccc.org.uk/wp-content/uploads/2023/01/Barriers-to-financing-adaptation-actions-in-the-UK-Frontier-Economics-Paul-Watkiss-Associates.pdf

[16] Committee on Climate Change (2023) *Progress in Adapting to Climate Change 2023: Report to Parliament*, https://www.theccc.org.uk/wp-content/uploads/2023/03/WEB-Progress-in-adapting-to-climate-change-2023-Report-to-Parliament.pdf.

[17] The Scottish National Investment Bank (2023) *Impact Report 2023*, https://www.thebank.scot/sites/default/files/2023-04/Impact%20Investment%20Report_Finals.pdf

[18] Scottish Government (2021) *Export Statistics Scotland 2019*, https://www.gov.scot/publications/export-statistics-scotland-2019/.

[19] Wardle, M., Mainelli, M. and Mills, S., (2023) The Global Green Finance Index 11, https://www.longfinance.net/media/documents/GGFI_11_Report_2022.04.20_v1.1.pub.pdf

[20] CCC (2023) *Investment for a Well-Adapted UK,* https://www.theccc.org.uk/wp-content/uploads/2023/01/Investment-for-a-well-adapted-UK-CCC.pdf

[21] Office for National Statistics (2023) *Business Insights and Impact on the UK Economy - BICS Wave 88 Edition of This Dataset 10 August 2023*, https://www.ons.gov.uk/economy/economicoutputandproductivity/output/datasets/businessinsightsandimpactontheukeconomy.

[22] Office for National Statistics (2023) *Business Insights and Impact on the UK Economy - BICS Wave 88 Edition of This Dataset 10 August 2023*, https://www.ons.gov.uk/economy/economicoutputandproductivity/output/datasets/businessinsightsandimpactontheukeconomy.

[23] Climate Ready Clyde (2021) *Adaptation Strategy and Action Plan*, https://climatereadyclyde.org.uk/adaptation-strategy-and-action-plan/

[24] Murtagh, E., Watkiss, P., Khosla, S., Beswick, A., England, K., Connor, B., Martel, P. J., Gale, A., Faichney, D., Fraser, L., Robinson, P., (2022) *A Guide to Adaptation Climate Finance*, https://www.adaptationscotland.org.uk/application/files/9016/6255/4638/A_Guide_to_Adaptation_Climate_Finance.pdf.

[25] Scottish National Investment Bank (2018) *Implementation Plan*, https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2018/02/scottish-national-investment-bank-implementation-plan/documents/00532119-pdf/00532119-pdf/govscot%3Adocument/00532119.pdf

[26] The Scottish National Investment Bank (2023) *Impact Report 2023*, https://www.thebank.scot/sites/default/files/2023-04/Impact%20Investment%20Report_Finals.pdf

[27] Dark Matter Labs (2023) *Trees as Infrastructure*, https://darkmatterlabs.org/Trees-as-Infrastructure-A-platform-to-value-and-invest-in-nature

[28] Climate Ready Clyde (2023) *Climate Vulnerability Map*, https://climatereadyclyde.org.uk/climate-vulnerability-map/

[29] Climate Ready Clyde (2021) *Glasgow City Region Climate Adaptation Strategy and Action Plan*, http://climatereadyclyde.org.uk/wp-content/uploads/2021/09/10-Annex-3-Resource-Mobilisation-Plan.pdf

[30] The City of Copenhagen (2012) *Cloudburst Management Plan*, https://climate-adapt.eea.europa.eu/en/metadata/case-studies/the-economics-of-managing-heavy-rains-and-stormwater-in-copenhagen-2013-the-cloudburst-management-plan

[31] UnipolSai (2020) *Life DERRIS - DisastEr Risk Reduction InSurance*, https://www.unipolsai.com/en/about-us/sustainability/life-derris-disaster-risk-reduction-insurance

[32] Lloyds Banking Group plc (2022) *2022 Year-End Pillar 3 Disclosure*, https://www.lloydsbankinggroup.com/assets/pdfs/investors/financial-performance/lloyds-banking-group-plc/2022/full-year/2022-lbg-fy-pillar3.pdf

[33] Virgin Money UK (2022) *Annual Report and Account 2022*, https://www.virginmoneyukplc.com/downloads/pdf/virgin-money-uk-plc-2022-annual-report-and-accounts.pdf#page=233

[34] NatWest Group (2022) *Championing a Relationship Bank for a Digital World*, https://investors.natwestgroup.com/~/media/Files/R/RBS-IR-V2/results-center/17022023/nwg-2022-climate-related-disclosure-report.pdf

[35] Lloyds Banking Group plc (2022) *2022 Year-End Pillar 3 Disclosure*, https://www.lloydsbankinggroup.com/assets/pdfs/investors/financial-performance/lloyds-banking-group-plc/2022/full-year/2022-lbg-fy-pillar3.pdf

[36] Virgin Money UK (2022) *Pillar 3 Report 2022,* https://www.virginmoneyukplc.com/downloads/pdf/vmukplc-2022-pillar-3-report.pdf

[37] NatWest Group (2022) *2022 Pillar 3 Report,* https://investors.natwestgroup.com/~/media/Files/R/RBS-IR-V2/results-center/17022023/nwg-pillar-3-report-v1.pdf

[38] Scottish Widow (2022) *Task Force on Climate-related Financial Disclosures (TCFD) Report 2022,* https://adviser.scottishwidows.co.uk/assets/literature/docs/60629-22.pdf

[39] Standard Life Master Trust (2023) *TCFD Report – Standard Life DC Master Trust,* https://library.standardlife.com/SLMTC_TCFD_Master_Trust_Report.pdf

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