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Financing Adaptation and Resilience in London and the UK: Moving from Aspiration to Reality
Part II – Urban Adaptation Financing

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About This Paper

Based on insights from the industry, this paper is part of the research project: “Financing Adaptation and Resilience in London and the UK.” The project identifies and discusses drivers and challenges for investing in adaptation and resilience and necessary changes for developing capital market solutions in London and the UK. This research has been conducted by the Centre for Climate Finance & Investment (CCFI) at Imperial College Business School and the Singapore Green Finance Centre, following papers focusing on adaptation and nature financing (Buhr, B. (2022); Holtedahl, P., Köberle, A. & Koci I. (2023); Whittaker, S. & Nguyen, T. (2023)).

The research project, divided into three separate papers, takes a practical approach by focusing on the real estate and water sectors in London and the UK, ensuring the findings are directly applicable to the local context.

Part I Case Studies Analysis of the research project highlights various adaptation and resilience investment and financing models, with eight case studies in London and the UK. The analysis responds to the following three questions: What is the investment proposition and the role of the private sector in adaptation and resilience? What are the main investment models and financing instruments for private investors in these areas? What are major investment drivers for institutional investors such as pension funds and insurers?

Part II Urban Adaptation Financing focuses on urban adaptation financing, delving into the current state of adaptation finance in London and making a comparison with Copenhagen and Singapore. This comparison is particularly significant as it allows us to draw lessons from cities with different approaches and experiences, thereby enriching our understanding of urban adaptation financing. The research primarily focuses on private investment and aims to learn about the experience of London (covering the greater London area) in the delivery of climate finance and financing for urban climate change adaptation and understand the potential barriers and opportunities to mobilising finance. The research question ‘To what extent can cities and investors build for innovation in climate adaptation in cities?’ aims to inform and promote a better understanding of financing for climate change adaptation actions.

Part III Policy Recommendations develops policy recommendations taking into consideration the current policy context. Drawing on insights from the case studies analysis and the London urban adaptation finance research (Part 1 & 2 of this policy brief), this Paper develops several recommendations, addressing policymakers, regulators, and the financial industry—primarily banks, asset managers, exchanges, and marketplaces. Several recommendations need to be addressed simultaneously to enable private investment into adaptation in London and the UK, these activities need to be embraced by all actors: investors, regulators, Government, OFWAT, the Bank of England, standard setting agencies, corporations, and development companies etc.

Executive Summary & Key Messages

The goal of this research is to learn about the experience of London (covering the greater London area) in the delivery of climate finance and financing for urban climate change adaptation and understand the potential barriers and opportunities to mobilising finance. The research question 'To what extent can cities and investors build for innovation in climate adaptation in cities?' aims to inform and promote a better understanding of financing for climate change adaptation actions today.

This paper includes an extensive review of the literature and relevant policy documents (see Annex 1). The research was conducted focusing on London in 2023. Through this project, we gathered industry insights provided by leading institutions, senior officials, and policymakers, which are presented (for the research methodology and complete results, see Annex 2).

Cities are highly vulnerable to climate change. Without massive investments in adaptation, cities, their economies, infrastructure, and people are highly vulnerable to climate-induced extreme events, which will be very costly to all. Especially in a city such as London without a well-developed, funded, and financed urban adaptation program, impacts and economic consequences could be much higher than anticipated, and markets can play a role to help to avert a looming disaster.

Among the key findings are:

- London and the UK need to **clarify the adaptation financing gap**, which is the difference between the total cost of adaptation measures and the amount currently being spent. While the Greater London Authority lacks cost estimates, the UK's Climate Change Committee suggests £10 billion yearly for climate readiness across the UK (Rising et al., 2023). This figure represents a conservative estimate of the potential funding needed to bridge the adaptation financing gap.
- The **lack of clear articulation of adaptation needs and a sense of urgency** hinders the mobilisation of funding. Data on adaptation finance needs and predicted damage costs is limited and varies depending on the source and methodology employed. This urgent need for more comprehensive and reliable data underscores the immediate action required in climate adaptation financing in London. Tracking and accounting for adaptation investments is complex due to problems defining and agreeing on what adaptation is.
- **Governance and funding issues**. The **policy and financing ecosystem in greater London is fragmented**, with multiple layers of policies and funding sources that need to be more effectively aggregated. While planning and strategic initiatives have been present longer, financing initiatives have only started to emerge more recently. Additionally, **aggregating funding for climate adaptation, including pluvial and fluvial flooding, is challenging**.
- **Barriers to investment**. A lack of transparency on the city's climate adaptation needs, a lack of knowledge of what constitutes climate adaptation, the public good nature of investments, and the lack of investment opportunities have been found to be the most important factors causing investors of all types to postpone or delay investment activity. Other key factors include a lack of both a stable climate policy and adaptation policy framework.
- **London lags behind other cities in its adaptation financing efforts**. The three cities studied, namely Singapore, Copenhagen and London, face many climate change impacts, notably sea level rise, flooding, heat waves, and drought. These cities have implemented innovative adaptation financing strategies, which could serve as valuable lessons for London.
- **Singapore has an ambitious urban adaptation approach** that is widely considered a model among capital cities elsewhere. Yet there is still significant **deficiencies in terms of knowledge and partnerships** between the public and private sectors in terms of climate adaptation.
- **Singapore offers best practices for using AI and data analytics for climate transition and new instruments for insurers to cover the protection gap**. The protection gap refers to the difference between the economic losses caused by a disaster and the amount covered by insurance. In the context of climate adaptation, insurers face challenges in accurately assessing and pricing climate risks, which can lead to underinsurance and increased financial vulnerability.
- Despite being the green finance hub of the UK and Europe, **London's adaptation financing approach is predominantly based on public finance** (particularly the Environment Agency and London municipalities) and has more work to do to include private capital partners in financing adaptation infrastructure.

- **The role of the private sector has yet to be defined**, and there is a lack of investor networks for adaptation. Public networks like the Green Finance Institute (GFI) and the Centre for Greening Finance and Investment (CGFI) still need to focus on adaptation, although this is slowly changing, reflecting their recent establishment.
- Among significant actors, the research shows that **financing adaptation projects in London is limited to a small number of investors**, predominantly banks, water companies, and pooled local authority pension funds.
- Investors are undertaking **climate-proofing measures for infrastructure and property**, such as retrofitting office buildings with energy-efficient systems, installing flood barriers, and diversifying their investment portfolios to include more climate-resilient assets.

1. Urban Adaptation Financing in London

The impacts of climate change are evident and will continue to grow in the coming decades. Current policies heading for a 2.5-2.9°C temperature rise above pre-industrial levels this century mean we will have to learn to live in a warmer climate and cope with increasing heatwaves and other weather extremes (UNEP, 2023; EEA, 2024). At the urban level, climate change intersects with health, social, and economic inequalities.

London faces risks from extreme rainfall, flooding, storm surges, and droughts. In this century, the city's most significant flood risk came from rainwater overwhelming the drainage system rather than water spilling over from the Thames or its tributaries (Bloomberg, 2022). Sadiq Khan, the Mayor of London, emphasized in 2021 that "The climate emergency isn't a tomorrow issue, it's right here today on our doorstep", highlighting these impacts are already materialising (Reuters, 2021). A London climate resilience review has been launched to investigate these risks, with final results published in July 2024 (see Box 1) (Howard Boyd, Leigh & Sutton, 2024).

The summer floods in 2021 overwhelmed London's sewage system and led to a £2 million loss in passenger revenue for one station only (CCC, 2023). July 2022 saw extreme heatwaves when summer temperatures rose above 40°C, leading to an estimated loss of £8 million for Transport for London due to an estimated loss of 5 million passengers. Overall, the anticipated weather patterns for London correspond to the broader UK and Southeast region projections: hotter and drier summers and milder winters with more rainfall (Met Office, 2019).

Flash flooding or flooding from torrential rain threatens 42% of London's commercial buildings[1]. In addition, more than 30,000 homes in London are at medium or high risk of tidal or fluvial flooding, with 1.3 million people living and working in such areas (London Environmental Strategy, 2018). With London's projected average winter expected to be 15% wetter and sea levels predicted to rise by up to 1 meter by the end of the century, future risks are even more alarming.

Box 1: The London Climate Resilient Review – Lack of financial and human resources have been considered as major challenges to implementation at local level.

The report presents key recommendations that underscore the pivotal role of governance and strategic planning for London and the necessity of ensuring investment in adaptation is prioritised and delivered. The Review has found significant climate adaptation and resilience action underway across London. Examples are the Climate Resilient Schools programme and London's first surface water flooding strategy.

However, according to the Review, London needs to prepare more and needs a step change. As climate change will not impact Londoners equally, it is critical to identify those who are most exposed and vulnerable to climate hazards.

To deliver large scale change, the Review calls for action in the following six areas:

- A strategic, London-wide action plan on heat risk is needed;
- More coordination for surface water flooding;
- More understanding of cascading risks and system inter-dependencies;
- More investment in climate resilience, at national, regional and local level;
- Engage londoners on climate impacts and adaptation options;
- Coordinate strategically through a shared regional vision and framework

Source: The London Climate Resilient Review: Final Report

1 https://www.zurich.co.uk/media-centre/two-fifths-of-london-firms-at-risk-of-climate-fuelled-flash-floods

2. Key Adaptation Planning and Financing Initiatives in London

Over the past years, a multitude of planning and financing initiatives have emerged, each contributing to the city's climate change adaptation strategies (see Figure 1). These initiatives, with their varying governance structures (national vs. local) and diverse stakeholders (public authorities, agencies, infrastructure companies), underscore the collaborative nature of adaptation financing.

For instance, the Mayor's London Environment Strategy (2018) and the London Plan (2021) are strategic documents and practical roadmaps for enhancing the city's infrastructure resilience. These plans advocate for climate change adaptation through tangible actions like urban greening. The Greater London Authority aims to establish London as an international leader in addressing climate change (GLA, 2016). It recognises adaptation can provide broader benefits, including promoting green infrastructure and improving health and well-being (LCCAS, 2011).

On a **national level**, the **Third National Adaptation Programme** (2023) sets the actions needed to adapt to the impacts of climate change in the UK between 2023 and 2028, such as £5.2 billion investment in flood and coastal erosion schemes or the £16.2 billion Thames Estuary 2100 programme, which includes the **Thames Barrier in London**. The Thames Barrier, a classic urban climate resilience example, is one of the world's most considerable movable flood barriers and is run and maintained by the Environment Agency alongside London's other flood defences. The project is government-funded (Environment Agency, 2023).

The adaptation strategies stretch beyond the public authorities. Key infrastructure organisations, such as **Transport for London (TfL) or Thames Water (TW)**, have also produced their own adaptation plans, the Climate Change Adaptation Plan 2023 and Thames Water's climate adaptation reports, respectively. These include, for example, creating a budget for adaptation (TfL) and applying sustainable drainage systems (TW).

However, despite the growing acknowledgement of the importance of adapting to climate change, it is evident that the current adaptation strategies need to translate more effectively into practical implementation, and significant **policy gaps and deficiencies persist** (Climate Change Committee, 2023). These policy gaps are especially significant in financing, a crucial lever in increasing the delivery and implementation of adaptation initiatives (ibid, 2023).

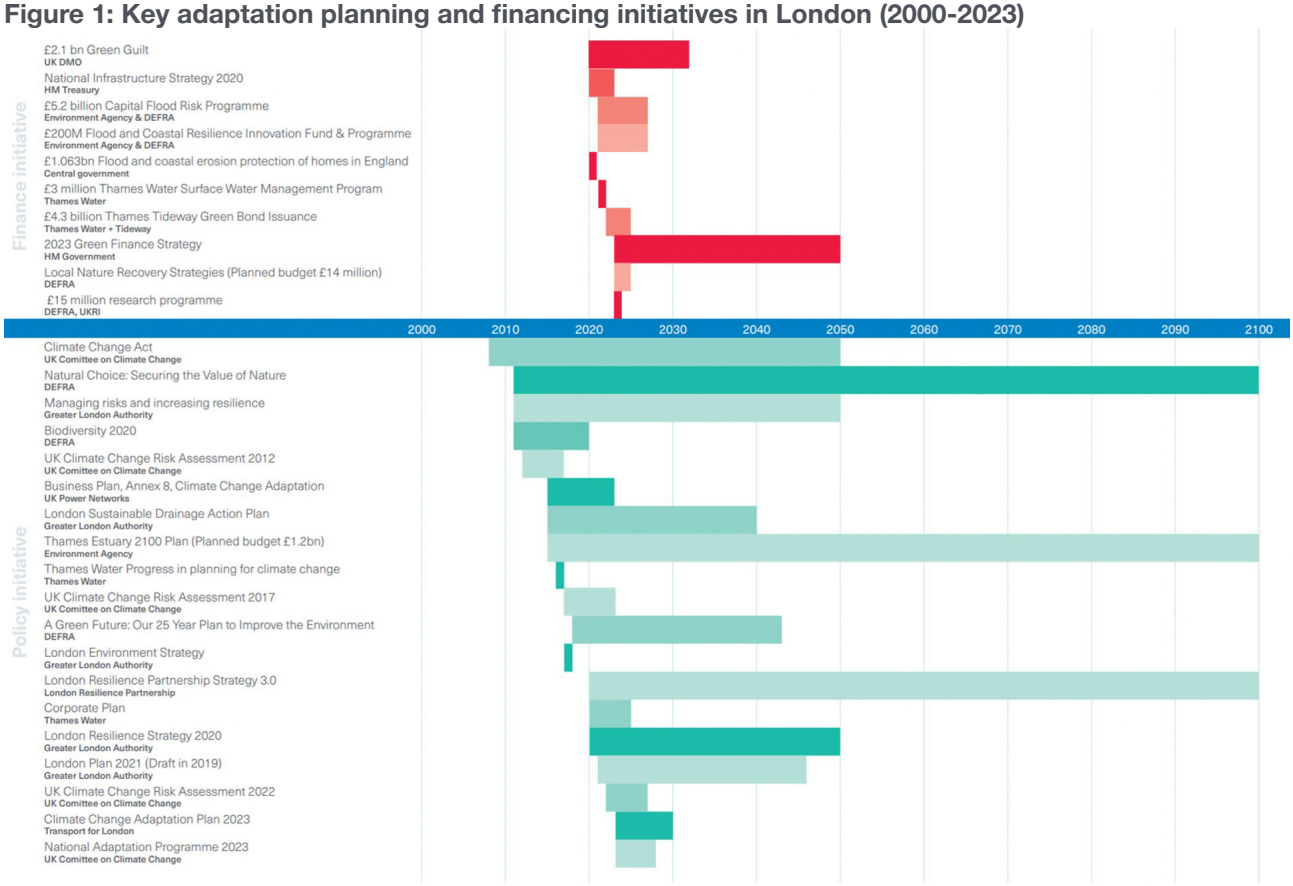
As London positions itself as a global leader in green finance, it has the potential to spearhead the mobilisation of private capital for climate change adaptation. While public finance initiatives, such as the £5.2 billion Capital Flood Risk Programme or the £1.2bn Thames Estuary 2100 Plan, serve as excellent examples, there is a clear need for more, particularly at the local level and in private finance.

Public funding can act as a catalyst in mobilising private adaptation investment, either by co-financing adaptation projects, or de-risking them (Whittaker & Jespersen, 2022). Recent publications like the London Climate Resilience Review, Mission Climate Ready UK or the Third National Adaptation Programme echo this sentiment (Ranger et al., 2023).

The scale of funding available across the myriad of programs and initiatives dedicated to adaptation or broader programs that encourage adaptation projects in Greater London (see Figure 1) must be commensurate with the need. This issue is connected to the lack of greater London's formulation of an adaptation need and cost estimates, a crucial first step in mobilising support and addressing the issue.

The current state of the policy and financing ecosystem in greater London is characterised by fragmentation, with multiple layers of policies and funding sources that are not effectively aggregated. While planning and strategic initiatives have been present for a longer time, financing initiatives have only started to emerge more recently. The role of the private sector hasn't been defined, and there is a lack of investor networks for adaptation. Public networks, such as the Green Finance Institute (GFI) and Centre for Greening Financial Institutions (CGFI) are not yet focusing on adaptation, although this is slowly changing, reflecting their recent establishment.

Figure 1: Key adaptation planning and financing initiatives in London (2000-2023)



Graphic is adapted from City of London Adaptive Pathways study (2020), Sources: Multiple, see References.

3. Singapore as a Model for Climate Adaptation

As London, Singapore functions as a financial hub for the region. Being a low-lying island city state, Singapore is exposed to climate hazards such as extreme heat and rising sea levels. In 2023, Singapore experienced one of the hottest years, confirming the rising temperature trend since the mid-1970s due to global warming and the urban heat island effect (MSS, 2023). Fighting climate change is henceforth of great national significance, as demonstrated through Singapore's commitment to a resilient net-zero future by 2050, and initiatives like the Singapore Green Plan 2030 and the Singapore Green Building Master Plan. The nation has also been actively promoting innovative technological solutions towards climate adaptation. Singapore has an ambitious urban adaptation approach that is widely considered a model among capital cities within Southeast Asia and even globally.

3.1 Opportunities and Challenges for Financing Adaptation in Singapore

Singapore has succeeded in developing a whole government approach to adaptation that sets a clear transition pathway to a climate-adapted city. The nation has a suite of green/climate financing initiatives in play that are rarely seen, or at least reported, in other cities. The Government's success in urban adaptation can be attributed to the presence of certain key conditions, including supportive national climate adaptation planning and water sensitive urban design (WSUD) frameworks, the involvement of the Central Bank - the Monetary Authority of Singapore (MAS), extensive government supported academic research and climate modelling, and a plethora of well-funded green and climate-focused non-governmental organizations (NGOs). However, there are still significant deficiencies in terms of knowledge and partnerships between the public and private sectors in terms of climate adaptation.

Based on a recent study on the landscape of climate adaptation financing in Singapore, the majority of adaptation projects in Singapore are publicly funded (Whittaker and Nguyen, 2023). This represents the current attitudes towards climate adaptation financing. Many investors share the sentiment that the responsibility for such investment lies firmly with the public sector and not with private companies. Although

a sense of urgency to tackle adaptation has been widely communicated from the top down, Singapore has not yet clearly articulated a role for the private sector and the market in financing adaptation. Singapore could experience problems into the future realising its ambitious goals and plans without a more diverse engagement in the sources of finance for adaptation measures. Far-reaching 'transformation' of the market is required to overcome current barriers to adaptation investment and enable the market to mature. The Singapore Government needs to signal to the private sector its intentions more clearly regarding the role for private capital in adaptation financing.

In addition, knowledge gap is another major issue. Urban adaptation is an area about which actors lack sufficient knowledge to find potential projects, assess investments and make informed decisions about whether to invest or not. Lack of knowledge of what constitutes climate adaptation, of the potential risks and returns of adaptation projects (possibly due to a lack of track record) is a very important factor causing investors of all types to postpone or delay investment activity. However, there is a clear interest from the investment community to increase knowledge on financing adaptation, as well as a willingness from some to consider experimentation in innovative deal structures (resilience bonds, adaptation bonds, etc.) and incentive schemes (tax exempt, subsidies) (see box 2 below).

Adaptation is a knowledge-intensive undertaking, which requires provision of access to relevant and usable knowledge to ensure effective implementation and outcome. More frequent dialogues among governments, investors, and academics to discuss potential financing models and evaluate ongoing efforts can help mending the current gaps in climate adaptation in Singapore. Actors from across the science, technology, investing, business, nonprofit, and community sectors should work together to identify breakthrough, cost-effective strategies. Due to its complexity, climate adaptation lends itself to an entrepreneurial approach with multi-stakeholder collaboration.

Box 2: Recent research on Adaptation Financing in Singapore

The Singapore Green Finance Centre (SGFC), an initiative of the Centre for Climate Finance and Investment (CCFI) at Imperial College Business School and the Sim Kee Boon Institute for Financial Economics (SKBI) at Singapore Management University has conducted recent research. The Centre is backed by the Monetary Authority of Singapore (MAS) and nine leading global financial institutions.

For the SGFC paper "Are markets interested in adapting to climate? Insights from Singapore, "a series of interviews were conducted to learn about government and investor experiences as participants in the delivery of climate and adaptation financing in Singapore. This research investigates climate finance delivery for climate change projects in Singapore. The research question 'To what extent can markets build for transformation in climate adaptation financing in the city?' aims to inform and promote a better understanding of financing for climate change actions today. A motivation for the study is the scale of the impacts and the economic losses the city could face without adaptation (Whittaker and Nguyen, 2023).

3.2 Insurance and Greentech in Singapore

Since 2013, Singapore has been striving to become a global insurance marketplace. Today, Singapore is Asia's leading reinsurance hub, with a market share of 24%, and 16 of the top 25 reinsurers in the world have made Singapore their regional hub[2]. Global reinsurers are developing digitalisation, data analytics, and sustainability solutions for bespoke disaster risk financing, carbon credits, and renewable energy infrastructure.

FinTech and sustainable finance initiatives for climate resilience have been actively promoted and supported in Singapore. The Monetary Authority of Singapore (MAS) launched Project Greenprint in 2023, a blockchain-based network of registries to control the provenance of ESG certifications and verified data. Climate Impact Exchange, launched in 2023, uses Earth Observation technology, machine learning, and blockchain to trade nature-based carbon credits.

Given the sizeable protection gaps in Asia, Singapore is also focusing on better data for climate and alternative risk transfer instruments to expand capacity. The region experienced nearly US$1.2 trillion in economic losses from natural catastrophes ("nat-cat") from 2013 to 2022. However, only 13% of these

[2] https://www.mas.gov.sg/news/speeches/2023/reinsurance-for-asias-protection-gaps#

losses were insured, much lower than the global average of 37%.[3] MAS focuses on three alternative risk transfer initiatives: insurance-linked securities, captive insurance, and sovereign catastrophe risk pools. The Nanyang Technological University's Institute of Catastrophe Risk Management, working with the ASEAN governments and secretariat, has built an integrated data and analytics platform for flood, typhoon, and earthquake risks for ASEAN countries - ASEAN Disaster Risk Financing and Insurance Phase 2 Initiative (ADRFI-2). Issuers in Singapore can also benefit from MAS' ILS Grant Scheme that has supported 28 cat bond issuances from 2019 to 2024, raising a total of US$4.4 billion[4].

Leveraging AI and data analytics NovA! is a platform launched by MAS in 2023 to support financial institutions and companies for the issuance of financial instruments. This initiative was led by the Monetary Authority of Singapore and the Smart Nation Digital Government Office (SNDGO) and developed in collaboration with industry experts. NovA!'s initial area of focus was on sustainability-linked loans (SLLs) for real estate due to the sector's significant contribution to Singapore's CO2 emissions (over 20% of total emissions) and because of the rapid increase in demand for SLLs. SLLs have increased in popularity among borrowers, growing at a CAGR of more than 50% over the past five years to reach USD 362 billion in 2022. Climate risk is another case study of the NovA! project to help financial institutions assess and mitigate climate vulnerabilities across their portfolios.

However, with opportunities, AI solutions also present significant challenges. Digital space has led to the creation of new power structures that differ radically from their traditional forebears (Kong and Woods, 2018). The increasing demand for Data Centres (DC) services puts pressure on energy supplies, water resources, and land availability. Consequently, unchecked expansion of DC requirements can compromise Singapore's climate ambitions, including its target to achieve net zero emissions by 2050. It may disrupt resource allocation and urban planning in this already water-scarce and land-constrained city-state.

Therefore, while synergies between FinTech and sustainable finance are promising, the broader trend towards digitalisation in economic and financial realms necessitates careful consideration of associated trade-offs. Beyond energy efficiency and reduced carbon footprint, standards and regulation should include consideration for environmental impacts to reduce physical climate risks and assets deterioration.

Data centre operators and investors play a crucial role in leading sustainable transitions for tropical data centres by setting and disclosing sustainable targets, aligning expectations with value chain-wide transition, and investing in entire low-carbon digital ecosystems (Chow et al.,2024). There should also be strong policy support from the regulators by designing and implementing standards such as the BCA-IMDA Green Mark for Data Centres[5] and the Singapore-Asia Taxonomy for Sustainable Finance. Strong collaborative efforts from various stakeholders to ensure the transition to sustainable operations in tropical DCs. Singapore is well-positioned to test scale, invest, and promote more robust industrial best practices for greening tropical data centres (see box 3 below).

Box 3: Recent research on Singapore Fintech

A SGFC white paper published in April 2024, "Green FinTech and Data Centres", evaluated the environmental impacts of the rapidly growing DC sector in Singapore and its implications on the rest of Southeast Asia, uncovering the challenges and opportunities for DCs in tropical geographies to adopt cleaner operations, and explore the sustainable financing opportunities and limitations to 'greening' DCs and FinTech (Chow et al.,2024)).

Among the findings of the paper, environmental considerations for physical climate risk are not explicitly addressed in standards and regulations.On the contrary they should be integrated from the outset of DC site selection processes. These criteria should include assessment of physical climate risks under different temperature scenarios (e.g. flood, drought, heat stress).

[3] MAS speech citing Aon and Swiss Resources: https://www.mas.gov.sg/news/speeches/2023/growing-a-vibrant-insurance-linked-securities-market-in-asia#8
[4] Speech by Mr Lim Cheng Khai, Exec Director MAS, 11 July 2024. https://www.mas.gov.sg/news/speeches/2024/growth-and-opportunities-in-the-ils-market
[5] https://www.imda.gov.sg/how-we-can-help/bca-imda-green-mark-for-data-centres-scheme

3.3 Singapore Compared to its Southeast Asian Peers

Like Singapore, many other Southeast Asian cities like Bangkok, Manila, Jakarta and Ho Chi Minh face very real risks of huge economic losses should their climate measures be inadequate. Floods and heatwaves turn into regular occurrences across the region, affecting people's lives and economic growth of the nations. Southeast Asia must concertedly prioritise climate resilience involving both adaptation and mitigation.

Multiple adaptation initiatives have been carried out and planned in the region, especially within national boundaries, to cope and adapt to future climate hazards.

As the evidence points to rising sea levels as Southeast Asia's biggest climate worry, Singapore and Jakarta have developed coastal protection plans and allocated funding towards building sea walls and nature-based solutions like mangrove planting. These cities have started to focus urban planning and infrastructure upgrades in order to enhance urban resilience. For instance, the Philippines has recently presented an initiative ("The Resilience and Green Human Settlements Framework" (RGHSF)) to design and promote resilience housing designs, particularly in vulnerable coastal and low-lying areas.[6] Thailand plans a multi-billion dollar investment to upgrade its public infrastructure as well as to build new "green" and "blue" infrastructure (i.e., parks, water retention areas, etc.) to reduce risks of flooding while providing recreational space for the residents.[7]

Within the region, Singapore is a strong example worldwide for adaptation efforts. Its Green Plan 2030 adopts a whole-of-government approach to resource management and seeks to expand green spaces, cut solid and water wastage, expand public transportation, and switch from polluting fuels to cleaner alternatives. The nation also allocates substantial government budgets and dedicated funding towards climate adaptation, while some other countries heavily rely on international aids and face significant funding constraints. Singapore government has committed S$100 billion to protecting the city from Sea Level Rise (SLR) to the turn of the century. One estimate puts the global average for adaptation at 0.25 per cent of GDP per year, with costs potentially rise up to 20 percent of GDP for small, island nations exposed to tropical cyclones and rising seas. [8]

For the needed scale of green investments, government initiatives need the buy-in from the public and partnerships from the business community. Diversified funding sources presents the government with budget tightness, mitigating financial and bureaucratic challenges.

4. London Compared to its International Peers

The scale of investment in adaptation for London differs from other cities, like Singapore, which has pledged S$100 billion by the end of the century, equivalent to over S$1 billion annually (Whittaker & Nguyen, 2023). Additionally, an analysis of the situation in Copenhagen shows that their Cloudburst program will cost €1.5 billion by 2035, with coastal damage estimates of €0.2 to 0.4 billion by 2050 and €1.5 to 0.9 billion in a century (Whittaker & Jespersen, 2022). Potential losses from a single storm surge are also noted (Ibid, 2022). The Greater London Authority lacks cost estimates, but the UK's Climate Change Committee suggests £10 billion yearly for climate readiness across the UK (Climate Change Committee, 2023)[9]. None of the cities reveals their adaptation financing gaps, the funding they cannot cover publicly, and the role of private sector finance.

Table 1 shows spending estimates by the end of the century.

[6] https://unhabitat.org/sites/default/files/2023/06/resilient-and-green-human-settlements-framework-2023.pdf
[7] https://resilientcitiesnetwork.org/downloadable_resources/Network/Bangkok-Resilience-Strategy-English.pdf
[8] https://www.imf.org/en/Blogs/Articles/2022/03/23/blog032322-poor-and-vulnerable-countris-need-support-to-adapt-to-climate-change
[9] The CCC reports that for nine significant climate risks alone, annual damages could reach £5 billion to £10 billion per year by mid-century, rising to tens of billions of pounds annually by the late century (CCC, 2023).

Table 1: City climate adaptation financing estimates

	COPENHAGEN (CPH)	LONDON (LON)	SINGAPORE (SG)
Adaptation cost and spending estimates	• The City of Copenhagen's Cloudburst program costs €1.5 billion by 2035 • Coastal damage estimates of €0.2 to 0.4 billion to 2050 and €1.5 to 0.9 billion in a century (Whittaker & Jespersen, 2022)	• The Greater London Authority lacks cost estimates • The UK's Climate Change Committee suggests £10 billion yearly for climate readiness across the UK (CCC, 2023)	S$100 billion over a century for SLR protection, needing over S$1 billion annually (Whittaker & Nguyen, 2023)
Potential adaptation spending need turn of the century	>€3.4 billion to the end of the century, €40 m/ year	€12.65 billion/year (entire UK)	>€68 billion to end of the century, €0.9 b/year for SLR

Note: None of the cities reveal publicly their adaptation financing needs, the funding they can cover and the financing gap. Spending estimates are difficult to compile in each city, the figures in the table above are compiled from publicly available information.
Sources: Whittaker et. al, 2024 unpublished; Green Finance Institute, 2023

Recent research focused on Copenhagen's innovative funding mechanisms to protect against extreme rainfall and flooding (referred to as Cloudburst), utilising a water tariff and 'KommuneKredit,' a municipal pooled credit facility (Whittaker and Jespersen, 2023). The research concluded that while constructing a response to one climate hazard, such as Cloudburst, has been successful in Copenhagen and Denmark, the approach taken can have knock-on effects on addressing other climate hazards, partnerships, and investment prioritisation. This analysis is relevant to scholars and decision-makers in Denmark, Singapore, London, and beyond. Consequently, while Copenhagen is seen as a leader in urban adaptation financing, this perception perpetuates an approach adopted across Denmark's 98 municipalities involved in the country's Cloudburst response. This dominant approach often overlooks the importance of engaging investors, legitimising the 'crowding out' of the private sector in Denmark's adaptation response and perpetuating power imbalances and knowledge asymmetries.

Box 4: Copenhagen Cloudburst program

The Cloudburst program comprises 300 projects with a total cost of €1.5 billion (DKK 11 billion at 2015 prices, according to Climate-ADAPT 2016). "Cloudburst" is a term used by Danish authorities for their response to flooding caused by extreme rainfall events induced by climate change. Each Cloudburst project requires a detailed cost-benefit assessment in compliance with state regulations. The City's departments work closely with various stakeholders to engage in cross-sectoral knowledge platforms, fostering partnerships for Cloudburst planning and resulting in diverse measures, including green infrastructure projects. These Cloudburst investments are significant compared to the municipality's 2021 budget of €7.7 billion (DKK 52.790 billion) (CoC 2021). This planning was initiated in response to Copenhagen's experience of three major rainfall events between 2011 and 2022. The most severe was an extreme 1000-year cloudburst that caused over €0.8 billion in damages, excluding the direct costs of repairing municipal infrastructure and indirect costs such as loss of earnings, business losses, and increased insurance premiums (Climate-ADAPT 2016; CoC 2012; Danish Government 2012). The extent of the impact and the scale of the required response to such rainfall events is detailed in the city's Cloudburst Management Plan of 2012. As part of its response to rising sea levels, the Danish Government decided in 2021 to progress with the Lynetteholm artificial island (Carlson 2021) , which proposes constructing an artificial island off Copenhagen's coast to house 35,000 people and protect the city's harbor from rising waters.

Given London's and Singapore's edge as green finance hubs of their respective regions, it is worth reflecting on the similarities and differences perceived by investors, Government, and academic communities in these centres regarding investing in adaptation.

According to our research, London and Singapore exhibit distinct characteristics in their policy landscapes and investment patterns. London's approach to climate adaptation reveals a fragmented policy landscape with limited private-sector involvement (see Table 2). The primary financiers of adaptation projects in London are a select group of banks, notably those issuing and underwriting green bonds in other parts of Europe, water companies, local authority pension funds, and blended finance mechanisms. The sentiment regarding adaptation financing remains relatively negative in London, primarily caused by the unstable and fragmented general climate policy in London. Conversely, Singapore demonstrates an ambitious governmental commitment to climate adaptation, building upon its successful track record in mitigation. The Monetary Authority of Singapore (MAS) is influential in facilitating adaptation financing, contributing to regulatory certainty. Singapore showcases strong intra-governmental collaboration and active engagement between the private and public sectors. Optimism surrounds future adaptation financing, driven partly by the urgency created by the Government's commitment to adaptation and innovative financing instruments. Nevertheless, the level of private sector participation in adaptation remains relatively low.

Common themes emerge in both cities' climate adaptation financing strategies (see Annex 1 for a high-level summary of research outputs). Investment drivers include considerations of financial returns, societal impact, value creation, and the interests of shareholders and clients. Key barriers include the lack of regulatory stability, the challenge of identifying financially viable projects, and the need for leadership, agency, and knowledge within the investment and financial sector. The transformation required in these areas entails regulatory changes, improved impact measurement methodologies, financial innovation, knowledge dissemination, and scaling up the size of adaptation projects. Additionally, a prevalent mitigation bias is observed among investors, with the focus on achieving net-zero emissions goals potentially overshadowing the urgency of adaptation efforts.

Table 2: London and Singapore comparison

Planning/financing initiatives	London	Singapore	Examples
National/city climate risk mapping		2020	UK - CIP
National/city climate change committee	2008		UK - Climate Change Act
Minimum land reclamation level		2011	SG - Second National Climate Change Study
National climate finance network	2021		UK - Centre for Greening Finance & Investment
City adaptation strategy	2011		
Adaptation implementation plan	2023		
National storm surge plan		2021	
National adaptation strategy	2023	2012, 2022	UK - Third National Adaptation Programme and Fourth Strategy for Climate Adaptation Reporting SG - Singapore Green Plan 2030
City flood strategy/drainage plans	2015		UK - London Sustainable Drainage Action Plan
Estuary plan	2015, 2022		UK - Thames Estuary Plan 2100 (2.1b[10])
Cloudburst/SUDS/ABC	2015	2006	SG - Active, Beautiful, Clean (ABC) Water Programme
Climate risk assessment	2017, 2022		UK - Climate Change Risk Assessment
City plan	2021		UK - London Plan 2021, including climate resilience requirements
National coastal protection agency		2020	
National sea level research programme		2019	SG - National Sea Level Programme (NSLP) by the Centre for Climate Research Singapore (CCRS)
Coastal protection panel		2021	

[10] As of October 2023, 1£ is equivalent to €0.87.

Climate impact science research		2021	SG - The Climate Impact Science Research (CISR) Programme managed by the Climate Science Research Programme Office (CSRPO)
Drainage improvement works		2011	
Water security and supply strategy			SG - National Tap
Green buildings standard (includes resilience)		2015	SG - Green Mark (building standard)
Green sovereign bonds issuance (adaptation)	2020		UK - Green Gilt (€2.42b) includes flood and coastal erosion risk management
Industry climate finance network	2021		
National infrastructure strategy	2020		UK - National Infrastructure Strategy 2020 (€230 billion) and NIC Infrastructure Progress Review 2024
Flood and coastal resilience fund (national and/or city)	2021	2020	UK - €230m – Flood and Coastal Resilience Innovation Fund and Programme, €5.99b Capital Flood Risk Programme, €1.22bn Flood and coastal erosion protection of homes, €3.45m Thames Water Surface Water Management Program
London green finance strategy	2023		UK - Mayor's Green Finance Fund, London Climate Finance Facility
Climate proofing critical infrastructure (city)	2024		UK - Thames Estuary Plan SG - Marina barrage (Singapore river), Deep Tunnel sewer system
Adaptation infrastructure projects	2022		UK - Thames Tideway (€4.95b Green bond issuance)
Infrastructure Bank	2021		UK - Infrastructure Bank
Green Finance Strategy	2023		UK - Green Finance Strategy
Sustainability disclosure regulation	2023		UK - Sustainability Disclosure Standards
National/city adaptation funds		2022	SG - S$100b National Spending Plan: Adaptation 2022
Research and innovation (inc. adaptation)	2024		
Coastal and flood protection fund		2020	SG - Coastal and Flood Protection Fund (CFPF)
Significant Infrastructure Government Loan Act		2021	
Green Plan			SG - Singapore Green Plan 2030
Transition Taskforce	2022		UK - Transition Plan Taskforce
National Sustainable Finance Working Groups		2020	
EU Initiatives	2023		UK - EU Green Bond Standard, EU Taxonomy, UK Sustainability Disclosure Requirements
National climate investment hub		2020	
Stock Exchange green initiatives		2020, 2022	SG - SGX FIRST (Future in Reshaping Sustainability Together) (2020) and ESGenome disclosure platform (2022)
State Investment Bank initiatives		2022	SG - Sovereign Green Bonds (2023)

5. Urban Adaption Finance Research – Key Insights

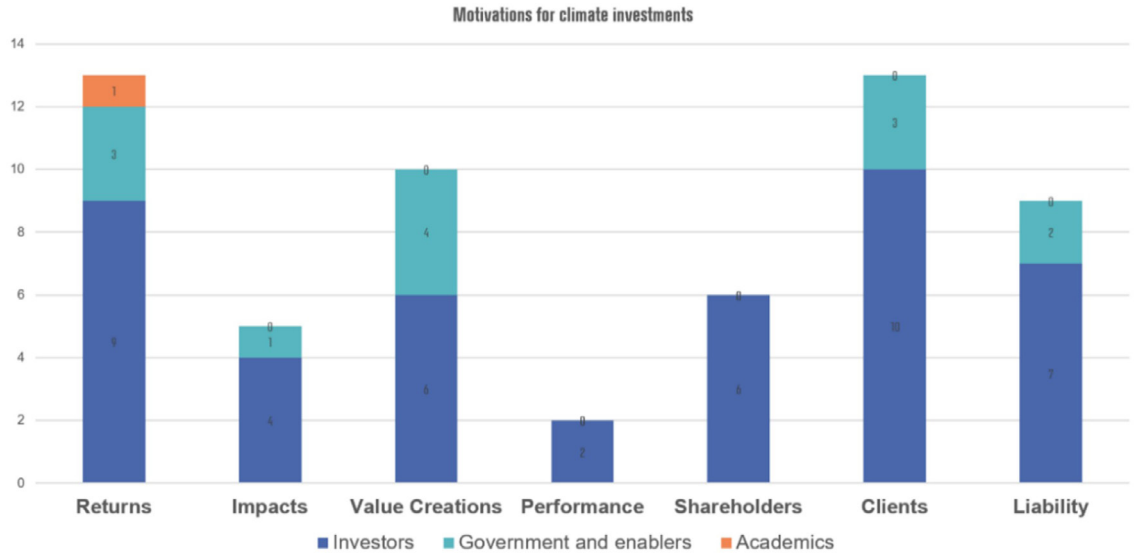
Research on London urban adaptation finance was conducted in 2023 by the Centre for Climate Finance and Investment (CCFI) at Imperial College Business School as a continuation of the series of urban adaptation financing papers[11] (Whittaker & Jespersen, 2022 and Whittaker & Nguyen, 2023). The goal of this research is to learn about the experience of London (covering the greater London area) in the delivery of climate finance and financing for urban climate change adaptation and understand the potential barriers and opportunities to mobilising finance. The research question 'To what extent can cities and investors build for innovation in climate adaptation in cities?', aims to inform and promote a better understanding of financing for climate change adaptation actions today.

Below, a summary of the main research findings on the factors that drive, hinder, and facilitate urban adaptation financing in London, derived from industry insights provided by leading institutions, senior officials, and policymakers, is presented (for the research methodology and complete results see Annex 2).

Drivers of Urban Adaptation Finance in London

Interviewees were asked to identify and discuss their key motivations for climate investment. The key drivers for urban adaptation financing in London can be summarized as follows. Overall, these drivers reflect a combination of financial considerations, stakeholder expectations, performance criteria, policy alignment, and risk management that motivate urban adaptation financing in London.

Figure 2: Drivers for green/climate investment in London (Interviews and workshop)

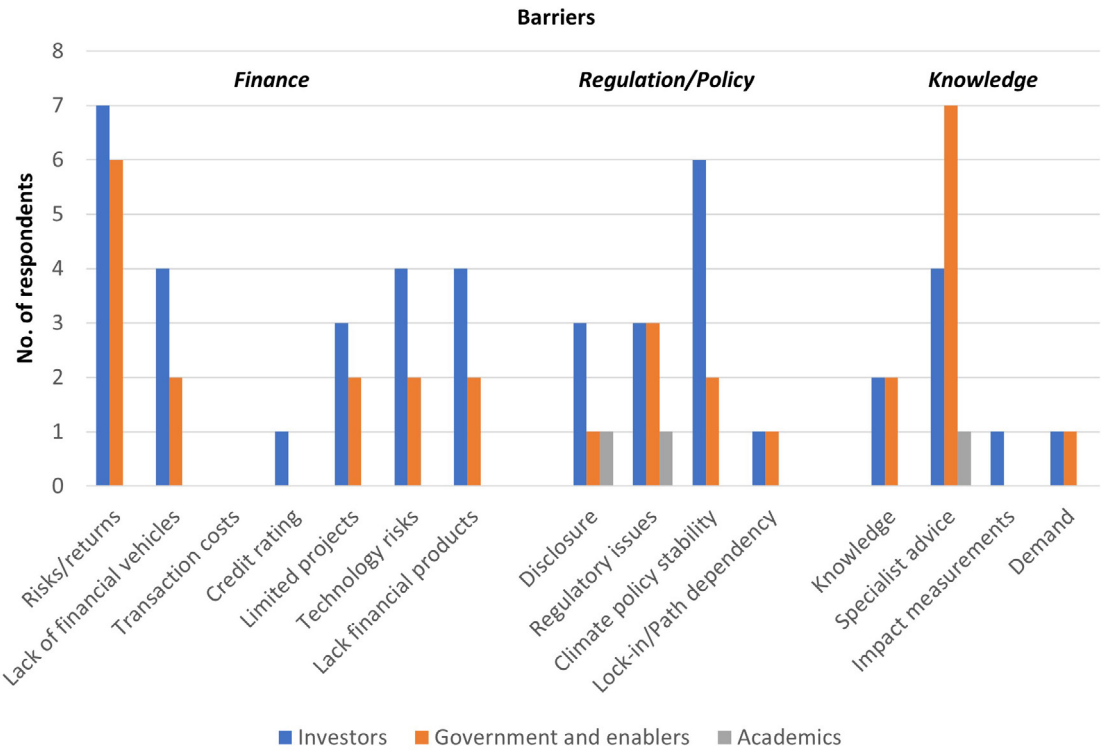


Barriers to Urban Adaptation Finance in London

The interviewees were asked to mention the barriers underlying investment into adaptation. The barriers cited in the interviews with the government differed from those cited by investor interviewees, demonstrating different priorities, concerns, and contexts. For instance, while all actors (investors, government officials, and academics) agreed on the most prominent barriers (returns, regulation, and knowledge), differences emerged amongst the interviewees on the importance of a stable climate policy and the importance aspects of knowledge.

[11] Main author of this research Stella Whittaker, a PhD research fellow at Copenhagen Business School, Copenhagen.

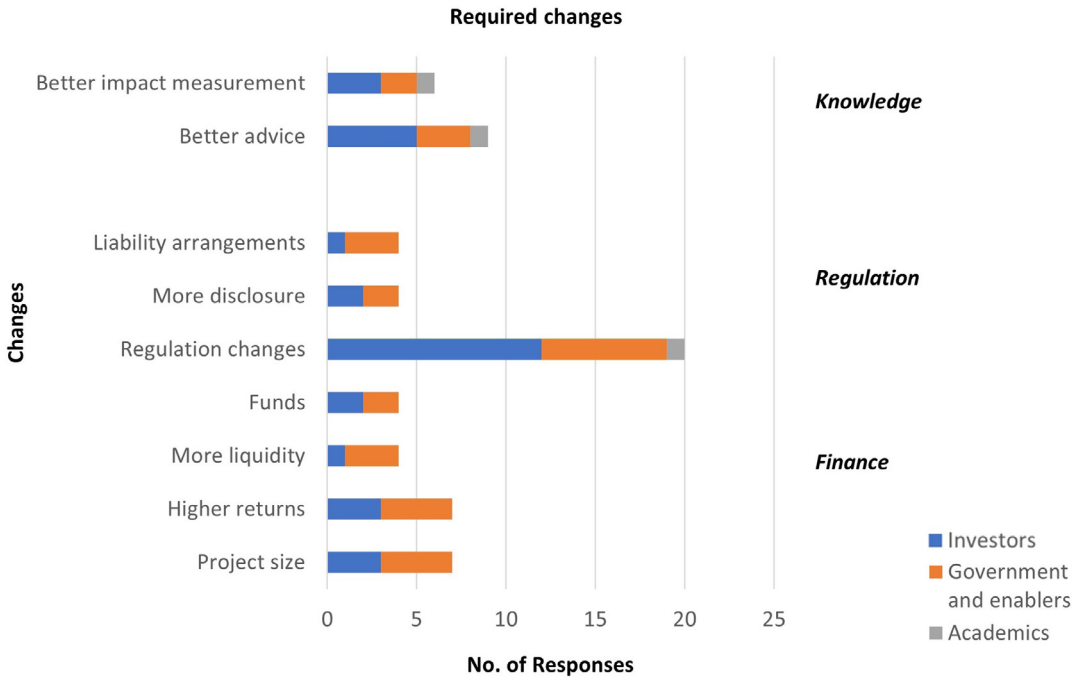
Figure 3: Barriers to adaptation investment in London (Interviews and workshop)



What needs to change?

Governments, investors, and academics listed prominent aspects needed to change to enable adaptation investment. These include better impact measurement, more knowledge, commercialisation of adaptation projects (financial returns, project size, more liquidity, financial incentivisation) as well as liability arrangements, climate disclosure, and embedding climate risk.

Figure 4: Required changes to climate adaptation investment in London (Interviews and workshop)



6. Conclusions

Cities are highly vulnerable to climate change. Without massive investments in adaptation, cities, their economies, infrastructure, and people are highly vulnerable to climate-induced extreme events, which will be very costly to all. Especially in a city such as London without a well-developed, funded, and financed urban adaptation program, impacts and economic consequences could be much higher than anticipated, and markets can play a role to help to avert a looming disaster.

Among the key findings are:

- London and the UK need to **clarify the adaptation financing gap**, which is the difference between the total cost of adaptation measures and the amount currently being spent from public sources. While the Greater London Authority lacks cost estimates, the UK's Climate Change Committee suggests £10 billion yearly for climate readiness across the UK (Rising et al., 2023). This figure represents a conservative estimate of the potential funding needed to bridge the adaptation financing gap.
- The **lack of clear articulation of adaptation needs and a sense of urgency** hinders the mobilization of funding. Data on adaptation finance needs and predicted damage costs is limited and varies depending on the source and methodology employed. This urgent need for more comprehensive and reliable data underscores the immediate action required in climate adaptation financing in London. Tracking and accounting for adaptation investments is complex due to problems defining and agreeing on what adaptation is.
- **Governance issues**. The **policy and financing ecosystem in greater London is fragmented**, with multiple layers of policies and funding sources that need to be more effectively aggregated. While planning and strategic initiatives have been present longer, financing initiatives have only started to emerge more recently. Additionally, **aggregating funding for climate adaptation, including pluvial and fluvial flooding, is challenging**.
- **Barriers to investment**. A lack of transparency on the city's climate adaptation needs, a lack of knowledge of what constitutes climate adaptation, the public good nature of investments, and the lack of investment opportunities have been found to be the most important factors causing investors of all types to postpone or delay investment activity. Other key factors include a stable climate policy and adaptation policy framework.
- **London lags behind other cities in its adaptation financing efforts**. The three cities studied, namely Singapore, Copenhagen and London, face many climate change impacts, notably sea level rise, flooding, heat waves, and drought. These cities have implemented innovative adaptation financing strategies, which could serve as valuable lessons for London.
- **Singapore has an ambitious urban adaptation approach** that is widely considered a model among capital cities elsewhere. Yet there is still significant **deficiencies in terms of knowledge and partnerships** between the public and private sectors in terms of climate adaptation.
- **Singapore offers best practices for using AI and data analytics for climate transition and new instruments for insurers to cover the protection gap**. The protection gap refers to the difference between the economic losses caused by a disaster and the amount covered by insurance. In the context of climate adaptation, insurers face challenges in accurately assessing and pricing climate risks, which can lead to underinsurance and increased financial vulnerability.
- Despite being the green finance hub of the UK and Europe, **London's adaptation financing** approach is predominantly **based on public finance** (particularly the Environment Agency and London municipalities) and has more work to do to include private capital partners in financing adaptation infrastructure.
- **The role of the private sector has yet to be defined**, and there is a lack of investor networks for adaptation. Public networks like the GFI and CGFI still need to focus on adaptation, although this is slowly changing, reflecting their recent establishment.
- Among significant actors, the research shows that financing adaptation projects in London is limited to a small number of investors, predominantly banks, water companies, and pooled local authority pension funds.
- Investors are undertaking **climate-proofing measures for infrastructure and property**, such as retrofitting office buildings with energy-efficient systems, installing flood barriers, and diversifying their investment portfolios to include more climate-resilient assets.

Glossary

Adaptation financing gap	The difference between adaptation funding being made available and actual adaptation requirements (Buhr, 2022). The United Nations Environment Programme publishes an annual report on the status of this gap. For 2023, please find it here.
Climate proofing	Climate proofing refers to a process that integrates climate change mitigation and adaptation measures into the development of infrastructure projects (European Commission, 2021)
Protection gap	The difference between the amount of insurance that is economically beneficial and the amount of coverage actually purchased (The Geneva Association, n.d.)
Pluvial flooding	Pluvial flooding refers to flooding events that are caused by extreme rainfall. Such floods occur when the ground cannot absorb rainwater effectively or urban drainage systems are overwhelmed by excessive water flow (Zurich Insurance, 2023).
Fluvial flooding	A fluvial, or river flood, occurs when the water level in a river, lake or stream rises and overflows onto the neighboring land. The water level rise of the river could be due to excessive rain or snowmelt (Zurich Insurance, 2023).

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Annex 1: Reviewed UK Adaptation Planning and Green/ Climate Finance Literature and Policy Documentation

Extended list of all policy and financing initiatives

Organisation	Name of financing or policy initiative	Start Year	End Year
UK Committee on Climate Change	Climate Change Act	2008	2050
DEFRA	Natural Choice: Securing the Value of Nature	2011	2100
Greater London Authority	Managing risks and increasing resilience: The Mayor's climate adaptation strategy	2011	2050
DEFRA	Biodiversity 2020: A strategy for England's wildlife and ecosystem services	2011	2020
UK Committee on Climate Change	UK Climate Change Risk Assessment 2012	2012	2017
UK Power Networks	Business Plan, Annex 8, Climate Change Adaptation	2015	2023
Greater London Authority	London Sustainable Drainage Action Plan	2015	2040
Environment Agency	Thames Estuary 2100 Plan (Planned budget £1.2bn)	2015	2100
Thames Water	Thames Water Progress in planning for climate change	2016	2016
UK Committee on Climate Change	UK Climate Change Risk Assessment 2017	2017	2023
DEFRA	A Green Future: Our 25 Year Plan to Improve the Environment	2018	2043
Greater London Authority	London Environment Strategy	2018	
Greater London Authority	The Draft New London Plan	2019	2041
UK Government &City of London Corporation	Green Finance Institute founded	2019	
London Resilience Partnership	London Resilience Partnership Strategy 3.0	2020	2100
Thames Water	Corporate Plan	2020	2025
Greater London Authority	London Resilience Strategy 2020	2020	2050
UK DMO	£2.1 bn Green Guilt - Investment into flood and coastal erosion risk management	2020	2032
HM Treasury	National Infrastructure Strategy 2020 (Planned budget £100 billion, incl. projects from broadband to road networks)	2020	2023
University of Oxford	UK Centre for Greening Finance & Investment founded	2021	
Greater London Authority	London Plan 2021	2021	2046
Environment Agency & DEFRA	£5.2 billion Capital Flood Risk Programme	2021	2027
Environment Agency & DEFRA	£200M Flood and Coastal Resilience Innovation Fund & Programme, £8M for adaptation pathway plans including TE2100	2021	2027
Central government	£1.063bn Flood and coastal erosion protection of homes in England	2021	
	UK Infrastructure Bank set up	2021	
UK Committee on Climate Change	UK Climate Change Risk Assessment 2022	2022	2027
Thames Water	£3 million Thames Water Surface Water Management Program	2022	
Thames Water + Tideway	£4.3 billion Thames Tideway Green Bond Issuance	2022	2025

UK Treasury	UK Transition Plan Taskforce founded	2022	
Transport for London	Climate Change Adaptation Plan 2023	2023	2030
UK Committee on Climate Change	National Adaptation Programme 2023	2023	2028
HM Government	2023 Green Finance Strategy	2023	2050
DEFRA	Local Nature Recovery Strategies (Planned budget £14 million)	2023	2025
Department for Business & Trade	UK Sustainability Disclosure Requirements published	2023	
DEFRA, UKRI	£15 million research programme	2024	

List of documents (policies, strategies, financing initiatives) analysed

Author	Report	Link
Policy graphic documents		
GLA	The Natural Choice: securing the value of nature	Link
GLA	Managing risks and increasing resilience: The Mayor's climate adaptation strategy	Link
DEFRA	Biodiversity 2020: A strategy for England's wildlife and ecosystem services	Link
UK Committee on Climate Change	UK Climate Change Risk Assessment 2012	Link
UK Power Networks	Business Plan, Annex 8, Climate Change Adaptation	Link
GLA	London Sustainable Drainage Action Plan	Link
DEFRA, Environment Agency	Thames Estuary 2100 Plan	Link
Thames Water	Thames Water Progress in planning for climate change	Link
UK Committee on Climate Change	UK Climate Change Risk Assessment 2017	Link
DEFRA	A Green Future: Our 25 Year Plan to Improve the Environment	Link
GLA	London Environment Strategy	Link
GLA	The Draft New London Plan	Link
London Resilience Partnership	London Resilience Partnership Strategy 3.0	Link
Thames Water	Corporate Plan	Link
GLA	London Resilience Strategy 2020	Link
HM Treasury	National Infrastructure Strategy 2020	Link
UK Committee on Climate Change	UK Climate Change Risk Assessment 2022	Link
Transport for London	Climate Change Adaptation Plan 2023	Link
UK Committee on Climate Change	National Adaptation Programme 2023	Link
HM Government	2023 Green Finance Strategy	Link
Other documents analysed		
GFI, Oxford	Mission Climate Ready	Link
Oxford	Case studies in adaptation finance in the UK	Link
PWA	Barriers to financing adaptation actions in the UK	Link
LSE	What will climate change cost the UK?	Link
CCC	Investment for well-adapted UK	Link
CCC	Progress in adapting to climate change: Report to Parliament 2023	Link
CCC	Independent Assessment of UK Climate Risk (CCRA3)	Link
City of London	City of London: Adaptive Pathways Study	Link
GFI	The Finance Gap for UK Nature	Link
Adaptation Scotland	Climate Adaptation Finance: Insights and Opportunities for Scotland	Link
UNEP	Adaptation Gap Report 2023	Link

Annex 2 - About the Urban Adaptation Financing Research

Methodology

The research was carried out by Stella Whittaker a PhD research fellow at Copenhagen Business School with assistance from researchers at Imperial College Centre for Climate Finance and Investment (CCFI)and Singapore Management University. It was based on a qualitative approach, including an extensive review of the literature and relevant policy documents . Qualitative data was also collected from interviews (n=34) and from a workshop (n=16) held with the interviewees and their associates. This enabled the collection of insights from some of London's leading practitioners and researchers which are presented in Table 3 below.

Table 3: Interviewees (34) and workshop participants (16)

Organisation type	Grouping and interviewee coding	Number of interview participants	Number of workshop participants	Country
State Government (11)	Government & enablers (G)	3	3	UK
GLA	(G)	1	1	UK
Municipality	(G)	3	1	UK
Consultant (Engineering & Finance)	(G)	0	1	UK
Government – Other	(G)	1		UK
NGO/NFP	(G)	3	2	UK & Global
Bank (21)	Investors & enablers (IV)	4	2	UK
Asset Man	(IV)	2		UK
Institutional Investor/Pension Fund	(IV)	3	2	UK
Consultant (Finance)	(IV)	4		UK & Global
Finance – Other	(IV)	8		UK & Global
Academic	Academics (A)	1	4	UK

A literature and policy documentation review of London's and the UK's urban adaptation planning, and green/climate finance was performed. Together the data sets afford an understanding of how adaptation funding and financing is conceptualised in London. The second dataset is from qualitative analysis of semi-structured interviews with the relevant actors (n = 34: government and enablers (n = 11), investors (n = 22), academics (n = 1)). A third dataset is provided by a workshop held with actors who were previously interviewed (n = 16) to deep dive into barriers, enablers, and innovative financing products.

The question format for the 60-minute semi-structured interviews was open-ended (Longhurst 2010), based on an interview guide in accordance with the approach recommended by Guion et al. (2011) for conducting in-depth interviews. Following the script for these interviews, the authors asked interviewees to review pre-prepared lists extracted from the literature on drivers, barriers, and enablers of urban adaptation financing. For the data analysis, ATLAS.ti qualitative analysis software was used to code the data systematically (ATLAS.ti™ Scientific Software Development GmbH). Steps were taken to ensure that all interviewees shared a common understanding of urban adaptation, and all interviewees were selected who had a working knowledge or urban climate change adaptation infrastructure projects. This selection was facilitated through email correspondence that included a pre- circulated interview script and definitions of urban adaptation projects. The semi-structured interviews were allowed to unfold in a conversational manner offering.

Research Results - Drivers/Barriers/Enablers - Additional Tables

Table 4: Main drivers for green/climate finance activity (Interviews and workshop)

Actors	Summary of findings	Interviewee Quotations
Investors	• Performance criteria and outcomes: Reaching a minimum performance of a project in terms of financial return on investment is seen as an important driver for investors, such as number of people relieved from vulnerability due to climate impacts. • Value creation: Investors are motivated by the potential for value creation through urban adaptation projects in the form of return and impact. • Stakeholder consideration: Investors see clients and shareholders as an important driver, with urban adaptation financing driven by fiduciary duty, i.e., the legal requirement to put funds into those investments that generate the highest return for investors • Declaration of policies by local authorities: Action groups and the declaration of climate commitments by local authorities can act as a catalyst for urban adaptation financing activity for local authority pension funds. The alignment of local pension funds with the policies and goals of local councils influences investment decisions in this regard (specific for local authority pension fund).	*"I think the other issue is what you define is adaptation. There's no definite definition of that."* *"And even the definition of what an adaptation type fund is obscure and is looks a lot like either a nature positive or a do no harm principle type fund or an impact fund. So, again, you know, all these words are starting to be ill defined."*
Governments	• Risk reduction and portfolio diversification: Urban adaptation financing is seen as a way to diversify investment portfolios and reduce risks associated with long-term climate impacts, mainly for government officials. • Impact and impact measurement: Government officials see a positive impact on the financial side, nature as well as local communities as an important driver. Additionally, impact measurement, is seen as crucial.	*'It's a way to diversify and to reduce risk across the portfolio if you're thinking about longer term climate risks'.* *'Well, it's not returns. We're not after making money from it. We just don't do it. It's not liability. Really. Impact is the main [driver], [for] shareholders, clients, resident's'.* *'I would say impact is probably the primary one [driver]. Also, value creation and then diversification and risk reduction'.*

Researchers	• Academics recognise all the aspects above (need for a financial return, value creation, fiduciary duty, policy landscape) as important driver for investment into adaptation to accelerate.	*'Focusing just on adaptation I would say at the moment that it is purely about fiduciary duties of companies. Which leads to a little bit of all of those [factors]. Being able to demonstrate that you are doing actions that are in the best interest of the company. So that links into returns, it links into performance, into shareholders and value creation. […] I think that is what is sort of pushing them to think quite short term as well. So, there's not many companies that I've seen that are really thinking seriously about longer term climate change and actually making decisions. So there's a lot of analysis done, but actually, changing their decisions based on that, I've not seen that. I think that that's going to change quite soon'.*

Barriers to urban adaptation finance in London

Table 5: Barriers to adaptation financing in London (Interviews and workshop)

Barrier	Summary of findings	Interviewee Quotations
Returns	For investors and government officials, a crucial barrier is the risk and return profile of adaptation projects, which is considered insufficient, and less attractive than mitigation.	*'There are limited projects with acceptable return profiles […] and a lack of strategic commitment by Governments'.* *'They are perceived as less attractive than perhaps other investments in climate mitigation'.* *'There are limited projects with acceptable return profiles […] and a lack of strategic commitment by Governments'.*

Regulation – Climate policy stability	For investors, the regulatory landscape and lack of a stable climate policy were mentioned as a salient barrier.	*'A clearer policy framework and a regulatory framework that incentivizes this kind of investment. There has to be a clear policy direction in some of these sectors, especially as far as urban mitigation goes. […] because that would set a very clear direction of travel'.* *'Depends on whether regulation strengthens in the UK, certainly everything seems uncertain in government at the moment. If you look at, for example, the new environmental regulations that are due to be coming in and the biodiversity side which has strong links to adaptation - that will push firms to invest more in environmental protection'.*
Knowledge – Specialist advice	The knowledge barriers were strongly cited especially by the government representatives.	*'I'm not so sure that people are against investing. It's just that there's not good enough knowledge to understand across the whole breadth of issues, this is what makes it harder for people to do adaptation'.*

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Table 6: Barriers to adaptation investment in London (Interviews and workshop)

Dominant factors	Actor descriptions of barriers
Regulation/Policy • **Regulatory constraints**	• Regulations (financial & non-financial) disenabling adaptation investment • Lack of a stable climate policy and adaptation policy framework • Lack of processes for adaptation investment • Lack of incentive alignment to encourage investors participation • Lack of transparency on the adaptation need, finance available & the potential adaptation finance gap
Financial Barriers • **Unacceptable risk/return** • **Lack of income generation** • **Lack of suitable financial vehicles/ instruments**	• No or limited identified income/revenue/cash flow streams for adaptation • Adaptation projects do not present an acceptable risk-return profile for investors / Limited projects with acceptable return profiles • Lack of collaboration between private and public actors • Lack of demand side economic policies to incentivise investment in adaptation (e.g., taxes, rebates, quotas) • Lack of investor confidence; lack of adaptation projects, no data, no transaction history & limited disclosure record • Lack of investment-ready bankable adaption projects & project pipeline • Lack of demand and bias towards mitigation projects • Lack of liquidity in the sector • Scale and aggregation – need to demonstrate proof of concept on large projects attracting capital • The system disincentivizes investment in adaptation (administration process, especially insurance) • Adaptation projects perceived as less financially attractive than mitigation projects/investments • Limited financial vehicles and instruments • Lack of adaptation finance leadership – State Bank (BoE) and through leaders in finance sector • Lack of co-investment & use of private/public partnerships
Knowledge & Heuristics • **Lack of knowledge** • **Lack of knowledge of business models** • **Difficulties measuring impacts**	• Unfamiliarity & lack of knowledge of climate change adaptation within the investor community • Expectation that adaptation is a public good and should be funded by the government • Lack of knowledge on the roles of different players and the investment requirements in adaptation projects • Lack of data (finance needed, finance pledged, adaptation metrics, etc.) • Complexity in assessment of climate impacts • Lack of proactive mindset regarding transition to a low carbon and resilient economy • The issue is complex and broad, knowledge not adequate • Learning networks, experimentation, pilots, case studies – green investment network

Source: Interviews and workshops

What needs to change?

Table 7: What London interviewees said need to change (Interviews and workshop)

Barrier	Summary of findings	Interviewee Quotations
Regulatory change	The insights from governments and investors highlights room for substantial improvement in the financial and regulatory landscape of urban adaptation financing. The UK is described as having a strong green investment network with investment firms focusing on environmentally sustainable initiatives. Stronger requirements on infrastructure investment are emphasised, which must meet adaptation-related standards, potentially leading to changes in financial regulations to enable companies to take on longer-term risks associated with climate adaptation, such as new asset classes. The EU Taxonomy and TCFD (Task Force on Climate-related Financial Disclosures) are mentioned as potentially influencing investor behaviour but are not yet driving it. Governments are encouraged to incentivise adaptation-aligned investment through, for example, climate-proofing measures by simplifying the process, introducing regulations, and possibly offering grants through various schemes.	*'And what the government should do is to incentivise investment – on all buildings, more climate proofing, more climate resilience – made easier and more straightforward. More regulation and perhaps some grants as well.'*
Commercialisation of adaptation projects	The development of financial products and revenue streams is seen as crucial by investors for unlocking the market and fostering innovation, potentially requiring government support. Lastly, it is recognized that the magnitude of investment required for addressing climate issues is substantial and cannot be solely covered by public sector funds. Instead, public sector funds play a role in proving concepts, de-risking, producing a bankable project pipeline and making initial investments to attract private sector funds by demonstrating their financial viability.	*'It's not financial regulation, it's broader policy to incentivise companies to make these investments and ensure that there's an adequate return.'* *'The kind of money that is required to tackle the climate issue is really rather large. And that's why I say it's absolutely unthinkable that public sector money can cover the investment needs. The public sector money's got the very specific role of proving the concept, making the first investments so that private sector money can follow because they can see how they can make a financial return out of it.'*
Knowledge	Valuing and measuring adaptation have also been listed as a key area needing change, especially by the investor community. This includes impact measurement of adaptation projects, defining adaptation and resilience metrics to disclose.	*'And then once you've done the unlocking [of finance for adaptation], then we need to deal with how do you get the technical advice? How do you measure the impact?'* *'Adaptation is just a lot more complex to communicate [than mitigation]. In addition to the financial impact of the project, what's the climate impacts?'*