

Case studies in adaptation finance

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Summary and Recommendations

The role of adaptation finance in the UK

- Adaptation finance refers to the capital that is needed to prepare the UK for the impacts of climate change. The context of adaptation finance in the UK is very different from the international debate. Internationally, securing climate finance is an objective in its own right, with explicit targets and mechanisms for financial flows. In the UK, adaptation finance is a means to an end. UK adaptation outcomes are driven by government policy and market initiative, and financing is needed to support both.

How to assess the need for adaptation finance

- Climate change costs are no longer hypothetical. Damages are being experienced now and future costs can be projected. Both need to be budgeted for. Public and private sector organisations need to formulate their adaptation needs, map them against available sources of finance and identify financing gaps.
- Financing needs cannot be defined without an understanding of the adaptation context. To quantify project costs and benefits, it is necessary to specify adaptation objectives (e.g. acceptable risk levels and intended outcomes), approaches (e.g. robust vs sequential adaptation) and, in some sectors, regulatory expectations.
- An explicit focus on resource mobilisation must be an integral part of strategy development, rather than a separate task once an adaptation strategy is in place. Adaptation needs should be integrated into wider financial planning. Adaptation is most efficient when mainstreamed as part of a wider set of decisions with multiple objectives, and finance is raised for the overall programme.

How to overcome constraints to adaptation finance

- We need a systematic approach to identifying and addressing gaps in adaptation finance. Many barriers, for example in infrastructure projects, do not relate to the adaptation component of the transaction, but to the project as a whole or the context in which it takes place. To increase adaptation finance, decision makers need to respond to this broader set of barriers, as well as specific barriers related to finance.
- High transaction costs are a material barrier to adaptation finance, particularly nature-based solutions. New processes and institutions, such as brokers, aggregators and trading platforms, can reduce upfront costs by exploiting economies of scale, creating

pools of expertise and reducing search costs. They make innovative adaptation solutions accessible to a wider group of businesses.

How to mobilise adaptation finance

- Adaptation offers multiple business opportunities, but there is a significant gap between concepts and proven solutions. New financing structures to realise opportunities are emerging, often involving partnerships between public, private and third sector actors. They need to be accelerated and supported by dedicated innovation finance.
- The financial sector needs to better manage its own exposure to the impacts of climate change. Financiers will make better decisions if they understand and disclose the climate risks in their portfolios. They need to work proactively with their clients to manage and mitigate them in the real economy. Effective regulatory and supervisory regimes are, in turn, crucial for embedding these actions.
- Public funding for adaptation is an important complement to, and enabler of, private adaptation. Climate risks must be a consideration across all Government policies, plans and programmes. There is a need for both direct adaptation funding and broader resilience investments, as well as ensuring that all public spending preserves or enhances resilience to climate change. This requires capacity development across government and investment in information and tools.
- For both public and private finance, it is important to have better systems to understand, monitor and evaluate its impact on adaptation and resilience goals. Better information, through the disclosure of risks, adaptation plans and wider theories of change, is vital to determine whether the UK is meeting its adaptation goals.

About this paper

Background. This paper provides complementary information to a report by the Climate Change Committee on Adaptation Finance, which was produced by the CCC's Adaptation Committee (Adaptation Committee 2023). The Adaptation Committee set up an advisory group to guide the production of the Adaptation Finance report. The present paper was produced by members of the advisory group and independent researchers.

Objectives. The objective of this paper is to demonstrate how places and institutions are adapting to climate change and mobilising the finance this requires. We provide a series of case studies, which illustrate how adaptation works and is financed in practice. We

showcase innovative finance and practical adaptation solutions, but also highlight pitfalls and structural challenges.

Case studies. Our case studies explore three themes that are crucial to adaptation finance in the UK. The first theme is understanding the *need* for adaptation finance, an issue that is linked to the question of adaptation costs. The second theme concerns potential *constraints* to the flow of adaptation finance and how they can be overcome. Thirdly, the case studies explore potential *sources* of adaptation finance and ways to mobilise finance for public and private adaptation. The three themes are explored in different contexts and for both public and private finance, but there is no aspiration to be comprehensive (see Table 1). We derive from the case studies a set of practical insights for financing of adaptation in the UK.

Table 1: Five case studies on adaptation finance

Case studies		Themes and contexts	
1. Transformative adaptation in Glasgow City Region	Adaptation needs	Public finance	Municipal adaptation
2. Place-based adaptation in Belfast, Edinburgh and Leeds	Adaptation constraints	Public and private finance	Municipal adaptation
3. Market enablers for nature-based solutions	Adaptation constraints	Private finance	Nature-based adaptation
4. Financing adaptation through green bonds	Sources of financing	Private finance	Cross-sectoral adaptation
5. Using Covid recovery spending for climate resilience	Sources of financing	Public finance	Cross-sectoral adaptation

Overview

The role of adaptation finance in the UK

Why adaptation finance is important. Adaptation finance refers to the financial capital that needs to be deployed to prepare the UK for the impacts of climate change. The interest of UK policy makers in adaptation finance reflects in part the saliency of climate finance in the international debate. Yet the UK context is different. Most of the features that make climate finance a central topic of international climate diplomacy do not apply here. It is important therefore to be clear about the policy context for adaptation finance in the UK, and how it differs from the global debate.

Global adaptation finance. Climate finance is a key objective of international climate diplomacy. This has several reasons. First and foremost, the provision of climate finance is a core aspect of climate justice, linked to the pledge by rich countries, which have contributed most to climate change, to provide at least US\$100 billion a year in financial support to low-income countries. Second, the promise of climate finance helps to cement consensus around a global goal of net zero emissions and secure contributions from all countries towards this goal. Third, international finance is essential for the delivery of national climate outcomes. Limited access to finance is a significant barrier in many countries, which prevents effective solutions to both mitigation and adaptation. The importance of international climate finance has resulted in dedicated financial instruments providing grants, such as the Adaptation Fund and Green Climate Fund, and the forthcoming Loss and Damage facility agreed at COP27.

Adaptation finance in the UK. The UK situation is different. We have a deep, sophisticated and well-regulated financial sector, where access to finance is, in general, not a problem. Although adaptation has an opportunity cost, public and private decision makers have available capital to deploy for adaptation solutions. Where barriers exist, public policy can intervene to bring about the desired outcome. In doing so, the Government is guided by a forward-looking framework for adaptation planning, over which there is broad political consensus. The role of financial side payments, critical to forge a global consensus and ensure national delivery, is therefore much reduced. In the UK, adaptation outcomes are instead shaped by market initiative and government policy.

Framing UK adaptation finance. The different context suggests an alternative lens through which adaptation finance in the UK is worth exploring. It is not about climate finance targets and funding commitments. Instead, the study of adaptation finance is important in the following ways:

- A better understanding of adaptation finance, and barriers thereto, will help policy makers to put in place any corrective measures that are needed so that access to adaptation finance is indeed guaranteed.
- The flow of adaptation finance can be a powerful indicator of progress in preparing for climate change. The absence of adaptation finance is a sign of important barriers in adaptation decision making.
- Where barriers persist, public finance becomes a potential adaptation tool. That is, the public sector may have to step in not just as an enabler and regulator of adaptation, but as a provider of public good adaptations.

Theme 1: The need for adaptation finance

Why estimating financing needs is important. The first theme explored in the case studies is the need for better information about adaptation costs. Good data are important to help organisations gauge their investment needs and articulate the context in which financing is sought.

The urgency of adaptation. Climate change is already happening. It is now possible to say with statistical precision how much more likely individual weather events have been made by climate change. The UK record 40°C summer temperatures of July 2022, for example, would have been “extremely unlikely” statistically without anthropogenic climate change (World Weather Attribution 2022).

This means that adaptation decisions, and the need to allocate adaptation funding is a matter for current budget cycles and investment decisions. Managing climate risks will be a continual, iterative process over many years, but it is a process that has to start now.

Mapping funding needs to sources of finance. Public and private entities need high-quality adaptation strategies, which allow them to respond to the growing risks. To be operationally effective, the strategies must be complemented by a financing plan. Priority measures need to be costed and funding needs mapped against potential sources of finance.

Case study 1 introduces a promising way of doing this, which has been pioneered by Glasgow City Region. The Glasgow approach is novel for its inclusion of a transformative finance workstream in the strategy itself. The focus on systemic change and transformative finance, which is at the cutting edge of adaptation finance thinking, allowed the development

of value propositions, which can help cities and regions dramatically increase the pace and scale of adaptation efforts over the next decade.

Formulating adaptation objectives and outcomes. Financing needs cannot be defined without an understanding of the adaptation context, including well-defined adaptation objectives. Adaptation costs depend not just on the operational and commercial materiality of climate risks (Coalition for Climate Resilient Investment. 2021), but also on the attitude of stakeholders and decision makers (including regulatory agencies) towards those risks. The formulation, and ideally quantification of acceptable risk levels (e.g. reliable infrastructure services up to a 1:100 year event) will determine both upfront capital needs and subsequent maintenance costs (which may be higher at lower levels of protection).

Adaptation costs also depend on the way organisations deal with climate uncertainty. While the impact of human activity on the global climate is unequivocal, the local nature of these impacts remains uncertain. How uncertainty is handled in adaptation strategies has implications for financing needs. Robust decision-making approaches, where structures are protected against the full range of possible climate outcomes, will probably increase, and certainly front-load financing needs. Sequential decision making, where actors continually respond to new climate information, leaves total funding needs more uncertain and spreads them over a longer period of time.

Mainstreaming adaptation into broader financial planning. Information about the costs of adaptation is improving (Watkiss 2022). This is important to understand the economic burden of climate change. However, traditional adaptation cost studies are less useful when it comes to financial planning. This is because adaptation is context-specific, and results do not transfer easily. Each intervention needs to be costed in its own right, and the synergies and trade-offs with other objectives (such as nature conservation) explored and managed.

In many practical settings, adaptation is incorporated into a wider portfolio of investment decisions, which meet multiple objectives. Adaptation finance needs to be incorporated into the financing strategies for these wider plans. Case studies 1 and 2 illustrate this point for the case of place-based climate action in Belfast, Edinburgh, Glasgow and Leeds. The case studies show how adaptation at the local level is part of a complex system of place-based objectives related to economic regeneration, social protection and other environmental objectives including, net zero emissions, air quality and the circular economy.

Theme 2: Constraints to adaptation finance

Why addressing adaptation barriers is important. As a second theme, the case studies show how adaptation is held back by a set of interlinked constraints. Understanding where to intervene is important to unblock both adaptation action and the requisite finance.

Barriers to autonomous adaptation. Many experts maintain that adaptation to climate change will be mostly autonomous, that is, it will be undertaken by public or private actors, without much need for strategic adaptation planning. They point out that the benefits of adaptation are largely private (they accrue to the party bearing the costs), which incentivises adaptation action. They also point to the success of humans in adapting to current climatic conditions, which has been driven in no small part by private initiative.

Yet on a closer look, constraints to adaptation abound (Frontier Economics and Paul Watkiss & Associates 2022). Few communities are prepared perfectly to current, let alone future climate risks. Lack of finance is often highlighted as an adaptation barrier. However, this is a claim worth unpacking.

Lack of available finance as a sign of broader barriers. The UK financial systems scores well against most pertinent indicators of financial strength (World Bank 2022). This does not mean that access to finance is always unproblematic. Small and medium-sized enterprises routinely report gaps in the supply of finance (British Business Bank 2021). Local authorities face an increasingly tight financial environment, with significant spending reductions over the next decade. Borrowers are confronted with soaring interest rates as a result of high inflation.

Nevertheless, the strength of the UK financial sector suggests that the absence of finance will often be a symptom of problems elsewhere, rather than the key barrier. Poor access to adaptation finance can be a constraint. For example, there may be knowledge barriers and financial institutions are imperfectly informed about the merits of adaptation. But in many cases, financiers may react to genuine issues with a project, such as the absence of sufficiently defined revenues or prohibitively high transaction costs.

Adopting a systematic approach to addressing adaptation barriers. The integration of adaptation into wider policy objectives (as proposed above) implies that barriers to adaptation will often be found at the systems, rather than project level. Securing adaptation financing therefore requires a holistic approach, which intervenes at the right point in the system and puts in place appropriate enabling conditions.

Local adaptation, for example, occurs in a context of very limited capacity within local authorities. Case study 2 illustrates the multiple barriers affecting place-based adaptation

solutions, with local councils pursuing a number of objectives in a context of tight budget constraints. In Scotland, the Scottish Environmental Protection Agency is predominantly associated with governing flood risks, rather than heatwaves or broader climate risks. It is these underlying governance issues that need to be addressed in a first instance.

Similarly, difficulties with climate-proofing infrastructure are as likely to relate to broader issues with infrastructure investment (National Infrastructure Commission 2022) as they do to adaptation-related challenges. Infrastructure regulation can either be a constraint (if adaptation expenditures are not recognised as a permissible cost) or a powerful driver of adaptation (if resilience standards are prescribed by the regulator).

Using financial innovation to reduce transaction costs. A recurring constraint in many projects is high transaction costs. They are particularly prevalent in nature-based adaptation solutions. Nature-based adaptation has multiple benefits, which will accrue reliably once a scheme is set up (Smith and Chausson 2021). However, nature-based solutions are often small, usually complex and always context-specific. They may require close cooperation between multiple partners and with local communities. Revenue streams may be difficult to establish.

Because of this upfront complexity, nature-based solutions can be difficult to finance (Young et al 2022). However, through financial innovation it is possible to reduce transaction costs. Case study 3 discusses the scope for new enabling institutions, such as brokers and trading platforms, which can bring down upfront costs, make complex transactions easier to process and open up nature-based solutions to a wider set of beneficiaries.

Theme 3: Sources of adaptation finance

Why mobilising new sources of finance is important. The first two themes covered in the case studies deal with the demand side of finance, that is, identifying investment needs and making adaptation proposals financeable. This has to be matched by measures on the supply side to increase the flow of capital into adaptation.

Making corporate finance climate-resilient. Implicitly or explicitly, the financial sector is already funding adaptation. The economic assets it finances are all adapted to current climatic conditions, though not always perfectly and seldom to future climates. Much adaptation finance is therefore happening autonomously, and without being tracked, as part of day-to-day financing operations. The flip side of this coin is that physical climate risks are ubiquitous in the portfolios of financial institutions.

To be able to finance adaptation effectively, the financial sector must itself become more climate-resilient. As climate change unfolds, financiers and their regulators need to continually assess, measure and disclose the climate risks in their portfolios, as well as the opportunities that may be realised through adaptation. They need to work proactively with their clients to manage climate risks and opportunities in the real economy. This is a continual process, but it has to start now.

Increasing finance flows into adaptation. The careful management of climate risks in its core portfolio will allow the financial sector to explore new adaptation opportunities. They could be significant. Innovative financing structures are starting to emerge to move beyond corporate financing for adaptation and begin to realise wider adaptation benefits.

Among the most promising new financing structures are green bonds and payment for ecosystem services (PES). Examples of successful PES adaptation schemes are included in the main report to this paper (Adaptation Committee 2023). They illustrate how nature-based adaptation can be turned into a financeable project by tapping into previously unmonetised benefits. Case study 4 illustrates the versatility of green bonds for adaptation by showcasing a diverse set of bond issuances arranged by one of Britain's largest banks.

Improving the regulatory regime for climate risk management. Effective regulatory and supervisory regimes are crucial for embedding climate-resilience in financial sector decisions. There are currently no universally applied systems that track the impact of adaptation spending, or require private firms to disclose their adaptation plans, beyond those covered by the Adaptation Reporting Power. Encouragingly, the Taskforce on Climate-related Financial Disclosures and the International Sustainability Standards Board are both setting out physical climate disclosure requirements that will move practice in this direction. The proposed UK Green Taxonomy should provide further impetus.

Acknowledging the importance, and different roles, of public adaptation finance. Some of the most emblematic adaptation actions are public goods and these are typically provided by the state. Prominent examples include flood defence, coastal protection and emergency recovery. The Government therefore has a key role not just as an enabler and regulator of private adaptation, but as a provider and funder of public good adaptation.

Public expenditure can also be used to blend, lever and de-risk private investment, for example by providing guarantees to allow the private sector to invest, or to subsidise projects and programmes to allow for greater returns on investment. A good example is the Environment Agency's partnership funding model for flood risk management. However, for

such schemes to be successful, clarity is important about the respective responsibilities of public and private partners for the intended adaptation outcome.

Public funding for adaptation goes beyond spending on bespoke programmes. Case study 5 uses the example of Covid recovery spending to make the case for the integration of adaptation and resilience across all Government programmes and investments. In the face of adverse climate impacts, there is a clear need for both direct adaptation actions and broader resilience investments, balancing immediate and longer-term resilience considerations, as well as ensuring all public spending is resilient to climate change. This will require substantial capacity development across Government and investment in information and tools.

Improving arrangements to monitor financial flows and their impact. For both public and private adaptation finance, it is important to put in place better systems to monitor and evaluate their impact on adaptation and resilience goals. The methodology adopted in case study 5, alongside emerging green budget tagging initiatives, could be the basis for an expanded monitoring system for public adaptation finance. Such information is vital to ascertain whether the UK is advancing in a positive direction in terms of its adaptation goals.

Case study 1:

Financing transformative adaptation in Glasgow City Region¹

Public and private entities are developing adaptation strategies to respond to growing climate risks. These strategies must be complemented by a financing plan, which maps funding needs against potential sources of finance and seeks to mobilise resources accordingly.

This case study introduces the innovative approach taken by Glasgow City Region in its 2021 adaptation strategy. The case study illustrates a range of practical methods and tools that can help identify funding needs and financing sources for adaptation. It highlights the benefits of including a dedicated resource mobilisation workstream as part of strategy development, rather than looking for finance at the end of the process.

Glasgow City Region's adaptation strategy and action plan

The 2021 Adaptation Strategy and Action Plan of Glasgow City Region has a dedicated focus on delivering transformation. It seeks to achieve this through a set of early interventions and the preparation of a dedicated innovation portfolio. Financing was a key focus of strategy development. The strategy process explicitly included a resource mobilisation workstream aimed at accelerating finance for strategy interventions, as well as exploring the role of finance in supporting wider systems change and transformation.

The project to develop the strategy and portfolio, called 'Clyde Re-Built', was funded by EIT Climate-KIC and the 15 regional partners, as part of Climate-KIC's 'Forging Resilient Regions' Deep Demonstration programme.

To strengthen the overall case for intervention, the strategy undertook an analysis of the costs of climate change and the benefits of adaptation. This drew on support from an EU Research and Innovation programme, COACCH (Co-designing the Assessment of Climate Change Costs). The analysis provided an assessment of the impact of climate change on local GDP under multiple future climate scenarios, the benefits of adaptation, as well as

¹ This case study was drafted by Kit England and draws on extensive background material by Climate Ready Clyde.

economic assessments of adaptation to flooding, health and heat, and temperature-related economic opportunities.

Subsequently, the Clyde Re-Built project estimated a baseline public adaptation finance gap for 2018/19 for the region's eight Local Authorities and two regional NHS boards. This estimated the amount of additional public finance needed at £184m a year. The estimate was generated by reviewing public expenditure statistics and applying an adaptation mark-up (percentage).

A dedicated resource mobilisation workstream sought to identify suitable finance for each of the Strategy's 11 interventions. To help this, the study developed a typology of financing types. This recognised the need to finance both incremental and transformational adaptation, using both conventional and transformative adaptation financing approaches. It included the strategic use of public sector funds to attract private sector investment, and the piloting of new approaches. This is shown in Table 2. The 11 interventions were mapped to this matrix to help developing relevant strategies. The workstream also reviewed relevant international financing models for adaptation and explored their transferability to Glasgow City Region.

The work proceeded to develop a high-level structure to enable the funding and financing of adaptation and identified broader enabling criteria which would help the City Region in accessing finance. Finally, initial business cases were developed for four 'low regret' interventions identified in the strategy: a heat-health warning system, a climate resilient building retrofit, a component of the Clyde climate forest and an adaptation finance lab.

Table 2. The Adaptation Finance Matrix

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

Source: Clyde Re-Built.

An innovative portfolio of finance

In addition to estimating financing needs for the main adaptation strategy, the project team investigated the potential role of finance as an enabler for wider systems change. Through EIT Climate-KIC's Deep Demonstration process, the project team worked with stakeholders to identify areas in the Glasgow City Region where levers of change could stimulate more transformational change.

The Deep Demonstration project adopted a whole-system approach that looked at business, governance and behaviour change, in addition to technological, environmental and social innovations, which would accelerate progress. The aim was to identify systemic solutions in heat, health and wellbeing, and in the finance system itself. The work was used to identify large-scale innovation actions which could significantly accelerate adaptation progress across all areas of the strategy.

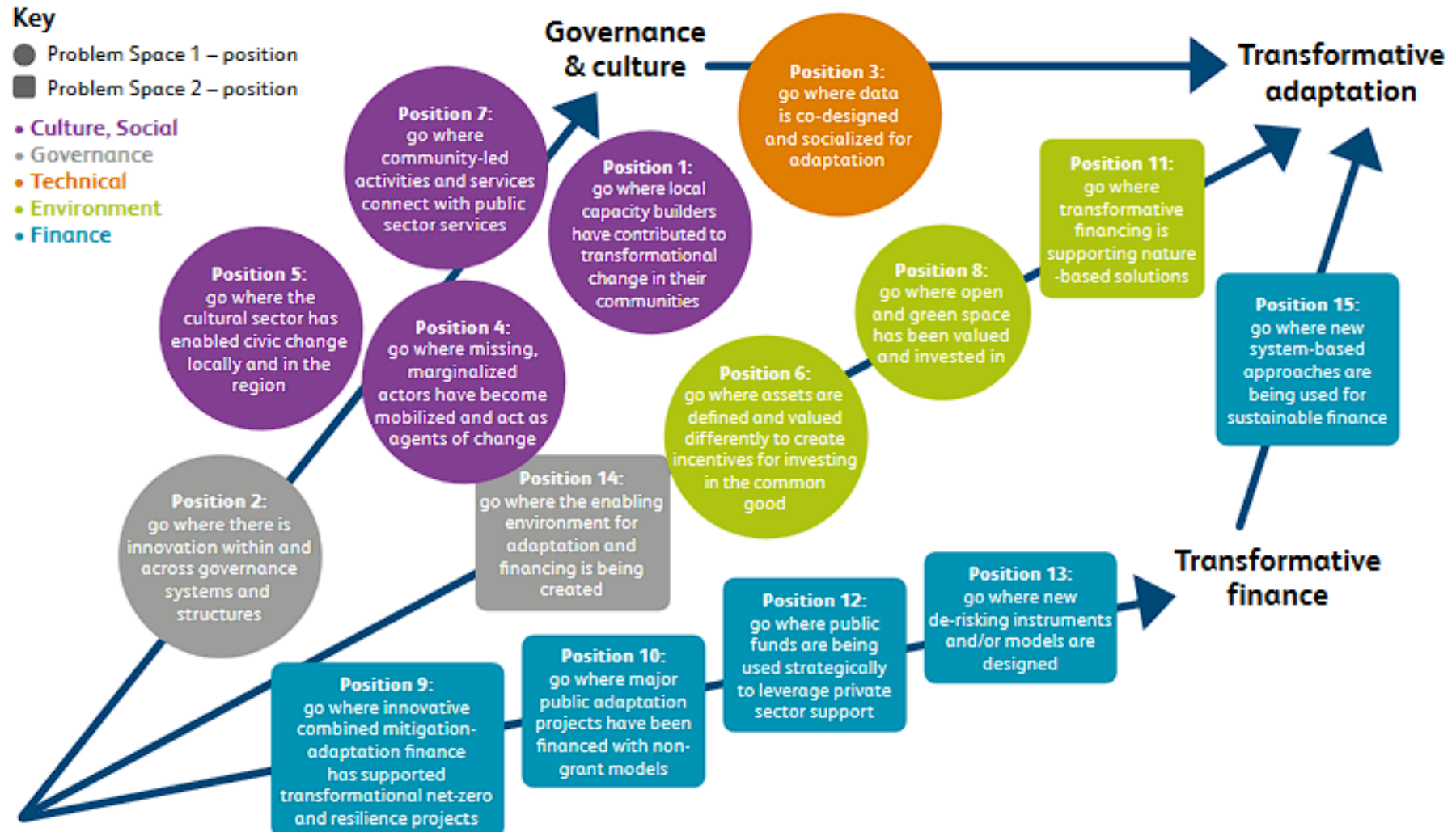
As part of strategy development, the Clyde Re-Built project engaged with new actors from within Glasgow City Region to map the systems relating to culture, governance and delivery of adaptation. Alongside this, it looked at new approaches for financing adaptation, including innovative instruments. These were used to create a 'blueprint' of 15 'positions' – areas where urgent, innovative solutions could help accelerate the region's climate-resilient transition. The areas identified, and their relevant systems are shown in Figure 1.

In support of the innovation portfolio, the project team then co-developed a series of new value blended finance solutions to unlock finance for Glasgow City Region. These focused on seven early promising options:

- Green Infrastructure Blended Finance Lending Facility
- Clyde Climate Forest Fund
- Placemaking Crowdfunded Climate Bond
- Adaptation infrastructure including green and sustainable urban drainage systems
- Climate Risk Reduction Public Private Partnership (PPP)
- Glasgow City Region Climate Adaptation Innovation Fund
- Revolving fund to transfer climate benefits to adaptation

The suitability of each of these options was assessed based on criteria such as the potential for revenue stream generation, the scope for innovation and the ability to be used as a blended finance vehicle (Table 3).

Figure 1: Systems innovation positions for adaptation efforts, relating to heat, health and wellbeing and transformative finance



Source: Clyde Re-Built.

Table 3: Evaluation of financing options for Glasgow City Region

Financing option	Evaluation criteria					SCORE
	Revenue potential	Portfolio opportunity	Existing examples	Scope for innovation	Blended finance	
Green blended finance facility	High	High	Medium	Medium	High	High
Clyde climate forest fund	Medium	Medium	Medium	High	High	Medium
Crowdfunded climate bond	High	High	High	High	High	High
Adaptation infrastructure	Medium	Medium	High	High	High	High
Climate risk reduction PPP	Medium	High	High	High	Medium	Medium
Adaptation innovation fund	High	Medium	High	High	High	High
Revolving fund for adaptation	Medium	Low	Low	Medium	Medium	Medium

Source: Clyde re-Built.

Case study 2:

Place-based adaptation in Belfast, Edinburgh and Leeds²

Adaptation is unique to the location within which a climate impact occurs, reflecting a context-specific web of social, economic, environmental, infrastructural cross-sectoral complexities. Place-based adaptation becomes even more complex when a growing number of other urgent issues, such as the cost of living crisis, are layered on top of the climate change agenda .

This case study discusses challenges to place-based adaptation, and associated financing issues, in Belfast, Edinburgh and Leeds. All three cities participate in the Place-based Climate Action Network (PCAN) and have set up independent climate commissions as a platform for debate and information sharing on both mitigation and adaptation.

Adaptation in Belfast, Edinburgh and Leeds

Like other locations across the UK, the cities of Belfast, Edinburgh and Leeds are increasingly exposed and vulnerable to climate change. The political and strategic responses to this threat differ depending on the local context, governance processes, local networks and community engagement practices as well as the range of other local challenges that divert focus away from climate action. But all three cities have taken steps to prepare for the impacts of climate change.

Belfast has established a Resilience and Sustainability Board, which acts as a collaborative partnership to help build Belfast's preparedness to climate change. In 2020, the board developed a *Resilience Strategy*, which sets out a range of long-term transformational programmes across the city and includes recommendations by a Belfast All-Party Working Group representing each of the eight political parties. Since 2020, Belfast City Council has developed a draft adaptation plan and has commissioned further risk modelling and prioritisation work.

Edinburgh has conducted a couple of city-level risk assessments, which identify climate risks and opportunities. There is a planning framework, the *Resilient Edinburgh Climate Change*

² This case study was drafted by Candice Howarth and Adeline Stuart-Watt, based on material from the Place-based Climate Action Network (PCAN).

Adaptation Framework (2014-2020), which sets out the city's strategic approach to prepare for climate change. Based on this framework, Edinburgh embarked on a partnership-based approach, *Our Vision for a Climate Ready Edinburgh*, to define mid-term (2025) and long-term (2050) adaptation goals, and produce the city's first climate change adaptation plan, *Edinburgh Adapts*, with over a hundred sectoral adaptation actions. More recently the city has produced a climate strategy with a new working group on adaptation to take forward actions in partnership.

Leeds recently produced a *Climate Adaptation and Resilience Plan (2022)*, which captures lessons and activity across the city to date and outlines plans for a council-wide climate risk assessment. The 2022 plan was the first major council-led initiative on adaptation since the *Leeds Climate Change Strategies (2009-2011 and 2011-2015)*. Adaptation is also considered in the city's wider climate plans following its 2019 declaration of a climate emergency. However, most actions are aimed at carbon reduction. Adaptation has focused on preparing for heatwaves and their impacts, planning for flood risk, protecting infrastructure with higher specifications, protecting water resources, and supporting nature for better biodiversity and resilient local habitats.

Governance challenges

Adaptation across the three cities is hampered by weak governance, especially in comparison to mitigation. Effective governance of adaptation requires institutions, regulations, rules, values, and norms that guide the collective efforts of multiple actors, including different levels of government, the private sector, and communities.

Adaptation planning has been challenging because, unlike mitigation, adaptation does not have easily quantifiable objectives and lacks a common goal – which is why governance on mitigation cannot just be replicated for adaptation. Adaptation also involves addressing climate risks that are uncertain and defining and communicating (good) adaptation is itself a barrier to action.

While there is legislation and policy at the national level, at the local level, local authorities, civil organisations and the private sector often lack a clear understanding of their roles and responsibilities in managing climate risk, as well as the requisite staffing. Even where legislation is technically in place, there may not be sufficient resources to support its implementation. Fragmentation between levels of government and different departments, as well as between city actors, creates further barriers to coordinated adaptation.

While public organisations, like infrastructure providers, report on adaptation progress through the Adaptation Reporting Power, there are no such requirements for local authorities. Until 2010, they reported on adaptation through the National Indicator 188 'Planning to Adapt to Climate Change', but this has since been discontinued. The Scottish Government and public bodies have a regulatory annual reporting system for adaptation. However, it lacks the necessary detail to act as a key driver for implementation

Although the UK Government issued *Good-practice Guidance on Adaptation for Local Governments* in 2019, there is no consistent national methodology for the monitoring, evaluation and baselining of adaptation action. There are gaps in public/private reporting and procurement, and gaps in the formulation of plans on aspects such as adaptation finance, community engagement and just transition. This paints a picture of under-utilised local governments in national delivery plans and lack of guidance, requirements or resources for this work by national government.

Currently, local adaptation depends on the willingness of local actors to voluntarily prioritise action and coordination. As a result, local authorities' adaptation has been, at best, *ad hoc* as they have to prioritise legislative requirements not related to adaptation. Climate action plans are almost exclusively focused on climate mitigation and some sunset adaptation plans have not been renewed. Important opportunities are missed for a more holistic and systematic approach to climate action that integrates adaptation outcomes.

Data, capacity and expertise

Across the three cities, insufficient information is limiting local actors' ability to develop and fund adaptation measures. Data and evidence are often unavailable or not fit-for-purpose for decision-making at the local level. This includes information needed to assess local climate risks, such as local hazard mapping, and socio-economic and environmental data, as well as evidence to support investment decisions, such as economic assessments and an understanding of community priorities.

Even when data and evidence exist, there is often limited knowledge of their availability, usefulness and useability at the city scale. Across the three cities, there are very knowledgeable and competent people working on climate change. Nevertheless, there remain gaps in the technical expertise and skills necessary to understand and assess climate risks and design adaptation measures. In particular, there is limited capacity within local authorities to translate climate hazard information into risks, and to undertake economic assessments of adaptation initiatives, which are needed to strengthen the business case for adaptation.

There are positive stories such as the Regional Community Resilience Group in Northern Ireland, which brings together emergency planning officers with relevant government agencies and NGOs to help communities respond to shocks and stresses proactively. However, there are often not enough staff to undertake the breadth of adaptation work,

Apart from Adaptation Scotland, which hosts a risk assessment learning group, there is no real mechanism in place to bring data together and facilitate knowledge sharing on successes, challenges and cross-sectoral approaches for adaptation. Collaborative place-based mechanisms to convene, share knowledge and expertise in the three cities have been put in place through a 'Climate Commission' model (supported by the Place-based Climate Action Network). The Commissions bring together a range of cross-sectoral stakeholders who would not necessarily connect under a climate change agenda. However, they have historically been set up to address the climate mitigation agenda and are only now turning to adaptation.

Unlocking adaptation finance

While financial constraints are a limiting factor across all cities, broader barriers to adaptation reduce the cities' access funding. The reliance of local authorities on one-year financial settlements impacts their ability to plan for and budget effectively for systemic and long-term challenges, such as climate adaptation.

Additionally, while cities may aim to attract green investment, finance tends to flow towards mitigation rather than adaptation as it usually has a clearer return on investment: the financial benefits of adaptation are predominantly avoided future costs and indirect benefits like enhanced tourism revenues, which are hard to quantify. Local adaptation initiatives that aim to holistically address community climate resilience also face barriers to accessing national funding streams that tend to focus on a specific sector or policy.

Increasing adaptation finance requires responding to a broader set of barriers to adaptation as well as specific barriers to access finance. In Belfast, Edinburgh and Leeds, pertinent measures fall into two broad categories.

- **Local capacity and better governance:** Establishing clearer legislative requirements for local authorities on managing climate risk would help clarify their role, prioritise resources, and strengthen their mandate for adaptation. For local authorities, governance could be supported by training for councillors to understand climate change risks and their legal responsibilities for managing them. Investing in local partnerships can enhance the knowledge, skills and expertise of local authorities

and their adaptation partners and reduce city-level fragmentation. Climate services that are fit-for-purpose for local climate adaptation could help reduce the resource burden faced by local authorities and help address fragmented data and information across governments and departments.

- **Better integration.** Improving the integration of mitigation and adaptation in climate initiatives could exploit synergies between adaptation and mitigation measures. Mitigation projects are often prioritised and have greater access to funding, and integrating adaptation within these projects would enable more adaptation finance. Additionally, adaptation initiatives often have immediate local benefits and therefore have greater success in attracting finance when they are designed to deliver co-benefits. For example, green spaces not only reduce the urban heat island effects but enhance local liveability. More flexible funding opportunities are needed that capture local adaptation initiatives with more holistic approaches to climate resilience, instead of policy or sector specific funding. Increasing efforts to mainstream adaptation into existing policies, rather than standalone projects or teams, may enable adaptation to be better integrated into policies with established funding streams.

Case study 3:

Market enablers to nature-based solutions³

Ecosystem markets are developing across the UK. But despite their long-term promise, nature-based solutions face barriers such as a lack of scale and high upfront costs. To finance additional climate adaptation actions, buyers and sellers need to work together efficiently.

This case study explores how market enablers, such as brokers, aggregators and trading platforms, can help reduce transaction costs, create economies of scale, build centres of expertise, and reduce search costs and unfamiliar language. If successful, these new institutions can boost ecosystem markets and help finance nature-based adaptation.

The need to reduce transaction costs in environmental markets

Many climate adaptation actions are available through nature-based solutions (Smith and Chausson 2021). Mainly voluntary UK markets are established for peatland and woodland carbon credits, biodiversity units, and nutrient and flood risk catchment management actions. All of these markets, especially if designed to do so, can contribute to climate adaptation (as well as mitigation in the case of carbon credits). The actions funded are often at a relatively small scale, and context specific in delivery and management, but have widespread applicability and potential to be scaled up.

Aggregation of nature-based solutions (NbS) will make them more investable by providing scale and potentially spread of risks. However, transaction costs must be kept low enough to allow positive returns on investment. Transaction costs include search costs (for buyers and sellers to identify each other), contracting processes, monitoring and verification, and management of delivery risk. They can be a material barrier to ecosystem markets, and effect their ability to finance climate adaptation. However, they can be overcome through public sector actions (e.g. providing good market structures and regulations), technology innovations and through the role of market enablers.

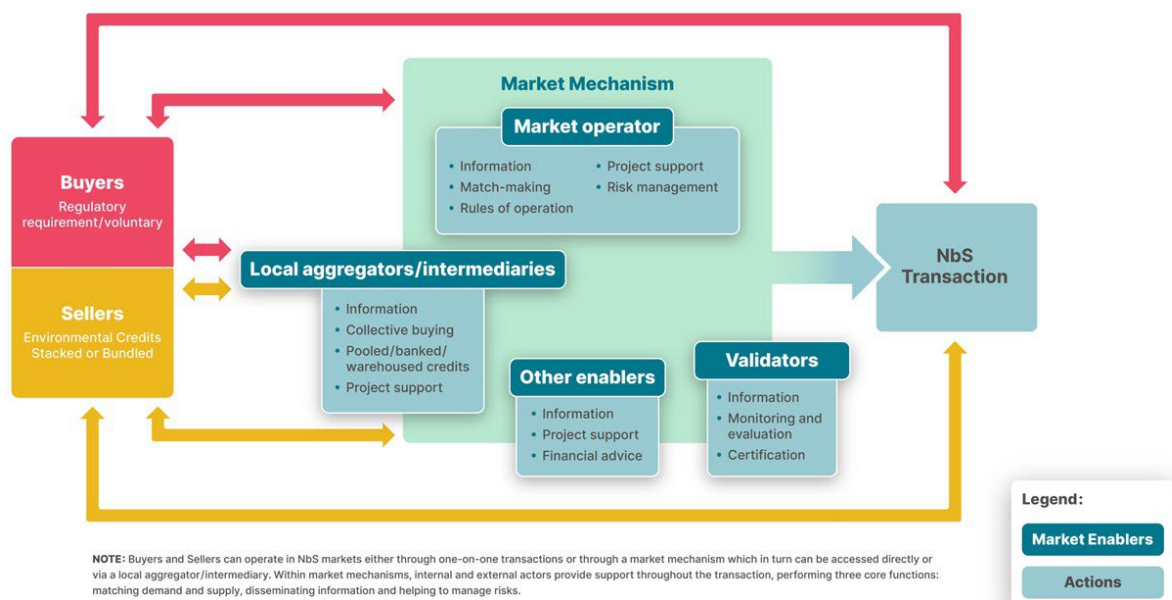
³ This case study was drafted by Ian Dickie and draws on eftec work by Ian Dickie and Tiziana Papa for East Sussex County Council, funded by the South East Local Enterprise Partnership.

The role of market enablers

Figure 2 shows the roles of enablers in a stylised NbS market. Buyers and sellers can transact: i) directly with each other; ii) through the market mechanism independently; or iii) in the market mechanism through local aggregators/ intermediaries. Buyers could be companies in any economic sector, including finance. They may buy in ecosystem markets to compensate for past or future harm, or to generate cash flows or save costs. The actions to generate these credits through NbS can contribute to climate adaptation for the buyer (e.g. by adapting to a climate change risk they are exposed to) and wider society.

Market enablers are defined as agents (individuals or organisations) which perform one or more of three core functions: matching demand and supply, disseminating information (including adaptation needs) and helping to manage risks (including climate resilience). They include operators of market mechanisms, local aggregators/ intermediaries and validators, and also other many organisations (e.g. who are involved in disseminating information). They vary in type, scale, focus and responsibilities, as well their geographic proximity to the NbS, and include innovators developing technologies for mapping, NbS quantification and trading.

Figure 2: Enabling Actors in a Stylised NbS Market



Source: Countryside and effec based on work for East Sussex County Council, funded by the South East Local Enterprise Partnership.

Note that in Figure 2, buyers or sellers do not need to use the same process. A buyer may buy direct, while sellers may use a local aggregator (an enabler who would market the combined credits from a group of sellers). This is an example of how enablers reduce search costs by helping buyers and sellers to identify each others' supply and demand, connect and transact. This is important for NbS, as many sellers into ecosystem markets are small individual or organisational land managers. They are best placed to deliver NbS with sound local environmental understanding, including the ability to target climate adaptation needs.

NbS market enablers can have different (and not mutually exclusive) motivations:

- Progressing their individual interest in the market: By aggregating with others, often from a nearby location, they ensure their own NbS transaction progresses. They may also achieve better value due to reduced transactions costs.
- Non-monetary returns: Third sector organisations like NGOs may enable transactions to help secure robust environmental outcomes. They may use their reputation and commercial neutrality to give reassurance to buyers and sellers in new markets.
- Profit: By taking a percentage fee in return for brokering a transaction, and for enabling efficiencies such as reducing search costs or risks.

The role of enablers in NbS markets, described above, link to the recommendations of the Financing Nature Recovery UK Initiative (Young et al 2022), which called for the establishment of market mechanisms and better environmental market governance. To ensure they can fulfil this role, all market actors, including the public sector, should:

- Consider supporting market enablers to engage potential sellers and buyers to design, deliver and invest in NbS that support climate adaptation in their area or sector.
- Encourage capacity building for sellers and buyers on NbS for climate adaptation, including through market enablers and the development of new standards.
- Facilitate the creation of specific spaces/tools to advertise of NbS opportunities – this should align to local nature recovery strategies, and involve enablers to help tailor it to the appropriate spatial scale for different parts of the UK and different NbS.

By helping ecosystem markets develop, and to factor local climate adaptation opportunities into transactions, NbS market enablers can play an important role in expediting new climate adaptation business opportunities and investments. However, markets need the right regulation and governance in the public interest, and also the right stakeholder representation and information such that investment meets local adaptation needs, and communities retain a stake in their outcomes.

Case study 4:

Financing adaptation through green bonds⁴

Green bonds raise debt capital for investments with environmental or sustainable development benefits. Green bonds have raised over US\$ 2 trillion in funding so far, according to the Climate Bonds Initiative.

This case study shows how green bonds can be used to raise adaptation funding using pertinent examples from NatWest bank. The examples demonstrate the versatility of green bonds, which have raised funding for multiple public and private sector institutions, from a wide range of investors and for a diversity of adaptation projects, including water management and flood protection. Benefits are often couched in terms of the sustainable development goals (SDGs).

Thames Water

In January 2022, NatWest acted as a joint bookrunner on Thames Water Utilities combined EUR 1billion green dual tranche transaction maturing in 2028 and 2032. The net proceeds from this issuance will be allocated towards projects that will reduce water leaks, encourage customers to use water efficiently, reduce pollution into rivers, and increase wastewater treatment capacity.

Thames Water is the UK's largest water and wastewater company by Regulated Capital Value and customers, serving 9 million water and 15 million wastewater customers. As such, the company plays an important role in preparing the UK's water sector for climate change. Since 2020, Thames has been an active player in green financing and as of 2022 has over 10% of its debt in green label. After an inaugural release of a green bond framework in 2020, the company released a new Sustainable Financing Framework (SFF) in December 2021 to broaden the scope of its impact by including additional project categories under green (environmentally sustainable management of natural resources and land use, and climate adaptation) and introducing a new social category "Access to essential services".

⁴ This case study was drafted by Kirsty Britz based on material from NatWest Group.



Environmental performance is measured on a number of metrics. Activities with respect to climate change contribute in particular to Sustainable Development Goals 6 (Clean water and sanitation) and 12 (Responsible consumption and production), and they cover both adaptation and mitigation. In terms of its 2020/21 performance, Thames reported that it had treated over 4.5 billion litres of wastewater and reduced market based emissions associated with each megalitre of wastewater supplied and treated to 4.66 kgCO₂e per megalitre. The company reached the target of 100 for Security of Supply Index (the ability to maintain a water supply during a drought), and created a long-term Drainage and Wastewater Management Plan (DWMP) that lays out an action plan to manage drainage and wastewater.

Nederlandse Waterschapsbank

In September 2019, NatWest acted as joint bookrunner on Nederlandse Waterschapsbank's (NWB) €500m green (water) bond issuance maturing in 2034. NWB intends to allocate the proceeds of the issuance toward environmental objectives outlined within the ICMA Green Bond Principles. These categories include 'adaptation' where the bank will provide funding for flood protection, other flood defenses, pumping stations, sustainable use of water and water shortage management.

Founded in 1954, NWB describes itself as Netherland's bank of and for the public water sector and "the sustainable water bank". It is an essential financial service provider in the Dutch public sector and a market leader for financing sustainability in the Netherlands.

Through its green bond issuances during 2019-2021, NWB has been able to allocate significant resources toward climate change adaptation in the Netherlands. Over 51% of planned investments between 2019-2022 are earmarked for projects that fall under the climate adaptation category. Ongoing projects have reinforced existing regional water defenses with a 24% increase in the length of primary water defenses that comply with safety standards between 2017 and 2020. NWB also placed an emphasis on enforcing the robust Dutch water standards such that 99.6% of regions managed by water authorities now comply with flooding standards. Finally, strong progress in water resource management has enabled water authorities to supply around 1.8bn m³ of extra water during dry periods in 2020.

SFIL Bank

In November 2021, NatWest acted as joint bookrunner on SFIL's €500m green bond issuance maturing in 2031. SFIL has allocated the proceeds of its green bond issuances into five different eligible green loan categories that are outlined within its green bond framework.

These categories include ‘sustainable water & sanitation and climate change adaptation’ which aims to target Sustainable Development Goals 1, 3, 6, 11, 12 and 13.

SFIL is a French public development bank. Established in 2013, SFIL supports local public sector financing across a wide range of activities and sectors, including schools, hospitals, roads, waste water treatment facilities and renewable energy systems.

Whilst SFIL are yet to disclose the allocation of its latest green bond issuances, previous allocations highlight the bank’s commitment to supporting climate change adaptation. Of the €500m allocated within the previous allocation reporting cycle, €155m (31%) was deployed toward sustainable water and sanitation and climate change adaptation over 76 green loans (see Table 4).

Table 4: SFIL green bond allocations for adaptation

	Number of loans	SFIL financing (m€)
Drinking water	39	78.5
Water treatment	33	67.3
Water management / flood protection	4	9.1
Total	76	154.9

Source: SFIL Group Green Bond Reporting 2021

UK Green Gilt

In October 2021, NatWest acted as joint bookrunner on a £6bn green gilt issuance by the UK Debt Management Office maturing in 2053. HM Treasury has outlined that it intends to allocate the proceeds from the issuance toward the environmental eligibility criteria outlined in its ‘Green Financing Framework’. The framework includes financing and refinancing for several green categories, including ‘Climate Change Adaptation’, where the focus is on flood protection and data driven climate monitoring.

The Government’s *Green Financing Allocation Report* sets out how the proceeds from green gilts have been allocated so far, including the funds raised in the NatWest book-ran deal. Over £8 billion were allocated in 2021-2022, of which £1.09 billion (13 per cent) was provided to the Environment Agency’s Floods Programme. This latest round of financing builds on a



previous programme, which improved flood protection for over 314,000 homes (exceeding its target of 300,000 homes).

Green gilts are expected to contribute substantially to the 2021-2027 flood protection programme. The Government has announced £5.2 billion in additional funding to develop 2,000 new flood defenses, which it expects will help avoid over £22 billion in property and infrastructure damages.

Case study 5:

Using Covid recovery spending for climate resilience⁵

The public sector plays an important role in adaptation finance. Many adaptation measures are public goods, which are typically provided by the state. In addition, the Government has broader responsibilities to protect the country against climate risks and ensure all public spending is resilient to climate change.

This case study looks at Covid-related spending in the UK and other countries and asks to what extent these massive programmes have enhanced adaptation and resilience to climate change. Covid recovery is a good example of how Government programmes can and should be used to integrate adaptation and resilience into all Government policies, programmes and investments.

If the UK is to meet its adaptation and other environmental objectives, all Government policies, programmes and investment decisions need to take into account the possible extent of climate change this century. This is recognised both in the UK 25 Year Environment Plan and the Treasury's Green Book. This case study asks to what extent this requirement has been met in the biggest Government spending programme of recent times, the rescue and recovery spending in response to Covid 19.

Covid spending with positive adaptation and resilience impact

Between March 2020 and December 2021, the UK spent over GBP 950 billion on Covid 19 rescue (to protect lives and livelihoods) and recovery (to revive the economy). Relative to GDP this was one of the largest support packages by any country.

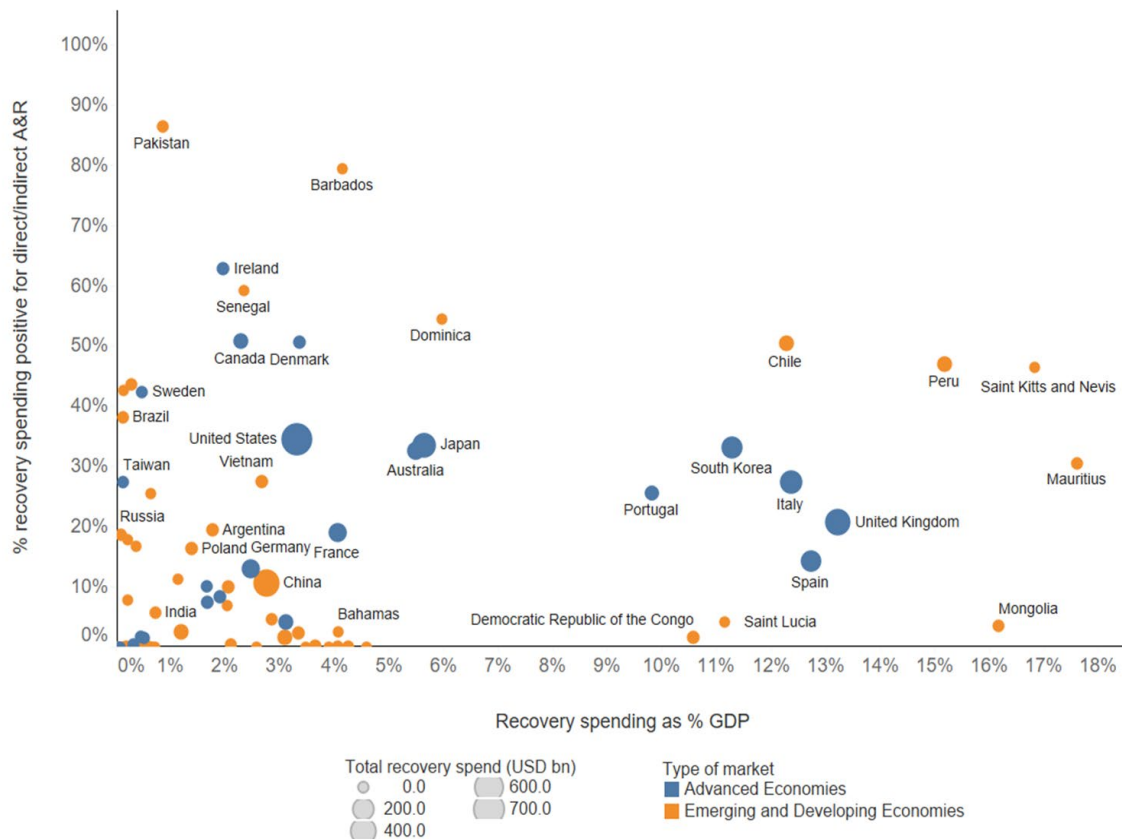
Of this vast sum, around GBP 18 billion (2%) potentially contributed directly to adaptation, and around GBP 76 billion (8%) contributed to adaptation and resilience building indirectly. Direct measures include specific adaptation projects like flood protection, while indirect measures include for example health expenditures, which enhance resilience more generally.

⁵ This case study was drafted by Nicola Ranger and draws on research commissioned by the UN Environment Programme (Sadler et al 2022).

For recovery spending only, the proportion is much higher. Here, 21% or GBP 55 billion of fiscal expenditure is estimated to contribute to resilience. Of this, GBP 18 billion contribute directly to adaptation and GBP 37 billion increase adaptive capacity and resilience indirectly. The higher proportion in the recovery phase is to be expected given the focus of the initial rescue phase on bolstering healthcare systems, supporting businesses and workers, and providing welfare support.

Figure 3 shows the position of the UK relative to other countries. The 21% share of UK fiscal spending, which contributed to adaptation and resilience during the recovery phase, was lower than that of most other G7 countries, including Canada (51%), the US (34%), Japan (33%) and Italy (27%). Among the G7 only France (19%) and Germany (13%) had lower shares.

Figure 3: A&R recovery spending against recovery spending as a proportion of GDP



Note: Size of circle indicates total spending.

Source: Sadler et al. (2022).

Specific measures with direct and indirect resilience benefits

Table 5 provides further detail on total (rescue and recovery) spending that has contributed positively to adaptation and resilience (A&R), either directly or indirectly.

The largest expenditure contributing positively (41% of total A&R spend) is liquidity support to subnational public entities. This is scored as contributing to indirect A&R because having systems in place that can provide fast liquidity to sub-national entities to provide essential services in the event of a crisis is an important contributor to national resilience, therefore indirectly reducing vulnerability and building adaptive capacity to climate risks. The second largest area was investment in R&D followed by broadband investment, which were similarly assessed to contribute to broader national resilience.

Table 5: UK COVID-19 spending contributing directly or indirectly to A&R

Policy/Investment Archetype	Sub-archetype	Total (GBP Billions)	% Total Direct + Indirect A&R
Liquidity support for subnational public entities	Support for states/regions and localities	38.5	41%
Communications infrastructure investment	Broadband investment	12.0	13%
Buildings upgrades and energy efficiency infrastructure investment	Green retrofitting programs (including daylighting, electricity and electrification, insulation)	4.2	4%
Large-scale infrastructure investments	Large-scale urban infrastructure for climate resilience	6.1	7%
Local (project-based) infrastructure investment	Clean and/or resilient new housing investment	1.2	1%
Natural infrastructure and green spaces investment	Environmental re(building) initiatives including afforestation, reforestation, and env. rehabilitation	1.0	1%
	Environmental protection initiatives including conservation and natural infrastructure resilience	0.0	0%
	Public parks and green spaces investment	0.0	0%
	Other	0.0	0%
Healthcare investment		5.6	6%
Disaster preparedness	Other direct (physical) climate change adaptation and resilience measures	5.1	5%
Education investment	Funding to support understanding of climate change mitigation, adaptation, and/or resilience	3.1	3%
	Other education investment	1.5	2%
Social and cultural investment (non-infrastructure)	Support for social care	0.0	0%
Research and development investment	Agriculture R&D programmes	0.0	0%
	Health and science programmes	15.4	16%
Total Direct A&R Spend		0.0	
Total Direct + Indirect A&R Expenditure		93.6	

Note: Entries in green are contributing directly to A&R.

Source: Derived from Sadler et al. (2022)

Areas that were assessed to directly contribute to UK adaptation were investments in large-scale infrastructure for climate resilience (GBP 6.1 billion), disaster preparedness (GBP 5.1 billion), education investments related to climate change (GBP 3.1 billion), resilient new housing (GBP 1.2 billion) and natural infrastructure and green spaces (GBP 1.0 billion).

Covid spending that increased vulnerability

To understand the full resilience impact of the Covid programme, it is necessary to examine expenditures that did not contribute positively to adaptation and resilience and assess whether they could contribute negatively, that is, increase vulnerability to climate change, or indeed lead to inefficiencies in fiscal expenditures through missing opportunities for cost-effective 'low-regrets' adaptation. We focus on the GBP 210 billion of recovery spending that was not classified as A&R positive.

The Green Book outlines the particular importance of considering the risks and impacts of climate change where there is vulnerability to climate, long lifetimes, significant investment or high value at stake such as critical infrastructure, significant interdependencies across areas of government policy or decisions that will result in 'lock-in' or irreversible damage.

While it should be noted that it is impossible to fully assess the impact of a policy based upon analyses of policy documents, preliminary analysis suggests that across the GBP 210 billion, up to GBP 155 billion (73%) could potentially have a negative impact on UK vulnerability to climate change or wider national resilience (Table 6).

This includes investments in transport infrastructure (rail, roads, public transport), housing and urban development and agriculture and fisheries that did not explicitly account for climate change in policy documents. Each of these areas falls into the Green Book framework for types of investments that are high priority to account for climate change. Infrastructure, housing and cities in particular have potential to lock-in future risks associated with climate change if adaptation is not accounted for up front in planning. Further work would be required to conduct a detailed impact assessment for these policies to assess if could indeed be having a negative impact on UK adaptation goals.

Monitoring and measuring adaptation spending

Better systems are needed to monitor and evaluate the impact of UK public finance on adaptation and resilience goals. The methodology applied in this case study provides an example of how such a monitoring system might look.

Table 6: UK COVID-19 spending assessed to contribute negatively to A&R

Policy/Investment Archetype	Sub-archetype	Total (GBP Billions)	% Total spending negative A&R
Traditional transport infrastructure investment	Indiscriminate	56.6	37%
	Road construction	29.7	19%
	Rail construction and capacity	7.9	5%
	Aviation infrastructure	3.2	2%
Local (project-based) infrastructure investment	General new housing investment	31.0	20%
	Urban development programs	7.1	5%
	Indiscriminate	1.8	1%
Clean transport infrastructure investment	Existing public transport capacity expansions	6.6	4%
	New public transport systems or line expansions	4.0	3%
	Indiscriminate	2.2	1%
	Cycling and walking infrastructure	2.2	1%
	EV charging infrastructure	1.8	1%
Agriculture and fisheries	General agricultural investment	1.1	1%
	General fisheries investment	0.0	0%
Tourism and leisure industry incentives	Incentives for general tourism	0.0	0%
Total spending negative for direct or indirect A&R		155.1	

Source: Derived from Sadler et al. (2022).

The case study draws upon research by the University of Oxford Smith School of Enterprise and the Environment to develop a full ‘adaptation taxonomy’ to analyse the contribution of policies, programmes and investments to adaptation and resilience (A&R) goals (Sadler et al. 2022). The taxonomy includes some 250 policy/investment archetypes and scored each archetype for its potential impact on climate A&R based on a detailed review of academic literature.

Policy archetypes are scored as having a likely positive, neutral, or negative impact on two dimensions: ‘direct’ A&R (defined as explicit efforts to adjust to actual or expected climate change effects), and ‘indirect’ A&R (efforts that increase adaptive capacity or reduce vulnerability to climate change, whether or not this outcome was intended to directly address climate risks). Examples of policy measures with likely positive impacts on direct climate A&R include the construction of seawalls or efforts to secure coastal ecosystems by expanding wetlands. Indirect A&R measures include liquidity support to subnational public entities, education investment and bolstering healthcare systems.

By scoring policies for both direct and indirect A&R impacts, the methodology recognises that climate A&R extends beyond physical adaptation actions and intersects with social, political, economic and environmental resilience.

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