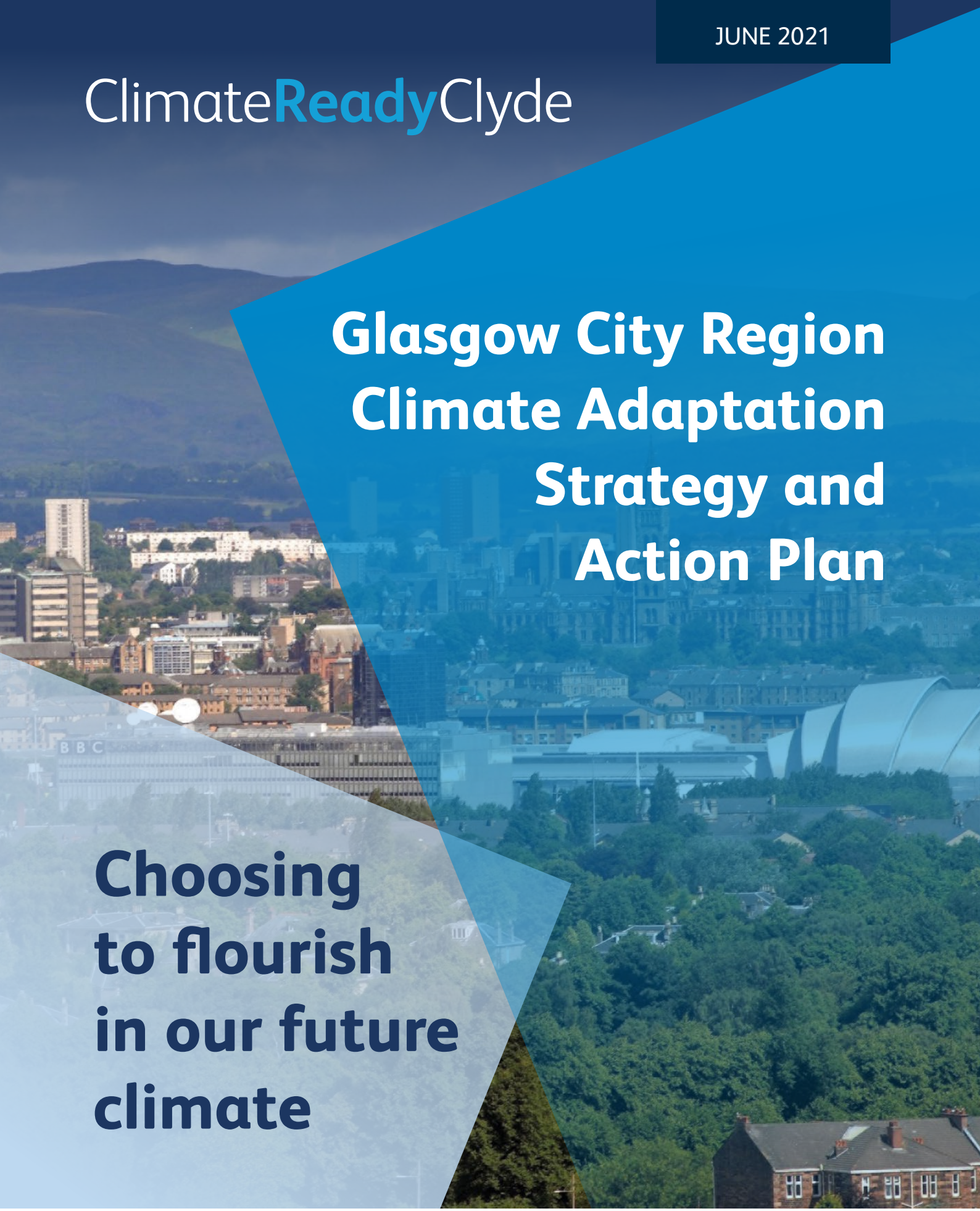
JUNE 2021

ClimateReadyClyde

Glasgow City Region Climate Adaptation Strategy and Action Plan



Choosing to flourish in our future climate

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Deep Demonstration
Resilient Regions
GLASGOW CITY REGION
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About Climate Ready Clyde

Climate Ready Clyde (CRC) is a cross-sector initiative funded by fifteen member organizations and supported by the Scottish Government to create a shared Vision, Strategy, and Action Plan for an adapting Glasgow City Region (GCR). 1.8 million people live, work and play in Glasgow City Region and a large number of businesses and organizations are based here, with £40 bn of GVA – a third of Scotland's population and wealth. Increasingly they are impacted by the effects of climate change, both directly and from changes happening around the world.

Adaptation is a strategic issue for Glasgow City Region in terms of securing inward investment and protecting the economy, as well as contributing to good placemaking, addressing inequality and minimizing and avoiding costs arising from unplanned impacts. Climate Ready Clyde was established on the basis that adapting is cheaper, easier and more effective when done together.

- **Collaborating for collective impact** – Ensuring society is resilient to climate change requires us to reach across silos, sectors and agendas to create collective impact. Our members are committed to working together and with others in an innovative and inclusive way, so that CRC leads by example and effectively governs the adaptation space.
- **Informing and shaping the direction of Glasgow City Region and wider Scotland** – Our members and the Secretariat are at the heart of the debates and discussion of the future of the City Region and wider Scotland, helping to shape a climate resilient future, for all those who live and work in the City Region.
- **Our work on evidence, adaptation guidance and resources** helps those in the City Region working on the delivery of adaptation do more, faster..
- **Leading in the global movement for climate action** – We place Glasgow City Region's efforts to adapt on a global stage, showcasing the leading work we do to inspire and support cities and regions around the world, and connecting and learning from those who can help us accelerate our plans.

Climate Ready Clyde is managed and delivered by Scottish sustainability charity Sniffer.

The future we choose

A Glasgow City Region flourishing in the future climate

It is 2050. We successfully strengthened Glasgow City Region's resilience to climate change and are flourishing in a new climate. In the 2020s, the challenge of the COVID-19 pandemic resulted in social renewal and a green recovery, bolstered by renewed ambition at COP26 in Glasgow, which strengthened the delivery of net-zero carbon emission targets for Glasgow City Region and Scotland. Media and cultural organizations joined efforts to imagine and help develop a better future.

Buoyed by the progress of the 2020s, civic society continued to step up; more people took on active roles to enable their communities to become climate resilient and society collaborated to reduce emissions and achieve net-zero. New groups emerged and engaged, whilst existing organizations and communities in Glasgow City Region took bold steps to redraw the landscape, directing resources and assets towards a climate-ready future. Government policies focused on ensuring well-being in a changing climate and long-term societal and economic resilience to several potential shocks and stresses.

As a result, Glasgow City Region thrives in 2050; it is a great place to live and work in, and to visit. Stepping outside, the air is clean and fresh due to the delivery of our net-zero ambitions, as well as from the abundant trees and green spaces which help keep the city and towns cool on hot days, regulate flows of water, and reduce flood risks. Most people get around by walking, biking, scooting or public transport, in a climate resilient transport network. Although flooding, heatwaves and storms still happen, infrastructure was modified to cope with their impacts and the routine plans established allow normal daily life to continue, supported by strong, resilient communities.

In the early 2020s, local governments, businesses and community groups collaborated closely. Responding to the changing river and coastline, they reshaped their local places and agreed how to best manage land over the long-term. Businesses and communities responded to strong public sector leadership and market signals, in turn accelerating public action. As a result, risks are reduced and building insurance is more affordable due to the combination of public investment, early warning and plans in place.

Local companies, including major multinationals, mainstreamed climate risks in their strategies in the 2020s, and now there is public and private investment in climate resilience, helping the region cope with the shocks and stresses of extreme weather events. Improved quality of life and enhanced resilience has also helped attract new investments into the region over the more recent decades. Businesses, organizations and communities have transformed, having honed their skills and knowledge to become climate ready. The transition created green jobs in climate change adaptation and today there is a thriving sector dedicated to managing risks and realizing climate opportunities.

In the 2020s it felt uncertain whether climate change would reduce the opportunities for the next generation, but the changes started then have led to a bright future for those in Glasgow City Region. Today, Glasgow City Region is seen as a centre of excellence on climate adaptation; our thriving community of adaptation experts provide support and evidence to other city regions around the world.

An un-adapted Glasgow City Region

It is 2050. More extreme weather events are regularly occurring, as scientists have warned for decades. Major flooding is widespread and big storms and heatwaves are now part of normal life.

Glasgow City Region is a much riskier place to live and climate-anxiety is commonplace. In winter, heavy rainfall and storms mean citizens now routinely check SEPA's flood forecasts as a necessity and the media regularly tell us that new threats are always a looming possibility.

Walking down the street feels profoundly different from the 2020s. Although there are still some green spaces, Glasgow City Region has an absence of places where we can experience nature. Access to green space is a postcode lottery and makes it harder for wildlife to migrate and survive. Riverbanks are lined by grey, concrete and steel; flood defences restrict people's access to the river and provide a vivid reminder of the constant risks of flooding. Spotting a redshank on the Clyde's banks is now cause for celebration rather than a regular occurrence.

Getting around needs careful planning; despite continued infrastructure investments, new developments weren't climate-proofed and disruption to travel is frequent. Flash flooding disrupts our commutes to work, and the school run, whilst coastal erosion along the river estuary has increased, damaging low-lying railway lines and breaking links into the city centre. Other trains are regularly delayed or cancelled due to flooding, landslides and heatwaves. Roads are also vulnerable, with the motorways, Erskine Bridge and the Rest and Be Thankful frequently closed due to climate extremes.

The region's coastal towns have grown with new developments, but these are proving prone to flooding and rising sea levels, and some are becoming uninsurable. Many other medium and long-term climate risks – such as extreme temperatures – have been neglected in forward planning. As a result, homes and buildings overheat regularly, affecting the elderly and the young, and care for the elderly is even more expensive as increased air conditioning requirements in care homes drive costs higher. These impacts have widened economic and social divides. There is widespread public concern about why previous decisions ignored climate risks. Now, communities are anxious about their futures, worrying about where and how they will live, and whether they can afford to move or retrofit their recently built homes.

Climate change hit public finances and the region's economy hard. An increasing share of the public budget is spent on addressing climate impacts, further reducing public services. Without wider support to respond strategically, many businesses only focus on managing the day-to-day shocks. As shareholders and asset managers have realized the threat of climate change, many companies have left Glasgow City Region, attracted to places that were adapting for the longer term, causing rising unemployment. For those that call Glasgow City Region home, climate change is driving the wedge deeper into existing inequalities and further eroding our community's social contract. The generation growing up in the region find themselves caught in the middle of a perfect storm and struggle to feel much hope.

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Any errors that remain in this report are the responsibility of the lead author.

Contents

Foreword: COVID-19, climate change and COP26 – leading a regional just, green recovery

The COVID-19 pandemic took hold halfway through the production of Climate Ready Clyde's Adaptation Strategy. Before that, Glasgow City Region was already under pressure, with a rising and moving population and increasing pressure on nature. We are expecting an additional 51,000 people to live here by 2043, whilst 49% fewer animal and plant species live here than in 1970. COVID-19 comes as a major health, social and economic shock on top of this. In Glasgow City Region, 217,000 staff were furloughed, with 38,000 additional people claiming some form of unemployment benefit.

But whilst the restrictions, lockdown and emergency response have been very difficult for everyone in Glasgow City Region and beyond, it also offered a glimpse of something else: the potential for a very different way of life. As society slowed down, nature returned, communities and businesses came together in pursuit of shared goals, and national and local governments made rapid shifts in the interest of health and well-being.

The pandemic may possibly be with us for years to come. And just like we were warned of the current health crisis, the risks from climate change have not gone away. They have the potential to be just as disruptive, if not more so. Calls for greater climate action have been replaced with louder ones for a green, just, economic recovery, which builds our resilience to a wider range of shocks and stresses. As the world works through the pandemic, and begins to recover and restart, we are at something of a unique moment. A moment with a window for significant change and an opportunity to listen to the views of scientists for our citizens and future generations.

Replicating global economic recovery approaches has not always worked well for Glasgow City Region, resulting in much longer recoveries than other cities around the UK. And our region's history of deindustrialization shows us only too well the results of catastrophic, unplanned (and ultimately unmanaged) economic change.

As Glasgow City Region prepares to host world leaders for the UN Climate Change Conference (COP26) in 2021, all eyes are on the steps we take next. UN Secretary General Antonio Guterres has said that the current crisis is an unprecedented wake-up call and that we need to turn the recovery into a real opportunity to do things right for the future. We wholeheartedly agree. With adaptation and resilience, finance and nature-based solutions all key themes of the conference, there is no better time to demonstrate their potential for transforming the world.

So, this Strategy offers a different approach – a path to a fairer future – one that improves the security for *all* in Glasgow City Region, as well as for wider Scotland, creating fairer, more inclusive places, resilient to climate impacts. It sets out 11 interventions, supported by our innovative Resilient Regions: Clyde Rebuilt project that will collectively deliver the social, cultural, economic, environmental and democratic renewal and change necessary to ensure everyone in Glasgow City Region can flourish in our future climate. It draws strength from our people, our communities and our businesses, and looks to harness our skills, innovation

and partnership to make our places more climate resilient in a just transition. And it draws on our history of transformation: from the 'dear green place' and the vision of New Lanark, to industrial powerhouse, from industrial decline to a European Capital of Culture, host of the Commonwealth Games and leading centre for wind energy and storage at Whitelee. As such, we believe it offers a compelling model for the regional transition that we and all other cities and regions around the world, must go through in the coming decade.

Ambitious action on mitigation started our next regional transition, so it's only right we honour the Paris Agreement by mirroring it with an equally ambitious approach to adaptation and resilience. As host city region for COP26, our citizens deserve nothing less. But such an approach will only succeed if we move together.

The world is watching – now it is time for every organization, community and business to deliver together.

James Curran
Chair, Climate Ready Clyde

PART 1 Introduction, background and context

1.1 Introduction, background and context

Welcome to Glasgow City Region's Climate Adaptation Strategy and Action Plan. This document is a significant output from Climate Ready Clyde, based on extensive engagement and evidence gathering to address the challenge of a changing climate for Glasgow City Region. Climate Ready Clyde has worked with a wide range of groups to develop a framework for adapting Glasgow City Region; a compelling vision of a Glasgow City Region that flourishes in a future climate and how Glasgow City Region can act to deliver it. Realizing its ambitions will only be possible by engaging and mobilizing a much larger cohort of public bodies, government, business and communities. Doing so will bring lasting benefits for all those who live, work in and visit the region, as well as for wider Scotland.

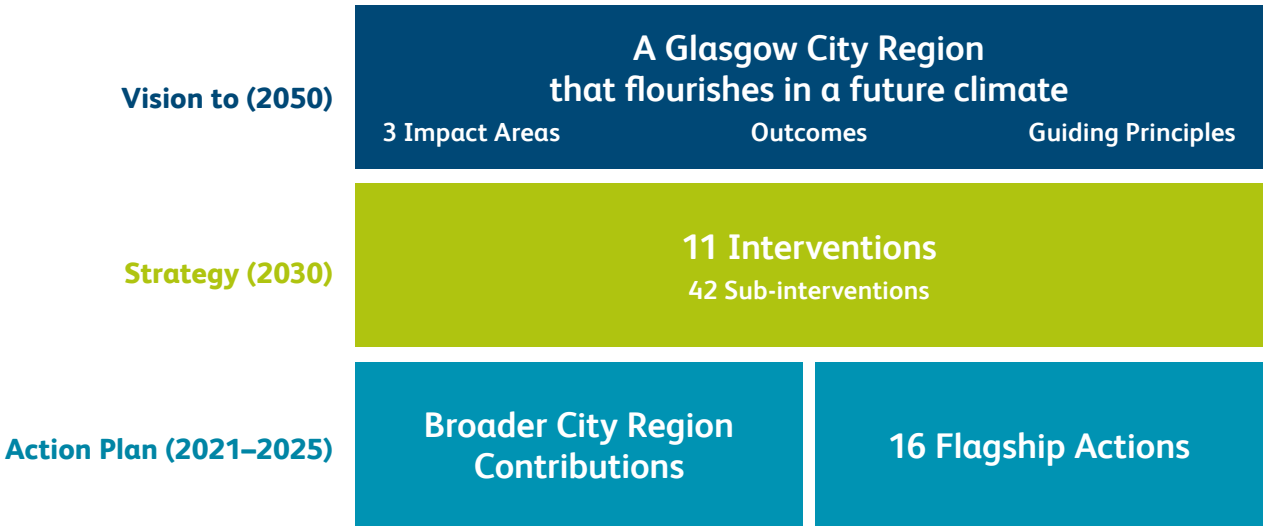


Fig. 1. Adaptation Framework for Glasgow City Region.

Given that climate change will affect each and every individual in the region, it is for **everyone**; every person, community group, business and organization with a stake. The document contains many messages and routes to express them, with the aim of ensuring as many people as possible do so, and act on them.

The overarching message is the intention **to transform the region to adapt to climate challenge and ensure everyone benefits from doing so.** Over the last four years, Climate Ready Clyde has laid the foundations for the transition. Now, the Strategy and Action Plan provides a comprehensive blueprint for how we will make it happen over the next decade. But it will only happen by mobilizing the collective capacity of all those with a stake in Glasgow City Region. In this regard, it is only the beginning of that journey, and the final pathway will change and develop as more people get involved and participate. The document is in three parts:

- **Part 1** sets out the background and context, our climate risks and opportunities, our vision, and the case for adaptation
- **Part 2** is the Adaptation Strategy, setting out the ambition, objectives and relevant policy, before setting out 11 strategic interventions needed by 2030 to take us towards meeting the vision
- **Part 3** is the Action Plan, setting out 16 Flagship Actions and wider contributions from across Glasgow City Region and beyond to deliver the Strategy in the next 5-year period. It also includes stretch targets, CRC's approach to enabling delivery, and the funding and financing approach.

1.2 About Glasgow City Region

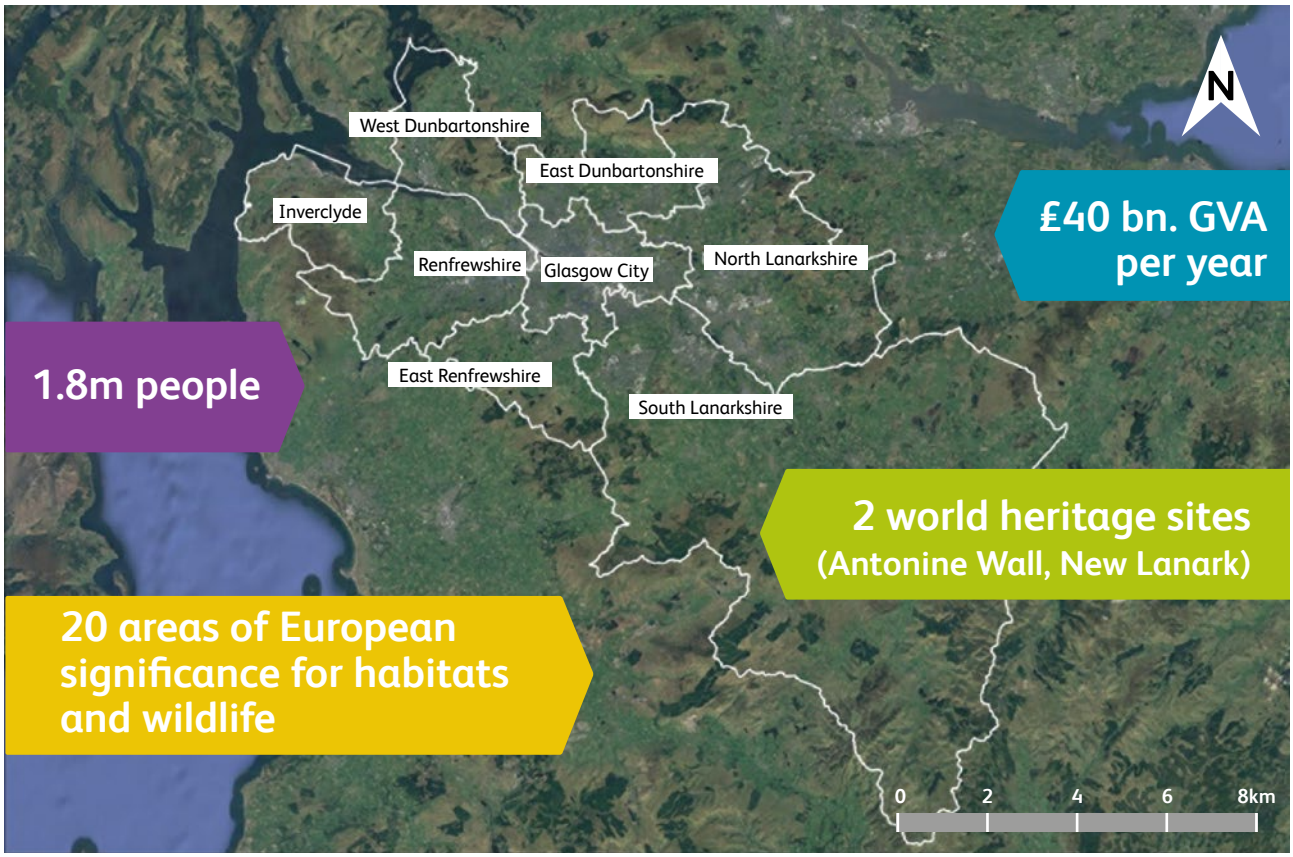


Fig. 2. Map of Glasgow City Region.

What is climate change adaptation?

Climate change adaptation comprises all the actions and solutions that a country, a region, a city, or a community can develop and implement to build more resilient societies and economies, to respond to the impacts of climate change that are already happening or are expected. It is a series of changes in processes, practices and structures that aim to moderate the potential damages brought by climate change. The solutions for climate adaptation vary from one context to another. They can range from building flood defences or setting up early warning systems for cyclones to redesigning communication systems, business operations and government policies.

Key climate facts

Our climate is already changing but there are goals to limit warming under the Paris Agreement:

+1°C
Rise in average global temperature that has already happened

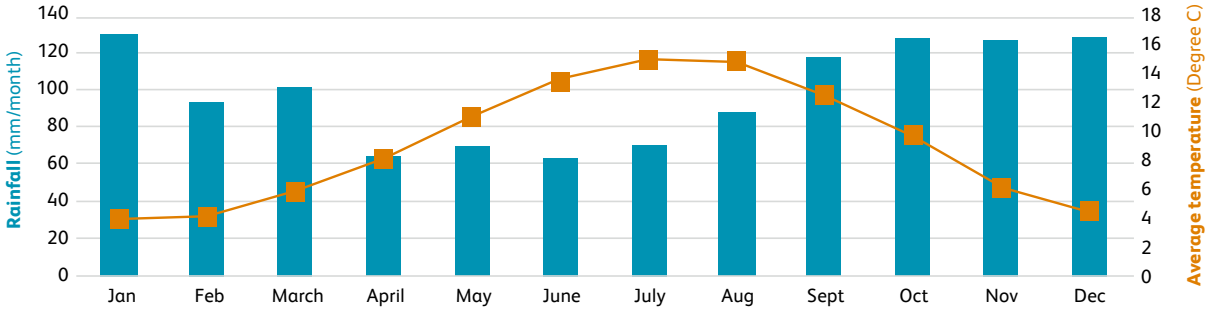
+2°C / +1.5°C
The 2015 Paris Agreement goal of limiting temperature rise to well **below 2°C** above pre-industrial levels and pursuing efforts to limit to **1.5°C**

And people in Scotland want us to act:

7 in 10
adults that agree climate change is an immediate and urgent problem

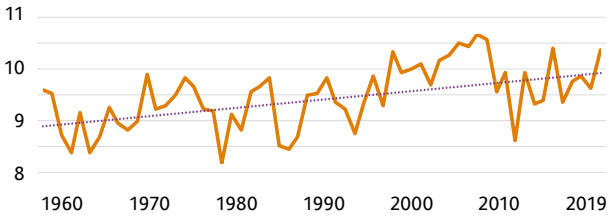
8 in 10
adults that agree climate change will impact Scotland

We're generally a cold and wet region:

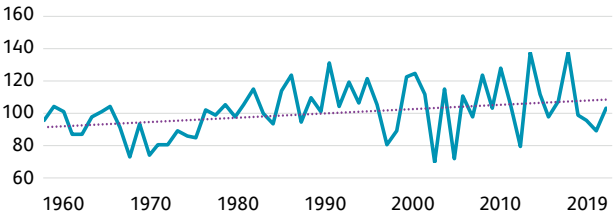


But observations show Glasgow City Region's temperatures and rainfall are increasing:

Average temperature in Glasgow City Region (Paisley), 1960–2019



Average annual rainfall in Glasgow City Region (Paisley), 1960–2019



In all scenarios, climate change means Glasgow City Region will experience:

- Increasing extreme weather
- Heavier winter rainfall and reduced summer rainfall
- Higher average temperatures, with more frequent and extreme heatwaves
- Sea level rise and coastal erosion
- Increased likelihood of flooding

All of these will lead to significant impact in our City Region. At present we have identified:

67
climate risks and opportunities

10
areas where more action is needed to address our risks in four areas: infrastructure; society and health; natural environment; and economy, business and industry

210
publicly listed companies exposed to physical climate risks

21,500
extra homes at risk of flooding by the 2080s

£££
£hundreds of millions/ year – damages by the 2050s without adaptation unmanaged

Sources: UKCP18 Probabilistic Projections, Met Office Hadley Centre, UK State of the Climate 2019, Met Office Historical Data, Climate Action Tracker, MSCI, and Scottish Household survey data explorer.

Fig. 3. Key climate facts.

However, future global emissions pathways will influence how big these changes will be i.e. depending on whether the world is broadly on a +2˚C pathway or a +4˚C pathway (relative to pre-industrial temperatures). The projected change is shown below for two pathways (RCP2.6 and RCP6.0) with are broadly equivalent to a +2˚C pathway (RCP2.6) and a +4˚C pathway (RCP6.0).

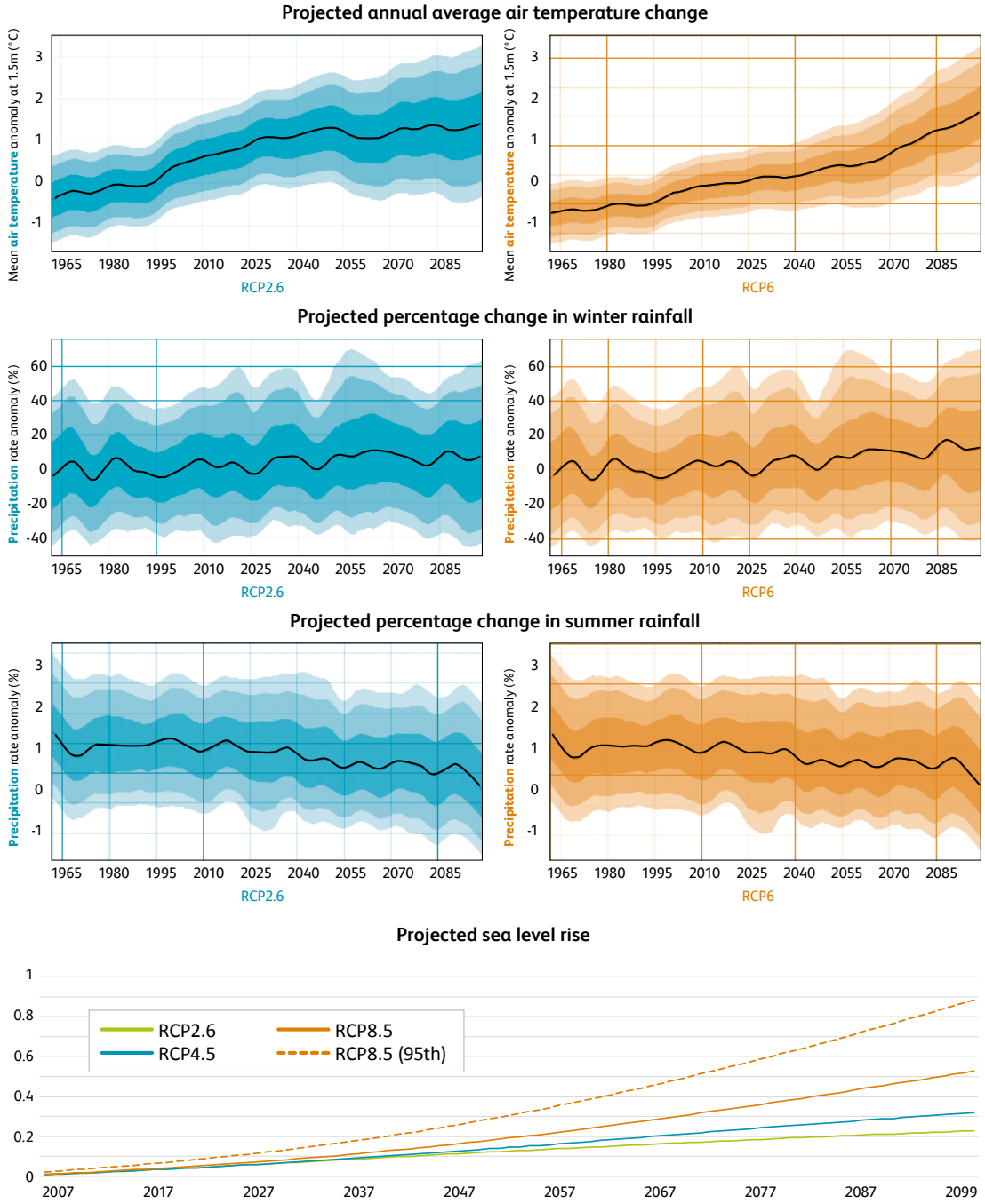


Fig. 4. Projected climate change for Glasgow City Region.

The figures show key projected changes (the anomaly) in temperature and rainfall for a number of Representative Concentration Pathways (the RCPs). The bold line shows the central project of the 50th percentile – i.e. as likely as not in the current scenario. The shaded areas show the other relative percentiles of probability – from 5, 10, 25th, 75th, 90th and 95th. RCP2.6 is a deep mitigation scenario and is representative of pathways that lead to very low greenhouse gas concentration levels. This scenario has a good chance of achieving the 2˚C goal. RCP6.0 is a medium emission scenario (with low mitigation) which is closer to current emission pledges. Note no marine projections for the RCP6.0 projections were produced for UKCP18, so they have not been included here.[1]

1.3 The climate crossroads

Glasgow City Region stands at a climate crossroads. People in the region are already beginning to experience the impacts of climate change, but how that looks and feels in the future depends on global action to reduce greenhouse gas emissions. At present, the world is not on track to achieve the goals set by the Paris Agreement[2] in 2015. The Scottish Government's national net-zero target for greenhouse gas emissions (by 2045) means that the region is delivering its own contribution towards mitigation, with Glasgow City setting its own more ambitious target for carbon neutrality by 2030. But even if the Paris Agreement is achieved globally, this will mean Glasgow City Region faces a very different climate over coming decades.

What is mitigation?

Mitigation strategies regroup all the efforts to reduce or prevent the emission of greenhouse gases (which leads to more climate change). Some of the ways to limit future emissions are the use of new technologies and renewable energies (including wind and solar power), to make older equipment more energy efficient and to change management practices or consumer behaviour.

The UK Climate Projections (UKCP18) show that the climate will change in Glasgow City Region will over the next decade or so, but these changes are projected to be broadly similar regardless of emissions. After 2030, this future becomes much more uncertain and depends on the success of global emissions reductions. By 2030, we will know if the world is on track to limit temperature rises to below 2°C, in line with the Paris Agreement, and what success there has been in limiting rises towards 1.5°C (relative to pre-industrial). If this has not been successful, we may face much higher temperature increases in the period that follows.

In 2019 Climate Ready Clyde completed a detailed Climate Risk and Opportunity Assessment[3] to understand what this could mean for Glasgow City Region's economy, society and environment in the short- and long-term. These were used to inform the development of the Adaptation Strategy and Action Plan. The assessment identified 67 risks and opportunities. Within this set, there were 10 particular risks or opportunities where further action is needed over the next five years:

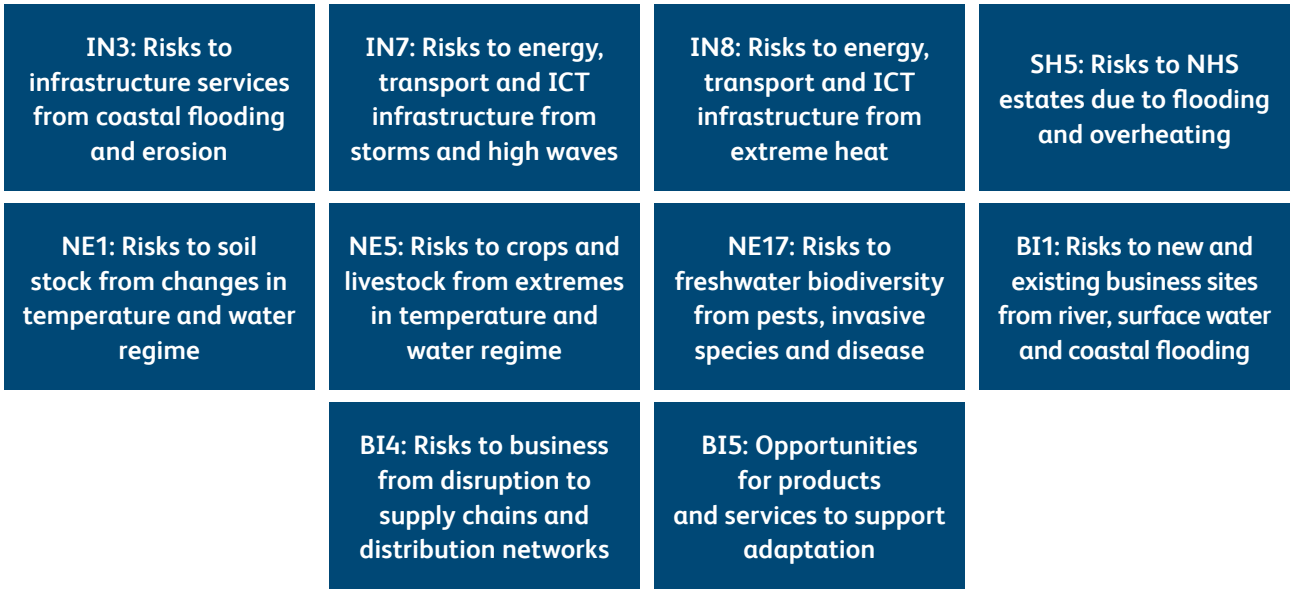


Fig.5. Glasgow City Region's risks and opportunities where more action is needed in the next five years.

The Assessment also found climate risks are unevenly distributed across Glasgow City Region. They will disproportionately affect those of us who are less well off, as such people tend to live in riskier places, be more vulnerable in general terms and have more limited means to respond. In addressing these risks there are potentially important opportunities (or benefits) from climate change, but these will not be fully realized, nor shared equally, without a planned and coordinated approach.

Therefore, we need to implement climate change adaptation solutions now and plan an approach over the next decade which ensures the region is climate ready for a range of possible changes and impacts. This means building our collective and individual capacity to adjust in the face of different climate futures (which have both general and extreme changes) and ensuring a focus on the most vulnerable to the impacts.

Doing so will help us reduce potential damages, cope with the consequences and ensure we take advantage of the few opportunities a changing climate offers the region. By planning and implementing adaptation alongside mitigation (net-zero) we can maximize the benefits of both strategies and minimize trade-offs.

1.4 Our vision, Theory of Change and principles

Climate Ready Clyde has worked with a wide range of groups to develop a compelling vision of a Glasgow City Region that flourishes in a future climate. The vision is underpinned by a Theory of Change,[4] developed ahead of the Adaptation Strategy, that sets out conditions required for that change to occur. We have used the vision and principles to inform the development of both the Strategy and Action Plan.

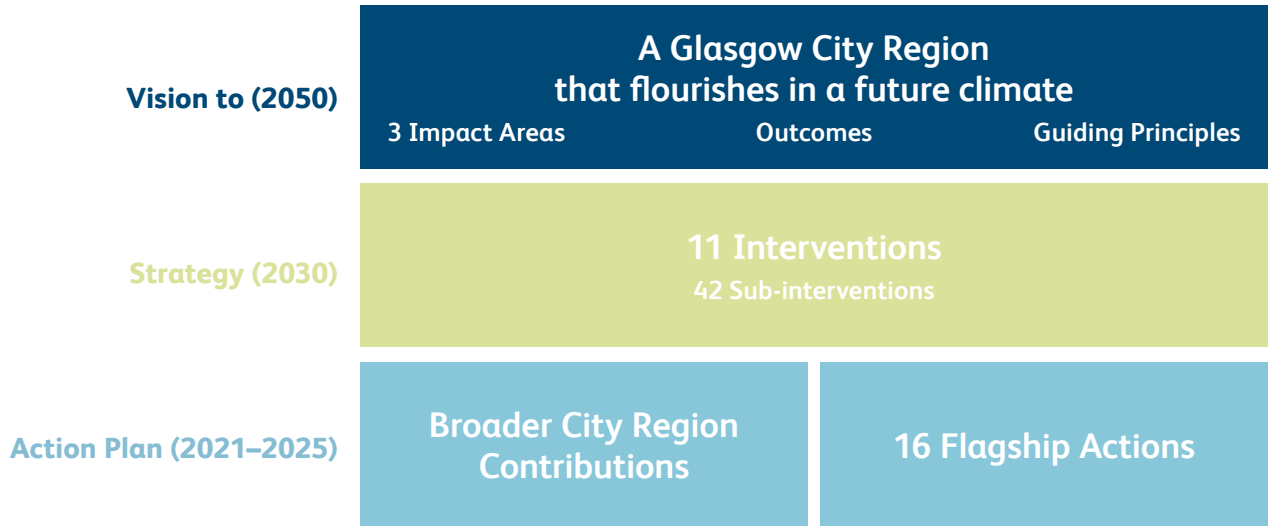


Fig.6. Vision and Theory of Change within Glasgow City Region's Adaptation Framework.

Fig.7. Theory of Change for a climate-ready Glasgow City Region.

The vision and Theory of Change are guided by the following principles:

- **More of the same will not do.** An effective response to climate change will require a revolutionary and systemic approach.
- **Climate and social justice.** People's lives can be made healthier and happier, and inequality and vulnerability lessened by efforts to build climate resilience.
- **Revolution in understanding.** There needs to be a 'revolution in understanding' the potential impacts of climate change and the adaptation options available to a much wider cohort of people and communities.
- **Revolution in planning.** There needs to be a 'revolution in planning'. We must rethink how we use land and space and where and what we build, with planners and developers empowered to prioritize climate resilience.
- **Revolution in finance.** There needs to be a 'revolution in finance' to ensure that the funds and resources necessary to build climate resilience are made available.
- **Recognizing uncertainty.** Our future is uncertain; we need to reduce global heating and plan for worst-case scenarios, recognizing that climate change is not a linear process.
- **Intrinsic value of nature.** Nature/biodiversity has tangible cultural and spiritual value and efforts to build climate resilience should do so in ecological, as well as human, communities.

1.5 The economics of climate change and adaptation

Climate Ready Clyde has assessed the potential economic costs of climate change in the region. The projected costs are shown below for three pathways (RCP2.6, RCP4.5 and RCP6.0), with the upper and lower of these being broadly equivalent to a +2˚C pathway (RCP2.6) and a +4˚C pathway (RCP6.0). This indicates economic costs of approximately 0.5% to 0.9% of regional GDP by 2045, for a low and high warming scenario respectively (RCP2.6 and RCP6). These impacts are dominated by flooding (from coastal, river and surface water flooding). The costs rise significantly in later years, especially for higher warming levels.

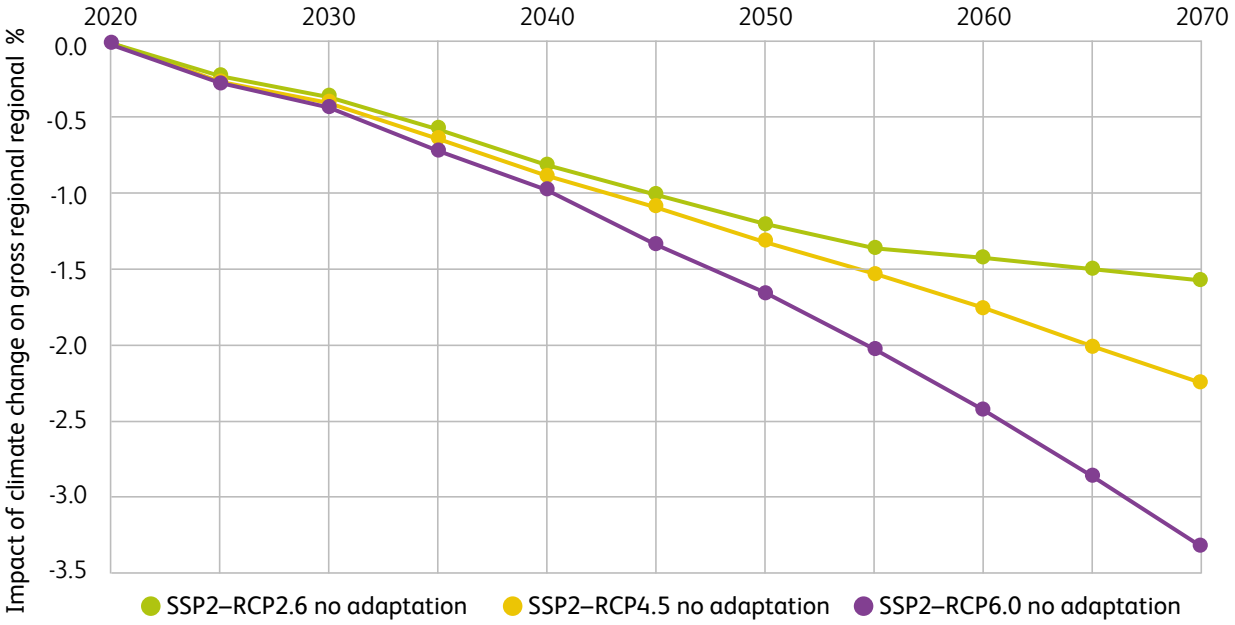


Fig.8. The potential economic costs of climate change in the region for multiple climate futures. Source: COACCH.[5]

Importantly, the figure shows that even if the world meets the Paris Agreement goal to limit warming, there will still be high economic costs from climate change for the region, i.e. which are already locked in. These impacts can only be reduced by adaptation. Recent studies identify that such adaptation makes sound economic sense, with the benefits of action far outweighing the costs of inaction, and further, adaptation has high benefit-to-cost ratios. Delaying action will make it much harder to tackle future climate risks and may make large future costs inevitable. A headline assessment of the benefits of adaptation to sea level rise and flooding for Glasgow City Region shows the potential to reduce the impact of climate change on GDP by up to 1% by 2065.

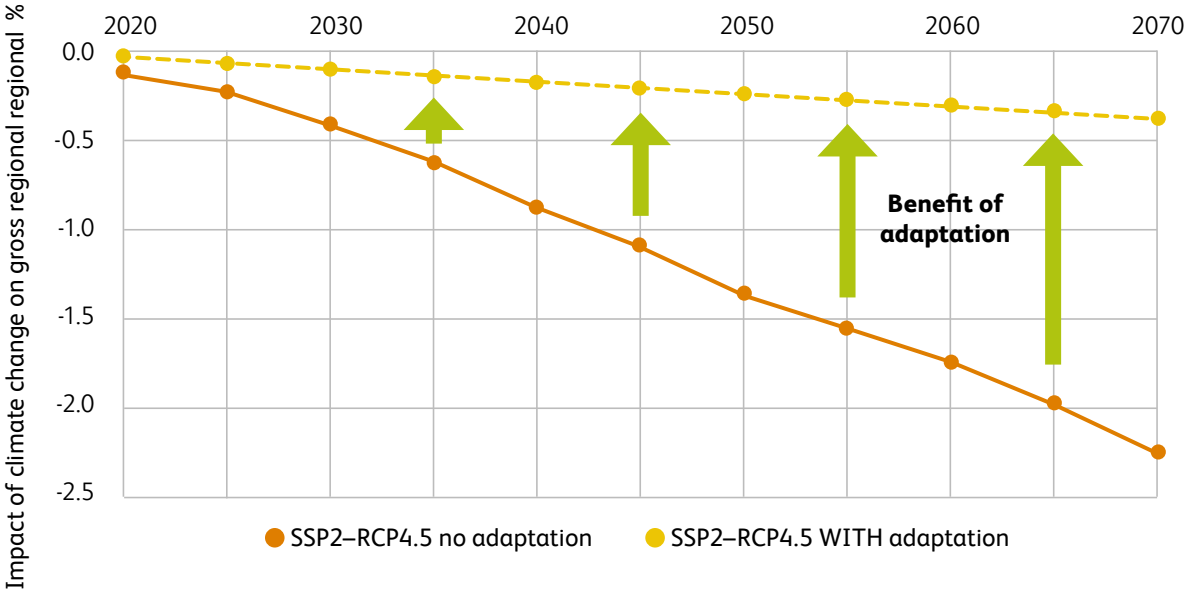


Fig.9. The benefits of adaptation for Glasgow City Region GDP, medium emission. Source: COACCH.

Glasgow City Region has started to manage climate risks and plan early responses, in line with the second Scottish Climate Change Adaptation Programme but much more is required to ensure we are climate ready by 2030 and on course to flourish in our future climate. The good news is that Climate Ready Clyde recognizes these challenges and is committed to addressing them with an inclusive and fair approach. We must act fast. It will require leadership, new governance mechanisms and funding regimes, and an explicit emphasis on addressing the current inequalities and inherent unfairness of climate change risks. The results will include benefits for our health and well-being, our economic prosperity and our way of life.

1.6 Delivering 'Just Resilience'

Implicit throughout this Strategy and Action Plan is a focus on just resilience. Scotland is developing its approach to a 'just transition' – making sure the transition to environmentally and socially sustainable jobs, sectors and economies, is done in a way which makes all possible efforts to create decent, fair and high value work, and does not negatively affect the current workforce and overall economy. For adaptation, it is equally important to ensure just resilience; addressing the social and economic inequalities created by the exposure to climate risk and the ability to deal with them. Achieving just resilience will ensure the benefits of our region's adaptation are widely and equitably shared.

Ensuring we include a balance of interventions for the region, that includes targeted action towards the most vulnerable, involves several considerations. It is important to recognize that wider social and economic factors, such as the gender, ethnicity, age, disabilities, other protected characteristics, housing tenure and income all affect how people are impacted by climate change. These wider social and economic determinants should be addressed as part of adaptation responses. A good example is how SEPA has assessed the factors of vulnerability to flooding to prioritize investment in flood risk management. It could also mean developing new heatwaves plans in a way which makes sure all groups affected, and particularly vulnerable groups, are not overlooked.

Increasingly, it will involve promoting long-term economic diversification to ensure that workers whose jobs are impacted by climate change are able to requalify and move towards green growth sectors. This will require improving our understanding of the effects of climate change on workers, working conditions, health and safety, assessing the related distributional effects.

Complementing just resilience by ensuring adaptation reduces, not increases vulnerability

A complementary piece to a just resilience approach is ensuring we also plan to ensure adaptation efforts avoid increasing vulnerability. Sometimes an adaptation intervention to address one issue or in one area can lead to detrimental effects for others for example, by redirecting water to other places and transferring risks or by accidentally raising property prices, reducing available incomes to adapt should a flood event occur. Some forms of adaptation may also give a false sense of security, reducing people's preparedness to future risks. Addressing these issues requires a greater focus on integrated and iterative adaptation.

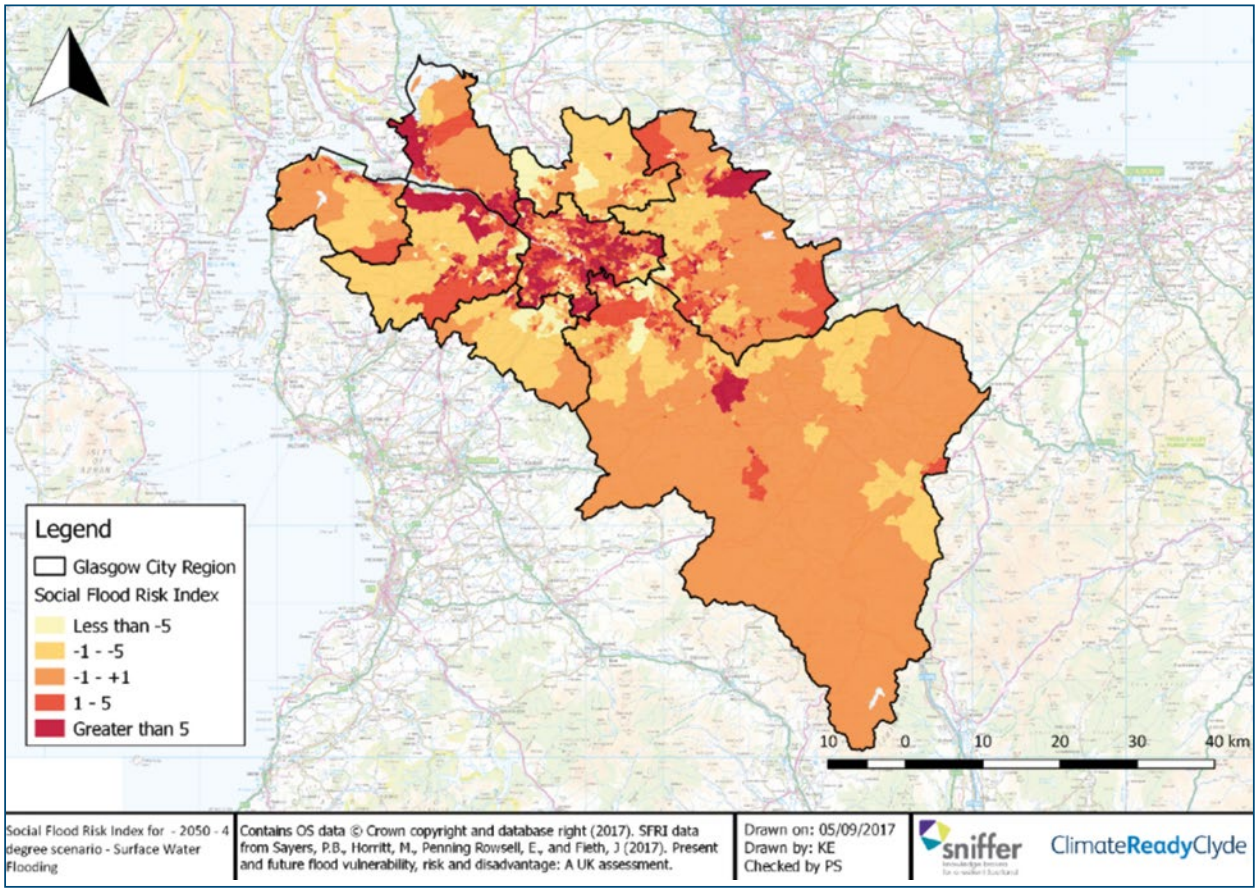


Fig.10. Intersection of future flood exposure and social vulnerability in 2050, 4˚C scenario. Source: Sayers et al. (2017).[6]

1.7 Building ecological resilience

Addressing the climate risks to people involves recognising that we are inherently related to and reliant upon the natural environment. Therefore adaptation must also seek to build the resilience of nature and wider ecological systems.

The recent Dasgupta Review on the Economics of Biodiversity[7] identified that our economy and society have collectively failed to engage with nature sustainably, to the extent that our demands far exceed its capacity to supply us with the goods and services we all rely on. This has neatly been acknowledged in the concept of 'Doughnut' economics – which explicitly recognises the environmental constraints, as well as the need to provide strong social foundations for all. As shown below, the world is operating far beyond the ecological ceiling in many areas, including climate change.

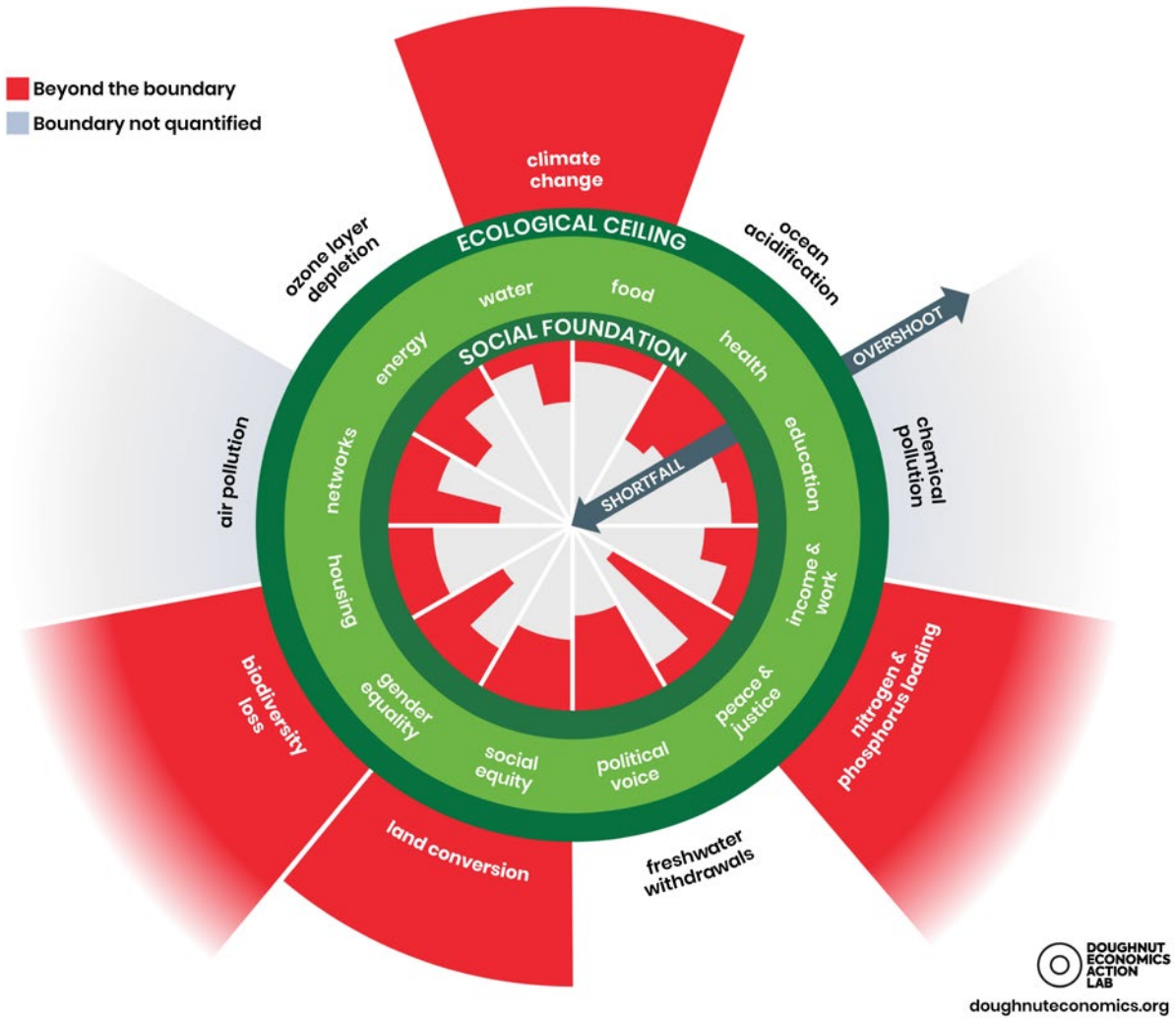


Fig 11: The Doughnut of social and planetary boundaries for the global population, with overshoot of planetary boundaries and shortfall on basic needs both shown in red. Source: Doughnut Economics Action Lab.

This global overshoot is mirrored at the UK and EU levels. The actions we take to adapt and build our own resilience to climate change (e.g. through nature-based solutions) also offer the potential to enhance the natural environment, protecting and building the resilience of vital habitats and ecosystems and our own in a virtuous cycle. This will help ecological systems adjust to the historic consequences of carbon emissions, as we restructure our economy and society to work within them.

Note: dark green circles show the ecological ceiling and social foundation. Blue wedges show social performance relative to a threshold associated with meeting basic needs. Green wedges show resource use relative to a biophysical boundary associated with sustainability. Red wedges show shortfalls below the social threshold or overshoot beyond the biophysical boundary, while grey wedges show indicators with missing data. Wedges with a dashed edge extend beyond the chart area.

Fig 12: Comparison of UK and EU-28 performance against the global ecological ceiling and social foundations. Source: University of Leeds.

PART 2

A Strategy for a City Region that flourishes in its future climate

2.1 About the Strategy

The Adaptation Strategy provides the strategic direction for Glasgow City Region through to 2030 to realize our vision and Theory of Change. It sets out 11 interventions supported by 42 sub-interventions, designed to shape our near-term Action Plan, as well as wider action across Glasgow City Region. Its role in the Adaptation Framework for Glasgow City Region is shown below:

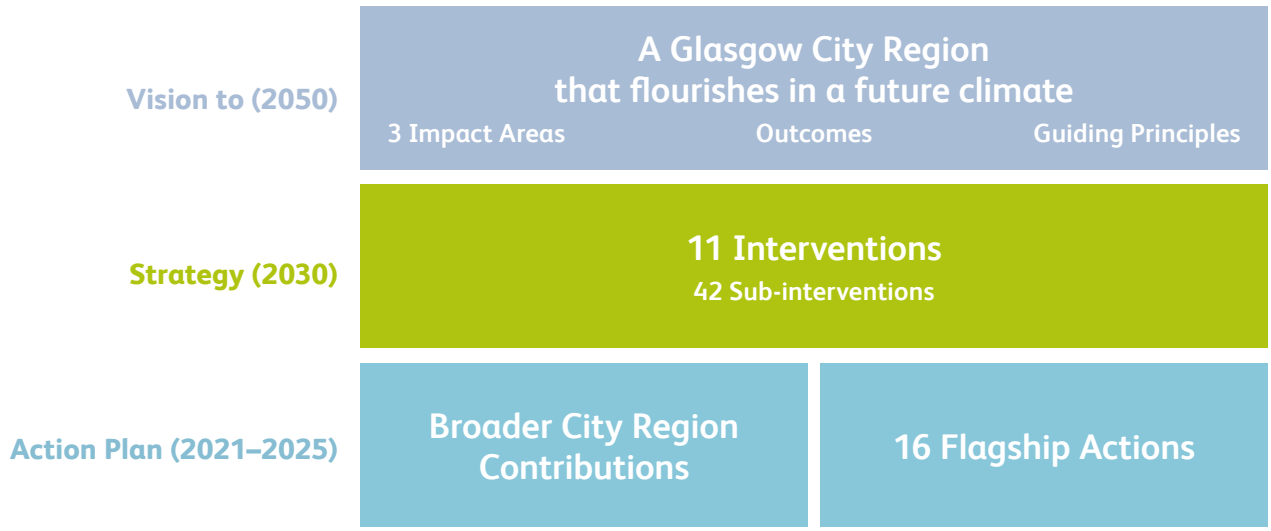


Fig.13. Adaptation Strategy within the Glasgow City Region Adaptation Framework.

2.2 Adaptation Strategy and Action Plan objectives

This Strategy and Action Plan:

- seeks to build the region's social, economic, and environmental resilience to climate change
- outlines the processes and early interventions needed to manage climate risks and realize opportunities in line with our Theory of Change
- provides a strategic framework for adaptation in and by Glasgow City Region that fits alongside and supports key plans, policies and activities to enable delivery
- sets out how we will deepen and expand collaboration and collective impact by working together and engaging, equipping and enabling citizens and organizations to play a role in realizing the vision
- sets out how progress in increasing climate resilience will be monitored, evaluated and learnt from to improve policies, strategies, programmes and projects.

Much of the ambition in this Strategy is aligned to existing or emerging Scottish policy, driven by the outcomes in the National Performance Framework. For example, Scotland's Place Principle is integral to our approach. Glasgow City Region is a place where people, location and resources combine to create a sense of identity and purpose. This is at the heart of addressing the needs and realizing the full potential of communities. This was also at the heart of National Planning Framework 4,[8] which embodies many other ongoing aspirations such as:

- **creating 20-minute neighbourhoods**
- **prioritizing the redevelopment of brownfield sites and addressing issues of vacant and derelict land**
- **re-imagining town centres identified as a high source of heat generation**
- **embedding the requirement for low and zero carbon design and energy efficiency**
- **securing low carbon heating solutions**
- **woodland creation and expansion**
- **use of open spaces, green infrastructure and biodiversity to make places more resilient**
- **the protection of peatland and carbon rich soils.**

It has also been designed to directly support Glasgow City Region's Economic Recovery Plan,[9] helping support efforts to simulate our economy and create jobs as we emerge from the COVID-19 pandemic. Much other existing policy contains the levers needed to achieve our vision. These are included in the technical annexes. It is important that all the activities undertaken to deliver the Strategy should be undertaken as sustainably as possible, making use of tools and processes and concepts such as the circular economy, the waste hierarchy, biodiversity net-gain, CEEQUAL and BRREAM.

Net-zero – achieving synergies, avoiding trade-offs

Achieving net-zero is an important ambition for Scotland, and will require wide-reaching change to transport, land use, energy and planning systems of a similar type to those outlined here. When done in parallel, such changes have the potential to create synergies (for example, protecting and restoring peatlands to store carbon and reduce flood risk), as well as trade-offs (for example, denser towns and cities can reduce transport emissions, but increase risks by creating heat islands). A key principle throughout the Strategy has been to maximize the synergies and minimize trade-offs, and such synergies will also be required for individual projects.

2.3 Our ambition: transformational adaptation, accelerated by systems-level innovation

Achieving our vision of a City Region that flourishes in a future climate will require widespread and sustained change. Glasgow City Region is getting ready to deliver its net-zero ambition in line with Scottish Government's commitments and with Glasgow City aspiring to a more ambitious target to be carbon neutral by 2030. We want a similarly ambitious approach in Glasgow City Region for adaptation.

Delivering this will require new types of **response**. Some interventions in the Strategy take a proactive but ***incremental*** approach to adaptation. In such cases, the aim is to improve the climate resilience of existing systems and actions. This often involves mainstreaming climate change into policies, programmes and plans. In other areas however, this incremental approach will not be sufficient to address the scale of future risks. In such cases, a different form of adaptation is needed, involving more **transformational adaptation**.[10]

As actors in the region shift into more transformational responses, their **coverage** changes; there is more overlap with both the net-zero agenda and wider sustainable development in the region, and a 'whole-systems' approach is needed. This increases the potential for both synergies and trade-offs between adaptation wider socio-economic goals and requires engagement with and action by a more diverse set of actors. The interventions in the Adaptation Strategy (and set out in the next section) represent a suite of actions, that start with incremental adaptation but move to transformation, as well as shifting from climate risk alone to wider sustainable development. The diagram below sets out where the interventions of the Strategy sit in terms of this response and coverage.

To complement and accelerate the interventions in the Adaptation Strategy and increase the pace and scale of change for adaptation, we have employed systems thinking to develop larger-scale innovation. Our vehicle for this approach has been the Resilient Regions: Clyde Rebuilt project, working in partnership with EIT Climate-KIC.

What is transformational adaptation?

Transformational adaptation involves changing existing approaches, altering governance arrangements, and addressing underlying causes of climate risk or vulnerability. It may also involve re-thinking the future vision of the region, including the societal, cultural, institutional, ecological and physical changes needed, as well as the region's political economy. Transformational approaches call for systems thinking and socio-institutional analysis, and offer the potential to deliver a larger, more sustainable, permanent, long-term change (Source: Clyde Rebuilt, 2020).

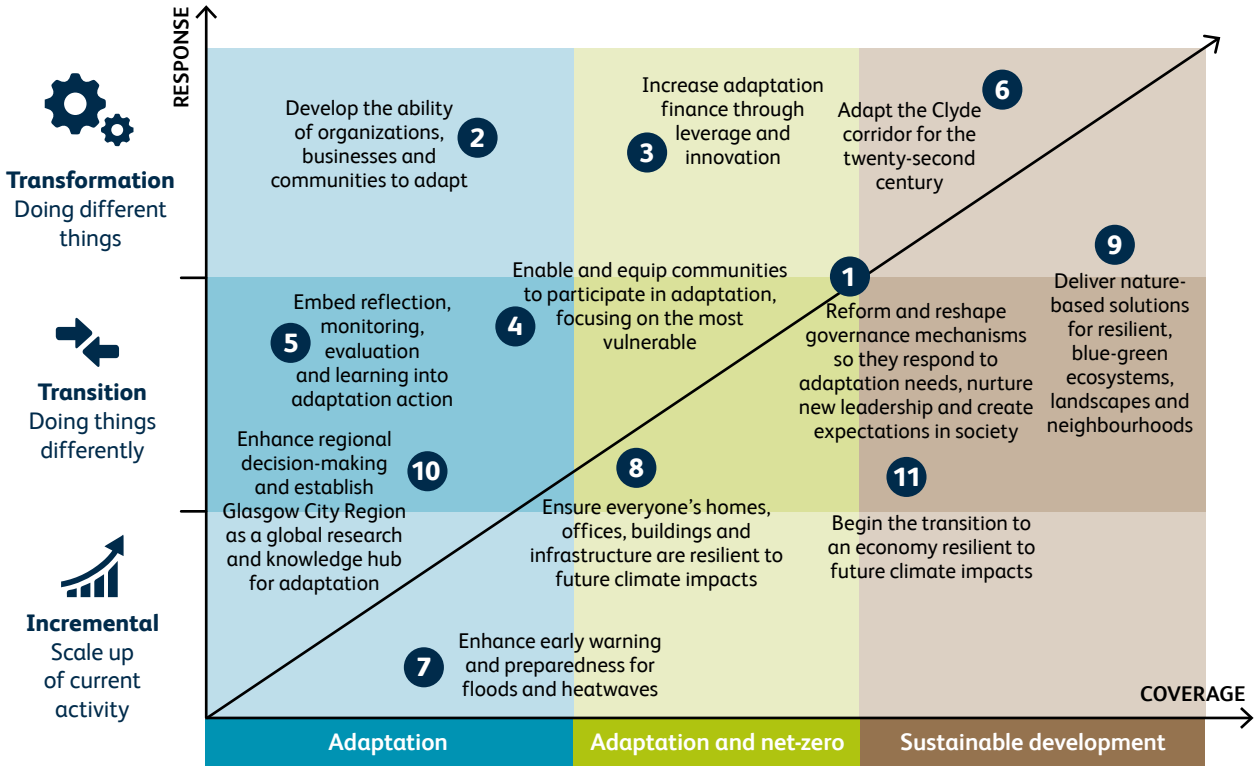


Fig.14. Regional Adaptation Strategy interventions by coverage and response.

2.4 How the Strategy was developed

To develop the Strategy, the Climate Ready Clyde Secretariat drew on two key inputs as the underpinning knowledge, evidence and insight:

- **A Climate Risk and Opportunity Assessment for Glasgow City Region** identifies the sectoral climate risks and opportunities, based on the approach to the UK's Climate Change Risk Assessment.
- **Vision and Theory of Change for a climate-ready Glasgow City Region** provides the positive vision, impacts and outcomes we can achieve from effective adaptation, and the conditions needed to achieve it.

The CRC Secretariat drew on them to develop the Strategy's 11 strategic interventions. In parallel, the Strategy was shaped during 2020 through the Resilient Regions: Clyde Rebuilt project – a joint effort with EIT Climate-KIC, the EU's climate innovation organization which is seeking to accelerate and transform cities and regions' responses to climate change over the next decade. Clyde Rebuilt resulted in two additional resources which provided further knowledge, evidence and insight:

- **Background literature reviews** on what transformational adaptation looks like and the potential to deliver a Green New Deal for Glasgow City Region in response to COVID-19.
- **Systems insights** to explore systems innovation that could rapidly accelerate progress in adaptation as well as how it might be financed. More detail on this process is set out in the box below.

The Clyde Rebuilt team also undertook an economic assessment and produced a Resource Mobilization Plan for the funding and financing of the Strategy. Throughout the process, the impacts of the Strategy on environment, habitats and people were assessed through a Strategic nvironmental Assessment, Habitat Regulations Appraisal and Social Impact Assessment. These were undertaken to align with key stages of the Strategy development, including the publication of the draft and final version.

The Strategy and Action Plan was written and compiled by members of the Climate Ready Clyde Secretariat (Sniffer), in conjunction with staff from economics consultancy Paul Watkiss Associates and charity Creative Carbon Scotland, on behalf of the Climate Ready Clyde Board. The full development process, including the evidence used to inform it, and how its environmental and social impacts have been assessed are set out in Figure 14.

Glasgow City Region Climate Adaptation Strategy timeline

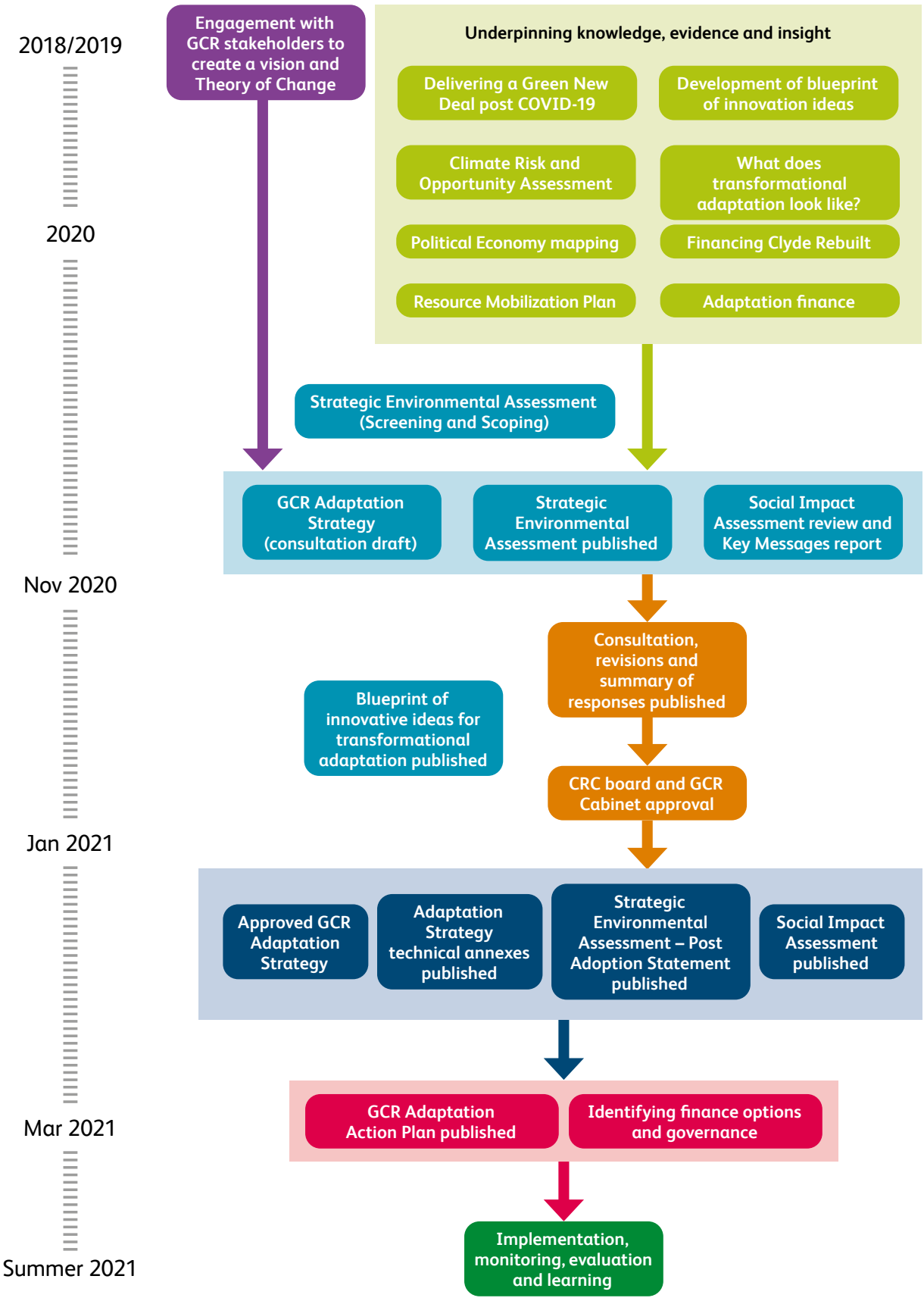


Fig.15. The development process.

Resilient Regions: Clyde Rebuilt – innovating to accelerate adaptation action

Glasgow City Region is taking a pioneering role to accelerate climate adaptation using innovation and is a front runner in a process which will be adopted and replicated by over 100 regions in Europe over the next decade. Through Clyde Rebuilt, Climate Ready Clyde worked in partnership with EIT Climate-KIC through its Deep Demonstration programme of Resilient Regions, which is championed by the European Commission's Adaptation Mission.[11] The Deep Demonstration approach focuses on a whole-system approach that looks at business, governance... and behaviour changes, in addition to technological, environmental and social innovations that will accelerate progress.

The process involves identifying new levers in Glasgow City Region's systems which have the potential to stimulate more transformational change, before piloting, evaluating, adjusting and scaling-up. These levers have then been used to identify large-scale innovation actions which will significantly accelerate adaptation progress across all areas of the Strategy's interventions.

During the Strategy development process, the Clyde Rebuilt project engaged with many new and different actors from within Glasgow City Region to map the systems relating to culture, governance and delivery of adaptation. Alongside this, it looked at new approaches for financing adaptation, including innovative instruments and with different actors. These have given us a 'blueprint' of 15 'positions' – areas where urgent, innovative solutions could help accelerate the region's climate-resilient transition. These are set out below. We have also reviewed emerging solutions in these spaces from other cities and regions, to see what progress is already being made and how it might apply locally. The focus has been on identifying systemic actions in relation to extreme heat, health and well-being, and transformative finance solutions.

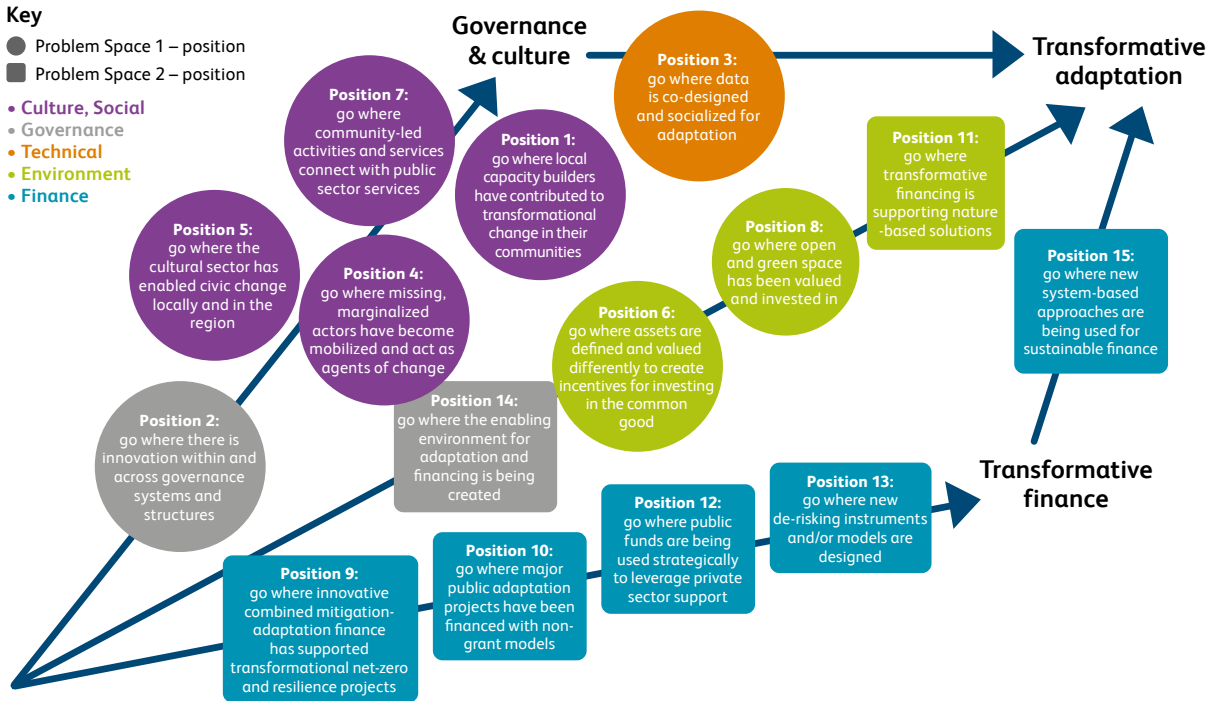


Fig.16. Systems innovation positions for Glasgow City Region's adaptation efforts.

2.5 Strategic interventions

For Glasgow City Region to flourish in our future climate, Glasgow City Region's businesses, communities and institutions must work to deliver a number of interventions. By an intervention we mean:

"A strategic package of activities designed to achieve intermediate outcomes and contribute to our long-term outcomes."

The interventions have been written to both respond to near-term risks and to bring about the long-term outcomes in the Theory of Change. Rather than working in silos, each intervention delivers activities which contribute to achieving multiple outcomes simultaneously. The mapping of these is shown in detail in the technical annexes. In terms of managing climate risks, each intervention has been designed to address one or more of following priorities for early adaptation:

- to implement early, low and no-regret adaptation to address current risks and build early resilience
- to intervene early in decisions that have long lifetimes (notably land use and infrastructure) with climate smart development
- to start planning for the longer term using an adaptive management framework (i.e. using an iterative approach that recognizes uncertainty) that includes more transformational actions.[12]

The interventions also address the priorities identified in the Climate Risk and Opportunity Assessment – see Figure 17.

More action needed risks	1 Reform and reshape governance mechanisms so they respond to adaptation needs, nurture new leadership and create expectations in society	2 Develop the ability of organizations, businesses and communities to adapt	3 Increase adaptation finance through leverage and innovation	4 Enable and equip communities to participate in adaptation	5 Embed reflection, monitoring, evaluation and learning into adaptation action	6 Adapt the Clyde corridor for the twenty-second century	7 Enhance early warning and preparedness for floods and heatwaves	8 Ensure our homes, offices, buildings and infra-structure are resilient to future climate impacts	9 Deliver nature-based solutions for resilient, blue-green ecosytems, landscapes and neighbourhoods	10 Establish Glasgow City Region as a global research and knowledge hub for adaptation	11 Begin the transition to an economy reislient to climate impacts
IN3: Risk to infrastructure services from coastal flooding and erosion		✓			✓	✓		✓		✓	
IN7: Risks to energy, transport and ICT infrastructure from storms and high waves					✓	✓		✓		✓	
IN8: Risks to energy, transport and ICT infrastructure from extreme heat					✓			✓			
SH5: Risks to NHS estates due to flooding and overheating						✓	✓	✓			
NE1: Risks to soil stock from changes in temperature and water regime									✓		✓
NE5: Risk to crops and livestock from extremes in temperature and water regime									✓		✓
NE17: Risks to freshwater biodiversity from pests, invasive species and disease									✓		✓
BI1: Risk to new and existing business sites from river, surface water and coastal flooding.						✓			✓		✓
BI4: Risks to business from disruption to supply chains and distribution networks						✓					✓
BI5: Opportunities for products and services to support adaptation to climate change	✓										✓

Fig.17. Climate Risk and Opportunity Assessment mapped to Strategy interventions.

Together they provide a suite of actions for managing future risks and taking advantage of opportunities. The interventions are a statement of our ambition; of what we want to see happen over the next decade. The Climate Ready Clyde Board stand ready to help move to this new trajectory alongside a wide range of organizations, businesses and communities, who together are already progressing interventions in this strategy to varying degrees. How we move from this initial action to a full delivery will be set out in the subsequent Action Plan. The details of how this will be developed are outlined in Section 8. The full set of interventions and what needs to happen is as follows:

Interventions

1 Reform and reshape governance mechanisms so they respond to adaptation needs, nurture new leadership and create expectations in society

- 1.1 A detailed review of the new institutional landscape needed for adaptation
- 1.2 A broader coalition of actors Mobilized to deliver the Adaptation Strategy
- 1.3 Adaptation leadership at all levels that is nurtured and developed
- 1.4 News, arts, media and cultural organizations telling stories about the climate crisis and opportunities to adapt

2 Develop the ability of organizations, businesses and communities to adapt

- 2.1 An enhanced programme to increase awareness of the potential impacts of climate change on organizations and communities, and opportunities to adapt
- 2.2 Establishment of a City Region working group/forum and mentoring programme
- 2.3 Targeted community capacity building for adaptation

3 Increase adaptation finance through leverage and innovation

- 3.1 Strategic use of public sector funds to attract private sector investment
- 3.2 A Regional Adaptation Finance Strategy and Action Plan
- 3.3 Mapping and measurement of regional adaptation finance flows
- 3.4 Piloting of new approaches to transformative adaptation finance

4 Enable and equip individuals and communities to participate in adaptation, focusing on the most vulnerable

- 4.1 A shared understanding of how current community engagement is structured for adaptation
- 4.2 Increased community involvement in the region's adaptation governance, decision-making, planning and delivery
- 4.3 Resources, training and education for communities and young people to shape their places
- 4.4 Collaborations between organizations, communities, artists and cultural practitioners to stimulate creative and relevant adaptation responses

5 Embed reflection, monitoring, evaluation and learning into adaptation action

- 5.1 Learning by doing – building in active reflection and learning process
- 5.2 Encourage large organizations to sign up to relevant international reporting initiatives
- 5.3 Alignment of planning assumptions between domestic adaptation planning and the emerging TCFD/investor regimes
- 5.4 Learning and knowledge exchange with other cities and regions

6 Adapt the Clyde corridor for the twenty-second century

- 6.1 Work through Clyde Mission to govern climate risks for the entire river corridor
- 6.2 An iterative adaptation pathway for the Clyde developed
- 6.3 The climate resilience of the river corridor reflected as a national priority

Interventions

7 Enhance early warning and preparedness for floods and heatwaves

7.1 Extension of the flood warning scheme in Glasgow City Region
7.2 Implementation of an integrated climate alert warning system for Glasgow City Region
7.3 Continued delivery of strategic Flood Risk Management activities
7.4 A regional property flood resilience and resistance installation programme
7.5 Exploration of new insurance models

8 Ensure everyone's homes, offices, buildings and infrastructure are resilient to future climate impacts

8.1 Adaptation embedded in Glasgow City Region's net-zero transition
8.2 Creation of an adaptation forum for Glasgow City Region infrastructure
8.3 Adaptation of existing infrastructure, with policies and regulation to require all new investment to be climate resilient
8.4 Strengthening of adaptation requirements in the planning system
8.5 Creation of a regional retrofit framework for climate resilience
8.6 Creation of a framework for adapting cultural heritage assets
8.7 Lobby UK and Scottish Governments to reform infrastructure investment frameworks
8.8 Evaluation of future adaptation infrastructure needs

9 Deliver nature-based solutions for resilient, blue-green ecosystems, landscapes and neighbourhoods

9.1 Identify regional priorities for nature-based solutions
9.2 Delivery of the regional Strategic Green Network
9.3 Creation of the Clyde Climate Forest
9.4 Increase investment in targeted habitat restoration
9.5 Roll out of large-scale blue and green infrastructure projects to demonstrate benefits to communities – either through new green infrastructure or removal of hard landscaping or public realm
9.6 Support for new local infill or expansion of existing nature-based solutions to strengthen the regional network
9.7 Develop and accelerate blue and green infrastructure financing

10 Enhance regional decision-making and establish Glasgow City Region as a global research and knowledge hub for adaptation

10.1 Enhanced adaptation research through open invitation to collaborate on publicly available research priorities
10.2 Glasgow City Region established as a living lab for climate adaptation
10.3 Convene an Expert Advisory Committee on Adaptation

11 Begin the transition to an economy resilient to future climate impacts

11.1 Adopt a climate smart regional economic development approach
11.2 Delivery of a just, climate resilient transition which nurtures adaptation skills
11.3 Climate-resilient supply chains as part of a net-zero, circular economy
11.4 An SME (Small and Medium Enterprise) support plan

Intervention 1

Reform, reshape and expand governance mechanisms to respond to adaptation needs, nurture new leadership and create expectations in society

Aim: To create societal expectations for transformative adaptation and ensure governance mechanisms, institutional structures and leadership involves new actors. Such approaches will create the space to explore and reconcile differences of opinion on the way forward, and will explicitly consider differing cultural identities, power structures and decision-making processes of institutions, groups and individuals across the region.

Background: Glasgow City Region has a deep-rooted history of fostering innovative, collaborative approaches to regional challenges, most recently evidenced in collaborative initiatives such as Clydeplan, the Metropolitan Glasgow Strategic Drainage Partnership and the Glasgow and Clyde Valley Green Network Partnership. Delivering the regional Adaptation Strategy needs widespread action by citizens, communities and businesses, and governance which enables this. Governance can take many forms, including cultural. Culture has proven a powerful mechanism for driving regional change, as happened with Glasgow's award as City of Culture in 1990, and the transformation it brought in the region's prospects and its citizens' outlook. There is an opportunity to deliver a similar shift in the climate domain.

The challenge: We need all citizens to play their part in this journey and to create societal expectations that political leaders and businesses will scale up activities to build resilience to climate change. News, media, art, music and theatre can all act as strong levers to engage wider audiences and shift collective behaviours. But the power and dynamics of the civic space are shifting. The large concentration of wealth in smaller numbers of individuals and companies, as well as new types of social and political actors require non-traditional mechanisms for collaboration. Private companies and individuals increasingly influence and reshape the policy landscape, whilst communities of both identity and geography can exercise their voices, facilitated by digital platforms such as Twitter are emerging. Both types of actor are working at a coherence, speed and efficiency beyond traditional public sector mechanisms for collaboration. Addressing this is a collective challenge and will require institutions to rebuild trust and put in place the necessary infrastructure for massive collaboration, allowing meaningful and genuine engagement.

Where are we now? Glasgow City Region has already begun developing new structures to deal with long-term challenges, such as Glasgow City Region City Deal and Clyde Mission, and has begun using new forms of technology and consultation approaches to better involve and engage citizens, along with holding regular dialogue with private sector actors. In addition, Climate Ready Clyde gives a clear focal point to allow the coordination of climate risk and adaptation in Glasgow City Region, but more could be done to make it more inclusive and to facilitate delivery.

What needs to happen:

1.1 A detailed review of the institutional landscape needed for adaptation which identifies ways of enhancing governance for adaptation, including within and between existing institutions, as well as whether new ones are needed. Such a review also needs to consider wider trends shaping governance, how to improve leadership opportunities and representation for communities and minorities, and how to meaningfully engage them in the process to enhance coordination and delivery of adaptation. It needs to account for the changing civic space and the shifting role of the region, private sector and technological advances.

1.2 A broader coalition of actors mobilized to deliver the Strategy with new public, private and third sector actors and communities engaged in discussing how to increase our adaptation effectiveness. Such as approach should be guided by the use of 'keystone' actors – those who hold an importance that goes beyond their own organization and instead whose actions have the potential to create wider change across the region, or relevant systems.

1.3 Adaptation leadership at all levels that is nurtured and developed where all those involved (public sector, trade and professional networks, politicians and community leaders) better understand the specific challenges associated with adaptation activity, such as in relation to finance, solutions, evidence and social change. This could be through the development and rollout of a specific adaptation leaders programme.

1.4 News, arts, media and cultural organizations telling stories about the climate crisis and opportunities to adapt with the cultural sector and media institutions supported in raising public awareness of the risks of climate change in Glasgow City Region, playing a key role as hubs for community building and resilience, and celebrating adaptation successes of those taking action across the region. This should focus both on ensuring the mainstream media raise awareness, as well as on avenues for allowing people to tell their own stories of how climate risks are affecting them, and adaptation is improving their lives as a mechanism for empowerment.

Intervention 2

Develop the ability of organizations, businesses and communities to adapt

Aim: For businesses, organizations and communities to increasingly contribute to making adaptation happen. By considering and addressing climate risks in all strategies, plans, programmes, projects and operations, as well as capability building across public institutions, businesses and community groups to systematically consider the positive and negative implications of a changing climate on their operations.

Background: The strategic, large-scale interventions included in this Strategy will unlock opportunities and drive systems change. They will make it easier for society to adapt but cannot replace the need for collective action. It is essential that public, private and third sector organizations and whole communities actively engage with adaptation and develop their ability to act.

The challenge: Climate change has the potential to make it harder for all organizations and communities to reach their existing goals and to deliver their programmes, plans, investments and projects. But many organizations or communities currently neglect climate change risks and opportunities for adaptation, and where they do act, it is often from an individual, siloed perspective, rather than an integrated and more strategic approach. What's more, they generally do not consider the need to develop skills of individuals and teams to adapt well. In the years ahead we must develop and expand the ability of citizens, professionals and organizations to collaborate and implement adaptation actions across all scales. This will require intensive capacity building and creating opportunities for collaboration, training and learning, as well as a flexible definition of a 'community', realizing that it means different things in different contexts.

Where are we now? Through Climate Ready Clyde we have begun to develop a community of adaptation leaders who are influencing change across their organizations, sectors and spheres of influence. We have seen the benefits of collaboration, skills development and shared learning in accelerating adaptation across all scales: from embedding climate risk in decision-making processes through to factoring adaptation actions in to planning and investment decisions.

Many organizations and strategic partnerships have begun to factor climate change considerations into their plans and strategies, decision-making and skills and organizational development. The Regional Economic, Spatial and Transport strategies, as well as the Regional Marine Plan are including a strong focus on adapting to climate change. On decision-making, Glasgow City Council, University of Glasgow and South Lanarkshire Council are among the first major organizations in Glasgow City Region to factor climate change risks into their decision-making. On skills and organizational development, SEPA's new Flooding Services Strategy actively recognizes the need for new approaches and skills.[13] More broadly, the Adaptation Scotland programme provides tools, resources and capacity building support to enable adaptation across all sectors, this includes an Adaptation Capability Framework which enables organizations to mature their approach to adaptation. In the private sector, the Task Force on Climate-Related Financial Disclosure (TFCD)[14] sets out requirements for businesses to address the governance, management and understanding of climate risks, and provides support to implement it.

What needs to happen:

2.1 An enhanced programme to increase awareness of the potential impacts of climate change on organizations and communities, and opportunities to adapt. This should involve targeted engagement with intermediary organizations such as trade bodies, as well as communities to raise awareness of climate impacts and risks to key sectors and systems in Glasgow City Region, enhancing the national work of Adaptation Scotland. This approach should use digital and physical methods and be underpinned by a robust evidence base on adapting to climate risk, providing information to support adaptation decisions and investments, and to ensure an integrated approach to adaptation is promoted across communities and organizations.

2.2 Establishment of a City Region working group/forum and mentoring programme. Partnering public, private and third sector organizations together with those that broker knowledge (e.g. Adaptation Scotland programme, research providers) to support greater integration of climate change into their strategic decision-making, supported by tools and techniques to make it happen. A key focus should be on mainstreaming consideration of climate risks into policies, plans, strategies, programmes and projects, with a particular focus on those organizations which have a material impact on the direction of Glasgow City Region. Priority should be given to organizations or sectors at particular risk, or of strategic importance to Glasgow City Region (e.g. financial services), or with opportunities for co-benefits, such as air quality or tourism management. It should also consider how such activities interact with wider sustainability goals.

2.3 Targeted community capacity building for adaptation. In addition to capacity building of organizations and communities most exposed or vulnerable to impacts should be given opportunities to build their adaptive capacity and resilience. Such opportunities should cover both practical resilience and adaptation measures, as well as mental welfare and resilience, and be delivered in partnership with the existing actors and networks, such as the Community Planning Partnerships and the Scottish Flood Forum.

Intervention 3

Increase adaptation finance through leverage and innovation

Aim: To mobilize and scale the resources needed across Glasgow City Region to implement the interventions in this Strategy.

Background: To implement planned adaptation options for Glasgow City Region, urgent mobilization of additional finance is crucial. This will require a scale up of funds from the public sector, the leverage of existing public funds to crowd in private sector investments, and innovation in financing structures to deploy and raise further private sector finance.

The challenge: Financing adaptation requires Glasgow City Region to overcome several barriers. Many adaptation investments are in public goods that do not generate an income stream for investors. There is also a challenge to reconcile short-term investment in adaptation versus the long-term benefits it will deliver. To overcome these challenges to adaptation finance, it is essential to consider how to strategically use available public resources, as well as to design new financial models for adaptation that includes a wider set of partners. Doing so can attract private sector finance by leveraging public sector funds, through innovative financing structures and instruments. For example, there are opportunities to use public funds to de-risk private sector investments using insurance and guarantee products. Platforms to facilitate such innovation for transformative finance are lacking and need further development. Priority areas for investment include those areas which risk locking in climate risk for the long-term, such as in the infrastructure and built environment sectors, nature-based solutions (where there is the potential for multiple benefits), and other areas where adaptation can provide both private and public goods.

Where are we now? Much work is underway globally on green finance, including with Scottish Government, SEPA and NatureScot, but little has focused on adaptation. At present, most funding of adaptation in Glasgow City Region and Scotland is grant based, with limited funds flowing into adaptation outside of flood risk management. However, there are some initiatives looking to develop new financing instruments and structures that consider ways to attract private sector investments. As Scotland's largest region, as well as a hub for insurance services, Glasgow City Region is well placed to further expand these initiatives to explore the role of transformative finance for adaptation.

What needs to happen:

3.1 Strategic use of public sector funds to attract private sector investment with public institutions taking a more commercial approach to spending, to lever in private sector investment. Such approaches should seek co-benefits with other places/projects, designing co-mitigation and adaptation opportunities where feasible, creating innovative financing structures and new instruments to address private sector investment risks and focusing on increasing the scale and replicability of adaptation options.

3.2 A Regional Adaptation Finance Strategy and Action Plan that sets out how to mobilize the required finance to deliver this Strategy. This should examine how to increase the public sector's fiscal flexibility (e.g. through debt finance such as green or resilience bonds), crowd in private sector investment and the strategic role of wider government-led green finance initiatives, such as the Green Investment Portfolio and the Scottish National Investment Bank. It should map the possible actors involved in the climate finance landscape and potential financing approaches, including the applicability of new finance models and instruments. The plan should also consider how changes to charges or subsidy regimes could be used to mobilize and direct finance towards most vulnerable households. It should scope the most appropriate delivery mechanisms, drawing on examples from other places including Greater Manchester and London.

3.3 Mapping and measurement of regional adaptation finance flows to build understanding of the region's finance requirements for adaptation, by developing methods to measure the amount of funds spent on adaptation and the estimated adaptation needs at the regional level.

3.4 Piloting of new approaches to transformative adaptation finance with the establishment of an 'Adaptation Climate Finance Lab' to incubate and innovate ideas. This will help bring together various actors, including a marketplace to help match finance to adaptation interventions. It will support the architecture for new adaptation financing models, and pilot, test, learn and up-scale the elements above, i.e. around new instruments and innovative structuring. This iterative approach will help develop solutions and bankability for adaptation strategies, for both incremental and transformational adaptation.

Intervention 4

Enable and equip individuals and communities to participate in adaptation, focusing on the most vulnerable

Aim: Increased desire of individuals and communities to shape their places so they are climate ready and an increase in resources for equipping them to do so, effectively building cohesion and social capital between intersecting communities of interest and geography. This should increase the pace and scale of community and local level action on adaptation.

Background: Glasgow City Region's 1.8m people, and in particular young people, have a long-term stake in their local places and a vested interest in making them climate ready. There are opportunities for a wide range of differing communities and groups to play a larger and more direct role in helping shape places to meet the challenge, but these vary depending on local diversity, geography and wider social and economic issues. Past transformations in the region have not always been for the better of all, creating inequalities.

The challenge: Adapting Glasgow City Region is a transformational challenge for all of society, which cannot be solved by a single 'top down' approach. Our approach must learn from past failures where transformation widened inequalities. Instead, it requires a plurality of views and new forms of decision-making, with communities directly involved in shaping the future of their local places. Doing this requires a range of engagement interventions which effectively support communities to understand issues and get involved.

Individuals and communities also need support to develop resiliency skills and knowledge, so that in time they are delivering adaptation responses themselves and can influence adaptation-related decisions that are being made within the region. At the same time, institutions must reshape to better respond to community needs, allowing ongoing dialogue and engagement with people to help adapt local places – especially in areas facing more challenging issues such as sea level rise. This is particularly important for those most likely to be affected by the impacts of climate change, who often lack the voice to make their views heard and ensure they are the focus. Where communities have no, or little, control over their immediate environment, there is evidence this correlates with chronic stress and resulting ill health and shortened life expectancy.[15]

In both cases, we will need a range of tools and trusted organizations at our disposal to effectively engage, educate and develop opportunities to work collaboratively with those living and working in Glasgow City Region. This will require working with different types of communities, including those that are difficult to reach and bringing them into a space of working towards shared and agreed outcomes – something that is extremely challenging, given the skills gap around effective community involvement and requires appropriate, time, resources and mechanisms.

Where are we now? The Scottish Government is increasingly creating opportunities for communities to participate but more is possible. Adaptation Scotland's[16] localities projects are building the capacity of communities who want to adapt and to have the skills to do so. Through Resilient Regions: Clyde Rebuilt and small projects such as Cultural Adaptations, cultural organizations have begun to be engaged on their roles in enhancing the region's resilience by working with communities on climate impact. More broadly, tools such as the Place Standard Tool are helping bring communities and residents into discussions about how their places develop.

What needs to happen:

4.1 A shared understanding of how current community engagement and empowerment activity is structured for adaptation and where it does/does not work. For example undertaking mapping via equality forums will help to design approaches to engage those who are not usually involved in shaping their places.

4.2 Increased community involvement in the region's adaptation governance, decision-making, planning and delivery with new decision-making processes that support implementation and delivery of adaptation that is more democratic and inclusive. This should focus on involving those most affected by climate impact (such as disadvantaged groups, women's groups and young people), by engaging those who can help overcome cultural and language barriers and stimulate effective community engagement. It should also seek to engage wider civil society, such as faith groups and schools.

4.3 Resources, training and education for communities and young people to shape their places with new/enhanced toolkits and resources to support communities to be able to engage with the potential impacts of climate change in their areas, with supporting information on local challenges and adaptation solutions. This will enable them to better articulate how they feel their local places should adapt. Mechanisms are needed to further educate, equip and mobilize the wider population through activities such as running local citizen's assemblies, bringing together residents and experts in climate risks to explore the most challenging issues in Glasgow City Region.

4.4 Collaborations between organizations, communities, artists and cultural practitioners to stimulate creative and relevant adaptation responses with new actors, communities, businesses and the public sector should be using creative and digital approaches and methods to inspire people and organizations to adapt their places. Such approaches should draw on the region's history of change and sense of place, to pilot new ways of addressing climate change through creative approaches, with a potential role for Creative Scotland and Creative Carbon Scotland to stimulate the growth of a market in this space.

The Strategy in action:
Partnership working across the cultural sector

Relevant interventions	1 Reform and reshape governance mechanisms so they respond to adaptation needs, nurture new leadership and create expectations in society 2 Develop the ability of organizations, businesses and communities to adapt 4 Enable and equip communities to participate in adaptation 5 Embed reflection, monitoring, evaluation and learning into adaptation action
Partners	Creative Carbon Scotland (Glasgow City Region), Axis (Dublin), Greentrack (Ghent), TILLT (Gothenburg)
Funders	Cultural Adaptations was co-funded by the Creative Europe programme of the European Union and the Scottish Government
Further information	Adapting our culture toolkit, Embedded Artist Project Toolkit, **https://www.culturaladaptations.com/**

Cultural Adaptations worked with four cultural organizations across Europe to increase the overall resilience of cultural organizations in two ways: helping cultural organizations to develop a new service in contributing their creative skills and knowledge to societal climate change adaptation and helping them develop their own plans to adapt to the impacts of climate change.

Fig. 18. A workshop in Glasgow to discuss adaptation for culture. Credit: CCS/Cultural Adaptations.

Building an adaptation toolkit appropriate for cultural organizations

The project identified that standard adaptation-planning approaches could be improved to reflect the issues facing cultural organizations, which needed a more sector-specific toolkit. A workshop in Glasgow to discuss the creation of a dedicated climate adaptation toolkit was attended by 20 local cultural organizations. Insights from workshop attendees highlighted key areas to focus on that were particularly relevant in supporting adaptation of cultural organizations.

"Teamwork was key to the development of the toolkits. This activity further helped to create bonds between project participants as everyone inputted their ideas and took responsibility for contributing."

Lesley Anne Rose, Producer and Writer

Collaboration of cultural and adaptation organizations through embedded artist projects

Each cultural organization formed a partnership with a local government organization working on climate change adaptation and together they engaged an artist to help provide novel, creative, transformational ways to make the transition to an adapted future successful. The Embedded Artists applied their skills, knowledge, experience and creativity within the adaptation projects, not to create a work of art but to achieve the aims of their 'adaptation partner'.

Working with the Climate Ready Clyde Board to create personal connections

Artist Lesley Anne Rose—using her skills as a producer and writer—was embedded within the Climate Ready Clyde Board and Secretariat to encourage them to rethink their values and connect to the people living in Glasgow City Region. The Board recognized that achieving the vision would require doing something different. Lesley Anne challenged them to think about the story behind the vision for Glasgow City Region. How would this be communicated to people and who has authorship?

"Asking the Board to describe an object that represented GCR gave people space and time to voice what their personal values were and to start to see people around the Board room in a different light, the aim being to open up thinking and support strong teamwork."

Lesley Anne Rose, Producer and Writer

Engaging communities in local adaptation projects

Over on the continent two projects invited embedded artists to engage local communities, giving them a voice in influencing adaptation projects local to them. In Gothenburg, artist Ulrika Janson worked with housing company Poseidon and a small community on a project to capture rain in the local area. Community members shared their stories, which fed into the design of a community-centred yard.

Artist Anyuta Wiazemsky Snauwaert was embedded in the local government in the City of Ghent to de-pave Paul De Smet De Naeyer Park (PDSDN). Anyuta worked with people to dig up pavements and plant gardens and created an artistic pathway through the park to increase rainwater absorption.

"Artists and creative practitioners can have a very direct relationship with communities, recognizing people as experts within their communities and ensuring their voices are heard and considered and inform the work they do."

Lesley Anne Rose, Producer and Writer

Continuous reflection, monitoring and learning was a crucial element for the project

Cultural adaptations was an 'action-research' project, with learning, monitoring and continuous reflection a core element of the work.

"Attending four transnational meetings enabled me to learn from partners and share my experiences. I have seen how the learning has influenced the design of the toolkits. External evaluators from both the cultural and sustainability worlds provided continuous evaluation to shape the project as it progressed."

Ben Twist, Director, Creative Carbon Scotland

"Artists informing projects at an early planning stage, if possible, opens up increased potential to achieve long-term benefits and the success of adaptation projects. Artistic and creative practitioners can help to create space to reflect in projects. Artists help to re-imagine value, examining projects from not just an economic value, but also social and environmental value and allowing space for failure to have value."

Lesley Anne Rose, Producer and Writer

Resilient Regions: Clyde Rebuilt would not have been possible without the foundation set by Cultural Adaptations

The success of Cultural Adaptations paved the way for the Clyde Rebuilt project. A collaboration of actors—community groups, local councils, universities, businesses, government agencies— working together to catalyse a transformational approach to the way the region's society, economy and environment operate to address climate change collectively.

Intervention 5

Embed reflection, monitoring, evaluation and learning into adaptation action

Aim: To foster a learning culture within Glasgow City Region that recognizes and uses various types of knowledge to increase the impact of our interventions and to enable citizens to hold organizations to account through a process of monitoring and evaluation. In addition, we want to build networks that further develop relationships with comparably vulnerable cities and regions around the world to exchange knowledge and learning, and to foster a learning culture within Glasgow City Region to accelerate the impact of the interventions we make.

Background: Becoming a climate-ready City Region will not be easy or straightforward to implement. It will be a complex and messy process, and it is likely that in some cases we will not get things right the first time. It will also involve drawing on the different types of knowledge: academic, cultural, experiential. Fostering a culture which recognizes the value of this knowledge, as well as evaluation and reflection, will enable us to iteratively improve implementation. Businesses, community groups and public bodies have much to learn from others in the region and beyond. In particular, the many regions and countries around the world that are more vulnerable to climate impacts and are many years ahead in their adaptation approaches.

The challenge: Leveraging different types of knowledge and learning and reflecting on our interventions will be crucial to ensure that we act, learn and improve our approaches. We also need to disclose and report our progress, so residents and communities can see progress and hold those responsible accountable. Disclosure will also provide confidence to businesses and investors that Glasgow City Region is continuing to implement leading climate action and will help us build partnerships with cities and regions around the world. As the host city region for COP26, we will take a leadership role in supporting international approaches to adaptation.

Where we are now: Glasgow City Region already has links to cities and regions globally such as New York, Copenhagen and the Nouvelle Aquitaine and Andalucía regions in France and Spain, and these will be further strengthened. The use of learning and knowledge exchange is increasingly emphasized at the national level through the Adaptation Scotland programme, which Climate Ready Clyde continue to engage with, contributing our learning and seeking to learn from good practice being implemented across Scotland and internationally. Climate Ready Clyde also supports major public sector organizations to report progress as required by the Public Bodies Climate Change Duties.

What needs to happen:

5.1 Learning by doing – building in active reflection and learning process with Climate Ready Clyde encouraging all those involved in delivery of the Strategy to draw on local and cultural knowledge (along with other more traditional technical and academic knowledge), adopt active reflection and learning, and document and share their experiences to support others facing similar challenges.

5.2 Encourage large organizations to sign up to relevant international reporting initiatives such as the International Sustainable Campus Network, Global Covenant of Mayors on Climate and Energy and not-for-profit disclosure organisation CDP, reporting our progress not just nationally, but under the major global reporting frameworks, to share learning and collaborate on effectiveness and increase the region's visibility of our work.

5.3 Alignment of planning assumptions between domestic adaptation planning and the emerging TCFD/investor regimes with mature relationships between public institutions with those working to support private sector reporting under TCFD. A key part of this is ensuring public planning assumptions, Glasgow City Region's risks and adaptation action are accurately reflected in risk models.

5.4 Learning and knowledge exchange with other cities and regions working through the international climate networks to develop new partnership and relationships to learn from progress and support further efforts in adaptation. The focus should be on delta cities and regions with comparable risks, with an emphasis on climate vulnerable countries, as well as continuing to exchange knowledge through the Adaptation Scotland programme.

Intervention 6

Adapt the Clyde corridor for the twenty-second century

Aim: To better match our investment planning with the changing climate risks, through use of a long-term, iterative strategic pathway which supports wider prosperity and regeneration. This will ensure decisions on new investment and development and infrastructure are placed within a longer term strategic adaptive management framework, helping maintain the success of riverside industries and improving the livelihoods of those who live within it as well as the wider success of the overall City Region from the source of the River Clyde in South Lanarkshire to its mouth in Inverclyde.

Background: The River Clyde and its corridor is Scotland's most important economic asset (Clydeplan, 2020), as well as being the backbone of the region's cultural heritage. It is also an internationally important area for biodiversity. 480,000 people live within a mile of the river, whilst half the region's jobs (430,000) are located there.

The challenge: The corridor is affected by coastal, river and surface flooding, and experiences periodic flood events today which affect large numbers of people and have high annual damage costs. In the absence of further action, future climate change poses major threats to the corridor,[17, 18] which will lead to both direct and indirect risks. Glasgow City Region is home to 219 publicly listed companies that are at risk of climate change, with this number expected to grow over time.[19] Managing the risks of flooding and other hazards along the corridor is important for long-term regional economic growth and investor confidence, as well as the long-term resilience of SMEs.

Where are we now? Clydeplan's Indicative Regional Spatial Strategy[20] identifies both the Clyde corridor and climate adaptation as key priorities. The forthcoming second cycle of Local Flood Risk Plans will continue to reduce flood risk, but they do not provide a long-term (100+ year) iterative framework, which considers the deep uncertainty of climate change effects on rainfall patterns, river flows, costal erosion, and sea level rise, as well as the effect of future adaptation options and relevant thresholds or tipping points. Early work on an Adaptation Pathway for the Clyde[21] has shown the potential to develop a flexible adaptation pathway for the river that would incorporate whole-system thinking and provide a long-term framework for action, using a mix of options with a preference towards nature-based solutions such as natural flood risk management and designated land for flooding.

What needs to happen:

6.1 Work through Clyde Mission to govern climate risks for the entire river corridor with SEPA, MGSDP, Clydeplan, Glasgow City Region, Scottish Government, Scottish Enterprise and Scottish Water, in addition to working with others to develop new governance arrangements to manage the entire of the Clyde corridor's changing climate risks over time.

6.2 An iterative adaptation pathway for the Clyde developed as a new, iterative, flexible approach to balancing development and climate risk in the river corridor over time in support of Clyde Mission. The focus should be on long-term management of coastal, river and surface water risks, but given the existing challenges of heat island effects, should seek to look for synergies for heat. The plan should be developed in conjunction with public bodies, communities and the private sector, and prioritize the use of natural solutions, such as blue and green infrastructure. It should evaluate the risks of multiple climate scenarios, identify a range of targets and thresholds that are acceptable to the public and sequence a set of options that can be implemented over time as information on climate change emerges. A key element would be to look at time-limited zoning of risky sites, as well as the role of vacant and derelict land in providing space for management of flooding.

6.3 The climate resilience of the river corridor reflected as a national priority with collaboration between Scottish Government, Clydeplan and Glasgow City Region to ensure the climate resilience of the river corridor is recognized as a national planning priority in frameworks such as the forthcoming Regional Spatial Strategy and National Planning Framework 4.

Intervention 7

Enhance early warning and preparedness for floods and heatwaves

Aim: To reduce the numbers of people impacted by flooding and overheating by investing in early warning and preparedness, and defences, with a focus on the most vulnerable to the impacts of climate change.

Background: Glasgow City Region is affected by periodic extremes of heavy rainfall and storms, creating coastal, river and surface floods. These are projected to increase in future, and additional risks are likely to emerge, such as increased heat extremes.

The challenge: Despite efforts to reduce flood risks, the number of homes and businesses at risk has continued to rise. The Second National Flood Risk Assessment[22] shows we have 79,200 homes at 0.5% risk of flooding in any year and this could rise to 100,700 homes by the 2080s due to climate change. Similarly, 15,270 businesses face the same level of risk, and this could rise to 18,700 by the 2080s. In the absence of further measures, insurance will also become more costly and could lead to problems of affordability.

Flooding has a devastating impact on people's lives, physical and mental health, and livelihoods as well as the wider economy. Flood protection involves public good characteristics and there are good reasons for public investment. However, there is also a role for homeowners and businesses to protect themselves from flooding and build personal resilience to impacts. There are important linkages here to insurance, and the need to ensure the benefits it provides in a changing climate. These additional areas can help deliver a more economically efficient approach to reduce flood risks, with a combination of early warning, preparedness and increased resilience of households, communities and business, and continuation of insurance.

In the decades to come heatwaves are projected to emerge as a new risk for Glasgow City Region, especially in the large urban towns and city where there is a heat-island effect. This will have potentially major impacts on health, well-being and economic productivity. Whilst they need different responses, there is also a need to ensure infrastructure is built (or retrofitted) to be able to cope with future unprecedented higher temperatures.

Where we are now: Under the Clyde and Loch Lomond Flood Risk Management Strategy[23], the roll out of Local Flood Risk Management Plans, and Flood Protection Schemes and Works in Glasgow City Region has continued, but less work has been undertaken to address complementary risk reduction measures. Scottish Government's Living with Flooding: Action Plan[24] is setting out a range of actions to help promote property flood resilience, and whilst SEPA's Floodline system works to warn communities of flood risk, it does not currently cover surface water flooding. Over 27,000 properties are projected to benefit from installing resistance (preventing water entering a property) or resilience (reducing recovery time) measures.[25] Some local authorities, such as the Borders, and Dumfries and Galloway, have begun providing subsidized property level protection, but this is not a universal approach.

What needs to happen:

7.1 Extension of the flood warning scheme in Glasgow City Region through collaboration between SEPA, Scottish Government, Scottish Water and local authorities to enhance flood warning in the region. In particular, the focus should be on enhancing the accuracy and coverage of flood sources to cover surface water flooding. It should also explore the potential to develop forecast-based financing, shifting to paying homeowners and businesses that are likely to flood in extreme weather in advance, to provide them with capacity to better prepare, respond and recover, and therefore minimizing damage and disruption for those most vulnerable.

7.2 Implementation of an integrated climate alert warning system for Glasgow City Region, covering the full range of hazards, such as drought, heat, wildfires and landslips. This should provide infrastructure for alerts and focus on putting in place the processes needed for effective responses for those at risk. It should build on existing approaches such as SEPA's Flood Alert System, and Local and Regional Resilience Partnerships, but expanded to new partners such as health boards. It should explore the potential to pilot, with a view to scaling regionally and potentially nationally.

7.3 Continued delivery of strategic Flood Risk Management activities. SEPA, the regional local authorities and other key partners should continue to work together to complete the second cycle of Local Flood Risk Management Plans, and the subsequent investment in strategic flood risk management activities. The work should consider the fit with both the long-term adaptation pathway, and property level protection, as well as trialling new approaches to blended finance and private sector involvement.

7.4 A regional property flood resilience and resistance installation programme should subsidize the cost of installing property resilience and resistance measures, to accelerate roll out of property level protection across Glasgow City Region, with priority going to the most socially vulnerable. This should be carefully constructed to avoid compromising the viability of future flood protection schemes. The programme should cover all aspects of installation, from finance to maintenance, and quality assurance.

7.5 Exploration of new insurance models to cover potential risks to the existing insurance models and new insurance models or instruments to ensure a viable long-term market.

The Strategy in action:
A smart canal supports communities

Relevant interventions	3 Increase adaptation finance through leverage and innovation 6 Adapt the Clyde corridor for the twenty-second century 7 Enhance early warning and preparedness for floods and heatwaves 9 Deliver nature-based solutions for resilient, blue-green landscapes and neighbourhoods
Funders	Capital funding through Glasgow City Region City Deal, the European Regional Development Fund (ERDF), the Green Infrastructure Fund managed by Nature Scot and the 8th City – the Smart City.
Further information	**https://www.glasgow.gov.uk/article/23393/Glasgows-Smart-Canal-is-a-first-for-Europe**

Fig. 19. The Smart Canal, North Glasgow. Credit: SC/GCC.

Unlocking community regeneration

Development of a smart canal on the Forth & Clyde Canal unlocks five regeneration sites in North Glasgow. This area was previously at risk from flooding due to overflowing sewage systems and surface water runoff. The Smart Canal reduces flood risk by managing surface water. In doing so it is bringing forward development possibilities in five regeneration sites—which were previously vacant and derelict—into productive use such as housing, a school campus, retail and parks.

"The key benefit to communities is the regeneration of these areas, taking away the blight of vacant and derelict land. It also improves connectivity to the blue-green corridor along the canal for active travel and recreation. Investment into the canal gives it additional purpose, helping to safeguard the future, and maintain the corridor for these communities."

David Hay, Group Manager – Engineering, Project Management & Design, Glasgow City Council

Commitment to a 60-year partnership between Scottish Canals, Scottish Water and Glasgow City Council has made this possible. An innovative funding package shares financial risks allowing for the development of the Smart Canal.

A smart system reduces flood risk

An early warning system is used to predict periods of heavy rainfall. A live weather forecast feeds into a hydraulic model which determines whether the water level of the canal should be lowered. When there is risk of flooding, canal water is moved through a system of sustainable urban drainage (SUDS) ponds, lowering the water level by 10cm. This creates space in the canal for rainwater runoff. Water quality is monitored at various points along the canal network.

"Communities will have an appreciation of water levels fluctuating with rainfall through the rise and fall of the water levels in the drainage systems in the park that form part of this dynamic water management system."

David Hay, Group Manager – Engineering, Project Management & Design, Glasgow City Council

The value of surface water

Throughout the regeneration sites a network of SUDS are in place for the management of surface water. This replicates a natural river flood plain.

"Traditionally runoff water has been managed underground. The use of surface water ponds within the surrounding parks creates space for water and has benefits for the visual aspect of the landscape. Biodiversity benefits through creating new habitats and space for nature."

David Hay, Group Manager – Engineering, Project Management & Design, Glasgow City Council

Storing water in household tanks

Future water management plans in Glasgow include grey water recycling. Rainfall is collected underground in tanks and pumped into buildings for use in households such as toilets.

"We are exploring the possibility of making these grey water storage systems smart, so that before a heavy rainfall event the storage tanks are pumped out so that surface water can be captured reducing flood risk. Creating space for water in planning is a principle taken forward from the Smart Canal."

David Hay, Group Manager – Engineering, Project Management & Design, Glasgow City Council

Green corridors for communities in Medellin, Colombia

Nature-based solutions are being rolled out around the world, including in the Municipality of Medellin to address severe urban heat island effect in an effort to reduce extreme temperatures, urban greening began in 2015. Citizens were involved in planting over 30 green corridors.

Intervention 8

Ensure everyone's homes, offices, buildings, and infrastructure are resilient to future climate impacts

Aim: To implement a set of activities which ensure climate resilience for new and existing homes, offices and energy, water, transport, and communications infrastructure, and to begin planning new infrastructure required for long-term resilience in Glasgow City Region. Where possible, such approaches should be linked to broader community wealth building and activity to enhance adaptive capacity.

Background: By 2030, Glasgow City Region's 1.8m population is forecast to grow, with need for an additional 80,200 homes[26]. Our built environment and energy, water, transport, and communications infrastructure rely on one another; together, they underpin our communities' and economy's ability to flourish. Over £16 bn. of capital investment is projected to be spent over the next 20 years to address existing challenges and new demands[27].

The challenge: Decisions made now on location and design of new houses, developments and infrastructure will influence patterns of exposure or vulnerability to future climate change over the next few decades. They involve a lock-in risk (i.e. development in areas that will become at risk in the future or buildings that are not designed for the climate of the 2050s). Infrastructures are interdependent and need careful planning and strong political commitment to ensure the whole system is climate resilient. Existing homes, offices, and infrastructure, as well as cultural heritage sites such as the UNESCO World Heritage Sites of New Lanark and the Antonine Wall were not designed with the future climate in mind. What's more, there are many different actors such as private landlords and housing associations, who have much control in this space, particularly for those most vulnerable to climate impacts. We have a window of time to address this and plan for our future development, balancing the costs for residents, businesses, and government. New infrastructure specifically focused on delivering climate resilience may also be needed.

Where are we now? The Glasgow City Region City Deal, and the emerging community wealth building agenda have the potential to be transformative in this space. The City Deal has already been assessed for climate risks[28] and there are opportunities to enhance climate risk screening and integration of adaptation. Projects like the University of Strathclyde's Climate Resilient Climate Neutral Innovation District are already showcasing adaptation options and their wider benefits. There is also regional guidance embedding consideration of climate risk into new development and this is being used by some planning new developments.[29]

What needs to happen:

8.1 Adaptation embedded in Glasgow City Region's net-zero transition ensuring the pathway to net-zero is resilient to the changes ahead. This should include solutions which maximize co-benefits and synergies such as habitat restoration and seek to minimize trade-offs.

8.2 Creation of an adaptation forum for Glasgow City Region infrastructure working through the infrastructure portfolio of Glasgow City Region City Deal the forum should focus on improving knowledge and understanding of risks, as well as where responsibility for action sits.

8.3 Adaptation of existing infrastructure, with policies and regulation to require all new investment to be climate resilient starting with Climate Ready Clyde's members committing to assess climate risks and incorporate adaptation solutions for most risky infrastructure and consider climate risk in all future investment.

8.4 Strengthening of adaptation requirements in the planning system supported by Scottish Government, Clydeplan and local planning authorities through the National Planning Framework 4, the Regional Spatial Strategy and local development plans and building standards. These should be co-designed with developers

8.5 Creation of a regional retrofit framework for climate resilience for use by the region's building owners to assess climate resilience needs of building stock, and to underpin development of a retrofit programme which ensures stock is fit for the future, aligned with the net-zero target. This should also consider wider issues such as tenure, the ability to pay, and the importance of differing lifestyles and cultures in communities.

8.6 Creation of a framework for adapting cultural heritage assets with collaboration with Historic Environment Scotland, National Trust for Scotland, and Heritage Trusts to continue work to evaluate the impacts of climate change on the region's historic assets, such as the Antonine Wall and New Lanark.

8.7 Lobby UK and Scottish Governments to reform infrastructure investment frameworks with Core Cities, and the Scottish Cities Alliance making for reforms to drive more investment into adaptation.

8.8 Evaluation of future adaptation infrastructure needs with a strategic review for Glasgow City Region to identify and evaluate new infrastructure that may be required for future adaptation, with a view to developing an investment pipeline.

The strategy in action:
Co-designing a climate-ready Glasgow

Fig. 20. Heart of the Campus: design by RFB, rendered image by Float Digital.

Relevant interventions	8 Ensure our homes, offices, buildings and infrastructure are climate resilient 9 Deliver nature-based solutions for resilient, blue-green landscapes and neighbourhoods 10 Establish Glasgow City Region as a global research and knowledge hub for adaptation
Further information	**https://www.strath.ac.uk/professionalservices/sustainablestrathclyde/climatechange/**

The University of Strathclyde hosts a variety of projects tackling mitigation and adaptation to climate change that work to establish Glasgow City Region as a global research and knowledge hub. All of these projects are collaborative in nature and are aligned with the University's partnership approach and deployment of innovative ideas and solutions."

Dr Roddy Yarr, Vice Chair, Climate Ready Clyde, and Assistant Director for Sustainability, University of Strathclyde

Putting pedestrians first in the Heart of the Campus

"The people-orientated Heart of the Campus project will create an accessible, climate-resilient green space. The former site of Rottenrow Maternity Hospital has received planning approval to be redesigned as a green, inclusive, traffic-free, pedestrian-focused garden space that is adapted to climate change, providing space for nature and people."

Dr Roddy Yarr, Assistant Director for Sustainability, University of Strathclyde

A timber-covered walkway and smart seating will increase accessibility of the area, providing protection from future climate changes such as increased likelihood of flooding and higher average temperatures. New entrances, step handrails and reduced path gradients will increase the inclusivity of the area for people. Climate resilience is improved through planting rain gardens which clean and filter rainwater through the gardens. A diverse range of plants—a nature-based solution—will be grown that are adapted to a future climate and also provide key habitats for species such as insects and birds. Further biodiversity benefits of the park include bird and bat boxes.

Fig. 21. Heart of the Campus: design by RFB, rendered image by Float Digital.

A new Teaching and Learning hub designed with students for students

Working with staff and students, the University has developed a new building—linking climate adaptation and mitigation actions—to provide space for flexible and group learning as well as the Students Union. Using the shell and core of two existing buildings to redesign the Teaching and Learning Building has meant carbon associated with the original construction of these buildings is not released – there is an embodied carbon saving of 67%. The carbon saved is the same as the amount of carbon generated by 3,350 Scottish homes in one year.

Transformational change in Climate Neutral Innovation District

The projects described above have contributed to the development of a large-scale, collaborative Climate Neutral Innovation District in the heart of Glasgow. A whole-systems approach is used to link four areas of heat, power, transport and community well-being for climate resilience with plans for 100% renewable energy. A community focus underpins the research putting people at the centre of the plan to integrate these four areas. The project will work with a range of stakeholders that have new approaches to help address the climate emergency, create opportunities around a green economy and promote sustainability in the long-term.

Read more about the planned projects as part the Climate Neutral Innovation District and plans to replicate the 'district' in other areas, such as North Lanarkshire, Renfrewshire, West Dunbartonshire.

Similar projects in Europe: Creating areas of cool in Paris

Climate adaptation creating green space and well-being benefits for people is also happening across Europe. In Paris, Project Oasis aims to re-green 800 concrete school courtyards to what has been described as "islands of cool". Plans include planting green walls, increasing vegetation to increase shade and replacing concrete with drainable surfaces. Spaces will be open to the wider communities living in and around the schools, providing shelters from extreme heat. Conversations between children and their parents about the school courtyards raises awareness of climate adaptation, encouraging wider cultural changes. Not only will this project reduce the heat island effect in Paris, but it will also improve access to green spaces for communities in a city with a low percentage of green space, enhancing well-being of the people that live there.

Intervention 9

Deliver nature-based solutions for resilient, blue-green ecosystems, landscapes and neighbourhoods

Aim: To accelerate the roll out of blue and green solutions, through a regional strategic network, land management and targeted local interventions. This requires increasing the involvement of homeowners, landlords, landowners, businesses and whole communities to scale up and roll out solutions, supported by increased access to finance. There is also a role for exploring how vacant and derelict land in Glasgow City Region can also be brought into use to support these objectives, particularly in the Clyde corridor.

Background: Glasgow City Region is a dynamic urban and rural mix, including world-renowned landscapes such as parts of the Loch Lomond and Trossachs National Park, as well as villages, towns and the city of Glasgow. This is also reflected in our economy, with financial services sitting alongside agriculture, forestry and wind farm construction. Our high-quality natural environment supports all of these activities, and is part of what makes Glasgow City Region a great place to live and invest. Glasgow City Region has 50,867 hectares (ha) of greenspace, of which 73% is accessible, along with 56,850 hectares of woodland. It is also important for wildlife, with 11 Special Areas of Conservation, 7 Special Protection Areas and 2 RAMSAR sites.

The challenge: These celebrated landscapes, their wildlife and our rural activities such as farming, face challenges from climate change, including flooding, high winds, extreme temperatures, pest and diseases, and invasive species. Nature-based solutions can respond to these problems, while also helping address climate risks to people, buildings and infrastructure. Solutions can include green infrastructure, from the building level, through small-scale urban planting, to major urban green spaces and blue infrastructure around the coast and marine environment, or habitat restoration along river corridors. Such ecosystem-based adaptation can provide not only direct resilience benefits to both people and wildlife but also wider impacts: improving recreational opportunities and active travel routes, health and well-being, storing carbon, enhancing biodiversity and biosecurity. They can even boost property prices and local economic prosperity. However, despite all these benefits, they are not being rolled out at the scale and pace required.

Where are we now? Nature-based solutions are becoming prioritized across the region; the Glasgow and Clyde Valley Green Network Partnership is one exemplar organization planning their delivery with a focus on solutions for both people and wildlife, and local authorities are identifying the potential for adaptation through open space strategies. However more work is needed to target interventions in the most effective areas and shift to large-scale delivery.

What needs to happen:

9.1 Identify regional priorities for nature-based solutions. The region's local authorities, working in partnership with the Glasgow and Clyde Valley Green Network Partnership and others should identify priority areas for blue and green infrastructure, focusing on the communities, sectors and systems most vulnerable to high temperatures or flooding and developing the region's habitat network for climate resilience.

9.2 Delivery of the regional Strategic Green Network with an emphasis on maximizing the contribution of the network to adaptation.

9.3 Creation of the Clyde Climate Forest with Glasgow and Clyde Valley Green Network Partnership working with others to create the forest, creating a mechanism for carbon offsetting which will expand canopy cover in heat risk areas, connect habitats and store carbon emissions, with a focus on the most socially vulnerable neighbourhoods.

9.4 Increase investment in targeted habitat restoration for natural flood management, including in peatland, wetlands and transitional habitats. Through the Forestry and Woodland Strategy,[30] Clydeplan should continue to promote restoration of ancient and native woodland. At the same time, all partners should consider the opportunities and risks around transitional habitats such as salt marsh, and the potential need for managed retreat.

9.5 Roll out of large-scale blue and green infrastructure projects to demonstrate benefits to communities – either through new green infrastructure or removal of hard landscaping or public realm, with the Glasgow and Clyde Valley Green Network Partnership and MGSDP amongst others, continuing to develop and deliver large-scale demonstrators of green infrastructure across the region.

9.6 Support for new local infill or expansion of existing nature-based solutions to strengthen the regional network with a common local delivery approach to Open Space Strategies, Local Development Plans and individual developments. These should define where blue and green infrastructure can provide climate resilience for surface water management and high temperatures. The process should engage new actors such as landlords, tenants, community groups and businesses to understand opportunities and barriers to widespread roll-out.

9.7 Develop and accelerate blue and green infrastructure financing. To accelerate the above, we will work to develop new financing methods for green infrastructure (such as landscape enterprise networks), which seek to unlock private sector investment and mobilize communities to deliver.

The Strategy in action:
Living in a blue-green Glasgow City Region

The creation of blue-green landscapes in Glasgow City Region benefits local communities. Nature-based solutions have multiple values: improving access to blue-green spaces for recreation, enhancing well-being and social cohesion, creating space for biodiversity to flourish and helping to adapt to climate change.

Relevant interventions	3 Increase adaptation finance through leverage and innovation 4 Enable and equip communities to participate in adaptation 6 Adapt the Clyde corridor for the twenty-second century 9 Deliver nature-based solutions for resilient, blue-green landscapes and neighbourhoods
Partners	GCV Green Network Partnership, Scottish Forestry, supported by Woodland Trust, Green Action Trust, TCV Scotland, local authorities, university and housing associations
Further information	**https://www.gcvgreennetwork.gov.uk/**

Helping people and nature adapt

The Glasgow and Clyde Valley Green Network (GCV Green Network) Strategy proposes improving active travel routes along the Clyde corridor, making them greener and more pleasant to use, redirecting them away from roads.

> ***"The 'Blueprint' for the Green Network Strategy in Glasgow City Region creates space and connections for people and wildlife. Green living and working environments are essential for people's health and well-being, and people who are healthy in mind and body are more resilient to the impacts of climate change."***
>
> Max Hislop, Programme Manager, GCV Green Network Partnership

The GCV Green Network Strategy also creates a network for nature, delivering positive changes for biodiversity through connecting key habitats, facilitating the movement of species northwards as the Scottish climate changes. Within the Strategy several projects are being delivered at a local scale to provide community and climate adaptation benefits throughout Glasgow City Region.

Communities contribute to peatland restoration by dambuilding

In Fannyside Muir, North Lanarkshire, 230 ha of peatland was restored through the work of conservation charity Buglife Scotland, partners and volunteers. Peatlands are carbon sinks; restoration can lock up significant amounts of carbon from the atmosphere. The project worked with the community to construct over 4,300 dams and drainage ditches, allowing for the recovery of crucial sphagnum mosses. Converting dry areas to shallow pools provided excellent habitat for wading birds and insects, and reduced flooding in the area.

Community management in Scotland's largest urban wildlife site

On the boundary between Glasgow and North Lanarkshire, Seven Lochs Wetland Park integrates seven lochs, five nature reserves and a country park within housing developments. Surrounding communities experienced high levels of deprivation; development of the park has helped to regenerate the area socially, environmentally and economically. After an engagement period, it was identified that there was a need for permeable boundaries, ensuring existing communities had access and were connected to expanding green networks. Seven Lochs Wetland Park protects and enhances biodiversity and natural heritage, safeguarding it from a changing climate. Community groups help manage biodiversity and support cultural heritage through projects such as archaeological digs discover lost history whilst outdoor education and conservation volunteers improve understanding, awareness and management of key wetland habitats.

"Good quality, well-linked open spaces can help provide a range of benefits. They allow individuals to interact with the natural environment and provide habitats for wildlife. They can also be important in defining the character and identity of settlements. Connecting them in a green network can provide enhanced benefits for people, the environment and biodiversity."

Gillian Dick, Spatial Planning Manager,
Connecting Nature, Glasgow City Council

Flower power for pollinators and people

Volunteers at a community run wildflower nursery in Pollock Country Park grow 10,000 locally sourced wildflower seedlings, providing training opportunities for communities and building personal connections. The wildflowers from this Connecting Nature project support biodiversity projects across Glasgow, helping to address the devastating 97% decline in wildflower habitats seen in the UK. Use of locally grown wildflowers reduces carbon emissions from transportation and makes sure the plants are better adapted to survive in Glasgow's climate.

"Demonstrating how nature-based solutions can contribute to wider objectives of the council including health, well-being and climate adaption helps to get support from strategic partners who champion nature-based solutions in a way that embeds them in policies that will support the transformation of the city."

Gillian Dick, Spatial Planning Manager, Connecting Nature, Glasgow City Council

Planting 20 million trees provides multiple benefits

On the outskirts of Glasgow, the Woodland Trust has planted 250 ha of native woodland, putting communities at the heart of the restoration and involving local people at each stage of the project. The resulting mix of pasture and woodland creates areas for families with paths woven through the area and outdoor classrooms for the schools involved. ree planting in the Clyde Climate Forest will focus on three aspects: canopy, connectivity and carbon. Urban tree planting aims to improve canopy cover, providing benefits such as shade and cooling from increasing temperatures. The project will identify vacant and derelict land sites to promote connectivity for wildlife and to sequester carbon. 20 million trees will be planted over 10 years.

"A delivery project for the Blueprint is the Clyde Climate Forest. The Clyde Climate Forest is going for the big wins, targeting increases in urban tree canopy cover, woodland habitat connectivity and new forests to capture carbon emissions. The Clyde Climate Forest will provide climate adaptation benefits to people that include flood mitigation in periods of heavy rainfall and reduced urban temperatures at times of heatwaves."

Max Hislop, Programme Manager, GCV Green Network Partnership

Innovative finance for a Green Network Strategy

Underpinning the Green Network Strategy is the Blueprint that sets out the foundations for the creation for a network for people and a network for nature.

"There is a growing understanding that the natural environment is linked to the economic success of the region. New finance is needed to repair the damage we have done. The aim is to deliver nature-based projects at a large enough scale to tap into new funding streams. The two very different sectors of green investment and environmental management need to work together, linking the funding 'pipeline' into scalable projects to attract financial investment."

Max Hislop, Programme Manager, GCV Green Network Partnership

Intervention 10

Enhance regional decision-making, and establish Glasgow City Region as a global research and knowledge hub for adaptation

Aim: To fill evidence gaps, establish Glasgow City Region as a living lab for research and innovation, and draw on the collective strengths of our research institutions to provide actionable information for decision-making. In doing so, we will position Glasgow City Region as global hub on applied adaptation research, attracting world-leading researchers, enhancing institutional credentials and Glasgow City Region's climate resilience, and delivering benefits for wider Scotland, the UK and global adaptation efforts.

Background: Decisions on how and why to adapt Glasgow City Region need to be taken based on a robust understanding of potential risk, adaptation options and how they can be implemented. However, such research is not always transferrable – with local context and climatic conditions requiring specific consideration.

The challenge: At present, Glasgow City Region does not have a structured process for identifying evidence and research gaps needed for delivering on adaptation and then implementing projects to bridge them. And where this does happen, such information is not always communicated effectively to inform decision-making. Instead, universities tend to approach individual institutions in the region driven by calls from research councils (which tend to focus on primary research needs as opposed to implementation of adaptation by cities and regions) as well as use informal knowledge and connections from individuals. Adapting effectively means better structuring this process, to add value to decision-making, and to facilitate high impact research. Over time this will contribute to positioning Glasgow City Region as a global hub in applied adaptation, attracting the best global researchers to work here, as well as retaining talent to work in the local and global interest.

Where are we now: The University of Strathclyde, Glasgow Caledonian University, University of Glasgow, Glasgow School of Art and the University of the West of Scotland, and both our region's colleges and the wider business community all have a role to play. As well as being a strong part of our region's economy, they are training the next generation to help us manage and adapt to climate change and they have the research and innovation strengths which we can harness to support our efforts.

Glasgow City Region has long been collaborating with research projects to try and fill evidence gaps through dedicated Horizon 2020 projects such as Connecting Nature and COACCH, as well as by supporting individual researchers in their own projects where there is alignment with our own needs. The Climate Risk and Opportunity Assessment highlights several priorities that need to be filled to support adaptation activity going forward.

What needs to happen:

10.1 Enhanced adaptation research through open invitation to collaborate on publicly available research priorities with Glasgow City Region promoted as a place for research and experimentation on climate change adaptation. Climate Ready Clyde will work with others to develop, agree and publish a list of research priorities, reach out to relevant organizations and individuals, and provide support to funding bids where there is a strong prospect to move us forward on understanding risks and implementing adaptation, and will link academics to stakeholder programmes. Early research priorities for the programme include synergies and trade-offs with the region's path to net-zero, sectoral gaps such as the natural and built environments, and cross-cutting issues such as climate justice.

10.2 Glasgow City Region established as a living lab for climate adaptation providing a platform for academics to conduct research into climate resilience and adaptation in practice, using our resources, services and assets. This will provide Glasgow City Region with a greater understanding of their effectiveness, as well as providing wider benefits for the UK and internationally.

10.3 Convene an Expert Advisory Committee on Adaptation, to provide actionable advice to actors in Glasgow City Region to ensure better evidenced decision-making. This should draw on the leading adaptation expertise already in Glasgow City Region, with the role and remit being shaped and informed by the region's City of Science and Innovation group, universities and Glasgow City Region. To support the process, the Committee should run a process to identify and develop the relevant questions from regional policy makers, and to commission small research pieces to inform the work. Over time, this process should also lead to higher impact research on adaptation. The proposals should be developed working closely with ClimateXChange to build on their experience of connecting research and policy.

Intervention 11

Begin the transition to an economy resilient to future climate impacts

Aim: To shift Glasgow City Region's economy to be climate ready to the impacts, as well as take advantage of the opportunities of climate change, and create green jobs. This will involve addressing macro-economic issues of productivity, skills, employment and supply chains as well as direct support to SMEs and large corporations. The approach to doing so will be fair and inclusive, to ensure just resilience, strengthening livelihoods at the same time as the wider economy of Scotland and the UK.

Background: The effects of climate change will cascade across the entire economy of Glasgow City Region, changing demands in goods and services, affecting the profitability and in some cases the viability of sectors and businesses, affecting labour productivity and affecting risks to assets and operations, as well supply chains. These impacts will be negative in some sectors, and for some goods and services, but will be positive for others.

The challenge: We need to begin transitioning our economic system to one which is much more resilient to the impacts of climate change. This is complex, as the economy is already undergoing profound change because of COVID, decarbonization, automation and shifts to a circular economy, and challenges will vary – with forestry or agriculture facing different challenges to financial services. In parallel, we must capture the economic opportunities from a changing climate, creating the enabling environment to make sure potential economic benefits are fully realized, for the public and private sector, on top of the broader macroeconomic benefits delivered by the Strategy.

SMEs are the backbone of the Scottish economy, but often need support to consider longer term shifts that are outside their core focus. We also need to ensure this transition is fair and just, to both workers and businesses, supporting the most vulnerable to improve their resilience or transition into new industries or locations. Larger, publicly listed companies in Glasgow City Region have global operations which could be affected by climate change impacts around the world. These issues are rising up the agenda with climate related financial disclosure (of physical climate risk) and this will put pressure on companies located in the region, and in turn to those organizations responsible for the region's planning and development to adapt to ensure continued and increased investment.

Where are we now? There has been some early work to support business to become climate ready, but little focused on the region. Scottish Enterprise has completed a national assessment of how vulnerable certain sectors of the Scottish economy are, whilst Adaptation Scotland has already developed guidance for businesses to become climate ready. There has been little thought about the justice issues associated with a resilient transition – the Just Transition Commission has mainly focused on mitigation. Glasgow City Region is home to 216 publicly listed companies who are at risk of global climate change (MSCI, 2020). Our adaptation economy comprises 79 companies, employing 8,390 – and the sector is projected to grow at 19% a year.[31]

What needs to happen:

11.1 Adopt a climate smart regional economic development approach with a strategic approach that sets out to improve the resilience of the Glasgow City Region's economy as part of the revised regional economy strategy. This should focus on climate-smart approach, assessing what is needed to help realize opportunities and support growth of the region's adaptation sector.

11.2 Delivery of a just, climate resilient transition which nurtures adaptation skills broadening the concept of a just transition to adaptation, by identifying sectors, businesses locations and workers who are most vulnerable to climate change and developing plans to support them to adapt, as well as those sectors that will open up. This should also identify the skills requirements for the adaptation economy and develop them, as well as the potential to provide opportunities for those persistently excluded from employment, such as ex-offenders or those subject to community payback orders.

11.3 Climate-resilient supply chains, as part of a net-zero, circular economy with a collaborative approach involving Circular Glasgow, Zero Waste Scotland, Scottish Enterprise and others to ensure that the shift to a decarbonized and circular supply chain also increases resilience to climate change and considers associated justice and equity issues.

11.4 An SME support plan with Scottish Enterprise, FSB, Adaptation Scotland and others developing a package to support SMEs to both become resilient to the impacts of climate change across all aspects of their operations. This will focus on practical actions that can be taken by all, as well as more detailed services in future.

2.4 Place-based priorities

Glasgow City Region is a diverse and varied area, with a mix of a major city, towns and villages, as well as mixed landscape and rural environments. All these influence people's opportunities and help make Glasgow City Region a great place to live and to invest. Glasgow City Region's communities are very interlinked and interdependent, with linkage between where people live and work, as well as their leisure time.

Some climate impacts such as storms and extreme rainfall will have effects across the entire of Glasgow City Region. However, others are more geographically specific. In support of the Strategy's interventions we have identified a number of priority areas within Glasgow City Region.

Whilst place-based approaches are crucial across Glasgow City Region, we have identified a set of place-based priority areas that are regionally and nationally significant for adaptation. These are areas where there are one or more of the following conditions: current and future climate hazards are most acute, there is the potential to affect disproportionately vulnerable communities, there are significant concentrations of economic assets, and where significant regional decisions are being taken in relation to new development. These priority areas are:

- **The Clyde River corridor** – The 109 km River Clyde, running from the Lowther Hills in South Lanarkshire and ending at the Firth of Clyde, is a national economic asset, but is also where Glasgow City Region has a significant concentration of climate risks, with river, surface water and coastal flooding all coming together, alongside erosion. It is also home to a significant number of people who are disproportionately affected by flooding. Within this, the Clyde Mission area running from the Firth of Clyde in the west to Clyde Gateway in the east, is a focus for long-term economic development and for regeneration of regional and national significance.

- **New priority development sites** – The wider sites set out in the indicative Regional Spatial Strategy, including the major regeneration of Ravenscraig in North Lanarkshire, Eurocentral/Mossend and the Forth and Clyde Canal, are priorities to make sure we do not lock in future climate risks as part of the region's development.

- **Strategic Economic Investment Locations (SEILs)** – These locations offer potential for a rebalanced low-carbon economy, boosting competitiveness and tackling inequality. They also promote the Scottish Government's key economic sectors and Scottish Enterprise's locational priorities. The large-scale, long-term investment planned to achieve these outcomes means they have a high potential to lock in future climate risks.

- **The coast** – The coastal landscape is a unique part of Glasgow City Region's heritage and culture, but erosion and sea level rise will alter their shape and form significantly in places like Dumbarton, Greenock and Gourock, where there are already significant socio-economic challenges.

- **Urban and town centres** – The centre of Glasgow and town centres are vital links in Glasgow City Region's overall economy. But they are also heat islands. In the future, the concentration of urban development is likely to be affected by rising temperatures and heatwaves.

Defining place-based priorities helps provide a focus for where some of our interventions should take place on the ground and should be seen in the context of, and connected to, the broader climate resilience of Glasgow City Region overall. The criteria used to define the areas are set out below:

Area	Acute current/future hazards	Disproportionately vulnerable communities	Concentration of economic assets	Risk of 'lock-in' – significant new development
Clyde River corridor	✓	✓	✓	✓
Strategic Development Sites			✓	✓
Strategic Economic Investment Locations			✓	✓
The coast	✓	✓		
Urban and town centres	✓	✓	✓	

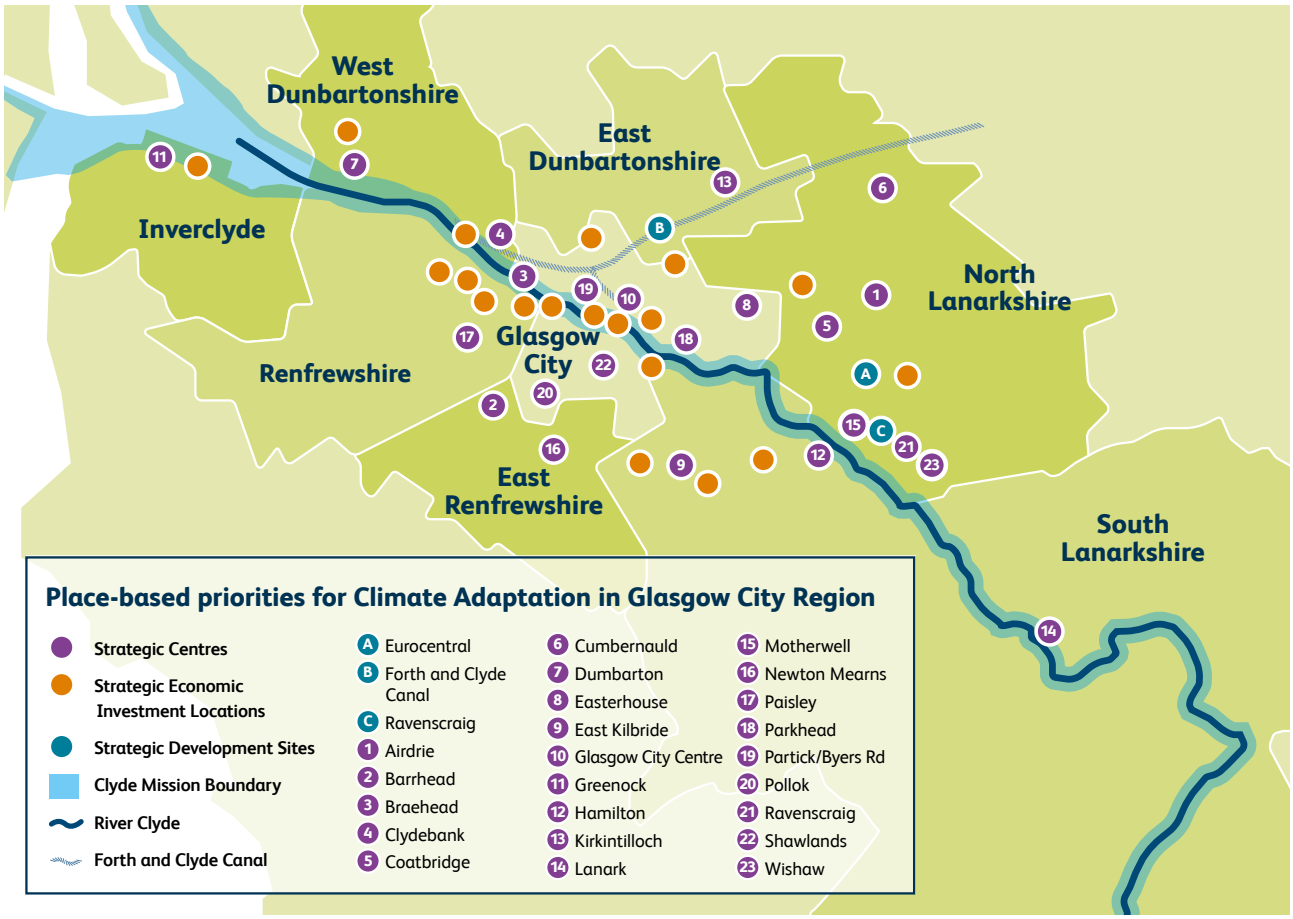


Fig.22. Place-based priorities for climate adaptation in Glasgow City Region.

Note: The areas outlined above are indicative, based on high level assessment by the Climate Ready Clyde Secretariat. This used existing knowledge of climate trends, social vulnerability and significant development, and will be further refined as evidence develops. Each of the factors above, should be further assessed at lower spatial scales to better define them in future. More detailed mapping showing distributions of flood and heat risk is available in the technical annexes to the Strategy.

2.5 Assessing social and environmental impacts of the Adaptation Strategy

In developing the Strategy, we have sought to better understand both the baseline social and environmental impacts of climate change and the Adaptation Strategy itself. Climate Ready Clyde is committed to ensuring our Adaptation Strategy seeks to create a more fair, just and inclusive region as part of the adaptation process, and ensuring that adaptation builds on and enhances protection of key heritage and environmental designations and frameworks, such as Natura 2000 and the Habitat Regulations. To ensure this, we have undertaken three parallel processes:

Social Impact Assessment

To better understand the social impacts of climate change and the Strategy interventions, the Climate Ready Clyde Secretariat developed and undertook a Social Impact Assessment. This voluntary assessment was designed to reflect duties under the Equality Act 2010, but also to consider broader social issues associated with climate change in Glasgow City Region. It evaluated the potential social impacts of climate change, developed recommendations for how the interventions could be strengthened to better reflect impacts on particular groups, and the intersectionality of climate and equality issues.

Strategic Environmental Assessment

The Strategy comes under the scope of the Strategic Environmental Assessment regulations. Therefore, a parallel assessment was run alongside development of the Strategy. This included a Scoping Report and Environmental Report, as well as a post-adoption statement. The Strategic Environmental Assessment (SEA) process influenced the development of the Adaptation Strategy, strengthening an emphasis on cultural heritage, education of young people on climate issues and by identifying issues for consideration in the Action Plan such as involvement of developers.

Habitats Regulations Appraisal

In addition to the Strategic Environmental Assessment, the Strategy has been subject to a Habitat Regulations Appraisal Screening, as required by the Habitats Directive (European Council Directive 92/43/EEC) and the Birds Directive (European Council Directive 79/409/EEC). This has evaluated the impact of the effect of the Strategy on sites of significant nature importance – notably European sites (those formerly known as Natura 2000 sites), Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and RAMSAR sites (wetlands of international importance under the 1971 Ramsar Convention). The amendments to the Habitats Regulations following EU Exit mean the requirements of the Habitats and Birds Directives to how European sites are designated and protected still apply.[32]

These process have been used to inform the Adaptation Strategy and have been considered alongside the consultation responses. All of these assessments have been published online on the **Climate Ready Clyde** website.

The implementation of interventions locally will require the development of project specific mitigation measures in consultation with both statutory and non-statutory consultees in order to minimize impacts and maximize the potential for enhancements to the local environment.

PART 3 Strategic Action Plan 2020–2025

3.1 About the Action Plan

Whilst the Strategy sets the direction for Glasgow City Region's adaptation efforts, significant action on the ground is needed. This action will come from many organizations, businesses and communities. To support delivery of the Adaptation Strategy, Climate Ready Clyde partners, working in collaboration with others in Glasgow City Region have developed a Strategic Action Plan. The Strategic Action Plan comprises a series of 16 Flagship Actions, and wider contributions from those across Glasgow City Region. Its role in Glasgow City Region's Adaptation Framework is set out below:

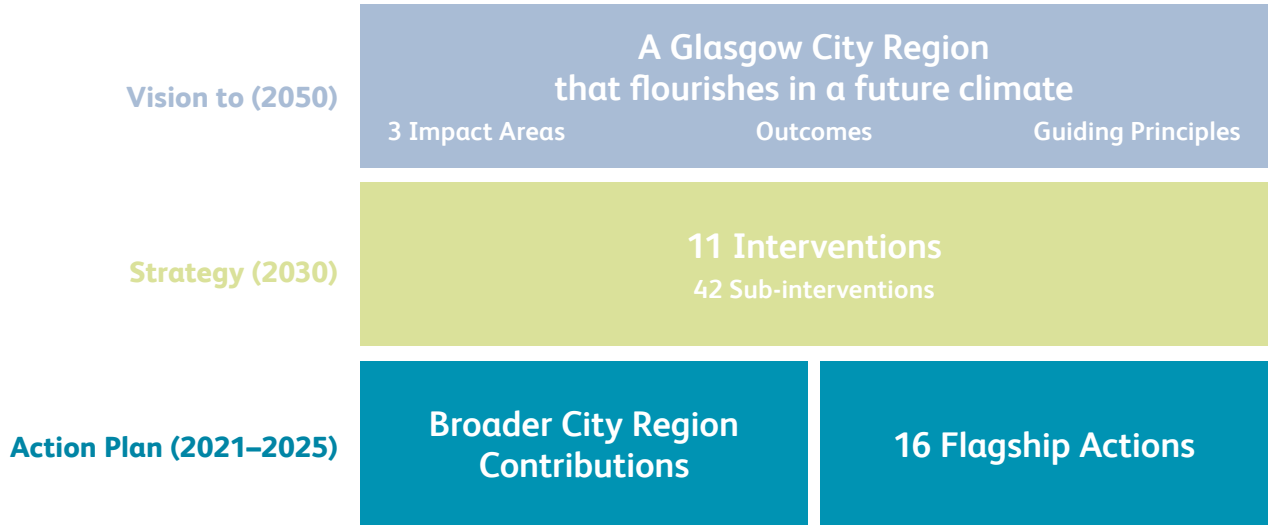


Fig.23. Action Plan within Glasgow City Region's Adaptation Framework.

The Flagship Actions are intended as an early, initial package of interlinked cross-cutting, synergized actions, supporting a systems level approach to implement the Adaptation Strategy over the next five years. The actions are not enough on their own; as adaptation is about a social transformation, there will be gaps to fill in the years ahead. Instead, they are a signal; a statement of intent that from here on in, things will start to look and feel very different as a region.

The process of developing the Action Plan has highlighted the need to broaden and involve new perspectives and actors. A systems approach, that looks to broader interconnections and complexity requires understanding the perspectives of many actors in the system and the governance arrangements around decisions. We are therefore taking a more inclusive approach – including the creative and cultural sectors to help build a groundswell of broader and more diverse voices and different ways of thinking, as well as the private sector, to bring economic factors in support of the transition.

On Climate Ready Clyde's invitation, we have received many contributions of new adaptation activities, plans and programmes that form the Action Plan and will help to deliver the Strategy over the coming five years. We would like to acknowledge and thank all organizations who have contributed so far. The range of contributors, and the scale of activities, demonstrates the collective commitment and intention across the region towards building climate resilience. These activities also fully support and complement the scale of ambition of the Flagship Actions.

The number of contributions are such that rather than detailing them here, we are looking to establish a separate online platform that presents all the contributions and allows for further, ongoing input from others. However, the following organizations deserve specific recognition as crucial collaborators:

3.2 Flagship Actions

A cornerstone of this change is committing to 16 Flagship Actions for Glasgow City Region. These are large-scale, high-ambition actions where there is strong consensus on the need for progress, and a recognition of the whole systems approach that is required to address core, underlying challenges. The actions are aligned with our region's vision of a Glasgow City Region that flourishes in a future climate, and its associated Theory of Change. Despite being at a formative stage, they represent a significant, step change from business as usual, designed to address systemic challenges, create the conditions for change and inspire further action. The actions, their type and the main spheres of actors are show below:

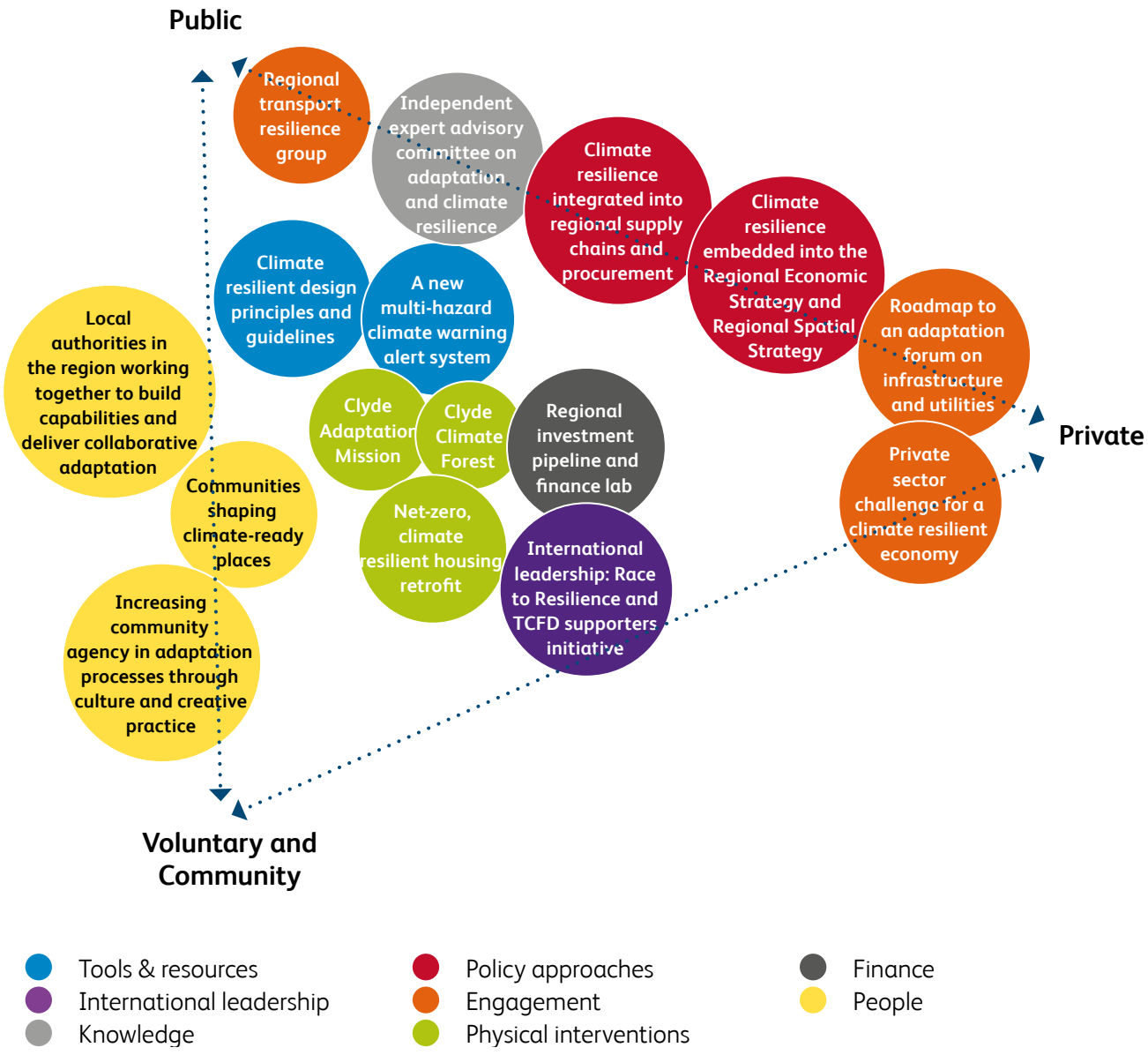


Fig.24. Flagship Actions mapped by type and relevant actors.

Each Flagship Action helps to deliver multiple interventions in the Strategy and invite a wide cohort of actors – public, private, third sector and communities – to coalesce behind them. They are also aligned to ,ational policy ambitions, as set out in the National Performance Framework and SCCAP2. The Flagship Actions meet a range of different principles, namely:

- **Fair** – Ensuring a level playing field for all those in the region facing climate risk
- **Enabling** – Unlocking barriers and constraints, to enable action by others, or building shared regional capacity, bringing mutual benefit to many
- **Inclusive** – Involving those affected in decisions
- **Just** – Addressing existing inequalities and future social vulnerability
- **Accountable and transparent** – Open to having progress monitored and scrutinized
- **Iterative and reflective** – Ensuring learning and including an adaptive management approach sharing learning and insights
- **Collaborative** – Working to achieve more than the sum of its parts
- **Beyond business as usual** – Part of creating a step change in adaptation action in Scotland

A hallmark of the Flagship Actions is the way in which they will be shaped and delivered by working together. They are all at different stages of maturity and momentum, and the Climate Ready Clyde Secretariat will play an enabling role, fostering the initial process but encouraging actors to own and grow the actions, deciding together on the best way to take them forward. **They have not yet been agreed with all of the key partners identified, but collective involvement will be crucial to success.**

The Climate Ready Clyde Secretariat will reflect and share success stories to increase momentum and accelerate action, as well as commissioning independent assessments of regional progress. The detail of this is set out in the section ‘Making it happen’. Whilst such scrutiny is important for long-term success, it is imperative that approaches are owned and developed within the region, with mechanisms that encourage effective participation and engagement. We believe an empowering, distributed approach to governance of these actions – allowing actors to decide and agree themselves on governance and accountability – offers the best opportunity to ensure action can become self-sustaining in the years ahead.

Our first cohort of Flagship Actions reflect the interest, energy and commitment from those already engaged in adaptation in Glasgow City Region. They are the beginning, not the end. Climate Ready Clyde’s members are committed to revise and expand the Flagship Actions in the years ahead and indeed new, and very different Flagship Actions.

Flagship Action 1:
Local authorities in the region working together to build capabilities and deliver collaborative adaptation

Intention
Local authorities based in Glasgow City Region will set up a regional forum to work together to build capacity to support adaptation action and look for opportunities to deliver integrated and collaborative adaptation. An early focus will be to develop a common approach to adaptation when implementing programmes and plans, such as Local Outcome Improvement Plans, Community Planning Partnerships, Local Development Plans, Open Space Strategies, flood risk management actions (including flood protection schemes) and capital investment decisions**.** The forum will collaborate on internal training programmes, including for elected members. A focus will be on sharing tools, guidance and experience on adaptation approaches, climate impacts on operations, and in engaging and equipping others in their organizations to adapt. Over time, this model would be transferred to other sectors, such as higher education and health boards.

Outcomes
Many of the changes needed for effective adaptation are influenced by, or directly delivered by local authority functions. This includes the support and services to local communities and locally-led activities. Sharing learning and developing consistent practices will better equip local authorities to ensure services, assets and resources are more climate resilient, with adaptation mainstreamed across broader corporate activities and plans. This in turn will lead to increased impact by raising the issue of adaptation to a higher level of awareness, governance and decision-making. This will nurture strong, trusted and supportive relationships between those in the region who are charged with delivering on the adaptation agenda, as well as engendering shifts more widely in these institutions. This cohort of individuals will become part of a network of adaptation champions, supporting the climate-ready vision and ambition to be shared across a range of institutions and actors. Strong adaptive capacity in local authorities is a necessary precondition of being able to engage well with a wider range of stakeholders, individuals and communities, and to enable and equip locally-led action: an essential aspect to support many of the Flagship Actions in the Action Plan.

Supporting and enabling mechanisms
- Adaptation Scotland's Adaptation Capability Framework and associated Benchmarking Working Group to benchmark and share learning on climate change adaptation.
- Potential dedicated programme of training and support for local authorities based in GCR.
- The Improvement Service and Architecture & Design Scotland are committed to supporting local government and partner organizations to embed climate change into their improvement activity and planning for recovery from COVID 19.

Supports delivery of the following Adaptation Strategy interventions 1 2 7 8 9 10

Key partners
All eight local authorities, SSN, Sniffer, Adaptation Scotland, the Improvement Service, COSLA, Architecture & Design Scotland, University of Strathclyde, University of Glasgow, NHS Greater Glasgow and Clyde, NHS Lanarkshire.

Flagship Action 2:
Communities shaping climate-ready places

Intention

Climate Ready Clyde partners commit to progressing place-based initiatives and approaches at a range of scales within the region with active participation and leadership of communities. In doing so, improvements to places are locally-led, driven by local interests, while building climate resilience and broader health and well-being benefits. Several existing initiatives have proven the benefits of a systems level approach to place-based developments, including aligning adaptation and net-zero needs. Building on existing experience and commitment, partners will explore new opportunities for co-design and co-delivery that applies local experience and targets local needs, investing in communities' capacity to engage, including programmes such as Renfrewshire's Town Centres Climate Resilience programme. Partners will share their learning and experiences with others in the region and more broadly.

Outcomes

Enhancing and investing in individuals' and communities' capability, and ensuring genuine co-design processes rooted in local interests and priorities, will help to increase the interest and desire for locally-led, climate-ready places. It also has the potential to bring new and informed forms of governance, decision-making and community ownership and agency. Multiple benefits derive from locally-led and inclusive adaptation action and placemaking including: empowered communities and organizations working together, improved health and well-being, increased open and green space, enhanced opportunity for active travel access, as well as reduced climate risks.

Several existing examples in the region demonstrate the significant benefits gained by place-based, community-led initiatives. As an example, **Places for Everyone** sees the University of Strathclyde collaborating with Glasgow City Council, City of Glasgow College, Sustrans and the local community to create cleaner, safer, pedestrian- and cycle-friendly streets across its campus. Similar applications exist in other areas, for example buildings, assets and energy systems can become more climate resilient and net-zero ready. This model also demonstrates the potential for a skilled workforce knowledgeable in climate resilient practices, and new business opportunities associated with adaptation.

Supporting and enabling mechanisms

- **Application of the Place Standard Tool** with a climate lens, and application of the tool via A Place in Childhood.
- **The Principles for Locally-Led Adaptation** offer a helpful framework and means of navigation to apply place-based initiatives, with community and local leadership at the heart.
- **University of Strathclyde's Heart of the Campus and Climate Neutral Innovation District projects** – a £6 m. investment in Glasgow by University of Strathclyde which offers a lasting city greenspace legacy.
- **Renfrewshire's Town Centres Climate Resilience programme** developing a local response to climate risks aimed at delivering programmes of beneficial interventions in its town centres with property owners, residents and users.

Supports delivery of the following Adaptation Strategy interventions 1 4 5 8 9

Key partners

University of Strathclyde, University of Glasgow, all eight local authorities, Sustrans, NHS Health Scotland, NHS Greater Glasgow and Clyde, Sniffer, Adaptation Scotland, Architecture & Design Scotland, Scottish Flood Forum, Public Health Scotland, Keep Scotland Beautiful, NHS Lanarkshire

Flagship Action 3:
Increasing community agency in adaptation processes through culture and creative practice

Intention
The development and testing of a new approach to engaging new actors and citizens in adaptation governance and delivery, through regional culture and the use of cultural and creative practices and processes. Creative Carbon Scotland will lead in working with several cultural organizations based in the region and with their communities, to develop a wider application of creative arts and communication that reaches new audiences. Applying different cultural practices and activities, co-designed with local cultural groups, will help to develop informed perspectives on adaptation and resilience. This in turn will help to build greater connection and ownership, so that individuals and communities are enabled and empowered to participate in adaptation processes. The results would be felt at a number of levels, such as in broad community and locally-led initiatives, in place-based approaches, and local and regional governance processes and the means by which decisions are made, helping drive systemic approaches to address more fundamental levers of change. Delivery of this action connects directly to synergies with Flagship Action 1 and 2.

Outcomes
The work will ensure a wide range of voices are included in the region's efforts in climate adaptation, particularly those most vulnerable to climate impacts, and those most marginalized in society. Working with cultural organizations will support the reach to different constituencies, develop different understandings and encourage new forms of communication about adaptation. This more inclusive approach will help to build a groundswell of much needed diversity, new voices and different ways of responding to the challenge. It will help ensure that individuals and communities have the desire and ambition to drive action so that their places are climate ready.

Such an approach has the potential to influence the design of new civic projects, to broaden perspectives in the discourse, to build a movement of empowered, mobilized individuals and communities. This has the potential to achieve shifts in mindsets, values and political priorities to support adaptation.

Supports delivery of the following Adaptation Strategy interventions 1 2 4 9

Key partners
Creative Carbon Scotland, Sniffer

Flagship Action 4:
Clyde Climate Forest

Intention

The Clyde Climate Forest (CCF) will build on the current momentum for tree planting and associated green-blue infrastructure, channelling it into transformative tree planting projects within the River Clyde catchment that deliver a broad range of climate, social and ecological benefits to Glasgow City Region. The initiative will engage with communities to ensure legacy. The CCF project is focusing on three elements:

- **canopy** – opportunities to increase canopy cover through new tree planting, particularly in areas of deprivation and at risk from the impacts of climate change
- **connectivity** – where new woodland planting will make connections that provide a potential migration route for woodland species from the headwaters of the River Clyde through to the Loch Lomond and Trossachs National Park
- **carbon** – where woodland creation will deliver good carbon sequestration opportunities.

By 2032, the project aims to increase average urban canopy to 20%, average woodland habitat network area by 20% and regional woodland cover to 20%.

Outcomes

Tree planting at scale is required as part of the solution to the climate and ecological emergencies. The connectivity of the CCF and the expansion of new areas will ensure that ecological systems are resilient. The new urban trees planted as part of the CCF will also help to manage climate risk through the management of rain and surface water during heavy rainstorms which otherwise will increasingly impact on the conurbation of Glasgow. They will also act to reduce overheating in urban area through transpiration and shading during the more frequent heatwaves which will also impact our region. The new forests and woodland created as part of the CCF in rural parts of the region will not only sequester atmospheric carbon but will also provide natural flood management to reduce downstream fluvial flooding. They will provide connections between habitats for woodland biodiversity making them more resilient to a changing climate. These areas will provide much larger benefits for recreation, active transport connections, etc. that will have large benefits for the health and well-being of the region.

Structured correctly, an innovative revolving model also has the potential to unlock wider funds for further protection of ecosystems and habitats, including and critically, peatland restoration. As well as directly reducing climate risks, the CCF will also inspire others to act further, by showing the benefits the trees provide. It also has the potential to provide education and training opportunities and new green jobs, supporting the wider transition to a green economy.

Supports delivery of the following Adaptation Strategy interventions 5 6 8 9

Key partners

EIT Climate-KIC, NatureScot, Glasgow and Clyde Valley Green Network Partnership, Scottish Forestry, Glasgow City Region Partnership, Woodland Trust, TCV, Green Action Trust, Trees for Cities, Forestry and Land Scotland, Scottish Water, Forestry & Woodland Sector, Architecture & Design Scotland, NHS Greater Glasgow and Clyde, NHS Lanarkshire

Flagship action 5:
A multi-hazard climate warning alert system

Intention

Partners will pilot, finance and deliver a multi-hazard climate warning alert system to allow people and organizations to better respond to the new range of climate hazards facing the region, and over time look to develop a possible multi-hazard integrated alert system. The alert system will be delivered in stages, focusing on priority hazards, seeking to provide the inputs required for multi-hazard early warning alerts (such as data from the Met Office), for the new emerging risks. It will also identify clear organizational processes which describe who needs to be aware of the information, what to respond to, and how to respond. It will seek to bridge the wider long-term gap between adaptation planning and emergency planning.

Such a system will build on, and in the longer-term be integrated with, existing tools and processes, such as SEPA's existing flood alert processes, and the pilot of surface water alerting conducted as part of the Commonwealth Games in 2014. The partners will also explore the potential for linking to a national system of climate warning, as well as how a system could support impact-based alerts. These early warning systems have some of the highest net economic benefits of any adaptation measure, and importantly, they provide immediate benefits today, which will increase with future climate change.

Outcomes

The hazards Glasgow City Region faces are changing, increasingly causing widespread disruption to people's lives and the critical systems on which we rely. SEPA's flood alerts provide early warning for river and coastal flooding. Alerts for surface water will need to be added over time, as well as other hazards, notably heatwaves, wildfires and landslides as such events become more frequent and severe.

These warning systems will enable more widespread awareness and advance warning of potential impacts, reducing weather related losses as well as impacts on people's lives. They will improve understanding of potential hazards, enabling people and organizations to become climate ready and better plan for, and respond to, climate impacts when they happen. This is a key part of building resilience for people and society, particularly the most vulnerable. It will also make a significant contribution to ensuring that on a day-to-day basis, the critical systems upon which we rely are fully resilient. Working towards a collaborative, integrated approach will provide greater impact; a more integrated, standardized approach is likely to be more effective and offers economies of scale.

Supporting and enabling mechanisms

- **SEPA Daily Flood Guidance Statement and Flood Alert System** – together forming the Scottish Flood Forecasting Service, a joint service between SEPA and the Met Office, which provides a strong existing system to build upon.
- **Existing hazard warning systems in other jurisdictions** – notably for heat in England.

Supports delivery of the following Adaptation Strategy interventions 2 7 8 9 11

Key partners

Regional Resilience Partnership, Local Resilience Partnerships, SEPA, NHS Greater Glasgow and Clyde, NHS Lanarkshire, Glasgow City Council (Lead), Ready Scotland, NHS Health Facilities Scotland, Scottish Government, Met Office, Scottish Fire and Rescue, Scottish Flood Forum, NHS Health Facilities Scotland, ABI, Scottish Trade Unions Congress, Natural Hazards Partnership (for health and pandemics), National Centre for Resilience, British Geological Survey, National Railway, Transport Scotland, Network Rail, Police Scotland, University of Strathclyde, SPEN, SGN.

Flagship Action 6:
Climate resilient design principles and guidelines

Intention
Local authorities, infrastructure companies and experts (architects, civil engineers, economists) will develop a set of harmonized design guidelines for large capital investment by local authorities and wider public bodies, which sets out how to use regionally specific climate projections for climate risk assessment. This will include the activities needed in the concept development, design, financing and delivery of infrastructure. The guidelines will contain step-by-step instructions on how to supplement historic climate data with specific, regional, forward-looking climate change data. Consideration to adaptation and economic appraisal approaches which consider multiple climate scenarios, suitable to the type of asset and its design lifetime (e.g. 50 years) will also be included. The guidelines will be developed for use by communities, planners, engineers, architects and others with a role in infrastructure and the built environment in Glasgow City Region to ensure a robust, consistent, consideration of climate risk across the entire project development process.

The guidelines will be developed iteratively, by focusing on specific asset classes, and drawing together learning from major projects currently underway in Glasgow City Region. In each case, the project teams will develop a series of guidelines. They will then draw them together into an overall set of guidance for the region. Once mature, Glasgow City Region's local authorities will consider how the guidelines can be best applied to infrastructure and built environment projects which use public funds – such as through a voluntary approach or mandatory requirements. They will also consider the potential to establish a more substantial climate risk management system to manage and monitor progress. Recent economic analysis highlights that enhancing the climate resilience of infrastructure makes sound economic sense, with on average, the benefits outweigh costs by a ratio of 4:1.[33]

Outcomes
As the understanding of climate risks and the need for adaptation grows, there is a need to enhance the frameworks for long-term resilience, ensuring we continue to make climate resilient investments. This is a form of due diligence (climate risk assessment is part of the Task Force on Climate-Related Financial Disclosures), recognizing that if not properly appraised, new developments, retrofits and refurbishments have the potential to lock in climate risks, to the mid-century and beyond. Improving climate risk assessment methods and processes will ensure assets and services work well in the future climate, as well as land, open space, water management and placemaking approaches.

The guidelines will address the risks of climate change, supporting due diligence activities and improving the financial case for adaptation investment. A regional approach, as well as providing efficiencies, will ensure that adaptation and climate resilience efforts align with the overall region's economic geography.

Supporting and enabling mechanisms
- **Existing large-scale infrastructure projects and planning processes** – e.g. Glasgow Metro, SEPA/GCC climate resilience in the planning process.
- **Climate risk management systems** – such as those in the World Bank, European Investment Bank.
- **International connections** – learning from other cities around the world (notably New York, Singapore, Amsterdam and London).

Supports delivery of the following Adaptation Strategy interventions 6 8

Key partners
Glasgow City Region, all eight local authorities, SPT, Transport Scotland, SEPA, Natural Hazards Partnership, SPEN, SGN, Architecture & Design Scotland, Adaptation Scotland, NHS Greater Glasgow and Clyde, NHS Lanarkshire

Flagship Action 7:
Net-zero, climate resilient housing retrofit

Intention
It is estimated that over 420,000 homes across the region currently fall below the standard of Energy Performance Certificate Band C (due to be the required minimum standard by Scottish Government), whilst the adaptation and resilience measures needed in the region's homes have yet to be quantified or costed. As part of the region's Economic Recovery Plan, Glasgow City Region will work with a wide range of partners to develop a proposal for the retrofit of these homes with energy efficiency, renewable electricity and explore the opportunity for adaptation measures. Glasgow City Region has commissioned a feasibility study to inform the development of the proposal. The study will consider the requirements and develop a roadmap for the rollout. This will include the technical requirements, potential financial approaches including how to structure such a financing model to target those in fuel poverty and who are most vulnerable to climate impacts, whilst avoiding additional costs, for example through higher heating costs or high payments for adaptation benefits. It will also assess the economic benefits of home energy retrofit, including the potential economic uplift, the opportunities for the local supply chain and the skills requirements.

The Feasibility Study will provide a clear set of recommendations for delivering retrofit that take into account the function, role, and powers of a range of different partners such as local authorities, national government, Skills Development Scotland, Scottish Funding Council, Scottish Enterprise, Construction Industry Training Board (CITB), the Scottish Housing Regulator, Association of Local Authority Chief Housing Officers, Scottish Federation of Housing Associations etc.

Outcomes
Domestic buildings account for about a fifth of Scotland's emissions, and therefore require substantial attention over the next 20 years in order to meet the net-zero target. At the same time, many buildings in the region need improvements to become resilient to climate impacts. Delivered in an integrated way, there are many benefits for people and the region: cheaper heating bills, less exposure to flooding or overheating, reduced fuel poverty. It also has the potential to provide a strong economic stimulus, for investment and training across the whole supply chain, creating new skilled, green jobs, and a wider market signal across the electricity and heat network companies and providers. A coordinated net-zero, resilient retrofit scheme will help to minimize future disruption to building owners and occupiers, lowering the total costs of delivering low carbon, climate resilient development. Such approaches will also drive wider community resilience.

Supporting and enabling mechanisms
- **Heat in Buildings Strategy/Local Heat and Energy Efficiency Strategies** – will set out the new regulatory framework for the transition to zero emissions in domestic buildings.
- **Resilient Regions: Clyde Rebuilt** – the project identified a financial model that could be used to bank savings on heating costs due to a warming climate as part of the wider project benefits.

Supports delivery of the following Adaptation Strategy interventions 5 8 11

Key partners
Glasgow City Region, all eight local authorities, housing associations, MGSDP, Scottish Government, EIT Climate-KIC, SEPA, NatureScot, Historic Environment Scotland, Scottish Power Energy Networks, Scottish Flood Forum, landlords, Skills Development Scotland, Architecture & Design Scotland, housing developers, contractors, FE Colleges

Flagship Action 8:
Regional transport climate resilience group

Intention
Strathclyde Partnership for Transport (SPT) and Network Rail will scope a terms of reference with a view to establishing a Regional Transport Climate Resilience Group to act as an informal forum for debate, discussion and exchange, as part of managing critical climate risks to the rail and wider transport infrastructure across Glasgow City Region. The group will facilitate discussion and share best practice on the strategic adaptation of the transport network with national, regional and local partners from a regional focus. This group will be separate from existing national, regional and local resilience groups and is not intended to replicate current arrangements around coordinated resilience activity for immediate extreme weather events impacting on the transport network.

Adaptation is considered in current transport plans and projects but more needs to be done to ensure a co-ordinated approach. In the longer term, the group will therefore aim to expand as appropriate to reflect the wider transport and active travel network and to help articulate regional priorities for investment in transport including in the forthcoming Regional Transport Strategy. Other activities could include promotion and application of Climate Ready Clyde's Climate Risk Screening Toolkit[34] and the links to the climate resilient design guidelines and principles in Flagship Action 6.

Outcomes
The movement of the 1.8 million people who live and work within Glasgow City Region underpins its vibrancy and economic prosperity, but could be profoundly affected by climate change. Glasgow City Region is also a national strategic transport hub; the importance of which is only likely to increase in the longer term, for example with the construction of HS2.

Climate change brings an increased risk of flooding, landslides and disruption as well as extreme temperatures, high winds and changes in vegetation growth rates, and changes in freeze thaw ratios affecting slope stability and embankments.

The group will increase coordination and enhanced partnership working on adaptation and resilience issues which are regionally significant and warrant greater prominence at the national level. It also allows climate change to be considered in the context of wider changes, such as the changing nature of transport needs post pandemic.

Supporting and enabling mechanisms
- **Adaptation Reporting Power** – requires organizations to assess and report on their risks and opportunities every five years.

Supports delivery of the following Adaptation Strategy interventions 8

Key partners
Initially Network Rail, SPT, Transport Scotland and ScotRail with scope to extend as appropriate to cover the wider transport and active travel network.

Flagship Action 9:
Roadmap to an adaptation forum on infrastructure and utilities

Intention
Partners will develop a roadmap to establish an Adaptation Forum on Infrastructure and Utilities to facilitate debate, discussion and exchange, as part of managing critical climate risks to infrastructure and utilities across Glasgow City Region. The group offers the opportunity for strategic oversight, to identify priority issues, as well as addressing practical, immediate concerns.

Outcomes
Through shared learning and common approaches in resilience and adaptation surveys of particular sites and operations, it is more possible to identify risk and vulnerabilities where increased resilience measures will be necessary. Critical assets, operations and services, on which the people, society and economy of Glasgow City Region rely will become more climate resilient and designed with future climate risks in mind, to avoid future lock in. Internal training on the CRC climate risk tool can look to build standardized requirements into major projects, site and network maintenance and new property construction. The connection to Flagship Action 6, to interact with and support development of the climate resilient principles and guidelines will be key.

Supporting and enabling mechanisms
- **Adaptation Reporting Power** – requires organizations to assess and report on their risks and opportunities every five years.
- **Infrastructure Operators Adaptation Forum** – the UK forum for national infrastructure operators also helps develop best practice in relation to climate risk assessment and adaptation planning for infrastructure.

Supports delivery of the following Adaptation Strategy interventions 8

Key partners
SGN, SPEN, Scottish Water, telecoms providers, Glasgow City Region Infrastructure Portfolio, all eight local authorities.

Flagship Action 10:
Private sector challenge for a climate resilient economy

Intention
Convene private sector representatives, primarily based and located, or with a presence in Glasgow City Region, to identify and set a challenge to push the private sector to become climate resilient, reducing costs to their businesses and realizing opportunities for new goods and services. The challenges will be identified through a series of roundtables and set within the framework of the Task Force on Climate-Related Financial Disclosures (TCFD). A positive and targeted dialogue with the private sector will also help the public sector inform economic development, planning policymaking. A number of the supporting Flagship Actions will be relevant to the 'challenges', including Flagship Action 7: Net-Zero Climate Resilient Housing Retrofit, Flagship Action 11: Clyde Adaptation Mission and Flagship Action 14: Embedding Resilience into the Regional Economic Strategy and Regional Spatial Strategy.

Outcomes
Businesses and industries which have helped transform Glasgow City Region's economy, and with a role in building a climate resilient economy are also, paradoxically exposed to many climate risks. Developing private sector 'challenges' will help businesses accelerate their planning to become resilient to climate change, reducing costs, increasing competitiveness and productivity, and identifying opportunities to build resilience into the regional economy including through potential cooperation with the public sector. It will also help drive early uptake and adoption of TCFD reporting, supporting business compliance.

Supporting and enabling mechanisms
- **Task Force on Climate-Related Financial Disclosures** – the new whole-economy reporting requirements for businesses require them to assess financial risks relating to the low carbon transition and the physical risks of climate change.

Supports delivery of the following Adaptation Strategy interventions 1 2 3 11

Key partners
Scottish Trade Union Congress, Scottish Enterprise, Clydeplan, Glasgow City Region PMO, all eight local authorities, EIT Climate-KIC, critical infrastructure providers (e.g. energy companies), representatives of the banking and insurance sector, Chambers of Commerce, selected larger companies with a commitment to tackling climate change in the region.

Flagship Action 11: Clyde Adaptation Mission

Intention

Clyde Mission, a partnership between Scottish Government and Glasgow City Region, brings together public and private sector partners to harness the opportunities and competitive advantage of the River Clyde and the surrounding assets to deliver economic, social and environmental benefits. Clyde Mission will create a 'Mission Group' of key strategic partners in the public, private and third sectors to drive new interventions and support the development of a long-term adaptation pathway which considers flood risk around the Clyde from the source in the Lowther Hills to the estuary (Clyde Mission footprint). Using the River Clyde as a national strategic asset, Clyde Mission aims to:

- create new, good and green jobs and a workforce with the skills to secure those jobs
- use vacant and derelict land for the benefit of the economy, the environment and communities
- adapt to climate risks, especially flooding
- accelerate Scotland's progress to net-zero
- use the river to create better places for people and communities.

Outcomes

The Clyde has a distinct place in Scotland's economic and social history and a strong sense of identity and place. It played a key role in the industrial development of Glasgow and now has the potential to play a key role in Scotland's economic future, the transition to net-zero and adapting to climate risks. Public and private investments such as those in the Barclays Glasgow Campus, the expansion of the Scottish Events Campus (SEC), the Glasgow Riverside Innovation District, along with the Advanced Manufacturing Innovation District and Queens Quay, are bringing new economic life and vibrancy to the Clyde. But the area's industrial past has left a legacy of vacant and derelict land and some communities close to river are among the most disadvantaged in Scotland.

The Clyde Mission seeks to address these challenges by ensuring the collective impact of public and private investment is optimized by attracting further investment and by bringing vacant and derelict land back into productive use. It also seeks to address the potential risk that tidal (and river) flooding presents to communities, businesses and the city. The Mission will consider how we can improve and open up the river for visitors, local people and communities and ensure that riverside activities are climate ready – adaptable and resilient to climate change. The Mission will also examine the use of the river as a source of heat and energy for businesses and communities. Part of this Mission – and a new outcome – will be to develop an adaptation pathway for the Clyde Mission. This will be an iterative long-term plan on ensuring the mission plans are resilient – but also looking to see how the Clyde Mission itself can deliver adaptation as a core objective.

Supporting and enabling mechanisms

- **Other mission-based approaches** – such as the EU's Horizon Europe missions (including the Adaptation Mission) and other missions by cities and regions.
- **Regions with iterative adaptive plans** – such as the Thames Estuary 2100 programme for London but also other countries including the Netherlands and Bangladesh.
- **The new BS 8631 Standard on Adaptation Pathways**[35] – which provides guidance on developing best practice adaptation approaches.

Supports delivery of the following Adaptation Strategy interventions 4 5 6 8

Key partners

Scottish Government, SEPA, Scottish Enterprise, SFT, Glasgow City Region, Glasgow City Council, Inverclyde Council, Renfrewshire Council, West Dunbartonshire Council, Argyll & Bute Council, North Lanarkshire Council, South Lanarkshire Council, NHS Greater Glasgow and Clyde, NHS Lanarkshire. This Flagship Action would require coordination with CRC partners and Secretariat and would benefit from access to expertise from across the CRC partnerships.

Flagship Action 12:
Regional investment pipeline and adaptation finance lab

Intention

Partners will work to establish an Adaptation Finance Lab to unlock new investments for funding adaptation action by supporting innovative financing models in Glasgow City Region, including to explore ways to blend public funds with private sector finance. This will build on the eight innovative models developed through the Resilient Regions: Clyde Rebuilt project, which will be further developed and taken forward with relevant stakeholders in the region.

The other function of the lab will be to develop a pipeline of investable projects for Glasgow City Region to match with suitable financing. A key part of this work will be to consider how to frame investments to allow for larger institutional investors to support adaptation in cities and regions.

Outcomes

Ensuring adequate adaptation funding and finance is a strategic challenge, not only for Glasgow City Region, but globally. In addition to the more strategic use of public sector expenditure, Clyde Rebuilt's Resource Mobilization Plan identified the need for public bodies operating in Glasgow City Region to adopt a more commercial mindset, and to foster innovation that could address private sector investment risks and support transformational adaptation measures.

Doing this through a lab presents an opportunity to test and scale new financing models, with a particular focus on crowding in private sector finance which would include the participation of different actors across sectors and functions. More broadly, the lab creates a clear signal to the market of our intent to attract adaptation finance at the scale needed for the region and provides a clear point of contact for actors interested in this space to coalesce around, ensuring the financial system supports climate resilience, as well as the shift towards a green economy.

Supporting and enabling mechanisms

- **Existing pipeline programmes** – the Scottish Government and Glasgow City Region already have a a number of approaches to identifying programmes of investment, such as the Green Investment Portfolio and Green Growth Accelerator.

Supports delivery of the following Adaptation Strategy interventions 3 9

Key partners

EIT Climate-KIC, Scottish Enterprise, Climate Ready Clyde, Regional Economic Partnership, all eight local authorities, Glasgow City Region, Skills Development Scotland, Scottish Government, Green Finance Institute, NatureScot, Adaptation Scotland, NHS Greater Glasgow and Clyde, NHS Lanarkshire

Flagship Action 13:
Independent expert advisory committee on adaptation and climate resilience

Intention
An independent advisory committee will be convened to provide an authoritative source of information on future climate change and its potential impacts to input into key decision in the region. The committee will draw on applied research and knowledge, from academic institutions in Glasgow City Region, and nationally, to ensure independent, evidence-based research and advice informs wider regional development.

The committee will act as an interface, to broker knowledge, understanding and facilitate a dialogue between the research and policy communities. As well as providing advice, the advisory committee would explore gaps in knowledge and help to formulate critical questions to interrogate, enhance and apply existing research, and to commission small research pieces where relevant. It will include consideration of the synergies and trade-offs with net-zero, and over time, the scope could also be broadened to address net-zero. The proposals should be developed working closely with ClimateXChange to build on their experience of connecting research and policy.

Outcomes
Drawing on the input of leading academic institutions and universities working in the field of climate risk and resilience can ensure that those operating in Glasgow City Region make better informed decisions. While we have sufficient information and knowledge to act, research and innovation can inform and improve our decisions and actions. An advisory committee that can facilitate the interface between policy and research, can help climate-proof policy, and develop the system-wide approach to ensure that adaptation is aligned and mainstreamed. Equally the research community will provide expertise and knowledge that is relevant, required and responds practically to broader societal needs and policy aspirations. Over time, this process should also lead to higher impact research on adaptation. The advisory committee can help to build the case for change regionally and nationally around new, innovative projects, demonstrators and programmes over time, which will help to inform and build an adaptation economy, with the necessary skills, norms and practices.

Supporting and enabling mechanisms
- **The UK Committee on Climate Change** – with extensive experience in advising governments
- **ClimateXChange** – the Scottish Government's Centre of Expertise on climate change has significant experience in commissioning research to ensure better informed decision-making
- **Existing City and Regional Advisory Committees** – cities and regions around the world have set-up similar committees to help them make more climate resilience decisions in development.

Supports delivery of the following Adaptation Strategy interventions 10

Key partners
ClimateXChange, University of Strathclyde, University of Glasgow, Glasgow Caledonian University, Architecture & Design Scotland

Flagship Action 14:
Climate resilience embedded into the Regional Economic Strategy and Regional Spatial Strategy

Intention
As part of Glasgow City Region's pivot towards a green economy and the drive for a green recovery, the Glasgow City Region Programme Management Office (PMO) will ensure that climate risks and adaptation needs are considered in the forthcoming Regional Economic Strategy and its spatial representation, the Regional Spatial Strategy.

The strategies will consider the key climate risks associated with the current economic model, particular sectors and the potential risks and benefits associated with the transition to a green economy. They will also consider climate risks and vulnerabilities of key sites in Glasgow City Region identified as an economic priority, to help avoid the risk of lock-in. This will also help to inform Local Economic Development Plans. It will also integrate spatial information for current and future risks, into the Regional Spatial Strategy. This will reduce the risks of lock-in and ensure climate resilient development.

Outcomes
Accounting for climate risks in regional development plans and investment decisions will help minimize economic and financial costs for the region and individual public authorities and private organizations, either from weather related damage of assets, or from climate change affecting operation, performance or revenues/benefits. It also provides a significant market signal to existing businesses or those considering investing in Glasgow City Region that the area is serious about providing a long-term, high-quality location to do business, and will help inform businesses reporting on climate risks as required by the UK Government. Similarly, there is a need to integrate climate risks geographically, e.g. with risk mapping, into spatial planning. Land-use plans lock in patterns of development for decades and the geographical nature of climate risks is going to change – it is therefore essential that climate risks are factored into regional spatial strategy – to ensure these lock-in risks are avoided.

Supporting and enabling mechanisms
- **Glasgow City Region Regional Economic Baseline**[36] – the Regional Economic Baseline identifies the key economic challenges for the region, including relating to mitigation and adaptation
- **Indicative Regional Spatial Strategy (iRSS)** – the iRSS identifies the key spatial priorities for development within Glasgow City Region
- **National Planning Framework 4** – the forthcoming National Planning Framework 4 will provide a framework to guide the inclusion of climate resilience into spatial planning.

Supports delivery of the following Adaptation Strategy interventions 9 11

Key partners
Glasgow City Region PMO, Clydeplan, Clyde Mission, all eight local authorities, SPT, Architecture & Design Scotland, Scottish Government

Flagship Action 15:
Climate resilience integrated into regional supply chains and procurement

Intention
Glasgow City Region is working collaboratively with partners to suppliers to develop a refreshed Sustainable Procurement Strategy that will use the region's procurement power to support our wider objectives of building resilience of private sector and local communities, supporting the transition to net zero emissions, and working with suppliers to incentivise climate resilience and mitigation efforts.

As a first stage in this work, Glasgow City Region will use the Scottish Government's Sustainable procurement tools to analyse the main procurement categories and identify where we can drive down emissions.

To improve the climate resilience of our supply chains and reduce their vulnerability to climate risks Glasgow City Region will work with the Scottish Government and other partners to develop an approach to baselining information about existing supply chains. This will identify the most vulnerable supply chains as a way of helping prioritise areas and identify opportunities to include climate resilience clauses within contracts. The learning will be shared across the region and beyond with other organizations to build their awareness of the tools and techniques involved.

At the same time, Glasgow City Region will explore how consideration of climate resilience and adaptation is embedded in the procurement process, and the procurement team will share training materials and resources to help build suppliers' capacity to adapt. The PMO will also explore the potential for adaptation activities to be added into the community benefit outcome menu to provide new ways suppliers can provide additional benefits to communities.

Outcomes
As a result of long supply chains and just-in-time practices, many climate risks faced in the region can arise outside of Glasgow City Region such as disruption to products, services or distribution. Beginning to require strong adaptation and resilience policies in the procurement process reduces the chances of risks occurring or the size of their impact. Embedding climate resilience requirements into contract clauses also helps drive wider take up and improvement of resilience and adaptation activity in the private sector.

Supporting and enabling mechanisms
- **Glasgow City Region Sustainable Procurement Action Plan** – setting out the regional approach.
- **Sustainable Procurement Duty** – The sustainable procurement duty requires that before a contracting authority buys anything, it must think about how it can improve the social, environmental and economic wellbeing of the area in which it operates, with a particular focus on reducing inequality.

Supports delivery of the following Adaptation Strategy interventions 3 11

Key partners
East Dunbartonshire Council, Glasgow City Region PMO, North Lanarkshire Council, South Lanarkshire Council, Renfrewshire Council, East Renfrewshire Council, Inverclyde Council, West Dunbartonshire Council, NHS National Services Scotland

Flagship Action 16:
International leadership: Race to Resilience and TCFD supporters initiative

Intention
Climate Ready Clyde will sign up to the United Nations Race to Resilience (Resilience campaign,) which seeks to build the resilience of four billion people globally, who are most vulnerable to the impacts of climate change. Through this umbrella campaign, the initiative will seek to strengthen understanding of who in the region is most vulnerable to climate impacts, where they are located, and target action to support them. We will also seek to crowd in a significant number of additional actors in Glasgow City Region, in service of this.

In parallel, the Secretariat will also become a supporting City Region for the Task Force on Climate-Related Financial Disclosures (TCFD). Over time, the initiative will work to make information on climate risk and adaptation action available to support companies in Glasgow City Region to assess climate risk and support decisions of those looking to locate here.

Outcomes
Climate Ready Clyde members are clear that we must ensure that the impacts of climate change do not fall disproportionately on the most vulnerable in our region, and that activities to adapt seek to reduce existing inequalities and vulnerabilities. Signing up to the Race for Resilience initiative will provide a signal of a shift in societal priorities to build resilience amongst the most vulnerable and drive a deeper shared understanding of who is most vulnerable to climate change.

At the same time, economic prosperity is fundamentally linked to a safe future climate. Joining the TCFD initiative is the start of an ongoing process of providing signals and actionable information to the wider market, to price climate risk accordingly and ensure the financial system supports climate resilience.

Supporting and enabling mechanisms
- **Data and evidence** – needed to help inform and target our work towards the most vulnerable, as well as to identify those businesses
- **Existing private sector and community governance mechanisms** – which may be a helpful starting point for considering how to embed considerations of climate risk and adaptation
- **TCFD Regulation** – the requirement for all businesses with 200 employees or more to consider their transition and climate risks from 2025.

Supports delivery of the following Adaptation Strategy interventions 1 2 4 5 11

Key partners
UK Government, UNFCCC, Clydeplan, SEPA, Dynamic Coast, 4 Earth Intelligence, CBI, Chambers of Commerce, Community Planning Partnerships, Glasgow City Region, large corporates in scope of TCFD reporting.

3.3 Making it happen

Glasgow City Region's first regional Adaptation Strategy and Action Plan is a bold and ambitious statement of the different future we want, to ensure the City Region flourishes in its future climate. Its intention is to be a catalyst; a call to action for all organizations, communities and businesses with a stake in Glasgow City Region to step forward and step up as is required. Action to deliver the Strategy is urgent and demands rapid progress. To support Strategy delivery, the initiative is setting stretch targets, structuring itself to enable delivery by others and working with others to unlock the investment required.

Stretch targets

It is not possible to condense the ambition above of flourishing in its future climate into a set of straightforward indicators which can be achieved, since the baseline level of climate will continue to change. However, we have identified stretching targets to help ensure the Action Plan stays true to the intention of supporting the most vulnerable, as well as overcoming the financial and inclusion barriers to achieving the Strategy's interventions. These targets are that by 2025, we will have:

Increased the resilience of over 140,000 of the region's most vulnerable people to the impact of climate change

Closed the region's adaptation finance gap of £184 m. a year

Involved 125 new organizations, community groups and businesses supporting Glasgow City Region to adapt

Achieving these targets do not mean that in and of itself the region will be flourishing in its future climate, but they will be markers of significant progress to making it happen in a fair and equitable way. The targets have been calculated based on an assessment of the baseline picture in Glasgow City Region of those most vulnerable and the adaptation gap.

The target of supporting the most vulnerable 140,000 in the region is aligned to the U.N.'s Race to Resilience campaign, which will build the resilience of four billion of the world's most vulnerable people to the impacts of climate change. In Glasgow City Region, 140,000 people are in the top 20% of the SIMD and live in areas that may experience either heat hazards or flood risk. Further detail on these, as well as the adaptation finance gap, and the methods used to calculate them, are included in the technical annexes.

Enabling delivery

Unlike other regions in Europe, Glasgow City Region has no clear mandated responsibility for delivering on adaptation. To support its implementation, Climate Ready Clyde's Board and our member organizations will therefore take the lead, supporting and enabling communities, businesses and institutions to play a role in delivering the Strategy by:

1. **Fostering an ambitious, adaptive culture, celebrating and monitoring progress.** The success of the Strategy hinges on continuing to nurture an inclusive approach to adaptation, where there is real buy-in and understanding of the need to adapt and its rewards, supported by self-organizing, distributed governance and accountability. As such, the Climate Ready Clyde Board will continue to foster and grow this culture, creating regular opportunities to showcase and celebrate collective success and to share learning, including through our annual report. At the same time, it will be important to monitor progress towards transforming the region and reducing climate risks and realizing opportunities. This will be done through a two yearly independent assessment of progress, as well as a strategic review and refresh of our Theory of Change (including whether the conditions for change are being met), and update of the Risk and Opportunity Assessment every five years following on from the UK Climate Change Risk Assessment.

2. **Coordinating and activating institutions, communities and business.** The Secretariat will continue to join up activity across the region and beyond, as well as involving new 'keystone' actors – those who are significant in the region's systems, and whose involvement and action can create significant change. Climate Ready Clyde will shortly launch details of how organizations can showcase their activity to support delivery of the Strategy and its interventions, and the support, engagement and recognition they can receive for doing so.

3. **Delivering innovation.** Working with others, Climate Ready Clyde will continue to pilot and deliver new innovations which support adaptation planning, financing and implementation, particularly where there is not an impetus for one organization to pursue this individually. The idea will be that over time these innovations will be adopted by those in Glasgow City Region to accelerate progress.

4. **Enabling and equipping action.** Climate Ready Clyde will continue to undertake functions such as training, capacity building, evidence development and technical support to build the region's adaptation capabilities, enabling others take action to adapt to climate change.

Through these processes, the Climate Ready Clyde Secretariat will seek to create an ambition loop on the region's adaptation action, like that used in the Paris Agreement itself. Strong public sector action and commitments, demonstrated here, should provide market signals, in turn driving action by the private sector. Together, these actions should open space for communities to play a stronger role, through direct involvement but also wider pressure on government at all levels for faster action. Our model is shown below:

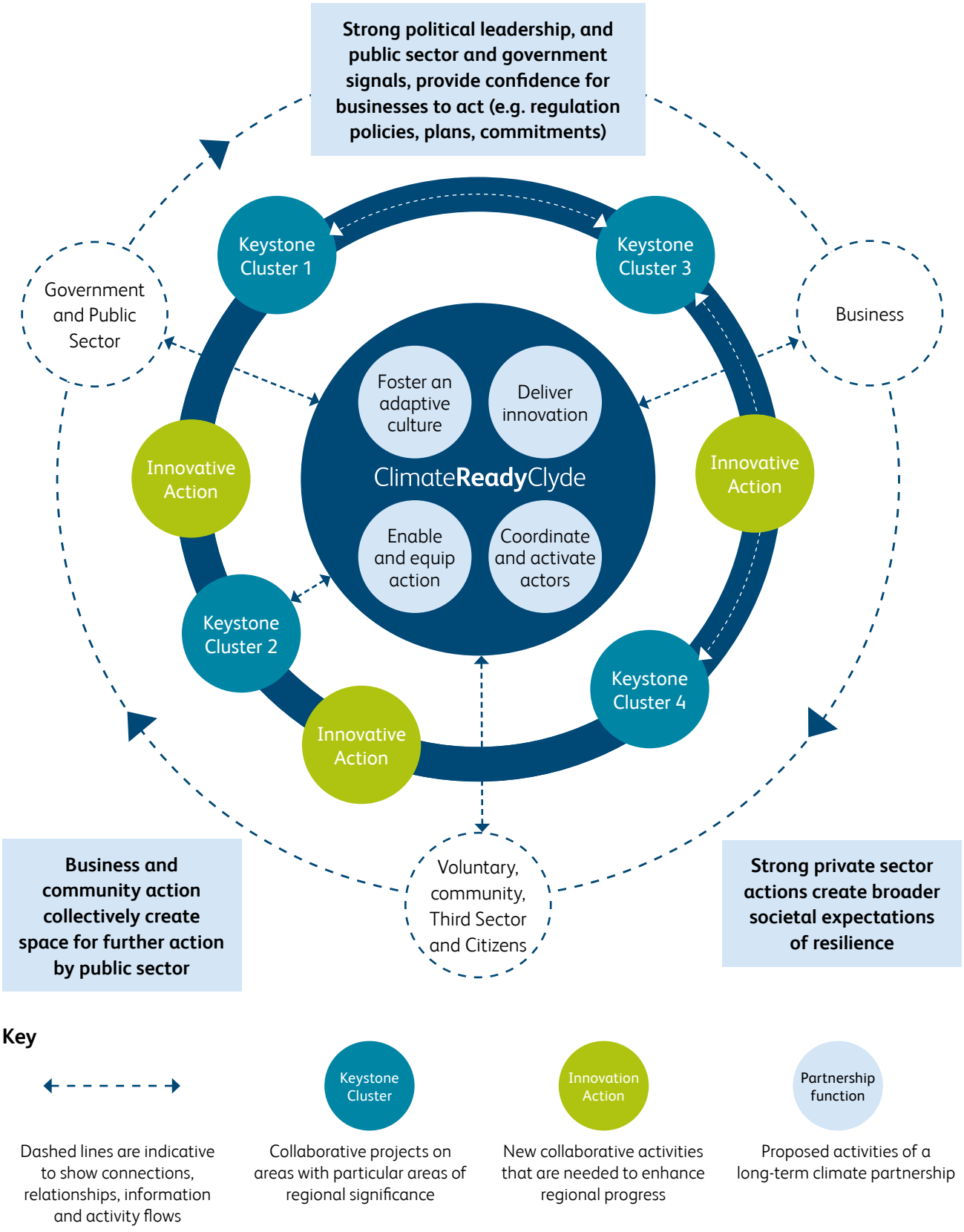


Fig.25. Glasgow City Region adaptation ambition loop.

Funding and financing

The overall case for taking action to address the future risks – and economic costs – of climate change in the region is strong. In preparing the Strategy, the Resilient Regions: Clyde Rebuilt project team assessed the economic case for action across the 11 intervention areas. Each individual intervention has a positive economic case, and together as a portfolio, they are estimated to deliver very large net economic benefits.

Intervention	Economic case
1. Reform and reshape governance mechanisms so they respond to adaptation needs, nurture new leadership and create expectations in society	**Good (enabling activity)**
2. Develop the ability of organizations, businesses and communities to adapt	**Good (enabling activity)**
3. Increase adaptation finance through leverage and innovation	**Very strong**
4. Enable and equip communities to participate in adaptation, focusing on the most vulnerable	**Strong**
5: Embed reflection, monitoring, evaluation and learning into adaptation action	**Good (enabling activity)**
6. Adapt the Clyde corridor for the twenty-second century	**Strong**
7. Enhance early warning and preparedness for floods and heatwaves	**Very Strong**
8. Ensure everyone's homes, offices, buildings and infrastructure are climate resilient	**Strong**
9. Deliver nature-based solutions for resilient, blue-green ecosystems, landscapes and neighbourhoods	**Strong**
10. Enhance regional decision-making and establish Glasgow City Region as a global research and knowledge adaptation hub	**Good (enabling activity)**
11. Begin the transition to an economy resilient to future climate impacts	**Good (enabling activity)**
Overall Adaptation Strategy	**Strong**

However, delivering them will require finance. Successfully unlocking the finance for Glasgow City Region's Adaptation Strategy, Action Plan and Innovation Portfolio, and thus bridging the adaptation finance gap, will require three strategies, working in partnership with local, national and UK actors.

1. **Increasing public investment and creating the conditions for adaptation.** There are some adaptation activities and investments that require (and justify) public intervention, because of market failures or because they involve investments where there is limited private sector interest. In these cases, public investment can support core adaptation. However, there are also opportunities to use public funds to create the enabling environment for actions by the private sector and others.

2. **Encouraging public organizations operating in Glasgow City Region to move towards a more commercial mindset.** There are opportunities to use public funds or assets to support public-private sector partnerships or unlock investment from the private sector for adaptation. These opportunities could be very significant.

3. **Developing innovation for adaptation.** There are emerging opportunities for adaptation and these can be developed through a cycle of innovation. There is a role to demonstrate new approaches working with new combinations of actors. This can be developed through partnerships including local research institutions and national and European research funders, local, Scottish and UK government, and the private sector. This would also position Glasgow City Region as an innovation hub for the emerging adaptation economy and subsequent opportunities.

A summary of a first order mapping of the interventions in this Adaptation Strategy to existing public sector finance – grants/debt/equity/tax to raise debt – is shown in Figure 26 below. Most of the 11 interventions will need some degree of public funding for their implementation. At the same time, the types of public funds and financing can be broadening significantly, to move away from simple grants, to multi-year, larger scale debt financing, equity financing and user charges. Furthermore, given likely constraints to public funds, available grant based public funds can be targeted towards essential public good and services without commercial opportunities, but also to interventions that can lever in new private sector investments. Such actions can create further economic opportunities and help drive green job creation.

Intervention	1	2	3	4	5	6	7	8	9	10	11
Sources of public finance – financing instrument used											
Grants	■	■	■	■		■	■	■	■	■	■
Debt	■	■	■	■	■	■		■	■		■
Equity			■			■		■	■		■
Tax to raise debt (including user charges)							■	■			■

Fig.26. Financing instruments for public finance mapped to the Adaptation Strategy interventions.

To deliver on the scale and urgency of finance needed for transformational adaptation in Glasgow City Region, a structure that integrates available sources of finance with new and innovative finance structures is proposed, i.e. towards transformative finance. This focuses on blended finance and new financial instruments for adaptation, using a more systems-based approach, to drive progressive adaptation interventions.

Doing this requires the private, public and third sectors to design a process for mobilizing public and private resources for innovation, making a broader range of financing instruments and models accessible, as well as developing long-term transformative financing solutions that are aligned to the different interests and requirements of the public and private sectors.

To help this, a typology of financing types has been developed for adaptation in Glasgow City Region. The approach recognizes that resource mobilization is needed to finance both incremental and transformational adaptation, using both conventional and transformative adaptation financing approaches. This is shown in the matrix below. All four areas are needed, for example, there is some conventional finance (left hand column) that will be needed for core adaptation actions, and this type of funding can also help test innovative actions, or scale up. However, new financing approaches (right hand column), using transformative finance, will also be needed.

		Type of Finance	
		Conventional finance	Transformative finance
Type of Adaptation	Incremental adaptation	Public sector funds using grants, i.e. business as usual	New instruments or financing models to scale up adapttion
	Transformational adaptation	Public sector funds for new innovative adaptation or delivering at scale	New instruments/financing models for innovative and systemic adaptation

Fig.27. The Adaptation Finance Matrix (typology).

In addition, a larger ecosystem of social network actors was mapped for finance in Glasgow City Region. draws out the potential interaction between public, private and third sector actors to finance adaptation – see Figure 28. The closer the actor to the centre, the greater their role in adaptation finance and the more likely ease of finance. This map is useful to understand which actors already play a strong role in financing adaptation and which ones need to be provided with incentives and enabling environments to encourage their participation. This could be an effective way to tease out combined mitigation-adaptation approaches to finance climate action or blending finance.

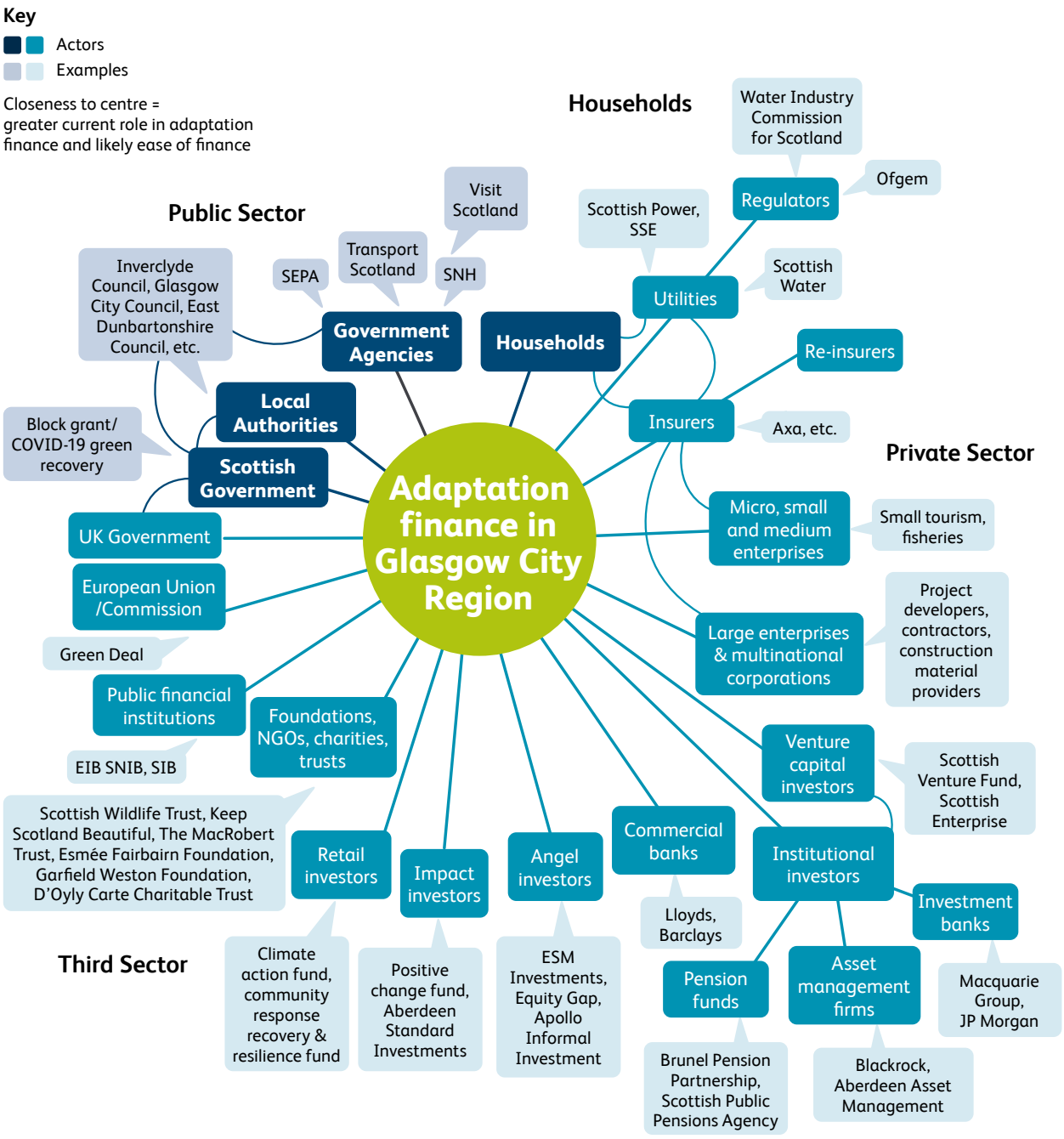


Fig.28. Adaptation Finance Social Network Map for Glasgow City Region.

More detail of the approach to finance adaptation can be found in the technical annexes.

3.4 Get involved

There are a number of ways you can become involved in helping deliver the Strategy and Action Plan:

- Help us deliver the action plan. We need people to pledge time and resources to help deliver the Strategy. Email us at **climatereadyclyde@sniffer.org.uk** telling us which areas of the Strategy or Actions you'd be interested in helping us deliver and we will arrange to speak to you.
- Take action to adapt. Think about what needs to be done in the Strategy and then come up with actions that help us achieve it together. The Adaptation Scotland website (**www.adaptationscotland.org.uk**) has lots of great resources for businesses, community groups and public sector organizations to take action. And don't forget to…
- Tell us what you are already doing. We are keen to hear and showcase what people are doing already – why not send us a tweet or a message?

Further information

For further information on the background to this Strategy, please visit the Climate Ready Clyde website at: **www.climatereadyclyde.org.uk**

For further information on anything contained in this Strategy, please contact the Climate Ready Clyde Secretariat using the following email address: **climatereadyclyde@sniffer.org.uk**

You can also get in touch with us and follow for regular updates on Twitter and LinkedIn.

Part 4: Glossary

Adaptation

Climate change adaptation comprises all the actions and solutions that a country, a region, a city, or a community can develop and implement to build more resilient societies and economies, to respond to the impacts of climate change that are already happening or are expected. It is a series of changes in processes, practices and structures that aim to moderate the potential damages brought by climate change. The solutions for climate adaptation vary from one context to another, they can range from building flood defences, setting up early warning systems for cyclones to redesigning communication systems, business operations and government policies. The impacts of climate change are felt globally, and without drastic action now, adapting to these impacts in the future will be more difficult and costly. To be successful, climate adaptation strategies must be developed together with national, regional and international organizations, but also with the private sectors, civil society and the population.

Climate change

Climate change is the global phenomenon of the long-term shift in global and regional climate patterns (as opposed to weather patterns, which can change from day to day). The earth's average temperature is about 15°C. Scientists say that temperatures are rising faster than previous natural fluctuations due to the greenhouse gas effect. There is a scientific consensus that climate change is caused by human activities, especially by burning fossil fuels, which add heat-trapping gases to the atmosphere of the earth. This contributes to increased temperature (also known as global warming), but also leads to sea-level rise, ocean warming and acidification, loss of ice mass in mountain glaciers worldwide, extreme weather events (including extended periods of drought, severe storms, and wildfire), and biodiversity loss.

In Glasgow City Region, climate change will cause more frequent and intense flooding, heatwaves and coastal erosion. Sea levels in the mouth of the River Clyde are forecast to rise by nearly half a metre by the 2080s while winter rainfall could increase by 50% by the 2080s. The increase in total rainfall and heavy downpours are already causing more frequent flooding episodes which disrupt the infrastructure and day-to-day services that the population relies on. Vital roads, bridges, rail lines and public buildings in the Glasgow area are at significant risk as extreme weather events like storms, flooding and heatwaves are becoming more frequent. The Royal Alexandra teaching hospital in Paisley for example is at high risk of surface water flooding. This will not only cause economic damage but will also deepen social inequality as climate change has a compounding effect on the health, financial stability and well-being of the most vulnerable population, who are less able to cope with such risks.

Climate Ready

Being climate ready means finding out about the likely effects climate change will have on your property, lifestyle, community and general circumstances, and making a plan to manage the risks.

Climate resilience

As we work to limit our emissions of greenhouse gases and avert the worst potential impacts of climate change, we must become more resilient, as some of these impacts are unavoidable. Climate resilience is the outcome of the ability to properly anticipate, to prepare for and to respond to hazardous climate events, as well as climate threats and vulnerabilities. Improving climate resilience involves understanding how climate change will create new climate-related risks and taking steps to better cope with these risks.

EIT Climate-KIC

EIT Climate-KIC is the EU's climate innovation agency, working to accelerate the transition to a zero-carbon and resilient world by enabling systems transformation. Headquartered in Amsterdam, it operates from 13 hubs across Europe and is active in 39 countries. EIT Climate-KIC was established in 2010 and is predominately funded by the European Institute of Innovation and Technology (EIT), a body of the European Union.

As a Knowledge and Innovation Community (KIC), it brings together more than 400 partners from business, academia, the public and non-profit sectors to create networks of expertise, through which innovative products, services and systems are developed, brought to market and scaled up for impact.

Fossil fuels

Coal, oil and natural gas are examples of fossil fuels that were created by decomposing animals and plants in the earth's crust. Fossil fuels are a non-renewable resource that take millions of years to create; our supply of fossil fuels will eventually run out. The burning of fossil fuels is the main contributor to global warming as they release carbon dioxide into the atmosphere, increasing the greenhouse gas effect.

Greenhouse gases

Greenhouse gases are gases in the earth's atmosphere that trap heat from the sun. Greenhouse gases include carbon dioxide, water vapour, ozone, nitrogen dioxide and methane.

Greenhouse gas effect

The greenhouse gas effect is when the gases in the earth's atmosphere trap the sun's heat, making the earth warmer. Human activities are changing earth's natural greenhouse gas effect by burning fossil fuels. Too many greenhouse gases in the earth's atmosphere trap in more and more heat from the sun, increasing the earth's temperature.

Incremental adaptation

Adaptation that maintains the essence and integrity of a system or process at a given scale. In some cases, incremental adaptation can accrue to result in transformational adaptation.

Mitigation

Climate change mitigation strategies regroup all the efforts to reduce or prevent the emission of greenhouse gases (which leads to more climate change). Some of the ways to limit future emissions are the use of new technologies and renewable energies (including wind and solar power), to make older equipment more energy efficient and to change management practices or consumer behaviour.

Net-zero emissions

Net-zero emission means that all man-made greenhouse gas emissions must be removed from the atmosphere through reduction measures, thus restoring the earth's natural greenhouse gas balance. To meet a goal of net-zero, any new greenhouse gas emissions that are produced must be as low as possible. And those produced emissions must be offset by a process that reduces greenhouses gases in the atmosphere (such as planting trees or capturing carbon dioxide).

Paris Agreement

The Paris Agreement is a global effort to respond to the threat of climate change. Signed by 195 countries in 2015 with the aim 'to keep the increase in global mean surface temperature to well below 2°C, and to limit the increase to 1.5°C, since this would significantly reduce the risks and impacts of climate change'.

Scotland net-zero emissions

Scotland set a target date for net-zero emissions of all greenhouse gasses by 2045 in the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019.

Systemic change

A system is a set of connected things that operate together. The world is made up of systems. There are a multitude of connections and interactions between many different components of these systems, which means a change in one system can have great consequences in others. Climate change operates in so many complex systems that it calls for a significant difference in how we design and take actions. This is why we need systemic change, and to implement changes simultaneously in multiple components of a system to reach all or most parts of a system.

Systems innovation with EIT Climate-KIC

EIT Climate-KIC has a way of working that is collaborative, mission-led and focused on creating a connected set (or portfolio) of interventions or actions with the aim to unlock change at scale. We call this systems innovation. The aim of these method and toolkits is to support 'challenge owners' like Clyde Rebuilt in their efforts to tackle climate change by transforming whole systems. With systems innovation, a set of integrated and coordinated interventions happen simultaneously in the economic, political and social systems and along whole value chains.

TCFD

The Task Force on Climate-Related Financial Disclosures (TCFD) was created in 2015 by the Financial Stability Board (FSB) to develop consistent climate-related financial risk disclosures for use by companies, banks and investors in providing information to stakeholders.

Transformational adaptation

Adaptation that changes the fundamental attributes of a socio-ecological system in anticipation of climate change and its impacts.

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