

# International practice on assessing investment needs and securing investment to adapt

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## Executive Summary

### Aims and approach

At a national and international scale the policy environment related to assessing investment needs and securing investment to adapt to climate change is fast moving, cross-cutting and emergent. This project sets out to learn from international attempts at assessing and securing the optimum level of investment in order to keep pace with climate change. With particular emphasis on flood risk management, coastal change and coastal erosion.

Flood risk management in Scotland is risk-based and plan led. Available investment is targeted at areas of greatest risk with consideration given to other factors like social vulnerability. In that context, this report sets-out to explore:

- how international jurisdictions are determining the appropriate level and desired impact of future investment
- how future change is accounted for in decision making
- how an optimal and balanced investment is considered
- how others are funding and planning to invest for the future, and
- lessons and approaches that may be applicable and transferable to Scotland

10 jurisdictions were selected for study to provide a range of different contexts and perspectives. The selected jurisdictions were:

California (USA), Canada, Denmark, Germany, Ireland, Louisiana (USA), New York (USA), Queensland (Australia) and Victoria (Australia)

The findings will support Scotland's response to the climate emergency, and the Scottish Government and partners in delivering the Flood Risk Management (Scotland) Act 2009 and the Second Scottish Climate Change Adaptation Programme (SCCAP).

## Key findings and conclusions

The main conclusion of the study is that **framing is everything**, meaning that how international jurisdictions frame their investment challenges and ambitions directly influences their investment portfolios, levels of investment and concepts of optimal investment. This subsequently influences how choices are made and the types of funding and financing solutions attracted and secured. The framing of investment ambitions is unique to each jurisdiction and is both place and time sensitive.

Scottish practices are commensurate with international peers. Innovation in resilience and adaptation is however fast moving and continued investment, experimentation and learning will be necessary to keep pace with emergent international practice. In framing future investments to keep pace with climate change, Scotland can learn from international practice by exploring:

1. Harmonising mitigation, adaptation and climate investment objectives
2. Strengthening the use of well-being and societal values within investment decision making
3. Enhancing the accessibility of climate science and design guidance
4. Enhancing investment appraisal guidance for flood risk management, coastal change and coastal erosion
5. Capturing and building the evidence base of costs associated with mitigation and adaptation
6. Enhancing the use of 'design-led' and co-design practices
7. Development of Scottish funding and financing guidance
8. Enhancing capacity and skills at the regional and local level
9. Strengthening the framework for action learning

Looking forward, international investment practice will continue to develop at pace, building on existing commitments and international activity described in this report. In the interest of Scottish practice going further and faster, it will be advantageous for Scotland to **formalise international collaboration and learning with respect to investment decision making, and funding and financing practice**. Canada, California and Queensland are good candidates for formal collaboration, particularly in relation to:

- development of guidance for investment appraisal (Action 4), and the securing of funding and finance (Action 7), to strengthen the framing of investment ambitions, and the mainstreaming of multiple sources of funding, and
- the use of 'design-led' and co-design practices (Action 6) to foster creativity and innovation in the development of solutions for flood resilience and coastal adaptation.

This will support future decisions regarding optimal national levels of investment, and help shape climate investment strategies and portfolios that are scalable at local, regional, national and international levels.

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# 1.0 Introduction

## 1.1. Purpose of the report

At a national and international scale the policy environment related to assessing investment needs and securing investment to adapt to climate change is fast moving, cross-cutting and emergent. This project sets out to learn from international attempts at assessing and securing the optimum level of investment in order to keep pace with climate change. With particular emphasis on flood risk management, coastal change and coastal erosion.

Scotland's National Flood Risk Assessment (NFRA) estimates that there are currently 284,000 homes, businesses and services at risk of coastal, river or surface water flooding in Scotland. Climate change will increase flood risk due to rising sea levels and changes in rainfall patterns. However, the amount of climate change Scotland needs to adapt to is uncertain as it will depend on future global emissions and response of the climate system. One projection for a high emissions scenario is that climate change could increase the numbers of properties at risk by 110,000 by the 2080s, alongside 2,000 km of roads, 500km of rail network and 200,000ha of agricultural land. This could be far higher in some high end sea level rise scenarios, or lower if global efforts to reduce emissions increase in pace<sup>1</sup>.

The urgent challenges for policy and investment are reflected in Scotland's response to the climate emergency, which states:

*"An emergency needs a systematic response that is appropriate to the scale of the challenges and not just knee-jerk, piecemeal action. All Cabinet secretaries are looking across a full range of policy areas to identify where we can go further, faster" - (Roseanna Cunningham, Cabinet Secretary for Environment, Climate Change and Land Reform – May 2019).*<sup>2</sup>

Flood risk management in Scotland is risk-based and plan led. Available investment is targeted at areas of greatest risk with consideration given to other factors like social vulnerability. In that context, this report sets-out to explore:

- how international jurisdictions are determining the appropriate level and desired impact of future investment;
- how future change is accounted for in decision making;
- how an optimal and balanced investment is considered;
- how others are funding and planning to invest for the future; and
- how lessons and approaches that may be applicable and transferable to Scotland.

The findings will support Scotland's overall response to the climate emergency, the Scottish Government and partners in delivering the Flood Risk Management (Scotland) Act 2009 and the Second Scottish Climate Change Adaptation Programme (SCCAP) 2019-2024<sup>3</sup>. The SCCAP's in turn supporting the vision: *"We live in a Scotland where*

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<sup>1</sup> <https://www.sepa.org.uk/media/399172/nfra-faq.pdf>

<sup>2</sup> <https://www.gov.scot/publications/global-climate-emergency-scotlands-response-climate-change-secretary-roseanna-cunninghams-statement/>

<sup>3</sup> <https://www.gov.scot/publications/climate-ready-scotland-second-scottish-climate-change-adaptation-programme-2019-2024/pages/6/>

*our built and natural places, supporting infrastructure, economy and societies are climate ready, adaptable and resilient to climate change”.*

## 1.2. Research objective, themes and questions

The primary objective for this research is **to identify learning from international attempts at assessing and securing the optimum level of investment in flood risk management, coastal change and coastal erosion in order to keep pace with climate change.**

The key research themes and secondary research questions are set out in *Table 1* below.

Table 1: Secondary research questions and associated themes

#	Theme	Research question
1	<b>Level of investment</b>	How are organisations and authorities in other jurisdictions determining the appropriate level of future investment?
2	<b>Investment change over time</b>	To what extent do these assessment account for change over time (2030, 2050, 2100)?
2a	<b>Investment in societal change</b>	To what extent do the assessments account for change over time (2030, 2050, 2100) considering wider societal change (for example, socio-economic change and development)?
2b	<b>Investment in climate change</b>	To what extent do the assessments account for change over time (2030, 2050, 2100) taking into account climate change (keeping pace with or getting ahead of)?
2c	<b>Investment in adaptation</b>	To what extent do the assessments account for change over time (2030, 2050, 2100), considering how investment takes account of managed adaptive approaches/adaptation pathways (i.e. ensuring investment is available to support adaptive plans over decades)?
3	<b>Private sector investment</b>	To what extent is private sector investment in adaptation included?
4a	<b>Optimal values of investment</b>	To what extent do the assessments consider how economically optimal values of investment are and how is this balanced with broader societal risks (e.g. standard of protection/thresholds)?
4b	<b>Investment trade-offs and synergies</b>	To what extent do the assessment consider how economically optimal values of investment are, and trade-offs such as environmental quality and food production?
5	<b>Planning to finance</b>	How are the organisations and authorities funding or planning to fund/finance that investment?
6	<b>Transferability to Scottish context</b>	How do these assessment methods and funding mechanisms fit with Scottish legislation, regulations and governance?

### 1.3 Summary of approach

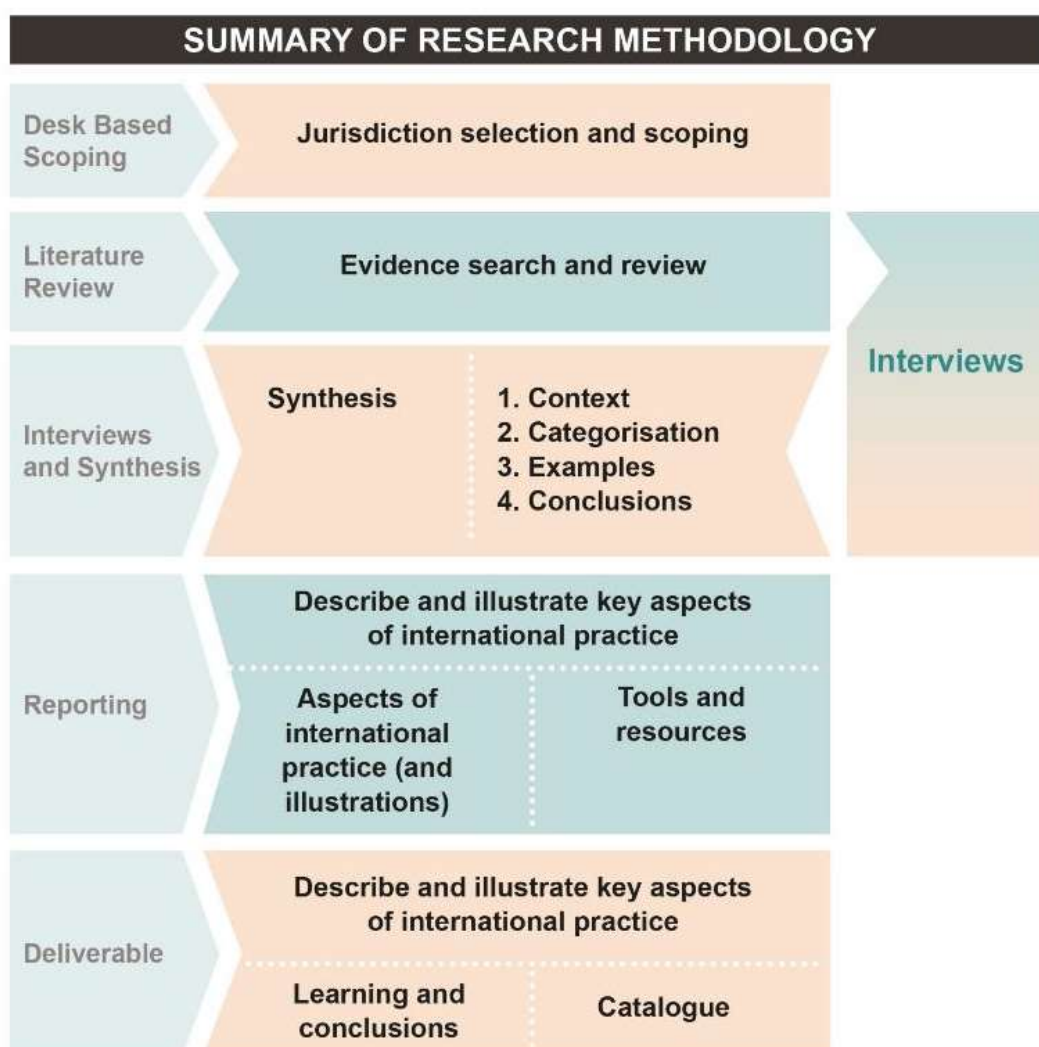
The research was centred around a literature review of international practice. The jurisdictions for study were chosen based on:

- Availability and accessibility of evidence in English
- Activity and research related to the research questions
- Similar physical challenges including coastal risk
- Relevance of governance

The research approach was exploratory in nature in order to capture the variation and breadth in international practice, and identify innovative practices that are potentially applicable and transferable to the Scottish context.

The research approach is summarised in *Figure 1* and discussed in detail in *Appendix A*.

Figure 1: Summary of research methodology





## 1.4 Structure of the report

The core sections of this report, and the associated Investment Catalogue (Appendix B), are structured to reflect the building blocks of international practice and decision-making shown in *Figure 2*.

Figure 2: The building blocks of international practice and decision-making



*Sections 3.0* and *4.0* describe international practices relating to “**shaping investment ambitions and assessing needs**”. *Section 3.0* describes how jurisdictions are defining investment needs and ambitions, and how the level of investment (Research Theme 1) is considered. *Section 4.0* then explores how jurisdictions are accounting for the future, in terms of socio-economic considerations and climate change (Research Themes 2A and 2B).

*Sections 5.0* and *6.0* set-out practices related to “**making choices and securing investment**”. *Section 5.0* explores international practice related to designing a balanced investment and the consideration of optimal (Research Theme 4). *Section 6.0* then examines practices related to planning to invest and deliver. This section addresses the consideration of adaptation, private sector investment and planning to finance (Research Themes 2C, 3 and 5).

Finally, *Section 7.0* summarises the key insights from emerging international practices and explores **the transferability of practices to Scotland** (Research Theme 6). *Section 8.0* then presents the main conclusions of this study.

## 2.0 Setting the scene

### 2.1 The selected jurisdiction

This research draws on insights from 10 jurisdictions that were selected to provide a range of different contexts, such as geographical and climate conditions, whilst maintaining a focus on those jurisdictions that were relevant and informative to the Scottish context in terms of transferability.

An initial long-list of jurisdictions were identified through relationship mapping and knowledge of the research team of international activity in the area of flood and coastal risk investment planning. The following criteria were used to refine the long-list of to a short-list of jurisdictions relevant to the Scottish context with the following criteria:

- Availability and accessibility of evidence in English
- Activity and research related to the research questions
- Similar physical challenges including coastal risk
- Similarity of governance

Jurisdictions were then categorised according to the characteristics below to select the final sample. The selection was finalised to provide diversity across all the characteristics to ensure a range of international practice was explored in the research:

- National vs sub-national governance level for flood and coastal risk management
- Location: northern vs southern hemisphere
- Location: European vs non-European
- Climate: Temperate vs sub-tropical/tropical
- Framing of investment: Allocation of resources vs Capacity of mainstreaming

A high-level check was undertaken before finalising selection to ensure availability and currency of evidence. The selection process is described in more detail in *Appendix A*.

The selection of jurisdictions explored in this report are:

- California, USA
- Canada
- Denmark
- Germany
- Ireland
- Louisiana, USA
- New York, USA
- New Zealand
- Queensland, Australia
- Victoria, Australia

### 2.2 Snapshots of jurisdictional investment activity and ambitions

Setting the scene for this report, the following table provides an indicative snapshot of investment activity and ambitions for each of the jurisdictions explored.

Table 2: Snapshot of jurisdictional investment activity and ambitions

<b>California, USA</b>
Over the last decade the State of California has made significant advance in the framing of investments and financing for flood and coastal change. Most recently this included a proposal for a \$4.75billion Climate Resilience Bond for California. Although this did not make it to the ballot box it is illustrative of the scale of the challenge in California. The 2018 State Adaptation Plan <sup>4</sup> continues to push for innovation on climate adaptation funding and financing.
<b>Canada</b>
Canada has a 12-Year Infrastructure Plan <sup>5</sup> which includes relevant funding streams, such as: a disaster and adaptation fund of \$2billion over 10 years; and specific funding of \$281million over 11 years to support climate adaptation and resilience. Separately the newly established Canadian Investment Bank is proposing to invest \$5billion in green infrastructure projects. Although historically the focus of investments has been on disaster management, there is a shift towards strengthening mitigation and the integration of adaptation investment and low carbon solutions within infrastructure spending. This is supported by an increasing uptake of new and emerging investment tools to pay for infrastructure and leverage private investment.
<b>Denmark</b>
The investment approach being taken in Denmark is to mainstream adaptation into long-term development. An example of this is the 20-year US\$1.4billion master plan <sup>6</sup> for Copenhagen storm water management designed to prevent storm water flooding, and deliver wider socio/economic including urban development and returns such as uplift in property values.
<b>Germany</b>
Coastal investment in Germany remains centred on coast protection and 'hold the line' strategies'. However to enhance funding to cope with the challenges of climate change adaptation an additional investment framework was established for the period 2009-2025 to provide up to €25million per annum of additional federal contributions. <sup>7</sup> Wider flood risk management investments remain reactive, although there are signs of a shift towards a more anticipatory and co-ordinated system due to increasing political and public awareness of flood risk. Funding and incentives remain an issue. <sup>8</sup>
<b>Ireland</b>
As part of the National Development Plan (2018-2027) <sup>9</sup> the Irish government has committed almost €1billion to flood relief measures. The National Flood Risk Policy (2018) includes the objective to protect 95% of properties assessed to be at risk of flooding. Within the National Adaptation Framework, the policy is to invest now to provide flexibility and greater choices later. To support the mainstreaming of adaptation within investment decision the government has worked to ensure there is a clear line of sight between policy and implementation. A sector-specific climate change adaptation plan <sup>10</sup> was established in 2018.

<sup>4</sup> <https://www.adaptationclearinghouse.org/resources/safeguarding-california-plan-2018-update.html>

<sup>5</sup> <https://www.infrastructure.gc.ca/alt-format/pdf/plan/icp-pic/IC-InvestingInCanadaPlan-ENG.pdf>

<sup>6</sup> <https://www.thesourcemagazine.org/copenhagen-unveils-first-city-wide-masterplan-for-cloudburst/>

<sup>7</sup> The law of coastal adaptation, insights from Germany and New Zealand, Linda Schumacher, page 63

<sup>8</sup> <https://www.genevaassociation.org/sites/default/files/flood-risk-management-germany.pdf>

<sup>9</sup> <https://assets.gov.ie/19240/62af938dce404ed68380e268d7e9a5bb.pdf>

<sup>10</sup> <https://www.dccae.gov.ie/en-ie/climate-action/topics/adapting-to-climate-change/national-adaptation-framework/sectoral-adaptation-planning/Pages/Sectoral.aspx>

<b>Louisiana, USA</b>
The Louisiana comprehensive masterplan (2017) <sup>11</sup> for a sustainable coast sets-out proposed investment of US\$19billion for structural protection and \$6billion for non-structural risk reduction. The programme includes 124 projects including marsh creation, sediment diversions and restoration works. The proposed investment aims to reduce expected annual damage by \$8.3billion, and would pay for themselves three times over. Separate plans to flood-proof 1,400 structures, elevate 22,400 structures, and acquisition of 2,400 structures most at risk are also being developed. Funding remains to be secured.
<b>New York, USA</b>
New York is a special case in that it has extensive assets at risk and has experienced a recent severe storm surge (Superstorm Sandy in 2012) that caused damages in the order of US\$ 70billion. Under the leadership of the Mayor, design-led resilience strategies have been developed with a total forecast expenditure of US\$ 20billion <sup>12</sup> . There remains a funding gap of US\$ 4.5billion. This has been the catalyst for the examination and development of new methods and approaches to funding and financing flood and coastal resilience.
<b>New Zealand</b>
The National Disaster Resilience Strategy (2019) <sup>13</sup> , aligned to the Treasury's Living Standards Framework <sup>14</sup> , has taken an approach to put intergenerational wellbeing at its core and is used to drive decision making that is responsive to the well-being of New Zealanders now and in the future. At this time the need for flood risk mitigation has been estimated at more than NZ\$350m per annum for at least the next ten years. There is currently an estimated shortfall of NZ\$174 / annum to meet flood resilience investment needs at the local level <sup>15</sup> .
<b>Queensland, Australia</b>
National Guidance on Prioritisation (2019) <sup>16</sup> sets out a strategic investment shift from 'assets' to 'services and communities'. At a state level, The Queensland Reconstruction Authority (QRA) administers disaster resilience funding programs including: Queensland Resilience and Risk Reduction Fund (QRRRF) <sup>17</sup> . A total of \$13.1 million is available in the 2019-20 round, comprising \$4.8 million from the Commonwealth Government and \$8.3 million from the Queensland Government to support delivery of disaster resilience and risk reduction projects.
<b>Victoria, Australia</b>
A total of AUS\$1.1 trillion is forecast to be invested in critical infrastructure in Victoria by 2050. The draft 30-year Infrastructure Plan <sup>18</sup> incorporates and integrates plans for flood resilience and coastal infrastructure investment. To secure future investment the National Disaster Risk Reduction Framework is encouraging innovation in new financing options, alongside the development of investment tools and guidance on investment mechanism.

<sup>11</sup> <http://coastal.la.gov/wp-content/uploads/2017/01/DRAFT-2017-Coastal-Master-Plan.pdf>

<sup>12</sup> <https://blogs.ei.columbia.edu/2019/04/26/new-york-city-preparing-climate-change/>

<sup>13</sup> <https://www.civildefence.govt.nz/assets/Uploads/publications/National-Disaster-Resilience-Strategy/National-Disaster-Resilience-Strategy-10-April-2019.pdf>

<sup>14</sup> <https://www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/our-living-standards-framework>

<sup>15</sup> <https://www.trc.govt.nz/assets/Documents/Research-reviews/hazards/FloodControlCoInvestment2019.pdf>

<sup>16</sup> <https://www.aidr.org.au/media/6933/05-prioritisation.pdf>

<sup>17</sup> <https://www.qra.qld.gov.au/QRRRF>

<sup>18</sup> <https://www.infrastructurevictoria.com.au/wp-content/uploads/2020/12/Victorias-Draft-30-Year-Infrastructure-Strategy-Volume-1-1.pdf>

## 3.0 Defining the Investment

### 3.1 Framing investment ambitions

This section explores how organisations and authorities in other jurisdictions are determining the appropriate level of future investment; and provides the context for the more detailed consideration of optimal investment in *Section 5.0*. The framing of Scotland’s investment ambitions is explored later in *Section 7.2*.

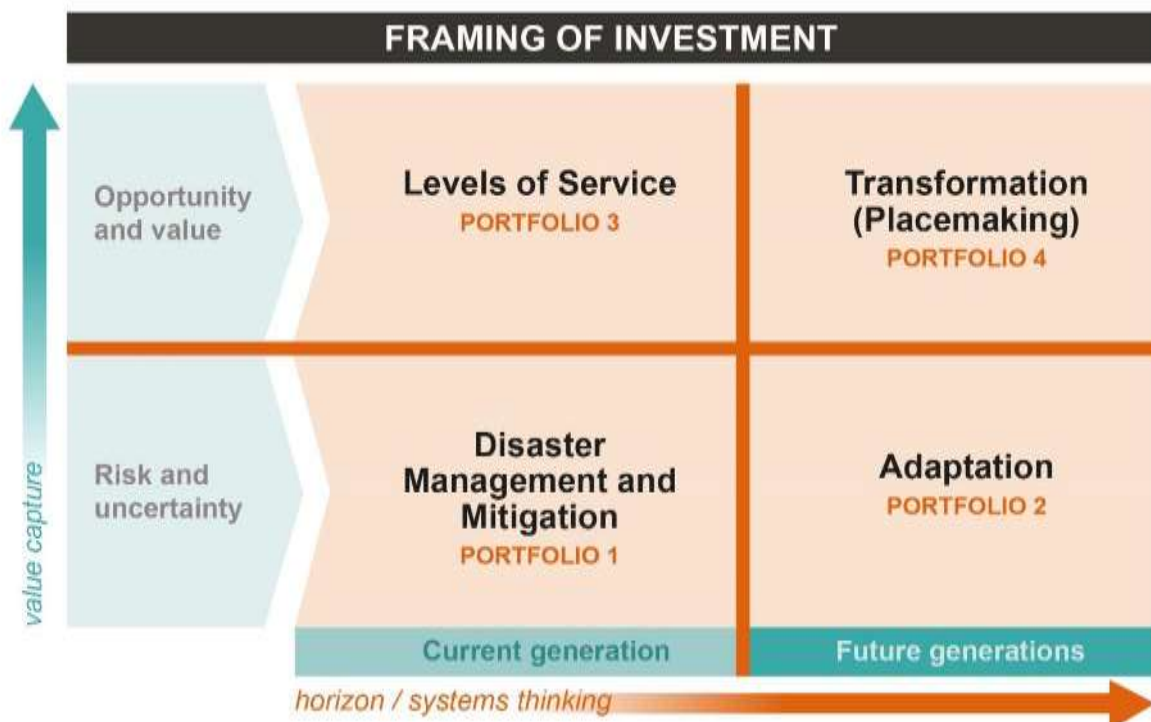
Jurisdictions frame their ambitions quite differently, with significant impact on the shaping of their investment portfolios, the subsequent level of investment and determination of optimal investment. The framing of ambitions is both place-sensitive and time-sensitive, and influenced by wider jurisdictional social, environmental and economic needs.

Two key dimensions that influence the framing of investment ambitions are the balance of investment choices between:

- ‘risk and uncertainty’ and ‘opportunity and value’
- ‘current generations’ and ‘future generations’

These two dimensions lead to four types of investment portfolio illustrated by *Figure 3* and described below. The investment portfolios are not mutually exclusive; however, the focus of individual jurisdictions tend to be weighted towards one or more of the portfolios types during any investment period.

Figure 3: International framing of investment ambition



**Portfolio 1: Disaster management and mitigation.** Within this portfolio investment decisions tend to be driven by the management of risk and uncertainty with a focus on the current generation and immediate needs. Investment tends to be driven by public sector funding with a significant focus on the security of people and property achieved through reactive investment in disaster assistance and upfront investments in mitigation. Asset management is a key aspect of this portfolio. Typical investments include: flood warning and preparedness, recovery assistance and compensation, flood defence, coast protection, and property-level protection.

**Portfolio 2: Adaptation.** Within this portfolio investment decision-making looks more to the long-term and considers the implications on future generations. Although still driven largely by the management of risk and uncertainty, decision making tends to focus on the wider system and place, not just people and property. Investments in this portfolio still tend to be driven by public sector funding but this portfolio presents greater opportunities for co-investment in wider longer-term social and environmental benefits. Investments in the portfolio include: managed realignment, nature-based solutions and system-wide solutions rather than individual assets.

**Portfolio 3: Levels of service.** This portfolio focuses very much on the current generation, but rather than just considering risk, investment decision making tends to consider the wider economic value to society and concepts such as willingness to pay. Investment in this portfolio tend to be more of a blend of public and private finance. Investments in resilient economic infrastructure are a key aspect of this portfolio. Investments include: utilities and infrastructure resilience (transport, ports and water).

**Portfolio 4: Transformation and place-making.** This portfolio is future focused with investment decisions driven by value creation and societal opportunity. Investments in this portfolio tend to be a blend of public and private finance. Like adaptation these investments bring changes to place and unlock social, environmental and economic benefits. Investments in the portfolio include: development, regeneration and green growth.

*Boxes 1-4* illustrate these portfolio types drawing on examples from New Zealand, Victoria, Queensland and Denmark. The

Box 1: Example Portfolio 1 – Disaster management and mitigation ambition<sup>19</sup>

The National Disaster Resilience Strategy for New Zealand describes its core goal as “To strengthen the resilience of the nation by managing risks, being ready to respond to and recover from emergencies, and by enabling, empowering and supporting individuals, organisations, and communities to act for themselves and others, for the safety and wellbeing of all.” This goal is underpinned through three pillars for actions:

1. Managing risks
2. Effective response to and recovery from emergencies
3. Enabling, empowering and supporting community resilience

<sup>19</sup> <https://www.civildefence.govt.nz/assets/Uploads/publications/National-Disaster-Resilience-Strategy/National-Disaster-Resilience-Strategy-10-April-2019.pdf>

Box 2: Example Portfolio 2 – Adaptation ambition<sup>20</sup>

The Victoria Climate Change Adaptation Plan sets out the State's priorities to build a climate-resilient Victoria and provides a framework for adaptation planning across the Victorian Government. The Government's approach is informed by 6 key principles:

1. Informed decision-making
2. Integrated decision-making
3. Risk Management
4. Complementarity
5. Equity
6. Community Engagement.

Pilots and guidance have been developed reflecting the States commitment.

Box 3: Example Portfolio 3: Levels of Service ambition<sup>21</sup>

The Guidance on Strategic Decisions on Climate and Disaster Risk in Queensland describes the ambition as a shift from 'assets' to services and communities, with investment ambitions aspiring towards:

1. Holistic understanding of systemic risk
2. Collective ownership across all sectors to reduce vulnerability
3. Knowledge across time, space and disciplines is harnessed
4. Adaptive learning and low-regret decisions are mainstreamed
5. Market, regulatory and policy incentives align
6. Hyper-connected systems cope, adapt or transform with change

The Guidance acknowledges the need to shift the focus of climate and disaster risk management from a predominately reactive approach to a more proactive approach with an emphasis on reducing the causes and effects of social vulnerability. The ambitions place a greater emphasis on investments that reduce vulnerability and clearly recognise the cross-scale and interconnected nature of these risks. Economic infrastructure resilience and connectivity for a key part of investments.

Box 4: Example Portfolio 4: Transformation (place-making) ambition<sup>22</sup>

The Vejle's Resilience Strategy in Denmark frames the investment ambition as "We transform challenges into new opportunities" and sets-out 4 strategic pillars for investment:

- **A Co-creating City** – We will create tomorrow's resilient city through productive partnerships across public and private sector
- **A Climate Resilient City** – We will use water and climate change as drivers for development of the city
- **A Socially Resilient City** – We will increase social and economic cohesion and create the best conditions for future generations
- **A Smart City** – We will embrace new technologies and improve co-creation, efficiency, outreach and inclusivity.

<sup>20</sup> [https://www.climatechange.vic.gov.au/\\_data/assets/pdf\\_file/0024/60729/Victorias-Climate-Change-Adaptation-Plan-2017-2020.pdf](https://www.climatechange.vic.gov.au/_data/assets/pdf_file/0024/60729/Victorias-Climate-Change-Adaptation-Plan-2017-2020.pdf)

<sup>21</sup> <https://knowledge.aidr.org.au/resources/strategic-disaster-risk-assessment-guidance/>

<sup>22</sup> <https://www.arup.com/perspectives/publications/research/section/vejle-resilience-strategy>

### 3.2 Integration with climate emergency investments

In addition to how jurisdictions are choosing to frame investment ambitions, there is also an emerging alignment between investments in flood and coastal risk management, adaptation and responses to the climate emergency in some jurisdictions. This is in keeping with the 2015 Paris Agreement<sup>23</sup> which calls on signatories to develop long-term low emission strategies (LT-LEDS) and also agreed a global goal for adaptation.

An example of this (*Box 5*) is the Low Carbon Resilience (LCR) approach being adopted in Canada, which seeks to embed low carbon resilience strategies within investment decision making. The Canadian disaster mitigation and adaptation fund is aligned with “The Climate Lens” requirements, and requires that GHG mitigation and climate resilience assessments are carried out as part of business case development.

Likewise similar requirements are emerging through the National Policy on Climate Action and Low-Carbon Development<sup>24</sup> in Ireland. This sets out to integrate climate and adaptation with sector plans, and encourages the addition of a climate lens as a criterion for the success of sectoral policy, strategies and projects.

Box 5: The Low Carbon Resilience approach Canada<sup>25</sup>

“The LCR approach encourages local governments to take advantage of integrated climate action strategies that are often lower in cost and deliver additional benefits. By taking an LCR approach, local governments can streamline limited resources and reduce the vulnerability of communities to climate change events, while also supporting progress toward Canada’s emissions targets and avoiding maladaptation. Additionally, in the Canadian context an LCR approach can bring co-benefits, including reduced competition for resources due to improved project efficiencies, harmonization of implementation objectives between adaptation and mitigation projects, and increased public support for mitigation projects (Hennessey et. al, 2017). Low carbon resilience is gaining recognition at the international level through the United Nations Sustainable Development Goals, the IPCC and the Paris Agreement, among others (ACT, 2016b).

While planning and funding for climate change adaptation and mitigation still largely happens separately in Canada, use of the LCR approach is growing, with federal, provincial, and local governments increasingly recognizing the benefits of integrating the two responses. For instance, exposure to and tools for nature-based and blue-green infrastructure projects, which increase resilience while lowering emissions, are gaining traction (Municipal Natural Assets Initiative (MNAI), 2018). Such opportunities to use the LCR approach are being realized at various scales across the country, holding promise for a greater emphasis on the coordination and/or integration of adaptation and mitigation in investment and procurement decisions.” (Zerbe, 2019)

<sup>23</sup> <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>

<sup>24</sup> <https://www.dcaae.gov.ie/en-ie/climate-action/publications/Documents/5/National%20Climate%20Policy%20Position.pdf>

<sup>25</sup> <https://act-adapt.org/wp-content/uploads/2020/04/ACT-Update-Paying-for-Urban-Infrastructure.pdf>



### 3.3 Level of investment

Jurisdictions were not commonly observed to be determining an absolute level of appropriate investment. This may in part reflect difficulties putting boundaries to the investment which frequently sit in different funding streams, and potentially to the lack of data on the actual costs of mitigation and adaptation. Even within a jurisdiction such as California, that has made advances in framing investment challenges and interventions, it is noted in the Fourth California Climate Assessment that “there [are no] estimates available for California (or any state) for how much money has been spent on adaptation to date and how much more is needed to support local adaptation” (Jesse M. Keenan, 2019).

The recently published UN Environment Programme ‘Adaptation Gap Report 2020’<sup>26</sup>, examines the progress in planning for, financing and implementing adaptation. This report recognises that the level of “international public adaptation finance is slowly rising, however there is insufficient data to identify such as trend in domestic public and private finance flows”. The report concludes that “as adaptation finance and adaptation costs are difficult to compare, all that can be deduced using the available evidence is that, given the pace of climate change and impacts, the adaptation finance gaps is not narrowing as a result of current efforts”. The report also recognises that levels of investment are in part a socio-economic choices, and not just an economic one.

The only identified example of a documented methodology for calculating the appropriate level of investment comes from a 2019 research publication in Canada, “*Investing in Canada’s Future: The Cost of Climate Adaptation*”<sup>27</sup>. This research was a first attempt in Canada “to establish a credible estimate of the investment in municipal infrastructure and local adaptation measures needed to reduce the impacts of climate change in Canada.” The approach taken by the study was to capture adaptation cost studies at the local level and then calculate the adaptation costs as a % of GDP. These estimates were then scaled up regionally and nationally. Key to this methodology was the establishment of an adaptation cost database for Canada including 414 adaptation cost estimates for 34 different locations. A planning horizon of 50-years was adopted for study and a discount rate of 2% was used in the calculations.

The report<sup>28</sup> revealed “an average percentage, weighted by regional variations, across all studies, populations, communities, locations, climate risks and infrastructure types of 0.26% of national GDP or \$5.3 billion annually. This figure represents adaptation investment in local public infrastructure only, that would be cost-shared between the three levels of government.” Furthermore the report identified that flooding ranked number 1 in terms of highest adaptation cost at 1.25% of GDP, and erosion investments ranked third at 0.12% of GDP. The report also grouped the findings against the type of infrastructure grey, green and soft, with investment percentages calculated as 0.75%, 0.05% and 0.03% of GDP respectively.

In Australia, the Queensland Reconstruction Authority has also prioritised the capture of cost information to support the determination of the appropriate level of future investment and enhance the reliability of estimates. This has been achieved through the establishment of the Repeat Events and Dollars Index (REDI) application (Box 6). The

<sup>26</sup> <https://www.unep.org/resources/adaptation-gap-report-2020>

<sup>27</sup> <https://data.fcm.ca/documents/reports/investing-in-canadas-future-the-cost-of-climate-adaptation.pdf>

<sup>28</sup> <https://data.fcm.ca/documents/reports/investing-in-canadas-future-the-cost-of-climate-adaptation.pdf>

application focuses on reconstruction costs related to natural disasters on the road network which are a major component of their investments in flood and coastal risk management. The application draws on \$5.5 billion of reconstruction costs over almost 10 years, across more than 20,000 assets in the 77 local government authorities in Queensland, which equates to about 600,000 damage locations.

Box 6: Repeat Events and Dollars Index application. (Source Queensland Reconstruction Authority)<sup>29</sup>

“Working closely with local government authorities and state agencies, Queensland has improved its ability to effectively collect geo-coded damage data of council and government assets. The Repeat Events and Dollars Index (REDI) application, uses GIS capability to highlight vulnerabilities in Queensland’s transport infrastructure network following disaster events and sharpens the focus on ‘hot spot’ areas where the most frequent and most costly damage occurs. REDI provides a user-friendly, interactive mapping application (or heat map) of a council’s historical reconstruction program, considering both frequency and cost of historical natural disasters on Council’s road network.

In developing REDI state-wide, QRA mapped almost \$5.5 billion of reconstruction costs over almost 10 years, across more than 20,000 assets in the 77 local government authorities in Queensland, which equates to about 600,000 damage locations.

The REDI Application provides an ideal user-friendly platform for Queensland’s councils to review historical damage patterns and reconstruction spending, identify their vulnerabilities, and to plan for future resilience initiatives. The REDI Application can be used to inform mitigation policy and investment, with benefits to be realised by all levels of government.

Each REDI point has the Events, the Dollars, and the combined REDI attached to it. A High value of the REDI can occur where a location has been impacted by many different climate events, or a high dollar value has been requested for its restoration, or a combination of these two criteria.”

## 4.0 Accounting for the future

### 4.1 Communication and application of knowledge

Communication of latest scientific knowledge to validate decision-making is central to the assessment activity and investments taking place within many of the jurisdictions studied. Accessibility to latest science and a close link between climate scientists and government bodies, such as that achieved in New York is a central component of translating science into local plans and investment decisions.

A number of tools and web-based platforms have been identified across the jurisdictions studied that assist with communicating climate change impacts, scenarios and adaptation actions. These aid collective understanding of the implications of scenarios,

<sup>29</sup> <https://www.gra.qld.gov.au/REDI>

and give climate science insight to improve assessment of investment needs and co-development of actions.

Some examples of jurisdictional platforms and information services being developed to communicate scenarios, vulnerability and risk to support local decision-makers in assessing investment needs are described in *Table 2*. Scottish examples are explored in *Section 7.3*.

Table 3: Examples of investments in knowledge sharing and communication of science

Platform	Description
Climate Atlas (Denmark) <sup>30</sup>	A nationwide platform providing municipalities with up-to-date climate data from Danish sources, the IPCC and other international databases. The platform supports Danish Municipalities to make future projections related to precipitation and sea level rise and plan for adaptation.
Climate Atlas of Canada <sup>31</sup>	Launched in 2018, this platform provides an open-access portal for climate projects. The platform was designed to support local, regional and national action to move from risk to resilience.
Climate Explorer (USA) <sup>32</sup>	This platform sits with the US Climate Resilience Toolkit and provides climate projection (including rainfall and tidal information) information for every US State. Projections are provided based on two possible futures: one low and one high emissions scenario.
Cal-Adapt (California) <sup>33</sup>	An open-access platform for the provision of climate change information including precipitation and sea level rise. The platform was established to provide tools, data and resources to support research, the development of adaptation plans and the submission of building applications.
Climate Ireland (Ireland) <sup>34</sup>	Provides a wide range of climate data and projections at a National Level and links to research information relevant to adaptation decision making.

Stakeholder dialogue is also being adopted in some jurisdictions as a communication vehicle for climate science and expressing science in the context of stakeholders' concerns. Ireland's National Dialogue on Climate Action process (*Box 7*) and Vejle (Denmark) co-creation process<sup>35</sup> are examples of engaging people with the challenge of climate change, motivating changes in behaviour; and creating structures at local, regional and national levels to assess future scenarios and support the generation of solutions, and their translation into appropriate cost-effective actions. These examples

<sup>30</sup> <https://en.klimatilpasning.dk/tools/climate-atlas/>

<sup>31</sup> <https://climateatlas.ca>

<sup>32</sup> <https://toolkit.climate.gov/tool/climate-explorer-0>

<sup>33</sup> <https://cal-adapt.org>

<sup>34</sup> <https://www.climateireland.ie/#/>

<sup>35</sup> [https://resilient.vejle.dk/media/4823/vejles\\_resilience\\_strategy\\_webquality\\_160316.pdf](https://resilient.vejle.dk/media/4823/vejles_resilience_strategy_webquality_160316.pdf)

are similar in nature to Scotland's Climate Assembly<sup>36</sup> and citizen assemblies in other parts of the world.

Box 7: National Dialogue (Ireland)<sup>37</sup>

The Programme for a Partnership Government commits to establishing a National Dialogue on Climate Action (NDCA). "It is essential that we put in place a system of community engagement to build public support for action plans that we need to put in place over the coming years and decades. Given the long-term nature of climate action, much still needs to be settled in terms of long-term policy direction and, in this context, a national dialogue is timely and will be a useful tool to engage people with the challenge of climate change; motivate changes in behaviour; and create structures at local, regional and national levels to support the generation of ideas and their translation into appropriate into appropriate cost-effective actions."

## 4.2 Accounting for socio-economic change

The consideration of socio-economic factors and their change over time within investment decision making is a developing area of practice. Socio-economic factors such as development and population changes can be seen to be considered at the project appraisal level. However, this research only identified one example of future socio-economic scenarios being applied for risk-based investment decision making at a jurisdictional level; this was the methodology described in *"Investing in Canada's Future: The Cost of Climate Adaptation"*<sup>38</sup>. Instead, the emerging evidence leans towards the creation of aspirational socio-economic values – 'what changes are required for society to become more resilient and where, when and how we start making change'. This approach seeks to deliver future multiple benefits through investment decisions rather than starting from a risk-based assessment of how society will change in the future.

This aspirational approach is reflected in recent guidance in Australia which aims to take a 'whole-society approach' through combining assessments of societal vulnerability, scenarios and prioritisation of investment<sup>39,40</sup>. Assessing vulnerability aims to understand what changes are required for society to become more resilient to disaster and where, when and how to start making change. This takes a vision-based approach to risk-based scenarios. The process starts by understanding how the choices which underpin current ways of living make communities vulnerable to disaster. The process then seeks to establish intervention options, and alternative choices, to sustain communities in the future (see Box 8).

<sup>36</sup> <https://www.climateassembly.scot/how-it-works/what-citizens-assembly>

<sup>37</sup> <https://www.dccae.gov.ie/en-ie/climate-action/topics/national-dialogue-on-climate-action/Pages/default.aspx>

<sup>38</sup> <https://data.fcm.ca/documents/reports/investing-in-canadas-future-the-cost-of-climate-adaptation.pdf>

<sup>39</sup> <https://www.aidr.org.au/media/6931/03-vulnerability.pdf>

<sup>40</sup> <https://i2insights.org/2017/06/20/values-rules-knowledge-and-transformation/>

Box 8: Guidance on Vulnerability (Australia)<sup>41, 42</sup>

The vulnerability guidance sets-out an approach to embedding vulnerability within investment decision-making taking account of an understanding of systemic disaster risk and values, choices and trade-offs. The approach to embedding societal aspects in decision making that includes: deconstructing disaster workshops, value analysis, systems thinking, Value-Rules-Knowledge (vrk) and learning into the future.

The New Zealand Government meanwhile has developed a ‘Living Standards Framework’<sup>43</sup> based on four capitals of social, human, natural and financial/physical capital aiming to incorporate wellbeing into decision making. The focus is on achieving higher living standards and intergenerational wellbeing. The framework is incorporated within the National Disaster Resilience Strategy embedding well-being evidence systematically throughout policy decision making and investment decisions. Decision-making is supported by the Treasury’s CBAX Tool (*Box 9*).

Box 9: CBAX Tool (New Zealand)<sup>44</sup>

The CBAX was first released by the New Zealand Treasury department in 2015, and then updated in 2019. The CBAX tool is a spreadsheet model designed to provide a consistent approach across government to cost benefit analysis. The tool aims to take a long-term and broad view of societal impacts, costs and benefits. The tool accommodates subjective well-being values within decision making and provides guidance for applying these values.

### 4.3 Accounting for a changing climate

As discussed in *Section 4.1*, through the development of web-based platforms and information services jurisdictions are making use of climate science to support local decision makers in assessing investment needs. The next challenge for decision makers is to relate these assessments and scenarios to the design of investments in resilience and adaptation. Of the ten jurisdictions studied, three have particularly well structured and documented approaches to accounting for a changing climate at the local level, namely: New York, California and Queensland.

In New York City (NYC), the NYC Panel on Climate Change (NPCC) provide sea level rise projections on the latest scientific basis for the City which are reflected in supporting policy and guidance such as the City’s Climate Resiliency Design Guidelines. These are tailored projections to ensure the latest science is fed into New York’s flood risk investment plans in a consistent manner keeping up with latest scientific evidence.

New York’s approach includes the use of high end and unlikely, but plausible scenarios (i.e. high ++ scenarios) in planning and decision-making. Within the Design Guidelines this is reflected by the inclusion of a low probability, high consequence Antarctic Rapid Ice Melt (ARIM) scenario, which gives a maximum rise of nearly 3 meters by 2100.

<sup>41</sup> <https://www.aidr.org.au/media/6931/03-vulnerability.pdf>

<sup>42</sup> <https://i2insights.org/2017/06/20/values-rules-knowledge-and-transformation/>

<sup>43</sup> <https://www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/our-living-standards-framework>

<sup>44</sup> <https://www.treasury.govt.nz/information-and-services/state-sector-leadership/investment-management/plan-investment-choices/cost-benefit-analysis-including-public-sector-discount-rates/treasurys-cbax-tool>

New York’s use of climate science is also integrated within their overall adaptation governance structure (Figure 5) which facilitates a strong relationship between science and policy makers.

Figure 5: New York City governance structure for connecting science and policy makers (adapted from The NYC Climate Resiliency Design Guidelines)



A similar approach to scenarios is taken in California where The State of California Sea Level rise guidance combines a probabilistic approach with high scenarios (high ++ which have no probability assessment) to cover the full range of possible sea level rise to 2150. Recommended projections for use in low, medium-high and extreme risk aversion decisions are outlined in 10-year epochs, as illustrated in *Table 4*. This ensures that decision makers are aware of the full envelope of possible change.

Such scenarios mean that planning takes place in consideration of full possible change. As a result, even though investments may be made in an adaptive context with usually a lower initial assumed climate change scenario, there is an understanding of the full implications of possible future impacts which may involve the need for transformational change.

Table 4: An illustration of the recommended scenarios for sea-Level rise in San Francisco (adapted from State of California Sea Level Rise Guidance)

Emission scenarios		Likely Range	1-in-200 Chance	H++ Scenario (single scenario)
		66% probability sea-level rise is between...	0.6% probability sea-level rise meets or exceeds...	
		Low Risk Aversion	Medium-High Risk Aversion	Extreme Risk Aversion
Recommended figures (in feet) shown in italics				
High Emissions	2030	0.3 to <i>0.5</i>	<i>0.8</i>	<i>1.0</i>
	2040	0.5 to <i>1.1</i>	<i>1.3</i>	<i>1.8</i>
	2050	0.6 to <i>1.1</i>	<i>1.9</i>	<i>2.7</i>

Then table recommendations includes:

Low emissions	Recommended figures provided every decade (2060 to 2150)
High emissions	Recommended figures provided every decade (2060 to 2150)

For example:

Low emissions	2100	1.0 to <i>2.4</i>	<i>5.7</i>	<i>10.2</i>
High emissions		1.6 to <i>3.4</i>	<i>6.9</i>	

Given the current high level of climate uncertainty, anticipatory decisions based on highly uncertain situations and over reliance on a single climate change scenario can lead to maladaptation or over/under investment. This is acknowledged in the Copenhagen Climate Adaptation Plan<sup>45</sup>:

*“The IPCC’s projections for the development of the climate are relatively certain for the next 30 to 40 years, but after this period there is great uncertainty on how the climate will develop. It is therefore pointless to plan in the very long term according to a particular scenario for future development in the climate. The planning has to reflect the uncertainties of the projections.”*

In Australia, this uncertainty is recognised through taking a ‘low-regrets’ approach in their national strategic climate and disaster risk assessment. This approach uses scenarios to explore highly uncertain futures and explore the potential implications of high-stakes strategic and operational decisions (Box 10). It acknowledges that multiple distinct futures are possible and there is no way of foretelling which future could come about with the emphasis on developing aspirational futures (visions) and selecting options that perform satisfactorily across a variety of possible futures (as opposed to options that perform best under the central or expected scenario) or create benefits no matter what the future.

Box 10: Scenarios Guidance (Australia)<sup>46</sup>

This Guidance document sets-out how to develop and apply different kinds of scenarios for different purposes. It explains how scenarios can be used to explore the potential implications of highly uncertain changes in hazards, exposure or vulnerability under a changing climate. It aims to help the navigation of high-stakes strategic and operational decisions. It emphasises the importance of using scenarios to develop aspirational futures or visions that inform goals and decision criteria to guide collective and adaptive actions. The Guidance on Scenarios acknowledges that multiple distinct futures are possible, and there is no way of foretelling which future could come about. Therefore, it emphasises how important scenarios are for enabling robust, low-regrets decisions in the context of such uncertainty.

<sup>45</sup> [https://en.klimatilpasning.dk/media/568851/copenhagen\\_adaption\\_plan.pdf](https://en.klimatilpasning.dk/media/568851/copenhagen_adaption_plan.pdf)

<sup>46</sup> <https://www.aidr.org.au/media/6932/04-scenarios.pdf>

## 5.0 Designing a balanced investment

### 5.1 Optimal values of investment

It was expected this research would find examples of international methods for assessing the 'economically optimum level of investment' at a jurisdictional level. However, from the 10 jurisdictions explored no such jurisdictional level methods or assessments were identified; although the *"Investing in Canada's Future: The Cost of Climate Adaptation"*, described in Section 3.3, does provide a method for quantifying future investment need as a %GDP.

Instead the research found that international practice takes a more portfolio-based approach to optimal investment that considers aspects such as risk sharing, incentives, efficiency and effectiveness. The optimum return on investment is then assessed at the local and project scale. This finding reflects the place-sensitive nature of emerging investment practices.

Direct comparison of the concept of optimal between jurisdictions is therefore not straightforward; however, if optimal is explored in terms of 'designing a balanced investment', then a number of informative themes and considerations can be observed from the patchwork of international practice.

Table 5: Designing a balanced investment – jurisdictional considerations

Theme	Key questions and considerations	Balance to be determined
Return on Investment	Is the return on investment to be driven by 'value at risk' and/or 'value potential'?	Risk management v Value creation
Performance	Is the investment best achieved through compliance or outcomes?	Standards v Levels of service
Timing of the investment	When is the optimum time to make the investment?	Now v Future
Risk appetite	What is the optimal level of risk and experimentation?	Compliance v Innovation
Governance	Which level of government and/or organisation is best placed to efficiently and effectively realise the investment?	National v Local
Risk sharing	How is the investment risk (and costs), and associated incentives, best shared?	Public v Private
Business case complexity	Recognising resource capacities and capabilities what is the optimum complexity of business case to support decision making?	Simple v Complex
Legitimacy	How is legitimate decision-making best achieved?	Consultation v Co-creation



These themes and considerations shape the multitude of international investment tools and frameworks sign-posted in the Investment Catalogue (*Appendix B*).

## 5.2 Making investment choices

Part B of the investment catalogue (*Appendix B*) sets out tools and frameworks that are being used internationally to shape investments and support optimal choices and investment prioritisation. Many of these tools and frameworks reflect recent changes in international practice, driven by attempts to:

- unlock greater value from investment decisions by enhancing wider socio-economic and environmental outcomes
- increase decision making capacities and resources related to planning and investment appraisal, and
- support the securing of additional sources of funding and financing.

Socio-economic and cultural aspects are included in many of the tools and frameworks used with the intention of achieving social equity within decision making. *Boxes 11 – 14* provide examples.

Box 11: Living Standards Framework (New Zealand) <sup>47</sup>

The Framework considers the range of impacts that a policy or option may have on the material and non-material factors that affect New Zealanders wellbeing now and, in the future. It is based on:

- 12 domains of current wellbeing outcomes
- Four capital stocks (natural, social, human and financial)
- Risk and resilience

It conceives of wellbeing as being comprised of a number of aspects of life experience (the 12 domains of wellbeing), such as cultural identity, environment, income, jobs, time use, social connections and housing. This Framework complements rather than replaces other analytical frameworks, aiming to promote higher living standards and greater intergenerational wellbeing now and in the future.

Box 12: SPARCC Capital Screen Tool (California) <sup>48</sup>

This is a multi-institutional initiative known as SPARCC (Strong, Prosperous and Resilience Communities Challenge). The underlying set of resources provides evaluation criteria and methodologies (e.g., weighted MCA) for a variety of asset classes ranging from housing to commercial facilities and from infrastructure to green space. The screening criteria consider racial equity, health and climate change.

<sup>47</sup> <https://www.treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/our-living-standards-framework>

<sup>48</sup> <https://www.sparcchub.org/2018/03/20/a-new-tool-for-rethinking-community-investment-the-sparcc-capital-screen/>

Box 13: PLASK (SPLASH) – A dialogue and calculation tool for climate adaptation, Denmark <sup>49</sup>

This freely available excel-based tool was designed by the Danish Environment Protection Agency to support investment collaboration between local authorities and utility companies. The tool encourages dialogue and knowledge sharing and compares up to 3 different climate-adaption solutions. Solutions are compared against:

- Socio-economic benefits – does it pay to adapt to climate change?
- Cost allocation – who should pay?
- What value does the project provide?

Box 14: Multi-Criteria Analysis – National Catchment-based Flood Risk Assessment and Management (CFRAM) Programme, Ireland. <sup>50</sup>

The option selection and prioritisation process for this national programme includes Multi-Criteria Analysis to take account of wider socio-economic considerations within the investment decision. Social indicators include:

- Minimise risk to human health and life of residents
- Minimise risk to high vulnerability properties
- Minimise risk to social infrastructure and amenity
- Minimise risk to local employment

In jurisdictions where the investment ambitions align with ‘levels of service’ and ‘transformation/place-making’ there is also an increasing focus on value-capture and benefits, alongside the management of risk and costs. *Boxes 15 and 16* provides examples from New York and Australia.

Box 15: Climate Resiliency Design Guideline– Benefits Capture (New York) <sup>51</sup>

The benefits analysis process for sea level rise (including coastal storm surge) and increased precipitation in New York allows for the capture of benefits associated with: avoided stress and anxiety, avoided lost productivity, environmental open space, Combined Sewer Overflow reduction, ecosystem services, real estate and quality of life/health benefits.

A guiding principle of the approach taken in New York is to balance assessment simplicity with accuracy. “For projects with construction costs below \$50 million, the project team is recommended to perform a qualitative benefits assessment on the interventions that meet the Guidelines’ recommendations for all applicable climate hazards. For projects with construction costs over \$50 million, or projects that are highly complex and critical, the project design team is recommended to perform an in-depth quantitative benefit calculation to identify the optimal interventions that meet Guidelines’ recommended design criteria.”

<sup>49</sup> <https://en.klimatilpasning.dk/tools/plask/>

<sup>50</sup> [https://s3-eu-west-](https://s3-eu-west-1.amazonaws.com/docs.floodinfo.opw/floodinfo_docs/CFRAM_Technical_Supporting_Documents/TMN_for_Option_Appraisal_and_MCA_Rev_B_160714.pdf)

[1.amazonaws.com/docs.floodinfo.opw/floodinfo\\_docs/CFRAM\\_Technical\\_Supporting\\_Documents/TMN\\_for\\_Option\\_Appraisal\\_and\\_MCA\\_Rev\\_B\\_160714.pdf](https://s3-eu-west-1.amazonaws.com/docs.floodinfo.opw/floodinfo_docs/CFRAM_Technical_Supporting_Documents/TMN_for_Option_Appraisal_and_MCA_Rev_B_160714.pdf)

<sup>51</sup> [https://www1.nyc.gov/assets/orr/pdf/NYC\\_Climate\\_Resiliency\\_Design\\_Guidelines\\_v3-0.pdf](https://www1.nyc.gov/assets/orr/pdf/NYC_Climate_Resiliency_Design_Guidelines_v3-0.pdf)

Box 16: Guidance on Prioritisation– Value Capture (Australia) <sup>52, 53</sup>

The comprehensive prioritisation guidance released in 2019 is designed to work standalone or integrated with other national guidance related to governance, vulnerability and scenarios. The Prioritisation Framework:

- allows users to evaluate interventions ('options and pathways') based on how much they reduce vulnerability ('value at risk') and the economic net benefits created ('value potential');
- is scenario-based. Users calibrate the framework to explore various possible combinations of future hazards, exposure, vulnerability and intervention options. They can apply different assumptions about changes in climate, population and socio-economic development; and
- provides a rapid assessment process for value creation and capture.”

Aspects influencing the prioritisation of climate and disaster risk reduction include:

- asset restoration
- socio-economic disruption
- environment and heritage disruption
- service performance
- economic uplift, and
- community resilience

The guidance indicates that a Net-Benefits approach is the preferred instrument for cost-benefit analysis and cites the 9-step process in Boardman’s CBA publication “as the single best source of doing this correctly”.

Aligned with the climate emergency, several of the jurisdictions also include a Greenhouse Gas (GHG) / carbon consideration within decision making. This includes factors such as carbon reduction, natural capital and nature-based solutions. *Boxes 17 to 19* provide examples from Canada, California and Ireland.

Box 17: Canadian Disaster Mitigation and Adaptation Fund (DMAF) Application Guide<sup>54</sup>

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<sup>52</sup> <https://knowledge.aidr.org.au/media/7712/05-prioritisation-guidance-strategic-decisions-climate-disaster-risk-2020.pdf>

<sup>53</sup> Boardman, A., David Greenberg, Aidan Vining and David Weimer, (2018), Cost-Benefit Analysis: Concepts and Practice, 5th Edition, Cambridge: Cambridge University Press

<sup>54</sup> [https://www.infrastructure.gc.ca/dmaf-faac/dmaf-guide-faac-eng.html?pedisable=true#Annex\\_B\\_EOI\\_Guidance](https://www.infrastructure.gc.ca/dmaf-faac/dmaf-guide-faac-eng.html?pedisable=true#Annex_B_EOI_Guidance)

This comprehensive guide sets-out the application process and requirements for funding. The application includes requirements for:

- Climate Lens resilience assessment compatible with ISO 3100 on Risk Management;
- The requirement to report on Community Employment Benefits for specific vulnerable populations; and
- Cost sharing.

To be considered eligible investments must reduce socio-economic, environmental and cultural impacts. The DMAF awards merit to projects that result in a Return on Investment higher than 2:1. Expressions of Interest submitted to the DMAF for funding, are also shared with the newly formed Canadian Infrastructure Bank (CIB) to determine whether the project can benefit from CIB support.

Box 18: Planning and Investing for a Resilient California <sup>55, 56</sup>

This guidebook for state agencies sets-out principles for embedding climate resilience and is designed to inform planning and investment processes to address the two primary elements of resilience – planning for future conditions and doing planning itself differently. The guidance document sets-out principles to support planning and investment decision making including:

- Prioritising actions that promote integrated climate action including GHG reduction and carbon sequestration;
- Prioritising actions that promote equity and foster community resilience;
- Prioritising actions that utilise nature and green infrastructure solutions and enhance nature resources. (The US Army Corps developed An Atlas for Engineering with Nature in 2018 which details and illustrates this concept with international practice).

The investment decision and prioritisation process give emphasis to the use of full life-cycle cost accounting, the evaluation of co-benefits and the use of an equity checklist.

Box 19: Flood Risk Management Climate Change Sectoral Adaptation Plan (Ireland) <sup>57, 58, 59</sup>

Prepared under the National Adaption Framework (NAF), Ireland established in 2019 a Sector Adaption Plan for flood risk management which sets-out objectives for an effective and sustainable approach to flood risk management for the future, and promotes co-ordination with other sectors.

The NAF sits within the context of the wider decision-making framework of the National Development Plan (2018-2027). This includes a Climate Action Fund of €500million (2018-2027) supporting innovation and capacity building towards the development of climate change solutions capable of being scaled and delivering benefits beyond a one-off impact.

<sup>55</sup> [https://opr.ca.gov/docs/20180313-Building\\_a\\_Resilient\\_CA.pdf](https://opr.ca.gov/docs/20180313-Building_a_Resilient_CA.pdf)

<sup>56</sup> <https://ewn.el.erdc.dren.mil/atlas.html>

<sup>57</sup> [https://www.dccae.gov.ie/documents/Flood\\_Risk\\_Management-Climate\\_Adaptation%20Plan.pdf](https://www.dccae.gov.ie/documents/Flood_Risk_Management-Climate_Adaptation%20Plan.pdf)

<sup>58</sup> <https://assets.gov.ie/19240/62af938dce404ed68380e268d7e9a5bb.pdf>

<sup>59</sup> <https://www.dccae.gov.ie/en-ie/climate-action/topics/climate-action-fund/Pages/default.aspx>

New practices and tools for prioritising and optimising investments are continuing to be developed in many of the jurisdictions. A key aspect of the Australian National Disaster Risk Framework (*Box 20*) is to develop disaster risk reduction investment tools to provide practice guidance on investment mechanisms, improve investment literacy and improve decision making. In Victoria the CRC for Water Sensitive Cities is also developing new investment tools for Cost Benefit Analysis and Value Capture (*Box 21*). Whilst in Queensland (*Box 22*) a new economic framework (currently unpublished) with associated tools are being developed to support increased investment.

Box 20: National Disaster Risk Framework (Australia) <sup>60</sup>

Priority 3 of the Framework (aligned with Sendai Framework Priority 3) is to enhance investment and where possible design investments to maximise broader outcomes including increased productivity, improved connectivity, and social inclusion. Strategy B of this priority (2019-2023) is to develop disaster risk reduction investment tools and to provide practical guidance on investment mechanisms. The intent is to improve investment literacy and capability to ensure potential investment opportunities are identified and leveraged by decision-makers across government, the private sector and communities.

Box 21: Benefit:Cost Analysis Tool (Victoria) <sup>61</sup>

As part of an evaluation framework, the Comprehensive economic evaluation framework (project-IRP2), the CRC for Water Sensitive Cities has developed tools and resources referred to as the Investment Framework for Economics of Water - Sensitive Cities (INFFEWS). This includes a Benefit: Cost Analysis Tool, a Value Tool, and detailed resources to guide their application and decision making

Box 22: Framework for the economic assessment of flood management projects (Queensland), (Source: Queensland Reconstruction Authority, *Unpublished*)

As part of the implementation actions of the *Brisbane River Strategic Floodplain Management Plan* (SFMP), Queensland Reconstruction Authority, in collaboration with the New South Wales and Victorian Governments, RMIT University and private practices, is developing a *Framework for the economic assessment of flood management projects*. This Framework acknowledges that consistent, comparable and complete economic assessments are a tool to support Australia's move towards increased investment in risk mitigation and disaster resilient communities. It will improve the robustness and consistency of economic assessments supporting decision making and investment in flood risk management intervention.

The following principles from the draft Framework should guide all economic assessments being undertaken as part of floodplain management studies, assessment and appraisal:

- Proportionate assessment
- Quantifying as much as possible
- Qualifying everything else
- Focus on the most relevant variables
- Capturing full benefits of options

<sup>60</sup> <https://www.homeaffairs.gov.au/emergency/files/national-disaster-risk-reduction-framework.pdf>

<sup>61</sup> <https://watersensitivetocities.org.au/research/our-research-focus-2016-2021/integrated-research/irp2-wp3/>

One secondary research question was whether or not trade-offs with issues such as food production are considered as part of optimal investment in flood risk management, coastal change and coastal erosion. The research found consideration of food production to be absent from the identified flood and coastal related tools and frameworks.

The evidence indicates that agricultural investments and food production considerations are typically more integrated with water resources and drought related investments.

Examples of this include:

- The Drought and Climate Adaption Programme (DCAP) in Queensland that has committed \$17.5 millions of funding in 2016 to improve the capacity of farmers and regional communities to become more resilient.
- The California Water Plan Update 2018: Managing Water Resources for Sustainability<sup>62</sup>

### 5.3 Investment solutions

Looking beyond the assessment of risks and benefits, the other key consideration that influences the shaping of optimal investment, the securing of funding and finance, and successful adaptation to climate change is the nature of the investment solutions. This is important not only from an investment performance perspective and suitability to place; but also because different solutions, and/or component of a solution, can attract or are best suited to different types of funding and finance.

A commonly used classification for solutions is Grey, Green and Soft Infrastructure, the report 'Investing in Canada's Future' defines these as three type of adaptation:

Box 23: Three Types of Adaptation <sup>63</sup>

**GREY:** Human-made physical infrastructure (e.g. dikes, sea walls)  
**GREEN:** Protecting, strengthening and light modifications to physical natural systems (e.g. wetlands, forest turnover rate, soil nutrition)  
**SOFT:** Legal, socio-cultural, political and financial management policies and systems that enable adaption.

Further commonly adopted terminology for describing investments in flood and coastal resilience are adopted in the recently published UK National Infrastructure Report 'Anticipate, React, Recover: Resilient Infrastructure Systems'<sup>64</sup> which includes six investment classifications: Anticipate, Resist, Absorb, Recover, Adapt and Transform. In terms of international flood and coastal risk management and adaptation we have classified these investments as set-out in *Table 6*.

As jurisdictions shift investments from Portfolio 1 to Portfolio's 2-4 (*figure 3*) the range of solutions (described in *Table 6*) are seen in the diverse investment choices and portfolios being developed to deliver optimal investment.

<sup>62</sup> <https://mavensnotebook.com/2018/12/26/california-water-plan-update-2018-managing-water-resources-for-sustainability/>

<sup>63</sup> <http://assets.ibr.ca/Documents/Disaster/The-Cost-of-Climate-Adaptation-infographic-EN.pdf>

<sup>64</sup> <https://nic.org.uk/app/uploads/Anticipate-React-Recover-28-May-2020.pdf>

Table 6: Investment Solutions for Flood and Coastal Resilience

Investment Category	Description	Examples
Anticipate	Investments designed to support preparedness in advance of shocks and stresses.	Public education and awareness Data collection and planning Soft Infrastructure (including regulation)
Resist	Investments undertaken to physically protect people, property, infrastructure and the environment.	Grey and Green Infrastructure Flood defence, Property Level Resilience, Coastal/natural resource protection, Nature Based Solutions Asset Management
Absorb	Investments design to accommodate and lessen impacts.	Flood warning and monitoring Incident response and emergency services, Evacuation
Recover	Investments designed to quickly restore expected levels of service following an event.	Community Support Programme Insurance Rebuilding and restoration
Adapt	Investments design to enable a place to continue delivering services in the face of changes.	Managed realignment and managed retreat, Moving and raising property Infrastructure systems Build back better
Transform	Investments to deliver enhanced economic, social and environmental benefits.	Place-making and development

In New York the prioritised portfolio of investments is tracked and monitored using a mitigations action database<sup>65</sup>. The current \$28bn programme of hazard mitigation, initiated in 2014, includes:

- 74 education and awareness projects
- 212 prevention and policy related projects
- 232 property protection projects
- 37 coastal/natural resources projects
- 164 emergency services projects

<sup>65</sup> <https://nychazardmitigation.com/all-hazards/mitigation/>

## 6.0 Planning to invest and deliver

### 6.1 Future funding and financing

Across the board, none of the jurisdictions explored are yet to mainstream multiple sources of funding and finance within their investment in flood and coastal risk management and adaptation. Jurisdictions such as California, New York and Canada have made great advances in the conceptualisation and the creative framing of finance and investment, but mainstreaming is yet to be achieved. Even in New York, with its strong financial market, the current portfolio of investments are still largely driven by public funds and grants.

That said, jurisdictions are working on their capacity to plan, design and finance their ambitions for flood and coastal risk management and adaptation. *Table 7* provides jurisdictional examples of funding and finance currently being used and explored. The type of jurisdictional investment portfolio, described in *Section 3.1*, has a significant influence on the types of new funding and financing opportunities being explored.

Table 7: Examples of international funding and financing

Source	Description/Example(s)
Insurance	<b>Insurance is a financing mechanism designed to support recovery in the event of climate impacts and extreme events. This source includes parametric insurance where payments are triggered by predefined occurrences/thresholds.</b>
	<b>Example: Catastrophe (Cat) Bonds.</b> The New York Metropolitan Transportation authority (MTA) issued a \$200 million parametric cat bond in 2013 to insure against defined storm surge events. This is said to be a rare use of cat bonds by municipal agencies. The insurance was renewed in 2017 at \$125 million, but with earthquake coverage added. The cat bond pays out the full \$125 million if particular parameters are met, ensuring that the MTA can repair its facilities and remain solvent in the event of a disaster. <sup>66</sup>
Public Sector	<b>Public-sector financing derived from local tax revenues, municipal bonds or central-government funds (such as capital grants/loans), including direct government financing of projects and in some jurisdictions land-value capture strategies.</b>
	Examples include: <b>Municipal Bonds:</b> In 2018, San Francisco approved a \$425 million general obligation bond, supported by an increase in property taxes, in part to finance the retrofitting and reinforcing of the city's 100-year-old Embarcadero seawall. (A similar Bond Programme exists in Miami which allocates nearly \$200 million for climate-related infrastructure and capital improvements in stormwater and flood management. <sup>67</sup> ).
Multi-Public Sector	<b>Multi-Public Sector is the aggregation of multiple sources of public funding to achieve multiple shared outcomes, and in some instances leverage contributions from other sources.</b>

<sup>66</sup>

[https://www.umb.edu/editor\\_uploads/images/centers\\_institutes/sustainable\\_solutions\\_lab/Financing\\_Climate\\_Resilience\\_April\\_2018.pdf](https://www.umb.edu/editor_uploads/images/centers_institutes/sustainable_solutions_lab/Financing_Climate_Resilience_April_2018.pdf)

<sup>67</sup> <https://www.goldmansachs.com/insights/pages/gs-research/taking-the-heat/report.pdf>



Source	Description/Example(s)
	<b>Example:</b> Councils responsible for the Clifton to Tangoio Coastal Strategy in New Zealand are working to develop contributory funding options. In this instance the Councils are exploring sharing of funds, development of a collaborative council-owned entity, and/or a funding agency of sharing holding councils to fund long-term adaptation and share the costs inter and intra-generationally.
Third Sector	<b>Third Sector, not-for-profit and community investments include: Crowd source funding and social impact bonds.</b>
	<b>Example:</b> NatureVest, the conservation-investing unit of the Nature Conservancy, awarded the Environmental Defense Fund (EDF) a Conservation Investment Accelerator Winner. Under this award, EDF will receive a grant and intends to use it to develop an EIB. The EIB will go towards funding a wetland restoration project from the Louisiana Coastal Master Plan. The plan is for the EIB to bring together government, corporate, and non-profit resources to accelerate coastal restoration. <sup>68</sup>
Private	<b>Private-sector financing, including green bonds, commercial bank loans and direct investments from institutional investors, particularly those seeking long-duration assets to offset their long-duration liabilities.</b>
	<b>Example: Climate Resilience Bond.</b> As part of a 5-year Climate Budget of \$12.5 billion, the California State are proposing a \$4.75 billion climate resilience bond (subject to voter approval in November 2020) <sup>69</sup>
Public/Private	<b>Combinations of Public and Private sources of funding and finance.</b>
	<b>The Canadian Infrastructure Bank:</b> In 2017 the Canadian Government established the Canadian Infrastructure Bank (CIB) which uses federal support to attract private sector investment to new revenue generating infrastructure projects in the public interest. \$5billion is projected to be invested in Green Infrastructure projects, including projects related to the mitigation and adaptation to climate change. <sup>70</sup>
User Fees	<b>User fees are payments made by beneficiaries for the use of infrastructure and/or the receipt services arising from infrastructure investments. Willingness to pay is a key aspect of User Fees.</b>
	<b>Examples:</b> In Louisiana user fees in the form of a property tax are being explored to fund property level resilience; and in Melbourne Victoria willingness to pay for ancillary environmental services beyond flood protection has been investigated.
PPP	<b>Public Private Partnerships is a mechanism whereby private sector partners meet the upfront investment cost and deliver the project (often through design, build and operation type contracts). Through performance-based payments the public sector then repays the investment.</b>

<sup>68</sup> <https://thewaterinstitute.org/assets/docs/reports/Finding-the-Means-Investment-and-Adaptation-in-Vulnerable-Communities.pdf>

<sup>69</sup> <http://www.ebudget.ca.gov/2020-21/pdf/BudgetSummary/ClimateResilience.pdf>

<sup>70</sup> <https://www.infrastructure.gc.ca/CIB-BIC/index-eng.html>

Source	Description/Example(s)
	<p><b>Example:</b> The Tweed River entrance sand bypass coast protection project in Queensland, although two decades old, remains innovative in its approach today. The PPP was jointly funded by the local and state governments with finance provided by ANZ bank. A special purpose vehicle (company) was established to deliver the project with performance linked to the volume of sand pumped.<sup>71</sup></p>

For jurisdictions focused on Portfolio 1 ‘Disaster management and mitigation’, future funding and finance tends to be considered in terms of public-sector spending with the optimal investment driven by avoidance of damages over the short to medium-term, and insurance.

In the case of Portfolio 2 ‘Adaptation’, future funding and financing is still dominated by public sector-spending and insurance with a focus on managing risk and uncertainty. However, Portfolio 2 tends to take a longer-term perspective of sustainable investment, with a greater focus on the integration of public investments and consideration of wider vulnerabilities and intergenerational outcomes. Third Sector and philanthropic investments are also seen to play a role in Portfolio 2.

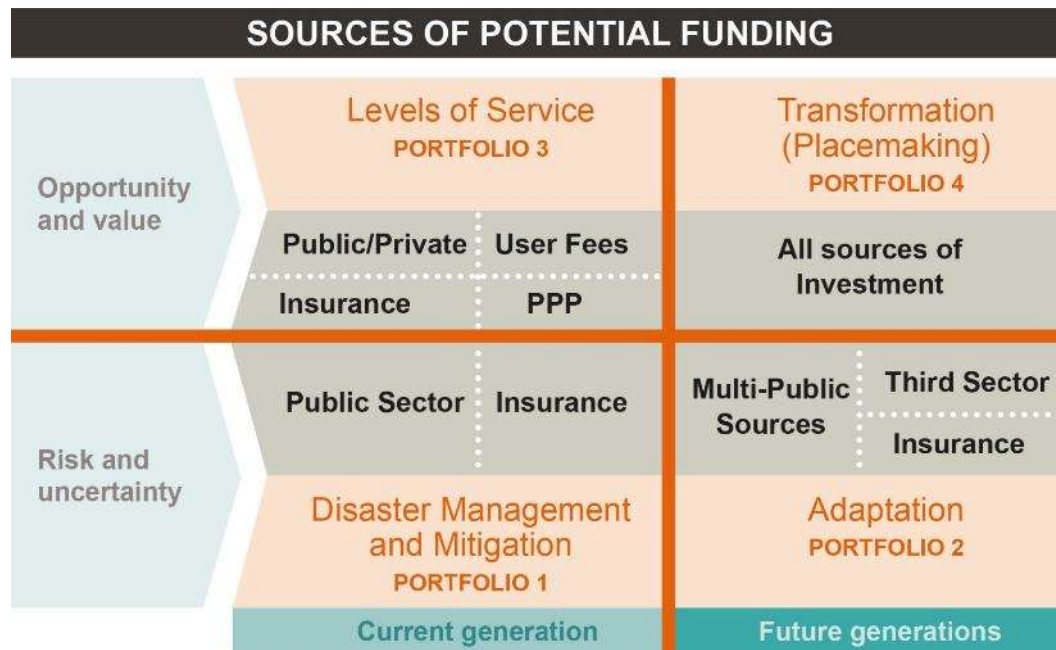
In the case of Portfolio 3 ‘Levels of service’ public investment and the role of insurance remains an essential part of future investments, but the increasing focus on opportunity enables a more blended investment of public and private funding and finance to be explored, alongside opportunities such as ‘user fees’, public-private partnerships (PPP) and private financing initiatives (PFI). Investment Portfolio 3 although more focused on wider economic outcomes than Portfolios 1 and 2 is still focused on the short to medium-term investment returns.

For jurisdictions focused on Portfolio 4 ‘Transformation (place-making)’ all the potential sources of investment are typically being explored. The investment portfolios tends to be more integrated with wider development ambitions and with a focus on longer-term resilience.

*Figure 6* illustrates the potential sources of funding and financing being explored within the four types of investment portfolio outlined in *Section 3.2*. For any given jurisdiction the applicability of any funding strategy will be influenced by the local legal, fiscal, regulatory and procurement norms.

<sup>71</sup> [https://www.nccarf.edu.au/settlements-infrastructure/sites/www.nccarf.edu.au/settlements-infrastructure/files/Funding%20Coastal%20Protection\\_ACCARNSI\\_Discussion\\_Paper\\_1\\_Final.pdf](https://www.nccarf.edu.au/settlements-infrastructure/sites/www.nccarf.edu.au/settlements-infrastructure/files/Funding%20Coastal%20Protection_ACCARNSI_Discussion_Paper_1_Final.pdf)

Figure 6: Sources of potential funding by investment portfolio



This research has also identified several enablers that support securing future funding and financing, these include:

- capacity building and knowledge sharing;
- investment design guidance,
- creative new approaches to the planning of investments such as design-led decision making,
- use of adaptation pathway approaches, and
- monitoring and action learning

Practices relating to these enablers are described in the following sub-sections.

## 6.2 Capacity building

Enabling the generation of plans, solutions and funding requires significant capacity within local government and partners. Although new funding and financing mechanisms are not yet mainstream, jurisdictions are investing significantly in their national, regional and local capacity to assess and secure funding and develop financeable solutions. *Boxes 24 to 29* provide examples of capacity building investments from Ireland, Canada, Queensland, California and New York.

Box 24: Climate Action Regional Offices (CARO's) (Ireland) <sup>72, 73</sup>

The CARO's were established in 2018 with €10 million of funding over 5 years to support the implementation of national climate policy and meet a key action under the National Mitigation Plan and National Adaptation Framework. Four CARO's were established, based on shared climate risks, to support capacity building and knowledge sharing, and drive climate action at the regional and local level in Ireland.

<sup>72</sup> <https://climate-adapt.eea.europa.eu/news-archive/establishment-of-climate-action-regional-offices-in-ireland>

<sup>73</sup> <https://www.climateireland.ie/#!/resources/caros>

Box 25: Building Adaptive and Resilient Communities (BARC) (Canada) <sup>74</sup>

BARC is a national programme run by ICLEI which aims to build the capacity of local government and support multi-stakeholder collaboration. BARC can be tailored to the needs of individual municipalities and provides innovation tools and resources for adaptation.

Box 26: QCoast2100 program (Queensland) <sup>75, 76</sup>

In June 2016 QCOAST<sub>2100</sub> was launched with a funding commitment of \$13 million to support local government capacity building with respect to coastal hazard adaptation planning. The programme is described as an opportunity to *“get on the front foot in adaptation planning to implement cost-effective measures over the medium and long term, plan for development and growth, budget for higher costs, collaborate regionally and seek investment opportunities”*. A major component of the investment was to develop minimum standards and guidelines for coastal hazard adaptation including socio-economic appraisal of adaptation options. These standards were published in 2016.

Box 27: Queensland Resilient Councils Programme <sup>77</sup>

The programme was established in 2016 by the Local Government Association of Queensland (LGAQ) and the Department for Environment and Science (DES) to strengthen decision-making capabilities to plan for and respond to the challenges and opportunities arising from climate change.

Box 28: The Alliance of Regional Collaboratives for Climate Adaptation (ARCCA) (California) <sup>78</sup>

ARCCA was established to build the capacity of local government by sharing best practices and resources, identifying strategies to overcome key barriers and challenges, and conducting joint campaigns and projects. ARCCA is also supporting two research projects that aim to define practical opportunities to overcome financial and institutional barriers to implementing local adaptation strategies as part of California’s Fourth Climate Change Assessment.

Box 29: NYC Mayor’s Office of Resiliency (New York) <sup>79</sup>

The vision of the Mayor’s Office of Resiliency (MOR) is *“to adapt New York City to unprecedented challenge of climate change, creating a more resilient, equitable and vibrant city for the New Yorkers of today and generations to come”*. The core functions include: Science-based analysis, policy and programme development, and capacity building. It creates tools, leads collaboration across sectors and builds capacity to enable public agencies, businesses, community organisations and residents to take climate-smart adaptation measures.

<sup>74</sup> <https://icleicanada.org/barc-program/>

<sup>75</sup> <http://www.qcoast2100.com.au>

<sup>76</sup> <https://www.qcoast2100.com.au/downloads/file/55/minimum-standards-and-guideline>

<sup>77</sup> <https://qcr.lgaq.asn.au>

<sup>78</sup> <http://arccacalifornia.org/about/>

<sup>79</sup> <https://www1.nyc.gov/site/orr/about/about.page>

### 6.3 Investment design guidance

Related to wider commitments to capacity building, several jurisdictions are investing in the development of investment and design guidance to support decision making. This ensures that solution development takes account of funding and financing strategies and options from an early stage.

In Australia, the 'National Disaster Risk Reduction Framework' includes four key priorities, one of which, Priority 3, focuses on actions to enhance investment. The framework prioritises 6 strategies for actions (*Box 30*) which include the development of disaster risk reduction investment tools to provide practical guidance on investment mechanisms. The purpose is to enhance investment literacy and capabilities so that potential investment opportunities can be leveraged collaboratively between government, the private sector and communities. Similar investment is also being explored in New Zealand.

Box 30: Disaster Risk Reduction Framework (Australia) <sup>80</sup>

The Framework includes six strategies for action (2019-2023) to achieve “enhanced investment”, namely:

- Strategy A: Pursue collaborative commercial financing options for disaster risk reduction.
- Strategy B: Develop disaster risk reduction investment tools to provide practical guidance on investment mechanism.
- Strategy C: Leverage existing and future government programmes to fund priority risk reduction measures.
- Strategy D: Identify additional current and future potential funding streams.
- Strategy E: Improve the accessibility, variety and uptake of insurance.
- Strategy F: Empower communities, individuals and small businesses to make informed and sustainable investments.

Both Australia and New Zealand are drawing inspiration from the guidance documents available in Canada and California summarised in *Boxes 31* and *32*.

Box 31: Paying for Urban Infrastructure Adaptation in Canada (Canada) <sup>81</sup>

This guidance document first produced in 2015, and updated in 2019, provides descriptions and examples of the emerging funding and financing mechanisms available in Canada, as well as existing tools that have experienced strengthening use in Canadian communities. The guidance is centred on Urban Infrastructure Adaptation, but the example tools support the potential integration of adaptation and mitigation, and the uptake of low carbon resilience.

<sup>80</sup> <https://www.coag.gov.au/sites/default/files/communique/national-disaster-risk-reduction-framework.pdf>

<sup>81</sup> <https://act-adapt.org/reports/update-paying-for-urban-infrastructure-in-canada/>

Box 32: Climate Adaptation finance and investment (California) <sup>82</sup>

This book serves as a guide for local governments and private enterprises to support climate change adaptation and resilience investment decisions. It provides a guide to identify potential funding sources and a roadmap for asset management and public finance processes. It also highlights practical synergies between funding mechanisms, as well as the conflicts that may arise between varying interests and strategies.

In California the development of guidance has been taken one step further to establish portfolio guidance (Box 33) and project level guidance (Box 34). These documents were developed to support the integration of design and investment decision making.

Box 33: The Finance Guide for Resilient by Design Bay Area Challenge Design Teams (California) <sup>83</sup>

This funding and financing reference guide assists integrated design teams and provides a strategic perspective and descriptive overview of funding and financing options to help orient design ideas towards more feasible and fundable projects from the outset. The guide states that it “focuses on funding sources more than financing mechanisms because the latter is irrelevant without the former”. For resilient infrastructure, too much emphasis has been placed on developing innovative financing mechanisms without regard to how to create new revenue sources to pay back debt holders or equity investors.

Box 34: Fortifying San Francisco’s Great Sea Wall: Strategies for funding the seawall (California) <sup>84</sup>

This project and asset level guidance document is for investigating options and developing solutions. A strength of this document is the use of a ‘funding strategies heat map’ to compare the strengths and weakness of the 38 funding strategies considered in the document.

A final guidance document that draws on the experience of eight USA cities is ‘Playbook 1.0: How Cities are Paying for Climate Resilience’ <sup>85</sup> (Box 35). This document describes emerging attempts and ideas to generate revenue to support the funding and financing of resilience measures. It illustrates the emerging nature and ‘newness’ of the concepts and ideas and ends by highlighting the important question of “*who will actually design, build and manage resilience investments. What institution, or combination of institutions, will build the technical and project management capabilities to undertake these complicated projects and manage the work across multiple affected stakeholders?*”.

<sup>82</sup> [https://opr.ca.gov/docs/20181106-Keenan\\_Climate\\_Adaptation\\_Finance\\_and\\_Investment\\_in\\_California\\_2018.pdf](https://opr.ca.gov/docs/20181106-Keenan_Climate_Adaptation_Finance_and_Investment_in_California_2018.pdf)

<sup>83</sup> <https://www.adaptationclearinghouse.org/resources/finance-guide-for-resilient-by-design-bay-area-challenge-design-teams.html>

<sup>84</sup> <https://onesanfrancisco.org/sites/default/files/inline-files/Seawall%20Finance%20Work%20Group%20Report%20Final%20version.pdf>

<sup>85</sup> <https://static1.squarespace.com/static/5736713fb654f9749a4f13d8/t/5d275d9135b62f0001df44b5/156286094712/Playbook+1.0+How+Cities+Are+Paying+for+Climate+Resilience+July+2019.pdf>

Box 35: Playbook 1.0: How Cities are Paying for Climate Resilience (New York and California) <sup>86</sup>

Building on experiences from eight cities in the USA this play book sets-out eight distinct strategies for deciding who will pay for what and how city governments will generate the needed revenue. The document does not provide definitive answers, but is useful to designers and decision makers in developing ideas and options. The eight strategies explored are:

- Generate local revenue
- Impose land-use costs
- Embed resilience standards into future infrastructure investments
- Leverage development opportunities
- Exploit federal funding niches
- Tap state government
- Develop financial innovations
- Pursue equity and in resilience

## 6.4 Design-led investment

In seeking to learn from attempts other jurisdictions are making in assessing and securing investment it is important to recognise the role of design in decision making and the shaping of investments and benefits. Many developed countries take a strong plan-led approach to investment decision making which seeks at its heart to ensure a balance between development and environmental protection (Box 36).

Box 36: Plan-Led<sup>87</sup>

*Plan-led “means that national and local planning policy is set out in formal development plans which describe what developments should and should not get planning permission, how land should be protected and seeks to ensure a balance between development and environmental protection in the public interest. Decisions on individual planning applications are made on the basis of the policies in these plans, unless there are other considerations that need to be taken into account.”*  
(from UK SPICe Briefing, 2016)

However, what is evident from many of the jurisdictions seeking to enhance the ‘opportunity value’ and value to future generations is that a more ‘design-led’ approach has been key to exploring alternative forms of funding and financing, and enhancing the legitimacy of decision making through co-creation (Box 37).

Box 37: Design-Led.

*“Design is an approach to solving problems and developing innovative solutions that is human-centred, experimental and challenging in nature”.* (Quote C. Bason – CEO Danish Design Centre)

<sup>86</sup>

<https://static1.squarespace.com/static/5736713fb654f9749a4f13d8/t/5d275d9135b62f0001df44b5/1562860947122/Playbook+1.0+How+Cities+Are+Paying+for+Climate+Resilience+July+2019.pdf>

<sup>87</sup> [http://www.parliament.scot/ResearchBriefingsAndFactsheets/S4/SB\\_16-03\\_Comparison\\_of\\_the\\_planning\\_systems\\_in\\_the\\_four\\_UK\\_countries.pdf](http://www.parliament.scot/ResearchBriefingsAndFactsheets/S4/SB_16-03_Comparison_of_the_planning_systems_in_the_four_UK_countries.pdf)

A strength of ‘design-led’ approaches is they tend to incorporate learning from experience, consider vulnerabilities from the perspective of beneficiaries and support resilience. A challenge of a design-led approach to optimisation can be the upfront cost of engagement, and the management of stakeholder expectations in relation to affordability. This was observed with the ‘Rebuild by Design’ (New York) competition and programme which was successful in fostering transformative solutions and mobilising partners. However, as in other cities, closing the funding gap remains a challenge (Box 38).

A further lesson from New York is that “*building business cases is a key part of this process, and complexity within this can make them stronger in the long run and help allocate funding from beneficiaries.*” (Quote from interviewee in New York).

Box 38: Rebuild by Design (New York) <sup>88, 89</sup>

Rebuild by Design began as a design competition, launched by the U.S. Department of Housing and Urban Development (HUD) in partnership with non-profits and the philanthropic sector, in response to Hurricane Sandy’s devastating impact on the eastern U.S. The premise was to raise the bar for response, preparedness, and resilience. Driven by innovation and collaboration, it became a model to help governments create research-based, collaborative processes that prepare communities and regions for future challenges.

The Rebuild by Design Hurricane Sandy Design Competition changed the way the federal government responds to disaster and became the model now used in other regions to prepare communities for future uncertainties. Its success has also inspired other efforts. In 2014, President Obama launched the National Disaster Resilience Competition, which awarded \$1 billion to 13 cities and states across the country to fund resilience-building projects.

One of the benefits of a major investment programme such as Rebuild by Design is the ability to draw lessons from the scale of the experiment. In June 2014 a round table was held to explore lessons in relation to collaboration, governance and restoration. The findings of the round table were published in ‘Policy by Design – Promoting Policy and Practice’. The headline lesson was that “*in addition to design innovation, we will need to develop innovative approaches to policy and governance for long-term resiliency*”.

Three further examples of design-led approaches being used to co-create investment solutions are described in Boxes 39 to 40.

<sup>88</sup> <http://www.rebuildbydesign.org/about>

<sup>89</sup> <https://drive.google.com/file/d/0BwJCwivaYX5oYXo4bIYyYU5ydzg/view>



Box 39: Water Futures (Queensland) <sup>90</sup>

This 'blue-print' for flood resilience and smart water catchment management across the state of Queensland is the result of a design-focused interaction and collaboration and illustrates the value of design-led approaches and design charrettes in developing innovative and practical solutions to adaptation and mitigation. This first of its kind approach in Australia was designed to drive interest and generate momentum towards investment from all levels of Government as well as private industry and local community groups.

Box 40: Resilience through social cohesion through co-creation (Denmark) <sup>91</sup>

The Danish Municipality of Vejle has established a series of City Laboratories to innovate through action learning to identify what optimal outcomes for resilience to climate change are, and how to fund them. Starting conditions assume that social cohesion is an important part of resilience. The Laboratory processes are designed to contribute to the development of social cohesion by directly engaging communities in the co-creation of resilience plans as well as the identification and design of optimal investments.

Box 41: Design-Led design support for regional adaptation (Victoria) <sup>92</sup>

This research project undertook design-led decision making for climate change adaptation in two Victorian communities. The purpose was to develop future design concepts at the landscape scale, in which regions are resilient to the impacts of climate change and are capable of dealing with unforeseen climate events. A key aspect of the research was the use of design-charrettes to address the positively and optimistic framed question: What might a 'climate-proof' future look like? In testing a design-led approach to adaptation, the project provided 6 policy recommendations:

1. Reframe climate adaptation from risks to opportunity
2. Provide an inclusive environment for co-design
3. The key is process and engagement rather than prescriptive solutions
4. Appraisal adds to the value of design-led exercise
5. Adaptation and mitigation efforts should be complementary
6. Ongoing co-ordination and financing is required.

## 6.5 Planning for adaptation

Of the ten jurisdictions explored, three - Queensland, Victoria and New York - show a strong commitment to incorporating adaptation and adaptive pathways into their investment decision making.

In Queensland the government has developed the QCOAST<sub>2100</sub> programme<sup>93</sup> and committed \$12million over three years to support councils to prepare 100-year Coastal Hazard Adaptation Strategies. The programme makes use of adaptive management

<sup>90</sup> [https://issuu.com/jamesdavidsonarchitect/docs/water\\_futures\\_book\\_-\\_digital\\_version](https://issuu.com/jamesdavidsonarchitect/docs/water_futures_book_-_digital_version)

<sup>91</sup> <https://www.arup.com/perspectives/publications/research/section/vejle-resilience-strategy>

<sup>92</sup> [http://www.vcccar.org.au/sites/default/files/publications/Project-report\\_design-led\\_decision\\_support\\_regional\\_climate\\_adaptation.pdf](http://www.vcccar.org.au/sites/default/files/publications/Project-report_design-led_decision_support_regional_climate_adaptation.pdf)

<sup>93</sup> <https://www.qcoast2100.com.au>

approaches and a continuous improvement cycle of coastal adaptation planning. The 6-Step improvement cycle is based on C-CADs: Coastal Climate Adaptation Support process is described below and supported by a web-based platform 'CoastAdapt'.<sup>94</sup>

The 6-Steps of the C-CADs process<sup>95</sup> are:

- Step 1 – Identify challenges
- Step 2 – Assess risks and vulnerabilities
- Step 3 – Identify options
- Step 4 – Evaluate options and prepare a plan
- Step 5 – Take action
- Step 6 – Monitor and evaluate

A similar 8-Step adaptation cycle (*Box 42*) is embedded in New York City's NYC Climate Resilience Design Guideline<sup>96</sup> which recognises the importance of flexibility and transformation in the approach. The methodology in New York adopts three timeframes for the consideration of adaptation; short-term (2020's), medium-term (2050's) and long-term (2080s, 2100 and beyond).

Box 42: New York City Panel on Climate Change (NPCC) Adaptation Framework<sup>97</sup>

NPCC have designed an 8-Step adaption framework to support the identification of explicit decision pathways for short, medium and long-term timeframes. The 8-Steps are:

- Step 1: Identify current and future climate hazards
- Step 2: Conduct inventory of infrastructure and assets
- Step 3: Characterise climate change risks on infrastructure
- Step 4: Develop initial adaptation strategies
- Step 5: Identify opportunities for co-ordination
- Step 6: Link strategies to capital and rehabilitation cycles
- Step 7: Prepare and implement adaptation plans
- Step 8: Monitor and reassess

In Victoria (Australia) Melbourne Water has developed Adaptive Pathway Planning Guidance<sup>98</sup> based on 12-steps to support identification of future investment needs. Melbourne Water's approach draws on international best practice. Their guide describes an applied adaptation pathway as a specific way of developing and graphically presenting choices and decision points to support with the preparation of adaptation plans and investment decision making. The underlying approach focuses on identifying, appraising and sequencing options through a participatory process. The resulting output is referred to as an adaptation pathways map'.

The framework adopted by Melbourne Water is described in *Figure 7* overleaf and is adapted from the nine-step Guide to Using and Developing Pathways developed by the Environment Agency for the TE2100 Plan (Reeder & Ranger, 2011 and Reeder, 2017). This approach is also embedded in the soon to be published BSI standard (*Box 43*).

<sup>94</sup> <https://coastadapt.com.au>

<sup>95</sup> [https://coastadapt.com.au/sites/default/files/infographics/16\\_061\\_CCADSIG\\_04%2020June.pdf](https://coastadapt.com.au/sites/default/files/infographics/16_061_CCADSIG_04%2020June.pdf)

<sup>96</sup> [https://www1.nyc.gov/assets/orr/pdf/NYC\\_Climate\\_Resiliency\\_Design\\_Guidelines\\_v4-0.pdf](https://www1.nyc.gov/assets/orr/pdf/NYC_Climate_Resiliency_Design_Guidelines_v4-0.pdf)

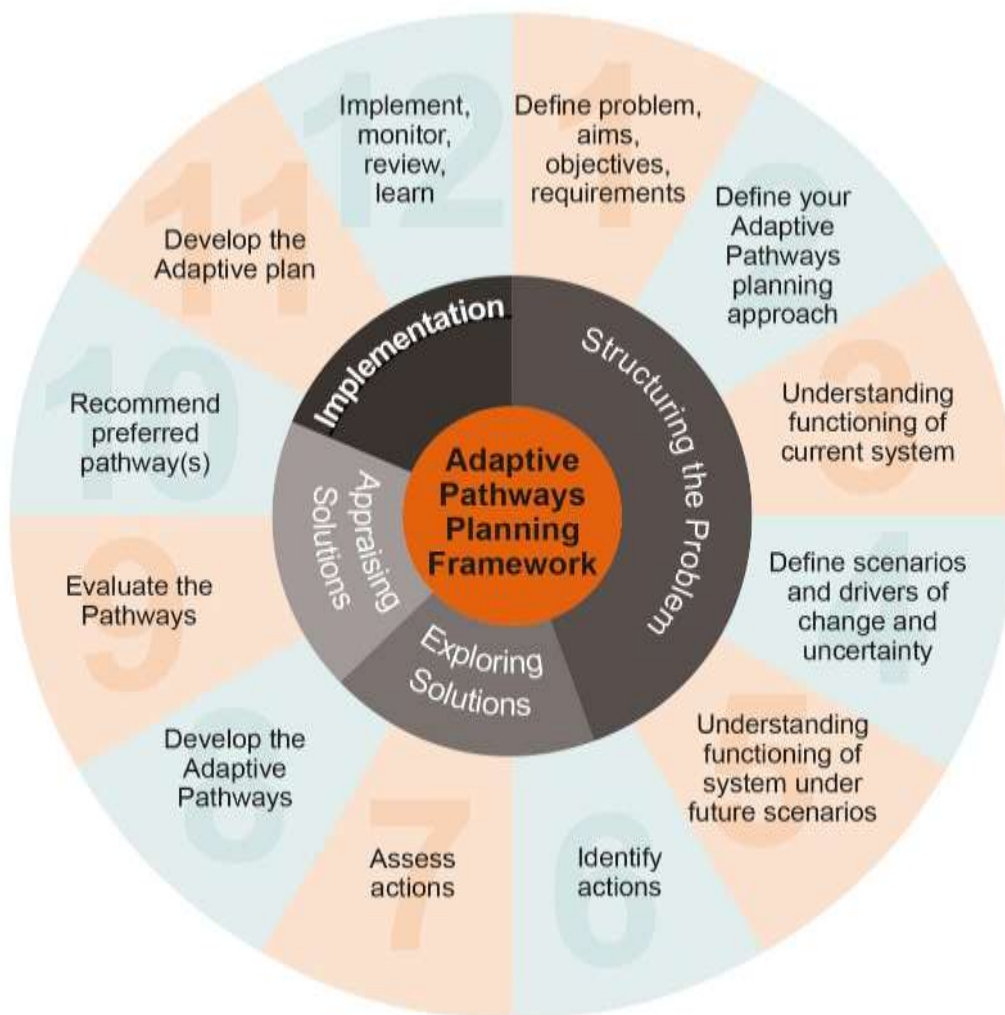
<sup>97</sup> <https://nyaspubs.onlinelibrary.wiley.com/doi/10.1111/nyas.14004>

<sup>98</sup> Melbourne Water, 2018. Melbourne Water Corporation Adaptive Pathway Planning Guidance, May, 1-31

Box 43: BS8631

The British Standards Institution (BSI) is preparing a standard which will provide a generic approach to **Decision Making for Climate Adaptation using Adaptation Pathways** - BS 8631. This will build on recent international standards for adaptation such as ISO 14090. It is intended to lead to a more widespread adoption of adaptation pathways across all sectors. It is based on a nine-step process and has been informed by practice in several of the jurisdictions covered in this report.

Figure 7: Melbourne Water Adaptive Pathways Planning Framework (Source : Melbourne Water)



Other jurisdictions such as New Zealand have emerging practice and guidance (Box 44), but there is limited evidence of proactively identifying long-term investment or funding streams. In fact, in New Zealand there is an indication of deferred decision making for investment in coastal adaptation:

*“A key part of implementation is the financing of adaptation. The types of adjustments that will eventually be necessary are unprecedented and will have significant implications for the ability to pay and what financing methods are used. Because sea-level rise is foreseeable, this gives a window of time to consider whether the current*

*financing instruments will be adequate or whether new ones will be needed to ensure a planned response to the consequences before they appear”*  
(extracted from: *Guidance for Local Government, 2017*<sup>99</sup>)

The challenge, as elsewhere, is the cost of construction and maintenance of schemes to meet future ‘acceptable levels of risk’ is beyond the reasonable capacity of ratepayers and directly affected property owners alone, to provide.

To improve the uptake of adaptation and address funding issues, the Climate Change Adaption Technical Working Group made recommendations to the New Zealand Government in 2018. The recommendations included three core actions and four supporting functions (*Box 45*). One of these core actions is to monitor and report on progress. The supporting functions recommendations include: building capacity and capabilities, and developing funding mechanisms to support action.

Box 44: Preparing for Coastal Change (New Zealand) <sup>100</sup>

The Ministry for Environment published guidance in 2017 for local authorities to prepare for coastal change which includes a 10-Step process grouped around the following five questions:

1. What is happening?
2. What matters most?
3. What can we do about it?
4. How can we implement the strategy?
5. How is it working?

The process is designed to be driven by community engagement and drivers for change (new climate information, signals and triggers, social cultural and economic change).

<sup>99</sup> <https://www.mfe.govt.nz/publications/climate-change/coastal-hazards-and-climate-change-guidance-local-government>

<sup>100</sup> <https://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/coastal-hazards-summary.pdf>

Box 45: Adapting to Climate Change (New Zealand) <sup>101</sup>

The Climate Change Adaptation Technical Working Group published recommendations to Government in 2018. The report recognised that New Zealand is only at the early stages of planning to adapt to the impacts of climate change and recommended foundational actions based on three core actions, and four supporting functions for adaptation to be effective in New Zealand:

**Foundational actions:** these are building blocks that are essential for effective adaptation across all levels of society, the environment, and the economy. Some of these actions need to start now and some will depend on other actions being delivered first. These include:

1. core actions of a:
  - regularly updated national adaptation action plan
  - regularly updated national climate change risk assessment to prioritise actions
  - monitoring and reporting function for assessing the progress of implementing the national adaptation action plan and its effectiveness in addressing changing risks and priorities
2. supporting functions including:
  - strong leadership to direct New Zealand's adaptation action
  - robust and accessible information for decision-making on climate risks and how to adapt
  - building capacity and capability to adapt
  - funding mechanisms to support action.”

## 6.6 Monitoring and action learning

Within the context of planning to invest and deliver, the frameworks being developed and implemented internationally recognise the need to establish decision support systems that can realise integrated actions and investments. To address gaps between emerging policy and today's best practice, jurisdictions are increasingly formalising the monitoring of, and the process of learning from their investments. Examples of this includes the proposed New York Climate Change and Resilience Indicators and Monitoring System (*Box 46*) and the recently adopted Queensland Management Lessons Learnt Framework (*Box 47*). Both of these examples recognise the important role of local communities in monitoring and learning alongside professionals.

<sup>101</sup> <https://www.mfe.govt.nz/sites/default/files/media/Climate%20Change/ccatwg-report-web.pdf>

Box 46: New York City Climate Change Resilience Indicators and Monitoring System<sup>102</sup>

To support the charting and monitoring of adaptive pathways, the New York City Panel on Climate Change is currently (2019) developing a system for monitoring resilience indicators to support planning and decision making. The system is being co-generated by scientist, practitioners and local communities to determine appropriate indicators that can be tracked over time. Four types of indicators are being considered:

- Data collection agencies
- NYC processing centres
- Urban decision makers
- Policies, projects and progress.

Box 47: Lessons Management Framework (Queensland) <sup>103, 104</sup>

As part of Queensland's commitment to embedding disaster resilience within investment decision making and actions, a lessons learnt framework has been developed. Published in 2020 the 'Queensland Disaster Management Lessons Learnt Framework' is designed to drive continuous improvement and knowledge sharing across disaster prevention, preparedness, response and recovery. The Framework consists of six key elements:

- Governance
- Enabling environment
- Engagement
- Learning culture
- Tools
- Lessons management lifecycle

This framework sits within a wide programme of *action learning* being delivered in Queensland and shared in Resilient Queensland in Action (February 2020).

At an asset management investment level the FAIR Framework<sup>105</sup>, piloted in Germany and Denmark on flood defence assets, also recognises the important role of action learning to drive innovation and improve adaptive investment planning. The FAIR project identified that there is often a gap between strategic and operational investment decisions in relation to flood asset management. The project proposes a methodology, the FAIR Framework, to achieve a tactical 'handshake' between strategy and operations to ensure that knowledge about the performance of assets (operation) as part of the overall system, can inform an adaptive asset management plan, and that the strategies planned are effectively embedded in the operational processes. Aside from recognising the importance of learning cycles within investment decision making, the Framework also highlights the important contribution that asset management makes to optimal and effective investment in flood and coastal risk management and adaptation strategies.

Other jurisdictions are also undertaking reviews of their practices to identify lessons and support continuous improvement. Canada undertook such as review of its' National

<sup>102</sup> <https://nyaspubs.onlinelibrary.wiley.com/doi/10.1111/nyas.14008>

<sup>103</sup> <https://www.igem.qld.gov.au/sites/default/files/2020-07/IGEM%20Lessons%20Management%20Framework.pdf>

<sup>104</sup> [https://www.qra.qld.gov.au/sites/default/files/2020-02/0501\\_Resilient%20Queensland%20in%20Action\\_V22\\_LR\\_February2020.pdf](https://www.qra.qld.gov.au/sites/default/files/2020-02/0501_Resilient%20Queensland%20in%20Action_V22_LR_February2020.pdf)

<sup>105</sup> [https://northsearegion.eu/media/13662/fair\\_end\\_report-03-06-2020.pdf](https://northsearegion.eu/media/13662/fair_end_report-03-06-2020.pdf)

Disaster Mitigation Programme' in 2019 (*Box 48*). A key finding of this review was the continued need for a whole-society approach to investment in mitigation.

Box 48: Evaluation of National Disaster Mitigation Programme (Canada)

The National Disaster Mitigation Programme (NDMP) was established in 2015 to reduce the impacts of flood disasters by focusing investments on significant, recurring flood risk and costs and to facilitate private residential insurance for surface water flooding. The NDMP included a Mitigation Contribution Component (MCC) and Target National Capabilities Component (TNCC). A key finding of the review was that a national approach to support flood disaster mitigation measures is needed and future mitigation programmes should consider interplay between hazards to improve communities' resilience. Additionally, the report identified a need for a whole-society approach to implement effective and cost-efficient ways to achieve the objectives of the NDMP and reduce the fiscal burden on local and federal governments in disaster recovery.

## 7.0 Learning from international practice

### 7.1 Lessons from international practice

This project set out to learn from international attempts at assessing and securing the optimum level of investment in order to keep pace with climate change. With particular emphasis on flood risk management, coastal change and coastal erosion. To best capture the patchwork of current and emerging international practice, insights have been categorised and reported in the proceeding chapters against:

Shaping investment ambitions and assessing needs

- defining the investment
- accounting for the future

Making choices and securing investments

- designing a balanced investment
- planning to invest and deliver

The following sub-sections (7.2, 7.3, 7.4 and 7.5) set out the principal findings from the proceeding chapters and explore the learning points in the context of Scotland and wider UK practice. *Section 7.6* then explores the transferability of international lessons, and *Section 7.7* sets-out key building blocks for shaping future investment practice in flood risk management, coastal change and coastal erosion in Scotland.

Specific international tools and frameworks have separately been captured in *Appendix B Investment Catalogue* to support the exploration of new possibilities for shaping future investment ambitions and securing investments.

### 7.2 Defining the investment

In seeking to answer the question of how jurisdictions are determining *the appropriate level and impact of future investment*, the main finding that can be taken from international practice is that **the framing of investment ambitions is unique to each jurisdiction**; and that framing is both place-sensitive and time-sensitive. Consequently, the shaping of investment portfolios, investment level commitments and interpretation of optimal investment are jurisdiction specific.

Scotland's risk based and plan led approach, described in "Implementation of the Flood Risk Management (Scotland) Act 2009: report to the Scottish Parliament - 2019"<sup>106</sup>, aims to achieve 6 outcomes:

1. A reduction in the number of people, homes and property at risk of flooding as a result of public funds being invested in actions that protect the most vulnerable and those areas at greatest risk of flooding;
2. Rural and urban landscapes with space to store water and slow down the progress of floods;
3. Sustainable surface water management that decreases burdens on our sewer systems while also delivering reduced flood risk and improved water environment;

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<sup>106</sup> <https://www.gov.scot/publications/implementation-flood-risk-management-scotland-act-2009-report-scottish-parliament-2019/pages/2/>



4. Coasts and estuaries managed in a way which aims to reduce flooding, respects the changing nature of the coast and takes into account potential impacts of interventions on flooding and erosion in adjacent areas;
5. A well informed public who understands flood risk and takes actions to protect themselves, their property or their business;
6. Flood management actions being undertaken that will stand the test of time and be adaptable to future changes in the climate.

These ambitions align with Portfolio 1 “Disaster management and mitigation”, the focus being on public sector investments (£420m over 10-years) in risk management to protect the most vulnerable and those areas at greatest risk. These ambitions are supported by the “Flood protection appraisals: guidance for SEPA and responsible authorities, 2016”<sup>107</sup> which allows for the inclusion of benefits related to risk to life, human health and social vulnerability within investment decision making.

The “Climate Ready Scotland: Second Scottish Climate Change Adaption Programme 2019-2024” incorporates wider ambitions for place-based outcomes. However, the specific policies and outcomes related to flooding and coastal change are aligned to the management of risk, rather than wider economic value creation. The exception to this being the Scottish Government and Partners commitments under the Blue-Green Cities Programme, which seek to pilot investment in multi-functional green infrastructure to manage flood risk and realise additional benefits.

Central to the Green-Blue Cities Programme is the Climate Ready Clyde “Draft Glasgow City Regional Climate Adaptation Strategy 2020-2030 – Choosing to flourish in our future climate, 2020”<sup>108</sup>. This recently published strategy seeks to integrate flood risk management, adaptation and place-making ambitions; and in doing so leverage adaptation funding and finance through innovation. This strategy reflects the ambition framing of Portfolio 4 Transformation (Placemaking).

Elsewhere in the UK public investment in flood risk management and coastal change currently reflects the ambitions of Portfolio 1. This, however, is beginning to change. In 2020, the Environment Agency published the “National Flood and Coastal Erosion Risk Management Strategy for England, July 2020”<sup>109</sup>. This ambitious strategy takes a long-term view to 2100. The strategy puts greater investment emphasis on adaptation to climate change, sustainable growth and infrastructure, and placemaking. These ambitions reflect Portfolios 2, 3 and 4 respectively.

This change in England is supported by a flood and coastal resilience innovation programme; and funding of £200m over the period 2021-2027 to pilot and explore new ways of working. A core aim of the resilience innovation programme is to establish the evidence for future investment decisions and business case development.

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<sup>107</sup> <https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2016/06/guidance-support-sepa-responsible-authorities/documents/00500974-pdf/00500974-pdf/govscot%3Adocument/00500974.pdf>

<sup>108</sup> <http://climatereadyclyde.org.uk/our-adaptation-strategy-and-action-plan-v2/>

<sup>109</sup> <https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2>

The resilience innovation programme is just one of the commitments in the “Flood and Coastal Erosion Risk Management, Policy Statement, July 2020”<sup>110</sup> which includes other actions to:

- Develop and improve the approach to assessing costs and benefits to target funding for maximum benefit, and
- Develop a national set of indicators to monitor trends over time to better understand the impact of policies.

In Wales, the recently published “National Strategy for Flood and Coastal Erosion Risk Management, 2020”<sup>111</sup> looks to strengthen the stance on prevention and links with new Welsh legislation and other policy areas to ensure problems are not stored up for future generations. This includes links to the “Wellbeing and Future Generations (Wales) Act 2015”<sup>112</sup>. The strategy reflects a strengthening of investments in Portfolio 1 and 2.

In Northern Ireland, again the current investment focus is Portfolio 1. However, the Living with Water Programme recently published “Living with water in Belfast, An Integrated Plan for Drainage and Wastewater Management in Great Belfast, 2020”<sup>113</sup>. This plan looks to both protect Belfast from flooding and support wider enhancements in blue/green infrastructure and economic growth by facilitating new development. This long-term plan reflects ambitions within Portfolios 1, 3 and 4.

These examples demonstrate that investment ambitions in Scotland, and the wider UK, are increasingly looking to exploit ‘opportunity and value’ alongside ‘risk and uncertainty’, and give greater consideration to ‘future generations’ within decision making. They also shows that even within the UK landscape, national and local ambitions are ‘place-sensitive’.

Importantly these ambitions are supported in Scotland by the statutory purpose of SEPA which is described in SEPA’s ‘One Plan Prosperity – Our Regulatory Strategy’<sup>114</sup> as:

*“Protect and improve the environment (environmental success) in ways that, as far as possible, create: health and well-being benefits (social success); and sustainable economic growth (economic success).”*

*SEPA’s draft regulatory flood strategy, to be published in 2021, will also strengthen these ambitions through a focus on four core themes:*

- Future flood risk – improved understanding and communication of future flood risk by Scotland enables action now to adapt to climate change
- Place – we enable the creation of successful and sustainable places
- Communities – we work together with people and communities, particularly in consideration of social equity and justice
- Partnerships – we work with current, and develop new, partners to plan for long term but act now

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[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/903705/flood-coastal-erosion-policy-statement.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/903705/flood-coastal-erosion-policy-statement.pdf)

111 <https://gov.wales/national-strategy-flood-and-coastal-erosion-risk-management-wales>

112 <https://wcva.cymru/influencing/legislation/the-wellbeing-of-future-generations-act/>

113 <https://www.infrastructure-ni.gov.uk/sites/default/files/consultations/infrastructure/living-with-water-in-belfast-consultation-20nov-20.pdf>

114 <https://www.sepa.org.uk/media/219427/one-planet-prosperity-our-regulatory-strategy.pdf>

### 7.3 Accounting for future change

Accounting for future socio-economic change and climate uncertainty are important for optimal investment in flood resilience, coastal change and coastal erosion.

In terms of socio-economic changes, the emerging international approach leans towards the **creation of aspirational socio-economic values** to drive the consideration of multiple-benefits within business case development, rather than a risk or scenario based assessment of how society may change in the future. This aspirational approach aligns with:

- the use of Scotland's National Performance Framework (NPF) to increase consideration of societal and well-being goals within decision making, and
- the links to the UN Sustainability Goals and priorities described in the most recent 'Climate change projections for Scotland'<sup>115</sup>

This aspirational approach is also reflected in the links between the National Strategy for Flood and Coastal Erosion Risk Management in Wales and the Welsh wellbeing and future generations goals.

With respect to accounting for future changes in climate, international jurisdictions are increasingly scaling **web-based platforms and climate (and design) information services** to support risk and opportunity management at the local level. This is fostering the capacity of decision makers to undertake scenario planning and consider managed adaptive approaches at a regional and local level. This type of investment is reflected in the tools and resources platform on the Adaptation Scotland webpages, the ongoing development of the Scottish Dynamic Coast platform<sup>116</sup>, the National Flood Risk Assessment (NFRA) Tool<sup>117</sup>, and the UK Climate Projections User Interface<sup>118</sup>. These investments provide a basis for future expansion of information services to support national and local investment decision making related to future change.

Jurisdictions such as New York, California and Australia have also adopted approaches to **climate scenario planning** that support consideration of a full range of possible changes to climate to enable robust, low-regrets decisions in the context of uncertainty.

Considering the approach taken in England, this research found no jurisdiction level approaches to the consideration of climate change risks and populations growth scenarios that were comparable to the "Long-term investment scenarios (LTIS) 2019"<sup>119</sup>. The LTIS research describes the application of climate change risks (UK Climate Projections 2018) and population growth scenarios to the consideration of optimal future investment (cost and benefits) in managing flooding and coastal erosion.

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<sup>115</sup>

[https://www.adaptationscotland.org.uk/application/files/5716/1114/1258/Climate\\_projections\\_for\\_Scotland\\_summary\\_single\\_page\\_FINAL.pdf](https://www.adaptationscotland.org.uk/application/files/5716/1114/1258/Climate_projections_for_Scotland_summary_single_page_FINAL.pdf)

<sup>116</sup> <http://www.dynamiccoast.com>

<sup>117</sup> <https://www.sepa.org.uk/data-visualisation/nfra2018/>

<sup>118</sup> <https://ukclimateprojections-ui.metoffice.gov.uk/ui/home>

<sup>119</sup> <https://www.gov.uk/government/publications/flood-and-coastal-risk-management-in-england-long-term-investment>

## 7.4 Designing a balanced investment

Optimal investment in any given jurisdiction is a function of the framing of investment ambitions described above and is both **‘place and time sensitive’**. From the jurisdictions explored there are eight commonly occurring themes that are seen to influence business case development and the design of a balanced investment. These are illustrated in *Figure 8* below. These themes are reflected in the multitude of tools and frameworks signposted in the investment catalogue (*Appendix B*).

Figure 8: Commonly occurring themes influencing optimal investment



The most recent of these international tools and frameworks for prioritisation, also reflect an increasing aspiration to shift investment practice from risk management to the wider concept of resilience.

These themes also play out in the UK and Scottish context, and in the drivers behind more place-based investment decision making, an increasing focus on resilience and adaptation, and a diversification of investments across Portfolios 1, 2, 3 and 4.

In Scotland this investment balance and focus on place is reflected in the recently published 'Water-Resilient Places – A policy framework for surface water management and blue-green infrastructure (February 2021)'<sup>120</sup> which includes the following draft vision for water resilient places:

*“Scotland’s blue-green towns and cities are thriving water-resilient places designed to adapt to increased rainfall, river flooding and sea level rise. They attract people, businesses and investors because they are great places to be and because they are resilient to climate change.*

*They provide a wide-ranging economic, social, environmental and well-being benefits to individuals, communities and the nation”*

This vision will inform future decisions regarding the concept of optimal and how the themes and decisions inherent in *Figure 8* are balanced in the future.

<sup>120</sup> <https://www.gov.scot/publications/water-resilient-places-policy-framework-surface-water-management-blue-green-infrastructure/pages/6/>

## 7.5 Planning to invest and deliver

**The securing of multiple sources of public, private and third-sector funding and finance for investment in flood resilience, coastal change and coastal erosion is far from mainstream.** Although jurisdictions such as California, New York and Canada have made great advances in the conceptualisation of funding and financing options, the current portfolio of investments in these jurisdictions and elsewhere is still largely the result of public funds and investment. In this regard Scottish investment practice is not so different from international peers.

What sets apart jurisdictions, such as California, New York and Canada, from Scotland is the current level of commitment to **capacity building and development of investment design guidance.** These commitments are intended to diversify future investment and co-investment options, and strengthen business case practices and design approaches to support funding and financing opportunities. Other jurisdictions, such as Queensland and New Zealand are looking to following the example of California to optimise future investment strategies.

That said, the soon to be published 'Financing Clyde Rebuilt' produced by the partners of Climate Ready Clyde provides an innovative blueprint, that could be scaled to explore funding and financing in the Scottish context. The report includes a typology for adaptation finance that aligns with the 4 portfolios described within this research report and the potential sources of funding and financing explored in *Section 6*. This alignment is described in *Table 8*.

Table 8: Alignment between the 4 Portfolios and the Climate Ready Clyde Finance Typology

Portfolios described in this report	Climate Ready Clyde finance typology		
	Type of Adaptation	Type of Finance	
Portfolio 1 Disaster management and mitigation	Incremental adaptation	Conventional finance	Public sector funds using grants, i.e. business as usual.
Portfolio 2 Adaptation	Transformational adaptation	Conventional finance	Public sector funds for new innovative adaptation or delivering at scale.
Portfolio 3 Levels of service	Incremental adaptation	Transformative finance	New instruments of financing models to scale-up adaptation.
Portfolio 4 Transformation (placemaking)	Transformational adaptation	Transformative finance	New instruments/ financing models for innovative systemic adaptation.

The recent Climate-KIC Australia publication 'Adaptation Finance – Emerging approaches to solve the climate adaptation finance gap'<sup>121</sup> also includes highly relevant lessons for Scotland and investment strategies such as Climate Ready Clyde. The report describes the importance of aligning the understanding of the problem to the project approach; and provides a framing that is comparable to the 4 portfolios described herein. The cross-sectoral group of experts from government, industry, insurance and

<sup>121</sup> [https://climate-kic.org.au/wp-content/uploads/2020/11/Adaptation-Finance\\_300ppi.pdf](https://climate-kic.org.au/wp-content/uploads/2020/11/Adaptation-Finance_300ppi.pdf)

banking made three key recommendations related to assessing and securing finance, and enhancing creativity, namely:

- “Bring together a diverse set of stakeholders who have a shared intent to transform the systems and develop principles to guide the project development phase for both the government and finance sector;
- Partner with challenge owners and adaptation programs that take a systems view;
- Incorporate the systems view to finance practice”.

To support investment creativity and co-creation, jurisdictions such as Denmark and New York are also experimenting with **‘design-led’ approaches** to solution development. The ‘design-led’ approach enhances co-creation with stakeholders and communities, fosters place and value-based decision making and more joined-up use of public and private investments. These characteristics were observed within the ‘Rebuild by Design’ competition in New York with lessons subsequently being applied elsewhere in the USA and internationally.

Design-led approaches have the potential to complement Scotland’s ‘plan-led’ practices and support adaptive management and design innovation. Scotland Place Standard and National Performance Framework reflects a design-led approach to investment decision making that can be used to strengthen investment practice in flood risk management, coastal change and coastal erosion. Design-led thinking is also reflected in the recent Architecture and Design Scotland publication ‘Designing for a Changing Climate: Carbon Conscious Places’<sup>122</sup> and the 8 Principles set out in the document.

With respect to incorporating **adaptation and adaptive pathways** into investment decision making, Queensland, Victoria and New York have shown strong commitments. However, international practice is still emergent and the links with business case development and securing investment are still developing. The forthcoming BS8631 ‘Decision making for climate adaptation using adaptive pathways’ will support greater international use of adaptation pathways and provides Scotland, and other jurisdictions, with an opportunity to strengthen practices based on international lessons.

In England £20m of funding has been allocated (2021-2027) from the flood and coastal resilience innovation programme, for long term planning for climate adaptation in the Thames and Humber estuaries, the Severn Valley and Yorkshire. Learning from this programme has the potential to complement the recent £12m commitment (2021-2026)<sup>123</sup> of the Scottish Government to coastal adaptation. The Welsh Government are also developing further guidance on coastal adaptation by 2022.

With international investment practice developing at pace, jurisdictions are increasingly formalising the monitoring of investments and strengthening of their **‘action-learning’** processes to drive innovation and improve adaptive investment planning. As Scotland explores new investment practices, enhanced ‘action-learning’ is likely to be beneficial in scaling solutions and managing the risks of innovation. Enhanced international collaboration and knowledge sharing is also likely to support future decisions regarding optimal national levels of investment, and help shape climate investment strategies and portfolios that are scalable at local, regional, national and international levels.

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<sup>122</sup> <https://www.ads.org.uk/wp-content/uploads/Carbon-Conscious-Places-Main-Report.pdf>

<sup>123</sup> <https://www.gov.scot/news/gbp-33-billion-investment-in-scotlands-future/>

## 7.6 Transferability of international lessons to Scotland

There is clearly much to learn from international attempts at assessing and securing the optimum level of investment in order to keep pace with climate change. Examining the transferability of international practices to the Scottish context it is important to recognise that what works in one jurisdictional setting may or may not translate to another.

Observable factors that make investment practices ‘place and time sensitive’ include:

- Governance structures and the role of government in supporting communities and business
- The affordability, availability and uptake of flood and disaster insurance
- Local environmental factors such as the magnitude of extremes and vulnerability of people and places to events and coastal change
- The consequences of extreme events and coastal change to economic infrastructure and regional/national connectivity, and risk to life
- Socio-economic and cultural aspects.

Further ‘time-sensitive’ influences on emerging investment practice include:

- whether or not vulnerability to extreme events and coastal change has reached a threshold in terms of political, economic or social acceptability
- competing demands, dependencies and aspirations for the optimal investment of finite public resources.

Taking account of the lessons described in this report, and the ‘place and time sensitive’ nature of investment practice, the starting point for exploring the transferability of international practices to Scotland rests, not in the specific choice of tools and methods, but with which ‘*framing of investment ambitions*’ is optimal for Scotland in the short, medium and long-term.

Drawing on the four investment portfolios described in *Section 3.0* and the emerging international practices set out in this report, the following *Tables 9 to 12* describe potential enabling actions for strengthening Scottish investment practice in flood resilience, coastal change and coastal erosion.

Regardless of which combination and balance of investment portfolios best represents optimal value for Scotland in the future, international practice indicates that harmonising mitigation, adaptation and climate investment objectives is likely to strengthen investment benefits realisation and support co-investment opportunities.

The following tables provide a starting point for exploring future actions and the transferability of international practice in the context of future investment ambitions. Each table references international ‘tools and frameworks for shaping investments’ that are described in the investment catalogue (*Appendix B*).

Table 9: Portfolio 1 - Potential actions to strengthen Scottish investment practice learning from international examples

<b>Portfolio 1: Disaster Management and Mitigation</b> This investment portfolio is driven by the management of risk and uncertainty with a focus the current generation and immediate needs. Investment tends to be driven by public sector funding with a significant focus on the security of people and property achieved through reactive investment in disaster assistance and upfront investments in flood mitigation. Asset management is a key aspect of this portfolio. Typical investments include: flood defence, coast protection, and property-level protection. <b>#assets #property #risk #public</b> <b>Investment ambitions characterised by: Current Generations + Risk and Uncertainty</b>			Applicability					Examples within the Investment Catalogue (Appendix B)	Potential Timeframe	Footnotes
			Investment Category			Investment Level			Short-term (S) Or Medium-Term (M)	
			Delivering flood and coastal resilience	Delivering adaptation	Responding to climate emergency	Portfolio Level	Asset Level			
Ref	Potential enabling action to strength investment practice Portfolio 1	Investment Benefits								
<b>Shaping investment ambitions and assessing needs</b>										
<b>A1: Defining the investment</b>										
1.1	Harmonize mitigation, adaptation and climate investment objectives.	Strengthen benefits realisation and support co-investment.	√	note <sup>124</sup>	√	√	√	A1.1, A1.7, A1.8	S	-
<b>A2: Accounting for change</b>										
1.2	Strengthen the use of societal values/goals within investment framing and business case decisions.	Strengthen benefits realisation and co-investment	√	-	√	√	√	A2.6	S	-
1.3	Enhance knowledge sharing tools to support a shift from risk management to resilience.	Strengthen outcomes and whole-life investment practice.	√	-	√	√	√	A2.1 – A2.5	S	-
<b>Making choices and securing investment</b>										
<b>B1: Designing a balance investment</b>										
1.4	Strengthen investment decision making tools to enhance resilience and take account of social inclusion and social value.	Embed resilience outcomes within business cases and enhance return on investment.	√	-	√	√	√	B1.4, B1.7, B2.14, B2.18	S	-
1.5	Strengthen investment guidance to support carbon reduction and nature based solutions.	Strengthen benefits realisation and co-investment	√	-	√	√	√	A1.1, B2.18	S	-
<b>B2: Planning to invest and deliver</b>										
1.6	Systematically capture and share mitigation costs (capital and revenue) and event damages.	Increased reliability of cost estimates and prioritisation.	√	-	-	√	√	B2.5	S	-
1.7	Strengthen frameworks for 'lessons learnt' to support prevention, preparedness, response, recovery; and links between policy/practice.	Strengthen learning cycle and innovation to accelerate flood resilience investments.	√	-	-	√	√	B2.28, B2.34, B2.35	S	-

<sup>124</sup> Isolated investment in this portfolio does not deliver adaptation. However, mitigation (such as flood defences) can support incremental adaptation



Table 10: Portfolio 2 - Potential actions to strengthen Scottish investment practice learning from international examples

<b>Portfolio 2: Adaptation</b> This investment portfolio takes a long-term view and considers the implications on future generations. Although still driven largely by the management of risk and uncertainty, decision making tends to focus on the wider system and place, not just people and property. Investments in this portfolio tend to be driven by public sector funding, but this portfolio presents greater opportunities for co-investment in wider longer-term social and environmental benefits. Investments in the portfolio include: managed realignment, nature-based solutions and system-wide solutions rather than individual assets. <b>#adaptation #systems #co-investment #risk #public</b>  <b>Investment ambitions characterised by: Future Generations + Risk and Uncertainty</b>			Applicability					Examples within the Investment Catalogue (Appendix B)	Potential Timeframe		Footnotes
			Investment Category			Investment Level			Short-term (S) Or Medium-Term (M)		
			Delivering flood and coastal resilience	Delivering adaptation	Responding to climate emergency	Portfolio Level	Asset Level				
Ref	Potential enabling action to strengthen / shift investment practice towards Portfolio 2	Investment benefits									
<b>Shaping investment ambitions and assessing needs</b>											
<b>A1: Defining the investment</b>											
2.1	Harmonize mitigation, adaptation and climate investment objectives.	Strengthen benefits realisation and co-investment.	√	√	√	√	√	A1.7 - A1.8	S	-	
<b>A2: Accounting for change</b>											
2.2	Strengthen the use of societal values/goals within investment framing and business case decisions.	Strengthen benefits realisation and co-investment.	√	√	√	√	√	A2.6	S	-	
2.3	Enhance knowledge sharing tools to support the use of future scenarios within local decision making.	Strengthen outcomes and whole-life investment practice.	√	√	√	√	√	A2.1 - A2.5	S	-	
2.4	Develop adaptive pathways guidance linked to business case development.	Strengthen uptake of adaptive pathways within investment decisions.	√	√	√	√	√	A2.17, A2.18	S	-	
<b>Making choices and securing investment</b>											
<b>B1: Designing a balance investment</b>											
2.5	Development of an adaptation and mitigation cost database to support reliable cost estimation, forecasting and prioritisation of investments.	Increased reliability of cost estimation and improved decision making.	√	√	-	√	√	B1.3	S	-	
2.6	Enhance cost benefit analysis tools and business case guidance to accommodate a long-term and broad view of societal impacts, costs and benefits.	Enhanced consideration of future generations within investment decisions.	√	√	√	√	√	B1.4	M	-	

<b>B2: Planning to invest and deliver</b>										
2.7	Enhance local authority capacity for adaptation planning and investment decision making.	Enhanced resource capacity, and adaptation and investment skills.	√	√	√	√	√	B2.22 - B2.26	S	-
2.8	Develop adaptation funding and finance guidance related to flood and coastal resilience to support design and business case development.	Drive alignment of objectives and design solutions with funding and finance options.	√	√	-	√	√	B2.1, B2.2, B2.15,	M	-

Table 11: Portfolio 3 - Potential actions to strengthen Scottish investment practice learning from international examples

<b>Portfolio 3: Levels of Service</b>			Applicability					Examples within the Investment Catalogue (Appendix B)	Potential Timeframe		Footnotes
Ref	Potential enabling action to strengthen / shift investment practice towards Portfolio 3	Investment benefits	Investment Category			Investment Level			Short-term (S) Or Medium-Term (M)		
			Delivering flood and coastal resilience	Delivering adaptation	Responding to climate emergency	Portfolio Level	Asset Level				
<p>This investment portfolio focuses on the value to today's generation, but rather than just considering risk, investment decision making includes the wider economic value to society, connectivity and concepts such as willingness to pay. Investment in this portfolio tend to be more of a blend of public and private finance. Investments in resilient economic infrastructure are a key aspect of this portfolio. Investments include: utilities and infrastructure resilience (transport, ports and water). <b>#infrastructure #service #connectivity #value #public #private</b></p> <p><b>Investment ambitions characterised by: Current Generations + Opportunity and Value</b></p>											
<b>Shaping investment ambitions and assessing needs</b>											
<b>A1: Defining the investment</b>											
3.1	Harmonize mitigation, adaptation and climate investment objectives.	Strengthen benefits realisation and co-investment.	√	√	√	√	√	A1.7 - A1.8	S	-	
3.2	Enhance investment ambitions to including infrastructure connectivity, infrastructure resilience and green growth.	Enhanced benefits realisation and opportunities for investment of 'multiple colours of money'.	√	√	√	√	√	A1.1, A1.3, B2.14	M	-	
<b>A2: Accounting for change</b>											
3.3	Enhance knowledge sharing tools to support a shift from risk management to resilience.	Strengthen outcomes and whole-life investment practice.	√	-	√	√	√	A2.1 – A2.5	S	-	
<b>Making choices and securing investment</b>											
<b>B1: Designing a balance investment</b>											
3.4	Develop guidance and tools to enable 'value-capture', service performance and economic uplift to be included in investment decision making.	Enables potential revenue streams and the opportunity to alternative sources of funding including: Private Sector, User Fees and PPP.	√	-	√	√	√	B1.1, B1.2, B1.5	M	-	

3.5	Promote co-ordination with other sector plans.	Strengthen benefits realisation and co-investment.	√	-	√	√	√	B1.8	M	-
<b>B2: Planning to invest and deliver</b>										
3.6	Enhance local authority capacity for investment decision making.	Enhanced resource capacity and investment skills.	√	-	-	√	√	B.22 – B2.26	M	-
3.7	Develop funding and finance guidance related to flood and coastal resilience to support design integration and business case development.	Drive alignment of objectives and design solutions with funding and finance options.	√	-	-	√	√	B2.1, B2.2, B2.15, B2.33	M	-

Table 12: Portfolio 4 - Potential actions to strengthen Scottish investment practice learning from international examples

<b>Portfolio 4: Transformation and Place-making</b> This investment portfolio is future focused with investment decisions driven by value creation and societal opportunity. Investments in this portfolio tend to be a blend of public and private finance. Like adaptation (Portfolio 2) these investments bring changes to place and unlock social, environmental and economic benefits. Investments in the portfolio include: development, regeneration and green growth. <b>#place-making #benefits #green-growth #value</b> <b>Investment ambitions characterised by: Future Generations + Opportunity and Value</b>			Applicability					Examples within the Investment Catalogue (Appendix B)	Potential Timeframe		Footnotes
			Investment Category			Investment Level			Short-term (S) Or Medium-Term (M)		
Ref	Potential enabling action to strengthen/ shift investment practice towards Portfolio 4	Investment benefits	Delivering flood and coastal	Delivering adaptation	Responding to climate emergency	Portfolio Level	Asset Level				
<b>Shaping investment ambitions and assessing needs</b>											
<b>A1: Defining the investment</b>											
4.1	Harmonize mitigation, adaptation and climate investment objectives.	Strengthen benefits realisation and co-investment.	√	√	√	√	√	A1.7 - A1.8	S	-	
4.2	Reframe investment ambitions to 'mission-led' driven by value creation, green growth and societal opportunity.	Enhances benefits realisation and opportunities for investment of 'multiple colours of money'	√	√	√	√	√	A1.3	M	-	
<b>A2: Accounting for change</b>											
4.3	Strengthen the use of societal values/goals within investment framing and business case decisions.	Strengthen benefits realisation and co-investment	√	√	√	√	√	A2.6	S	-	
<b>Making choices and securing investment</b>											
<b>B1: Designing a balance investment</b>											
4.4	Develop guidance and tools to enable 'value-capture', service performance and economic uplift to be included in investment decision making.	Enables potential revenue streams and the opportunity to alternative sources of funding.	√	√	√	√	√	B1.1, B1.2, B1.5	M	-	

<b>B2: Planning to invest and deliver</b>										
4.5	Enhance local authority capacity for adaptation planning and investment decision making.	Enhanced resource capacity, and adaptation and investment skills.	√	√	√	√	√	B2.22 - B2.26	S	-
4.6	Develop funding and finance guidance to support design and business case development.	Support business case development.	√	√	√	√	√	B2.1, B2.2, B2.15	M	-
4.7	Embrace 'design-led' approaches to support co-creation and experimentation.	Enhanced value-creation and investment decision.	√	√	√	√	√	B2.6, B2.29, B2.36, B2.37	M	-
4.8	Strengthen action-learning practices to support pilots, innovation and experimentation.	Enhance investment practice whilst managing risk and value	√	√	√	√	√	B2.28, B2.34, B2.35	M	-

## 7.7 Shaping future investment practice in Scotland

All four of the portfolios described in *Section 3.0* have value in terms of national, regional and local needs and ambitions. Regardless of which combination and balance of portfolios, best represents optimal value for Scotland, international practice indicates there are a number of common building blocks and enabling actions that can be explored to strengthen and shape future investment practice. Key building blocks are presented in *Figure 9*.

Figure 9: Building blocks for shaping future investment ambitions

Shaping investment ambitions and assessing needs		Making choices and securing investment	
Defining the investment	Accounting for change	Designing a balanced investment	Planning to invest and deliver
1 Aligned objectives	2 Social value and well-being	4 Appraisal guidance	6 Design led approaches
	3 Access to climate information	5 Cost information	7 Funding and finance guidance
			8 Capacity building
			9 Action learning

The concluding section of this report, considers these building blocks in the context of Scottish policies and practices, and describes potential short-term actions for strengthening Scottish investment practice for flood risk management, coastal change and coastal erosion in order to keep pace with climate change.

## 8.0 Conclusions

The main conclusion of the study is that **framing is everything**, meaning that how international jurisdictions frame their investment challenges and ambitions directly influences their investment portfolios, levels of investment and concepts of optimal investment. This framing of investment challenges and portfolios shapes the definition of investment outcomes, how needs are assessed, and how the future is accounted for in decision making. This subsequently influences how choices are made and the types of funding and financing solutions attracted and secured.

This framing and the associated choices are **'place and time sensitive'**. What works in one jurisdictional setting may or may not translate to another. What is consistent, to realise greater value and support adaptation, is the need to shift the framing of optimisation from a defensive short-term allocation of limited resources, to a more qualitative and quantitative framing driven by societal and environmental values, and economic return. In turn this shift requires enhanced approaches to business case development, the confidence of delivery teams to work across traditional boundaries, and greater stakeholder and public participation in decision making.

This study also concludes that the emerging practices and policies in Scotland, related to assessing investment needs and securing investment to adapt to climate change, are in keeping with emerging international practices. Innovation in resilience and adaptation is however fast moving and continued Scottish investment, experimentation and learning will be necessary to keep pace with emergent international practice.

Scotland's stated ambition is *"we live in a Scotland where our built and natural places, supporting infrastructure, economy and societies are climate ready, adaptable and resilient to climate change"* (Climate Ready Scotland, 2019). To realise this ambition the Scottish Government and partners will need to continue balancing the focus of public investments in flood risk management, coastal change and coastal erosion between:

- managing 'risk and uncertainty' and realising 'opportunity and value'
- addressing 'current generations' and 'future generations' needs.

In the framing of investment portfolios to keep pace with climate change, it will be increasingly important to determine how to best use public funds to leverage and secure additional sources of public and private funding and finance.

Regardless of which combination and balance of portfolios, represents optimal value for Scotland in the future, Scotland can learn from international practice by exploring the potential actions set-out in *Table 13*. Exploration should be informed by clear line-of-sight to future investment ambitions; and recognise that the Scottish Government and partners are already making advances in framing, assessing and securing investments related to resilience, adaptation and climate change. *Table 13* highlights synergies, and points of leverage, with existing policy developments, frameworks and programmes.

Table 13: Summary of potential short-term actions to strengthen investment practice for flood risk management, coastal change and coastal erosion in Scotland

Ref	Enabling action and description
<b>Shaping investment ambitions and assessing needs</b>	
<b>A1: Defining the investment</b>	
1	<p><b>Action: Harmonize mitigation, adaptation and climate investment objectives</b> to enhance the alignment of the objectives within the Flood Risk Management (Scotland) Act 2009 and the stated ambitions of the more recent Scottish Climate Change Adaptation Programme (SCCAP) 2019 and the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019. This harmonisation would support future business cases to deliver solutions that are climate ready, adaptable and resilient to climate change.</p> <p>Explore alignment of flood risk management, coastal change and coastal erosion investment practices with the proposed new <i>Infrastructure Assessment Framework</i> part of <i>A Blueprint for Scotland</i><sup>125</sup>, the recently published <i>Water-Resilient Places – A Policy Framework for Surface Water Management and Blue-Green Infrastructure</i><sup>126</sup>, and <i>Scotland's Fourth National Planning Position Statement</i><sup>127</sup>. This will foster alignment of mitigation, adaptation and climate investment objectives; and a common approach to decision-making and future investment practices in grey, green and soft infrastructure investments.</p>
<b>A2: Accounting for Change</b>	
2	<p><b>Action: Strengthen the use of well-being and societal values within investment decision making</b> to foster 'whole-society' considerations within business case development and investment prioritisation; and future-proof outcomes by accelerating a shift in investment practice from risk management to resilience.</p> <p>Strengthen investment practice by aligning flood risk management, coastal change and coastal erosion decision making with the National Performance Framework<sup>128</sup> and outcomes, and application of the Place Standard tool<sup>129</sup>.</p>
3	<p><b>Action: Enhance the accessibility of climate science and design guidance</b> to support risk and opportunity management at the local level, and foster the uptake of scenario planning and managed adaptive approaches, and consideration of a wider range of climate futures within decision making.</p> <p>Build on existing investments such as the Dynamic Coast Platform<sup>130</sup>, National Flood Risk Assessment (NFRA) Tool<sup>131</sup>, the UK Climate Projections User Interface<sup>132</sup> and the tools and resources on the Adaptation Scotland website<sup>133</sup> to enhance access to regional and local scale climate projections to support scenario planning, designing for uncertainty and use of adaptive</p>

<sup>125</sup> [https://infrastructurecommission.scot/storage/281/Phase1\\_FullReport.pdf](https://infrastructurecommission.scot/storage/281/Phase1_FullReport.pdf)

<sup>126</sup> <https://www.gov.scot/publications/water-resilient-places-policy-framework-surface-water-management-blue-green-infrastructure/pages/6/>

<sup>127</sup> <https://www.gov.scot/publications/scotlands-fourth-national-planning-framework-position-statement/>

<sup>128</sup> <https://nationalperformance.gov.scot>

<sup>129</sup> [https://www.placestandard.scot/docs/Place\\_Standard\\_Strategic\\_Plan.pdf](https://www.placestandard.scot/docs/Place_Standard_Strategic_Plan.pdf)

<sup>130</sup> <http://www.dynamiccoast.com>

<sup>131</sup> <https://www.sepa.org.uk/data-visualisation/nfra2018/>

<sup>132</sup> <https://ukclimateprojections-ui.metoffice.gov.uk/ui/home>

<sup>133</sup> <https://www.adaptationscotland.org.uk/how-adapt/tools-and-resources>

Ref	Enabling action and description
	pathways approaches (such as BS8631) within investment decisions. This action could be designed to support the forthcoming Scottish Climate Emergency Skills Action Plan.
Making choices and securing investment	
B1: Designing a balanced investment	
4	<p><b>Action: Enhance and renew investment appraisal guidance for flood and coast erosion risk management</b> to strengthen the consideration of investment uncertainties, multiple-benefits, value creation and alignment with decision making for other grey and green infrastructure.</p> <p>Enhance the Scottish Flood Protection Appraisal Guidance (2016) to support Actions 1 and 2; incorporate coastal related investments, and enhance evaluation of investment uncertainties, multiple-benefits and value creation. Future guidance to consider use of the 5-Case Model in line with other Sectors (including Transport Scotland) and Flood and Coastal Erosion Risk Management (FCERM) best practice in England, Wales and Northern Ireland.</p>
5	<p><b>Action: Systematically capture and build the evidence base of costs associated with mitigation and adaptation</b> to support business case development and reliable investment prioritisation at the national, regional and local level.</p> <p>Develop a national database for mitigation and adaptation costs to strengthen business case development, benchmarking and prioritisation. Action supports Action 3 and could be aligned with the proposed whole-life cost guidance to be developed by the Scottish Future Trust under the draft Infrastructure Investment Plan for Scotland<sup>134</sup>.</p>
B2: Planning to invest and deliver	
6	<p><b>Action: Enhance the use of 'design-led' and co-design practices</b> to foster creativity and innovation within investment solutions. Enhancing co-design practices may also strengthen the legitimacy of future decision making when considering opportunities and trade-offs, and strengthen the uptake of managed adaptive approaches.</p> <p>Build on the placemaking activities of Sniffer<sup>135</sup>, Architecture &amp; Design Scotland, and the example of Climate Ready Clyde, to promote 'design-led' and co-creation practices within flood risk management, coastal change and coastal erosion decision making in Scotland; and alignment of practices with The Scottish Government and COSLA's Place Principle<sup>136</sup> to support developments in investment practices and Action 2.</p>
7	<p><b>Action: Develop of Scottish funding and financing guidance</b> to support the framing of ambitions and objectives, and the line of sight to emerging funding and financing opportunities.</p>

<sup>134</sup> <https://www.gov.scot/publications/national-mission-local-impact-draft-infrastructure-investment-plan-scotland-202122-202526/>

<sup>135</sup> <https://www.sniffer.org.uk/>

<sup>136</sup> <https://www.gov.scot/publications/place-principle-introduction/>



Ref	Enabling action and description
	<p>Build on the current Climate Ready Clyde adaptation finance research<sup>137</sup>, ClimateXChange finance research<sup>138</sup>, and international guidance from Australia, California and Canada, to develop Scottish guidance to support the framing of investment ambitions and objectives, and the line of sight to emerging funding and financing opportunities.</p> <p>This action, and Action 4, are align with the finance recommendations 19-21 included with the 'Water-Resilient Places – A Policy for Surface Water Management and Blue-Green Infrastructure (2021)' publication<sup>139</sup>.</p>
8	<p><b>Action: Enhance capacity and skills at the regional and local level</b> to support business case capabilities with respect to investments in resilience and adaptation, and increased awareness emerging funding and finance opportunities.</p> <p>Continue to build on the Adaptation Scotland Programme and invest in capacity building at the regional and local level; and roll-out of the adaptation capability framework for a climate ready public sector<sup>140</sup>.</p>
9	<p><b>Action: Strengthen the framework for action learning</b> to support connectivity and feedback between policy and practice, and provide a foundation for greater experimentation and investment innovation to keep ahead of climate change and deliver new services and solutions.</p> <p>Build on existing Scottish international networks, and investments such as Hydro Nation and the hosting of COP26, to strengthen international action learning practices; and formal collaboration with jurisdictions seeking to accelerate world-class investment practice related to flood resilience and coastal adaptation.</p>

Looking forward, international investment practice will continue to develop at pace, building on existing commitments and international activity described in this report. In the interest of Scottish practice going further and faster, it will be advantageous for Scotland to **formalise international collaboration and learning with respect to investment decision making, and funding and financing practice**. Canada, California and Queensland are good candidates for formal collaboration, particularly in relation to:

- development of guidance for investment appraisal (Action 4), and the securing of funding and finance (Action 7), to strengthen the framing of investment ambitions, and the mainstreaming of multiple sources of funding, and
- the use of 'design-led' and co-design practices (Action 6) to foster creativity and innovation in the development of solutions for flood resilience and coastal adaptation.

This will support future decisions regarding optimal national levels of investment, and help shape climate investment strategies and portfolios that are scalable at local, regional, national and international levels.

<sup>137</sup> Climate Ready Clyde, December 2020, Financing Clyde Rebuilt (currently unpublished)

<sup>138</sup>

[https://www.climateexchange.org.uk/media/1730/financing\\_adaptation\\_to\\_climate\\_change\\_web\\_version.pdf](https://www.climateexchange.org.uk/media/1730/financing_adaptation_to_climate_change_web_version.pdf)

<sup>139</sup> <https://www.gov.scot/publications/water-resilient-places-policy-framework-surface-water-management-blue-green-infrastructure/pages/6/>

<sup>140</sup> <https://www.adaptationscotland.org.uk/how-adapt/tools-and-resources/capability-framework-climate-ready-public-sector>

# Appendix A Research methodology

## Research background

At a national and international scale the policy environment related to assessing investment needs and securing investment to adapt to climate change is fast moving, cross-cutting and emergent. The urgent challenges for policy and investment are reflected in Scotland's response to the climate emergency states:

*“An emergency needs a systematic response that is appropriate to the scale of the challenges and not just knee-jerk, piecemeal action. All Cabinet secretaries are looking across a full range of policy areas to identify where we can go further, faster”* - (Roseanna Cunningham, Cabinet Secretary for Environment, Climate Change and Land Reform – May 2019).

In addition to supporting Scotland's overall response to the climate emergency this research will support the Scottish Government and partners in delivering the Flood Risk Management (Scotland) Act 2009 and the Scottish Climate Change Adaptation Programme; in turn supporting the vision: *“We live in a Scotland where our built and natural places, supporting infrastructure, economy and societies are climate ready, adaptable and resilient to climate change”*.

At the core of the research objectives is what does 'securing the optimal level (and pattern) of investment' look like in the Scottish context and where is the tipping point between investing enough, but not too much? What does 'optimal' mean for Scotland in terms of the best allocation of investment across interventions to realise future security and return on investment? And in keeping pace with climate change, what are the choices related to the distribution of this investment over time?

Overall, this research aims to explore:

- how other jurisdictions are determining the appropriate level and impact of future investment;
- how future change is accounted for in decision making;
- how an optimal and balance investment is considered;
- how others are funding and planning to invest for the future; and
- what lessons, methods and mechanisms may be applicable and transferable to the Scottish context.

## Research questions

The primary research question is to:

- identify learning from attempts at assessing and securing the optimum level of investment in flood risk management, coastal change and coastal erosion in order to keep pace with climate change.

The secondary research questions are set out in Table 14.

Table 14: Secondary research questions

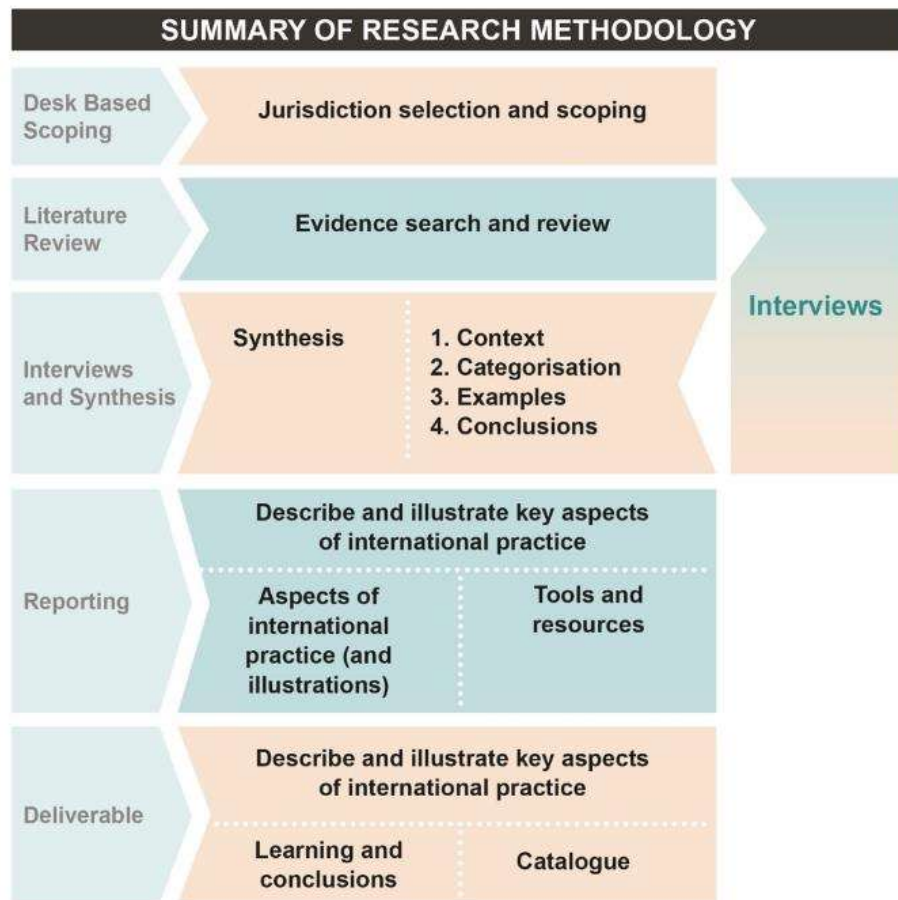
#	Theme	Research question
1	<b>Level of investment</b>	How are organisations and authorities in other jurisdictions determining the appropriate level of future investment?
2	<b>Investment change over time</b>	To what extent do these assessment account for change over time (2030, 2050, 2100)?
2a	<b>Investment in societal change</b>	To what extent do the assessments account for change over time (2030, 2050, 2100) considering the wider societal change (for example, socio-economic change and development)?
2b	<b>Investment in climate change</b>	To what extent do the assessments account for change over time (2030, 2050, 2100) taking into account climate change (keeping pace with or getting ahead of)?
2c	<b>Investment in adaptation</b>	To what extent do the assessments account for change over time (2030, 2050, 2100) considering how investment takes account of managed adaptive approaches/adaptation pathways (i.e. ensuring investment is available to support adaptive plans over decades)?
3	<b>Private sector investment</b>	To what extent is private sector investment in adaptation included?
4a	<b>Optimal values of investment</b>	To what extent do the assessments consider how economically optimal values of investment are and how is this balanced with broader societal risks (e.g. standard of protection/thresholds)?
4b	<b>Investment trade-offs and synergies</b>	To what extent do the assessment consider how economically optimal values of investment are, and trade-offs such as to environmental quality and food production?
5	<b>Planning to finance</b>	How are the organisations and authorities funding or planning to fund/finance that investment?
6	<b>Transferability to Scottish context</b>	How do these assessment methods and funding mechanisms fit with Scottish legislation, regulations and governance structures?

## Summary of approach

To explore emergent approaches in assessing and securing the optimum level of investment in order to keep pace with climate change, the research was centred around a literature review of a broad range of international jurisdictions. The research approach taken was exploratory in nature in order to capture the variation and breadth in international practice and identify innovative practices that are potentially applicable and transferable to the Scottish context.

The research approach is summarised in *Figure 1* and the methodology taken is discussed in detail within this appendix.

Figure 1: Summary of research method



## Selection of jurisdictions

The research was focused on practice emerging from 10 international jurisdictions. The jurisdictions were selected in order to gain insights from a range of different contexts, such as geographical and climate conditions, whilst maintaining a focus on those jurisdictions that were relevant and informative to the Scottish context to assess transferability.

An initial long-list of jurisdictions were identified through relationship mapping and knowledge by the research team of international activity in the area of flood and coastal risk investment planning. The following criteria were used to refine the long-list of to a short-list of jurisdictions relevant to the Scottish context with the following criteria:

1. Availability and accessibility of evidence in English
2. Activity and research related to the research questions
3. Similar physical challenges including coastal risk
4. Relevance of governance structure

Figure 10: Jurisdictions considered



Jurisdictions were then categorised according to the following characteristics to select a final sample of 10 jurisdictions. The selection was finalised to provide diversity across all the characteristics to ensure a range of international practice was explored:

1. National vs sub-national governance level for flood and coastal risk management
2. Location: northern vs southern hemisphere
3. Location: European vs non-European
4. Climate: Temperate vs sub-tropical/tropical

A final high-level check was undertaken before finalising the final selection to ensure availability and currency of evidence.

The 10 selection jurisdictions explore in this research are:

- California, USA
- Canada
- Denmark
- Germany
- Ireland
- Louisiana, USA
- New York, USA
- New Zealand
- Queensland, Australia
- Victoria, Australia

## Literature review - Evidence search

Evidence for the literature review was identified from Google searches and also obtained through a call for evidence disseminated through the research teams' network within the selected jurisdictions.

Searches were undertaken on Google and Google Scholar using the string:

<Jurisdiction name> AND (flood resilience OR flood risk management OR coast\* protection OR disaster OR natural hazard OR climate adaptation) AND (investment OR funding OR finance)

This search process was trialled and refined early in the process to ensure it was relevant in terminology across all jurisdictions. Results were screened for relevance on the first 10 pages of results from the Google search and first 2 pages of results from the Google Scholar results. Snowballing of sources was also undertaken to identify any other sources e.g. through government webpages and from reviewed documents.

Literature was screened against the criteria in Table 15. All screened literature was stored in a document referencing library (Mendeley), with shared access for easy cloud storage, categorisation by jurisdiction and sharing across the research team for a quality assured and auditable process.

Table 15: Literature screening criteria

Topic	Screening Criteria
Year	Post 2015 (unless there is valid reason that it is still current and relevant)
Language	Available in English
Jurisdiction	Relates to the jurisdiction in review
Investment	Relates to investment in flooding and/or coastal change and/or coastal erosion
Research type	Applied (not opinion pieces) i.e. policy, reports, grey literature, research paper and academic papers
Applicability	Supports one or more of the three priorities: <ul style="list-style-type: none"> <li>○ The Flood Risk Management (Scotland) Act 2009</li> <li>○ The Scottish Climate Change Adaptation Programme, and the</li> <li>○ Climate Emergency agenda</li> </ul>
Availability	Freely available source

From this process a total of 181 documents were reviewed across all jurisdictions (16).

Table 16: Number of documents reviewed by jurisdiction

Jurisdictions	Canada	California	New Zealand	Queensland	Ireland	Denmark	Louisiana	Germany	Victoria	New York
Number of documents reviewed	17	23	22	26	23	14	12	8	13	23

## Literature review - Evidence assessment

For each item of literature, source details were recorded within an evidence matrix spreadsheet including:

- Title of document, Year of publication, Number of pages, and Full reference
- Type of document (i.e. government report, academic paper, policy paper, industry grey literature, applied research, other)
- Document relevance rating
- Overview description of document

Each screened literature source was then reviewed and assessed in an evidence matrix spreadsheet against the research questions which were additionally broken down into elements to aid the reviewer in identifying and focusing on the key areas to be recorded (Table 17).

Table 17: Evidence assessment research questions and elements

	Theme	Research question	Elements	Description
1	<b>Level of investment</b>	How are organisations and authorities in other jurisdictions determining the appropriate level of future investment?	Objectives	What are the targets, ambitions, drivers and priorities? How active is the jurisdiction?
			Evidence	How is the level of need assessed/determined and/or how by? What level (%GDP) of investment is proposed?
			Economics	How are decisions taken? And communicated?
			Benefits	What benefits/outcomes are targets and what is measured?
			Future	What are the plans looking forward? How is this communicated and monitored?
2a	<b>Investment in societal change</b>	To what extent do the assessments account for change over time (2030, 2050, 2100) considering the wider societal change (for example, socio-economic change and development)	Overview/Drivers	What are the overall social change drivers that are identified in investment assessments/decisions?
			Development & Population	What are the scenarios/assumptions used for land-use change, planning and development changes over the timeframes? What are the scenarios/assumptions used for population changes over the timeframes?
			Social Justice	To what extent is fairness within society considered in terms of distribution of wealth/benefits across social groups including geographically, economic status etc?
2b	<b>Investment in climate change</b>	To what extent do the assessments account for change over time (2030, 2050, 2100) taking into account climate change (keeping pace with or getting ahead of)	Scenarios	Scenarios are illustrations of future impacts of climate change. This closely related to the word projections which is concerning a set of uniform forecasts with uncertainties explored in a consistent way
			Timing of investment	How is the timing of investment considered? Today, Tomorrow and Future
			Innovation	New techniques, practice or policy linking impacts of climate change on flood risk and coastal erosion management
2c	<b>Investment in adaptation</b>	To what extent do the assessments account for change over time	Adaptation	The practice surrounding successful planning and delivery of investment and practice to gain resilience and possible benefit from the impacts of climate change

Theme	Research question	Elements	Description
	(2030, 2050, 2100) considering how investment takes account of managed adaptive approaches/adaptation pathways (i.e. ensuring investment is available to support adaptive plans over decades)	Enables	The conditions or activities that contribute to an adaptive action occurring
		Transition	The need to recognise and facilitate the need to plan with sufficient forethought for major changes to flood risk and coastal erosion management including the possible need for major land use change
3	<b>Private sector investment</b> To what extent is private sector investment in adaptation included?	Drivers and sources	Factors that promote / incentivise private sector investment? And sources?
		Methods/Examples	Includes methods of incentivising and delivery (delivery models for example)? And Case Studies?
		Lessons	Findings that show emerging enablers or blockers of PSI?
4a	<b>Optimal values of investment</b> To what extent do the assessments consider how economically optimal values of investment are and how is this balanced with broader societal risks (e.g. standard of protection/thresholds)	Standards/Levels of Service	Is the approach based on standards of protection of levels of service?
		Dimensions of Optimal	What is considered with respect to OPTIMAL for example: Risk Sharing /Incentives / Efficiency / Legitimacy / Social Vulnerability; And who is considered the optimal party to invest?
		Allocation (Pattern of Investment)	How is investment allocated? * Anticipate/Preparedness *Resist * Absorb * Recover * Adapt/Transform
		Infrastructure Priorities	New >> Upgrades >> O&M >>Community-wide Infrastructure >> Soft Infrastructure
4b	<b>Investment trade-offs and synergies</b> To what extent do the assessment consider how economically optimal values of investment are, and trade-offs in relation to environmental quality and food production?	Synergies/trade-offs	What are the synergies and trade-offs that are considered/identified in making investment decisions?
		Environment	What are the specific trade-offs in environmental quality that are considered e.g. biodiversity impacts, habitat creation, land-use change) and how these are assessed in investment decisions?
		Food	What are the specific trade-offs with food production e.g. impact on agricultural land (values of different grade agriculture) in investment decision making?



	Theme	Research question	Elements	Description
5	<b>Planning to finance / types of methods</b>	How are the organisations and authorities funding or planning to fund/finance that investment?	Planning Funding Financing	Preparation and prioritisation for new or future actions that are vulnerable to climate change? How will up-front costs be secured? How will costs be recovered? Money provided, by an organization or government from it's internal resources or public funds, for a particular purpose? Money provided, by an external organisation, for a particular purpose?
6	<b>Transferability to Scottish context</b>	How do these assessment methods and funding mechanisms fit with Scottish legislation, regulations and governance structures	<i>Transferability to Scottish context was assessed in Step 5: Synthesis and Reporting but observations were collated against the research question during this stage to inform transferability</i>	

## Interviews

Interviews were undertaken with international practitioners the purpose of exploring the evidence identified, filling gaps in evidence that was not apparent, exploring lessons learnt and how policy has been applied. Interviews were un-structured and exploratory in nature 'adding colour' to the findings emerging from the literature and informing the reporting. Practitioners were identified through the research teams' network and from responses and interest received through the call for evidence. Insights identified from interviews were documented and added to the evidence matrix for a complete record of evidence.

## Synthesis and reporting

Synthesis of the literature review evidence was undertaken through a categorisation process. This approach enabled a broad evidence base to be organised and synthesised into complementary themes to compare and contrast international practice.

This approach was enabled through the development of a categorisation framework. This was initially informed by the BSI 8631 9-step framework ('Decision making for climate change – adaptation pathways') as it provides a meaningful, comprehensive structure and a 'connected whole' of international practice.

Themes and more detailed 'tiers' were created to organise and frame the evidence. This was iteratively informed and refined by the literature evidence and emerging themes and additional emergent categories were added when new themes or aspects were identified during the process. To ensure consistency of approach, brief descriptions were included for each 'tier 4 aspect'. The final categorisation framework against which the evidence was organised and synthesised is shown in 18.

Once the categorisation was completed, the research team were able to review and interpret the material across and between themes to develop a summary of key findings in relation to each research question.

Themes and research questions were mapped against the categorisation framework to inform the reporting structure.

Table 18: Categorisation framework for synthesis of evidence

Tier 1	Tier 2	Relationship to research themes	Tier 3	Tier 4 (Aspect description)	Tier 4 (Aspect)
International Practice	Shaping Investment Ambitions	Theme 1	Defining the investment	Framing the ambition - risk(s) and value(s)	framing
				Integration flood resilience, adaption and climate/green growth	integration
				Synergies and multiple benefits	multiple benefits
		Theme 2A	Accounting for the future	Level of investment	level
				Evidence of socio-economic considerations	drivers
	Theme 2B	Accounting for the future	Plan led application of climate science and evidence	growth and development	
			Leadership led application of climate science	well-being and vulnerability	
			Approaches to adaptation	fairness	
	Theme 2C	Accounting for the future	Approaches to adaptation	scale (national and local)	
	Securing investment	Themes 4A and 4B	Designing a balanced investment	Framing of optimisation	standards
Undertaking prioritisation				use of scenarios	
Themes 3 and 5		Planning to invest and deliver	Allocation of resources	communication of science	
			Approaches	foresight and uncertainty	
				commitment	
			adaptation pathways		
			strategic investment pathways		
			optimisation		
			prioritisation		
			benefit cost analysis		
			investment portfolio		
			governance		
			legal and policy		
			insurance		
			guidance		
			engagement		
			willingness to pay		
			capacity building		
			innovation		
			monitoring and learning		

Due to the emergent nature of the research questions, no single jurisdiction provides a comprehensive set of best practice that is directly applicable and transferable to the Scottish context. For this reason, we developed a Thematic Investment Catalogue to collate investment methods and mechanisms i.e. 'smart ideas', to support dissemination and future development as international practice emerges. Methods and mechanisms were identified during the evidence review and categorised into the following types:

- Framework
- Methodology
- Guidance
- Tool
- Mechanism

Finally, a Steering Group workshop made up of key stakeholders was undertaken at the reporting stage to explore and discuss the applicability and transferability of findings to the Scottish context.

## Appendix B Investment catalogue

### Introduction

The purpose of this catalogue is to signpost emerging international tools, frameworks and resources related to investing in flood resilience, coastal change and adaptation. The catalogue snapshots are designed to support the exploration of new possibilities for shaping investment ambitions and securing investments.

The catalogue has been developed to support the Scottish Government and partners to “go further and faster” in realising their shared vision: “We live in a Scotland where our built and natural places, supporting infrastructure, economy and societies are climate ready, adaptable and resilient to climate change.”

### Structure of the catalogue

To align with the main report, the catalogue set-out in *Section 3.0 (Figure 2)* is framed around the same building blocks of international practice and decision making:



Each catalogue entry includes a short title and a footnote<sup>141</sup> that provide a link to supporting information. To support print copies of the document a QR code has also be included.





Each entry includes a short overview of the resource, followed by categorisation by:

- **Applicability investment category:** delivery flood and coastal resilience, delivering adaptation, responding to the climate emergency
- **Applicability investment level:** portfolio, asset
- **Resource type:** framework, methodology, mechanism, tool, guidance or programme
- **Jurisdiction:** Australia, California, Canada, Denmark, Ireland, Germany, Louisiana, New York, New Zealand, Queensland, Victoria, UK, USA

<sup>141</sup> Links and QR Codes are correct at the time of publication (2021) but web-sources may move.

## Frameworks, resources and tools

Table 19: Investment catalogue: Frameworks, resources and tools



Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
<b>Part A1: Defining the investment</b>						
A1.1	<p>Planning and investing for a resilient California: A guidebook for state agencies<sup>142</sup></p> <p>A generalised framework for assessing climate impacts and risks in projects, as well as a variety of conceptual models for advancing data-informed decision-making processes.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p>	Portfolio	Framework	California	
A1.2	<p>The cost of adaptation at the local level<sup>143</sup></p> <p>A framework and methodology for establishing a credible national estimate of investment in disaster adaptation infrastructure to reduce the cost of climate change in Canada. The methodology takes account of population, lifespan of infrastructure and GDP.</p>	Delivering adaptation	Portfolio	Framework Methodology	Canada	
A1.3	<p>Copenhagen: climate adaptation results in green growth<sup>144</sup></p> <p>A climate adaptation investment prioritisation framework that is integrated into the green growth strategy. Each adaptation investment must drive growth so that at least part of the investment can be recovered from that growth.</p>	Delivering adaptation	Portfolio	Framework Methodology	Denmark	
A1.4	<p>Canada's Building Adaptive and Resilient Communities program<sup>145</sup></p>	Delivering adaptation	Portfolio	Framework Methodology	Canada	

<sup>142</sup> <https://www.opr.ca.gov/planning/icarp/resilient-ca.html>

<sup>143</sup> <http://assets.ibc.ca/Documents/Disaster/The-Cost-of-Climate-Adaptation-Report-EN.pdf>





<sup>144</sup> [https://en.klimatilpasning.dk/media/568851/copenhagen\\_adaption\\_plan.pdf](https://en.klimatilpasning.dk/media/568851/copenhagen_adaption_plan.pdf)

<sup>145</sup> <https://icleicanada.org/barc-program/>

Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
	The program provides a framework and comprehensive planning methodology to support municipalities in developing and implementing climate change adaptation plans.					
A1.5	<p><b>Victorian-Floodplain-Management-Strategy</b><sup>146</sup></p> <p>This is a Strategy for Victoria floodplain management aimed at key stakeholders in the State and Federal Gov. The strategy incorporates allowances for climate change impacts and encourages flexibility to adapt to uncertain rates of sea level rise. Optimal investment is seen essentially as place based. There is an ambition to link insurance premiums to the level of flood risk protection. The strategy links with Spatial planning strategies.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p>	Portfolio	<p>Framework</p> <p>Guidance</p>	Victoria	
A1.6	<p><b>The Sendai Framework for Disaster Risk Reduction 2015-2030</b><sup>147</sup></p> <p>The framework outlines seven clear targets and four priorities for action to prevent new and reduce existing disaster risks: (i) Understanding disaster risk; (ii) Strengthening disaster risk governance to manage disaster risk; (iii) Investing in disaster reduction for resilience and; (iv) Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction.</p> <p>It aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years.</p>	<p>Delivering flood and coastal resilience</p>	Portfolio	Framework	Canada and Australia	

<sup>146</sup> [www.water.vic.gov.au/managing-floodplains/new-victorian-floodplain-management-strategy](http://www.water.vic.gov.au/managing-floodplains/new-victorian-floodplain-management-strategy)

<sup>147</sup> <https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>




Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
A1.7	<p>Low Carbon Resilience Best Practice<sup>148</sup></p> <p>Best practice on the adoption of Low Carbon Resilience approach in Canada including case studies.</p>	Responding to the climate emergency	Portfolio	Guidance	Canada	
A1.8	<p>National Policy on Climate Action and Low-Carbon Development<sup>149</sup></p> <p>This policy framework sets out to integrate climate and adaptation with sector plans, and encourages the adding a climate lens as a criterion for the success of sectoral policy, strategies and projects.</p>	Responding to the climate emergency	Portfolio	Framework	Ireland	
Part A2: Accounting for future change						
A2.1	<p>Climate Atlas (Denmark)<sup>150</sup></p> <p>A nation wide platform providing municipalities with up to date climate data from Danish sources, the IPCC and other international databases. The platform supports Danish Municipalities to make future projections related to precipitation and sea level rise and plan for adaptation.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p> <p>Responding to the climate emergency</p>	Portfolio	Tool	Denmark	
A2.2	<p>Climate Atlas of Canada<sup>151</sup></p> <p>Launched in 2018, this platform provides an open-access portal for climate projects. The platform was designed to support local, regional and national action to move from risk to resilience.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p>	Portfolio	Tool	Canada	

<sup>148</sup> <http://act-adapt.org/lcr-professionals-final>

<sup>149</sup> <https://www.dccae.gov.ie/en-ie/climate-action/publications/Documents/5/National%20Climate%20Policy%20Position.pdf>

<sup>150</sup> <https://en.klimatilpasning.dk/tools/climate-atlas/>

<sup>151</sup> <https://climateatlas.ca>



Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
		Responding to the climate emergency				
A2.3	<p>Climate Explorer (USA)<sup>152</sup></p> <p>This platform sits with the US Climate Resilience Toolkit and provides climate projection (including rainfall and tidal information) information for every US State. Projections are provided based on two possible futures: one low and one high emissions scenario.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p> <p>Responding to climate emergency</p>	Portfolio	Tool	USA	
A2.4	<p>Cal-Adapt (California)<sup>153</sup></p> <p>An open-access platform for the provision of climate change information including precipitation and sea level rise. The platform was established to provide tools, data and resources to support research, the development of adaptation plans and the submission of building applications.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p> <p>Responding to the climate emergency</p>	Portfolio	Tool	California	
A2.5	<p>Climate Ireland (Ireland)<sup>154</sup></p> <p>Provides a wide range of climate data and projections at a National Level and links to research information relevant to adaptation decision making.</p>	<p>Delivering flood and coastal resilience</p>	Portfolio	Tool	Ireland	

<sup>152</sup> <https://toolkit.climate.gov/tool/climate-explorer-0>

<sup>153</sup> <https://cal-adapt.org>




<sup>154</sup> <https://www.climateireland.ie/#/>



Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
		Delivering adaptation Responding to the climate emergency				
A2.6	<p><b>Living Standards Framework</b><sup>155</sup></p> <p>The Framework considers the range of impacts that a policy or option may have on the material and non-material factors that affect New Zealanders wellbeing now and, in the future. It is based on:</p> <ul style="list-style-type: none"> <li>• 12 domains of current wellbeing outcomes</li> <li>• Four capital stocks (natural, social, human and financial)</li> <li>• Risk and resilience</li> </ul> <p>It conceives of wellbeing as being comprised of a number of aspects of life experience (the 12 domains of wellbeing), such as cultural identity, environment, income, jobs, time use, social connections and housing. This Framework complements rather than replaces other analytical frameworks, aiming to promote higher living standards and greater intergenerational wellbeing now and in the future.</p>	Delivering flood and coastal resilience Delivering Adaptation	Portfolio	Framework	New Zealand	
A2.7	<p><b>Robust, 'low-regrets' decision-making</b><sup>156</sup></p> <p>Low regrets decision-making approaches can be applied in informing decisions in the presence of deep uncertainty. They select options that perform satisfactorily across a variety of possible futures, as opposed to options that perform best under the central or expected scenario, or create benefits no matter what the future. They can help to reduce the range of uncertainty in an investment decision or across a range of policy measures. Robust approaches to decision making do this by testing possible interventions against integrated variations of climate and socio-economic scenarios to:</p>	Delivering flood and coastal resilience Delivering adaptation	Portfolio	Methodology	Queensland	

<sup>155</sup> <https://treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/our-living-standards-framework>



<sup>156</sup> <https://knowledge.aidr.org.au/media/7711/04-scenarios-guidance-strategic-decisions-climate-disaster-risk-2020.pdf>

Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
	<ul style="list-style-type: none"> <li>Find the best performing intervention option across scenarios</li> <li>Identify intervention options that can be flexibly applied and adjusted if needed (i.e. real options analysis) or</li> <li>Diversity the number or nature of adaptation options to reduce overall risks (i.e. portfolio risk)</li> </ul>					
A2.8	<p><b>Assessing social vulnerability</b><sup>157</sup></p> <p>Deconstructing Disaster Workshops provide a methodology for assessing societal vulnerability and societal values as well as trade-offs. They are designed to help people unpack vulnerability in a way which focuses on the context of their situation, providing an opportunity to translate complex and dry data into a powerful learning experience. It provides a range of conceptual tools to start the process of understanding causes, societal rules, values and knowledge to incentivise and inform trade-offs in decision making and potential points of intervention to create change.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p>	<p>Portfolio</p> <p>Asset</p>	<p>Methodology</p> <p>Tool</p>	<p>Queensland</p>	
A2.9	<p><b>Repeat Events and Dollars Index Dashboard</b><sup>158</sup></p> <p>Web-based interactive mapping application to understand risk, costs and repeat damages represented as a 'heat map' to identify and highlight the most frequent and costly damage sites helping Local Councils identify priority works and informed decisions for future investment.</p>	<p>Delivering flood and coastal resilience</p>	<p>Portfolio</p>	<p>Tool</p>	<p>Queensland</p>	
A2.10	<p><b>Canadian Disaster Database (CDD)</b><sup>159</sup></p> <p>A web-based repository of historical information on disasters that have directly affected Canadians, at home and abroad, since 1900. It contains detailed disaster information on over 1000 disasters, including those triggered by natural hazards, technological hazards or conflict (not including war). The database</p>	<p>Delivering flood and coastal resilience</p>	<p>Portfolio</p>	<p>Tool</p>	<p>Canada</p>	

<sup>157</sup> <https://knowledge.aidr.org.au/media/7710/03-vulnerability-guidance-strategic-decisions-climate-disaster-risk-2020.pdf>




<sup>158</sup> <https://www.qra.qld.gov.au/RED/>

<sup>159</sup> <https://www.publicsafety.gc.ca/cnt/rsrscs/cndn-dsstr-dtbs/index-en.aspx>

Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
	describes where and when a disaster occurred, who was affected, and provides a rough estimate of the costs.  The goal of the CDD is to bring historical data on Canadian disasters to residents and (Federal, Provinces and Territories) FPT governments to better understand, assess, and manage risks.					
A2.11	<b>Incorporating sea level rise within capital investment planning</b> <sup>160</sup> A six-step framework to incorporate sea level rise into capital planning in San Francisco and support adaptation. The six steps include: review science, assess vulnerability, assess risk, plan adaptation, implement adaptation and monitor.	Delivering flood and coastal resilience  Delivering adaptation	Portfolio  Asset	Guidance	California	
A2.12	<b>Copenhagen: Long term investment planning</b> <sup>161</sup> (page 81) A methodology for planning cash flow and fund raising for adaptive investment in an uncertain future. The staged investment framework considers uncertainties related to: climate, societal needs, knowledge and technology; and identifies the form of financing that is likely to be required based on available information on possible future climate change, investment options to those changes and the municipality's cost expectations.  The framework also considers whether current financing rules place limits on anticipated optimal adaptation options.	Delivering adaptation	Portfolio	Methodology	Denmark	
A2.13	<b>KLIWA</b> <sup>ref</sup> A long-term regional co-operation "Climate Change and Consequences for Water Management" framework based in Germany that informs practice in the water sector with latest science and long-term monitoring of regional water resources, quality and flows.	Delivering adaptation	Portfolio  Asset	Framework	Germany	n/a

<sup>160</sup> <https://onesanfrancisco.org/sites/default/files/inline-files/Guidance-for-Incorporating-Sea-Level-Rise-into-Capital-Planning1.pdf>

<sup>161</sup> [https://en.klimatilpasning.dk/media/568851/copenhagen\\_adaption\\_plan.pdf](https://en.klimatilpasning.dk/media/568851/copenhagen_adaption_plan.pdf)




Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
A2.14	<b>New York Panel on Climate Change NYPCC<sup>162</sup></b> The NYPCC have a long record of developing science and policy linked to NY. This has led to early development, advocacy and integration of an Adaptive approach into City Planning and continuing leading practice in linking latest science to policy and investments.	Delivering adaptation	Portfolio Asset	Framework	New York	
A2.15	<b>NYPCC Sea level rise projections<sup>163</sup></b> The latest science on sea level rise has proposed and outlined the benefits of looking at low probability but plausible high impacts scenarios. This should ensure planning take account of the full range of possible change.	Delivering adaptation	Portfolio Asset	Framework Methodology	New York	
A2.16	<b>Climate Resiliency – NY City Planning<sup>164</sup></b> The Department of City Planning (DCP) is working with communities throughout the floodplain to identify zoning and land use strategies to reduce flood risks and support the city's vitality and resiliency through long-term adaptive planning. After extensive outreach DCP is proposing to make permanent and improve upon existing zoning rules that were adopted on a temporary, emergency basis following superstorm Sandy. This would enable new and existing buildings to comply with requirements in NYC's Building Code. Also DCP recommends expanding the applicability of zoning rules to include areas that will be subject to high-risk of flooding in the future.	Delivering adaptation Responding to the climate emergency	Portfolio	Framework Methodology	New York	
A2.17	<b>Melbourne Water Corporation Adaptive Pathway Planning Guidance<sup>165</sup></b>	Delivering adaptation	Portfolio Asset	Guidance	Victoria	n/a

<sup>162</sup> <https://doi.org/10.1111/nyas.14004>

<sup>163</sup> <https://doi.org/10.1111/nyas.14006>

<sup>164</sup> <https://www1.nyc.gov/site/planning/plans/climate-resiliency/climate-resiliency.page>




<sup>165</sup> Melbourne Water, 2018. Melbourne Water Corporation Adaptive Pathway Planning Guidance, May, 1-31

Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
	This guidance provides Melbourne Water with leading guidance and practice on Adaptation Pathways for the water sector fitting in to Melbourne Water's (MW) business model.					
A2.18	<b>British Standard BS8631<sup>166</sup></b> This forthcoming standard provides a generalised approach to 'Decision making for climate adaption using Adaptive Pathways'.	Delivering adaptation	Portfolio Asset	Guidance Framework	UK	
<b>Part B1: Designing a balanced investment</b>						
B1.1	<b>Value at Risk vs Value Potential<sup>167</sup></b> Methodology to prioritise investment both the 'Value at Risk' (i.e. the damage, harm and costs that could be avoided through an investment into climate and disaster risk reduction) and the 'Value Potential' (i.e. the additional economic value created by the investment) of investments being considered, which together involves qualitative and quantitative elements.	Delivering flood and coastal resilience	Asset	Methodology	Queensland	
B1.2	<b>Prioritisation Framework<sup>168</sup></b> Framework to programme and project investment objectives by shifting the focus from 'assets' (economics) to 'services and communities' (vulnerability). It includes two novel capabilities to inform the prioritisation of investments to reduce climate and disaster risk and assists decision makers in their early rapid assessments of options that are more inclusive and comprehensive of uncertain and qualitative aspects of vulnerability or wellbeing: <ul style="list-style-type: none"> <li>Allows users to evaluate interventions ('options and pathways') based on how much they reduce vulnerability ('value at risk') and the economic net benefits created ('value potential')</li> </ul>	Delivering flood and coastal resilience	Portfolio	Guidance Framework	Queensland	

<sup>166</sup> <https://standardsdevelopment.bsigroup.com/projects/2019-00219#/section>

<sup>167</sup> <https://knowledge.aidr.org.au/media/7712/05-prioritisation-guidance-strategic-decisions-climate-disaster-risk-2020.pdf>



<sup>168</sup> <https://knowledge.aidr.org.au/media/7712/05-prioritisation-guidance-strategic-decisions-climate-disaster-risk-2020.pdf>

Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
	<ul style="list-style-type: none"> <li>Is scenario based – exploring various possible combinations of future hazards, exposure, vulnerability and intervention options and apply different assumptions about changes in climate, population and socio-economic development</li> <li>Provides a rapid assessment process of opportunities for value creation and capture.</li> </ul>					
B1.3	<p><b>Adaptation cost database</b> <sup>169</sup></p> <p>Canadian database of adaption cost estimates including 414 cost estimates for 34 communities across the country. The data base includes information on population, lifespan of the infrastructure, GDP, applicability and discount rates.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p>	<p>Portfolio</p> <p>Asset</p>	<p>Tool</p>	<p>Canada</p>	
B1.4	<p><b>CBAX Tool</b><sup>170</sup></p> <p>The CBAX was first released by the New Zealand Treasury department in 2015, and then updated in 2019. The CBAX tool is a spreadsheet model designed to provide a consistent approach across government to cost benefit analysis. The tool aims to take a long-term and broad view of societal impacts, costs and benefits. The tool accommodates subjective well-being values within decision making and provides guidance for applying these values.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p>	<p>Portfolio</p> <p>Asset</p>	<p>Tool</p>	<p>New Zealand</p>	
B1.5	<p><b>Comprehensive economic evaluation framework (project-IRP2) - CRC for Water sensitive cities</b><sup>171</sup></p> <p>This project has developed an economic evaluation framework and associated tools to identify and quantify economic, environmental and community values of investments in water sensitive practices and systems. It can be applied to business case development and</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p>	<p>Portfolio</p> <p>Asset</p>	<p>Framework</p> <p>Tool</p>	<p>Victoria</p>	

<sup>169</sup> <http://assets.abc.ca/Documents/Disaster/The-Cost-of-Climate-Adaptation-Report-EN.pdf>

<sup>170</sup> <https://www.treasury.govt.nz/information-and-services/state-sector-leadership/investment-management/plan-investment-choices/cost-benefit-analysis-including-public-sector-discount-rates/treasurys-cbax-tool>




<sup>171</sup> <https://watersensitivecities.org.au/content/project-irp2>

Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
	decision making at multiple levels in public and private sector organisations, and contribute towards achieving water sensitive, liveable and resilient cities.					
B1.6	<p><b>PLASK (SPLASH)<sup>172</sup></b> A dialogue and calculation tool for climate adaptation This freely available excel-base tool was designed by the Danish EPA to support investment collaboration between local authorities and utility companies. The tool encourages dialogue and knowledge sharing and compares up to 3 different climate-adaption solutions. Solutions are compared against:</p> <ul style="list-style-type: none"> <li>○ Socio-economic benefits – does it pay to adapt to climate change?</li> <li>○ Cost allocation – who should pay?</li> <li>○ What value does the project provide?</li> </ul>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p>	Portfolio Asset	Tool	Denmark	
B1.7	<p><b>CFRAM Multi-Criteria Analysis (MCA)<sup>173</sup></b></p> <p>The Catchment-based Flood Risk Assessment and Management (CFRAM) programme includes an MCA methodology that includes for social indicators such as:</p> <ul style="list-style-type: none"> <li>○ Minimise risk to human health and life of residents</li> <li>○ Minimise risk to high vulnerability properties</li> <li>○ Minimise risk to social infrastructure and amenity</li> <li>○ Minimise risk to local employment.</li> </ul>	Delivering flood and coastal resilience	Portfolio Asset	Methodology	Ireland	

<sup>172</sup> <https://en.klimatilpasning.dk/tools/plask/>

<sup>173</sup> [https://s3-eu-west-](https://s3-eu-west-1.amazonaws.com/docs.floodinfo.opw/floodinfo_docs/CFRAM_Technical_Supporting_Documents/TMN_for_Option_Appraisal_and_MCA_Rev_B_160714.pdf)

[1.amazonaws.com/docs.floodinfo.opw/floodinfo\\_docs/CFRAM\\_Technical\\_Supporting\\_Documents/TMN\\_for\\_Option\\_Appraisal\\_and\\_MCA\\_Rev\\_B\\_160714.pdf](https://s3-eu-west-1.amazonaws.com/docs.floodinfo.opw/floodinfo_docs/CFRAM_Technical_Supporting_Documents/TMN_for_Option_Appraisal_and_MCA_Rev_B_160714.pdf)





Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
B1.8	<p><b>Flood Risk Sectoral Adaptation Plan</b><sup>174</sup></p> <p>Prepared under the National Adaptation Framework (NAF) this document is an example of a Sector Adaptation Plan for flood risk management which sets-out objectives for an effective and sustainable approach to flood risk management for the future, and promotes co-ordination with other infrastructure sector plans.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p>	Portfolio	Framework	Ireland	
<b>Part B2: Planning to invest and deliver</b>						
B2.1	<p><b>Paying for urban infrastructure adaptation in Canada</b><sup>175</sup></p> <p>This guidance document provides an analysis of current and emerging economic instruments for local governments. The funding and financing tools covered are categorised either as current tools that are commonly used in Canada or as emerging tools that have the potential for greater uptake and use.</p> <p>The guidance highlights opportunities and example of tool that have the potential to incorporate low carbon resilience (LCR) in the planning and design of infrastructure adaptation.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p> <p>Responding to climate emergency</p>	<p>Portfolio</p> <p>Asset</p>	<p>Methods</p> <p>Mechanism</p>	Canada	
B2.2	<p><b>Climate adaptation finance and investment in California</b><sup>176</sup></p> <p>This book serves as a guide for local governments and private enterprises as they navigate the uncharted waters of investing in climate change adaptation and resilience. The guide provides a survey of the issues, considerations and sources of funding to help shape strategies and tactics for investing in adaptation and resilience.</p>	<p>Delivering adaptation</p>	<p>Portfolio</p> <p>Asset</p>	<p>Framework</p> <p>Mechanisms</p> <p>Guidance</p>	California	

<sup>174</sup> [https://www.dccae.gov.ie/documents/Flood\\_Risk\\_Management-Climate\\_Adaptation%20Plan.pdf](https://www.dccae.gov.ie/documents/Flood_Risk_Management-Climate_Adaptation%20Plan.pdf)

<sup>175</sup> <https://act-adapt.org/reports/update-paying-for-urban-infrastructure-in-canada/>

<sup>176</sup> [https://opr.ca.gov/docs/20181106-Keenan\\_Climate\\_Adaptation\\_Finance\\_and\\_Investment\\_in\\_California\\_2018.pdf](https://opr.ca.gov/docs/20181106-Keenan_Climate_Adaptation_Finance_and_Investment_in_California_2018.pdf)





Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
B2.3	<p><b>How to Finance America's Climate Changed Future</b><sup>177</sup></p> <p>This book is a guide to understanding existing resilient infrastructure project finance tools, how to uncover hidden funds, and emerging tools that help to build a business case for investments.</p>	Delivering adaptation	Portfolio Asset	Guidance	USA	
B2.4	<p><b>SPARCC Capital Screening Tool</b><sup>178</sup></p> <p>A multi-institutional initiative known as SPARCC (Strong, Prosperous and Resilience Communities Challenge). The underlying set of resources provides evaluation criteria and methodologies (e.g., weighted MCA) for a variety of asset classes ranging from housing to commercial facilities and from infrastructure to green space. The screening criteria consider racial equity, health and climate change.</p>	Delivering flood and coastal resilience	Portfolio Asset	Tool Guidance	California	
B2.5	<p><b>Repeat Events and Dollars Index Dashboard (REDI)</b><sup>179</sup></p> <p>REDI is a web-based interactive mapping application developed to help Queensland councils better understand their risk, costs and repeat damages from natural disaster events. The data is represented as a 'heat map' to identify and highlight the most frequent and costly damage sites helping Local Councils identify priority works and informed decisions for future investment.</p>	Delivering flood and coastal resilience	Portfolio	Tool	Queensland	
B2.6	<p><b>The Water Futures Book</b><sup>180</sup></p> <p>"The Water Futures book is the culmination of over 5 years of work by many people – all experts in their own right – from many disciplines, professions and walks of life. Hundreds of hours of collaborative efforts have gone into the making of this book. Through the medium of design, we propose a range of water</p>	Delivering flood and coastal resilience	Portfolio	Tool	Queensland	

<sup>177</sup> [https://www.amazon.co.uk/Money-Resilient-Infrastructure-Finance-Americas-ebook/dp/B07LG3QCK2/ref=sr\\_1\\_1?dchild=1&keywords=money+for+resilient+infrastructure&qid=1599496463&sr=8-1](https://www.amazon.co.uk/Money-Resilient-Infrastructure-Finance-Americas-ebook/dp/B07LG3QCK2/ref=sr_1_1?dchild=1&keywords=money+for+resilient+infrastructure&qid=1599496463&sr=8-1)

<sup>178</sup> <https://www.sparcchub.org/2018/03/20/a-new-tool-for-rethinking-community-investment-the-sparcc-capital-screen/>

<sup>179</sup> <https://qldra.maps.arcgis.com/apps/Cascade/index.html?appid=368f6ea5a00944efbc2da7af1da9bc07>


<sup>180</sup> [https://issuu.com/jamesdavidsonarchitect/docs/water\\_futures\\_book\\_-\\_digital\\_version](https://issuu.com/jamesdavidsonarchitect/docs/water_futures_book_-_digital_version)

Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
	management and urban design solutions and strategies that not only protect us in times of need and build community resilience, but will also reduce our ecological impact and improve our quality of life in the face of more frequent and extreme weather events. Water is the key to this; retaining water during drought and allowing it to either flow or slowing it down during floods. Learn. Design. Adapt.”	Delivering adaptation				
B2.7	<p><b>Coastal Response Contributory Fund</b><sup>181,182</sup></p> <p>Long-term funding mechanism being developed for coastal adaptation by Local Councils aiming to embrace current and future funding sources, including public and private beneficiaries (both local and national). Utilising rate payments of beneficiaries to build a fund over time, it seeks to ensure that liabilities fall equitably between current and future generations and consistent and equitable funding between councils.</p> <p>Mechanisms include:</p> <ul style="list-style-type: none"> <li>○ individual councils building and holding funds;</li> <li>○ a collaborative council-owned entity;</li> <li>○ a funding agency of shareholding councils as a council-controlled organisation.</li> </ul>	Delivering adaptation	Portfolio	Mechanism	New Zealand	
B2.8	<p><b>Value Capture</b><sup>183</sup></p> <p>Value Capture offers the potential to generate new funding streams by increasing and leveraging the value created for beneficiaries. This in turn allows governments to deliver new infrastructure that would otherwise not be funded or to bring forward planned infrastructure ahead of time.</p> <p>Value capture can provide a framework to monetise the wider benefits of new infrastructure to provide government with additional</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p>	Portfolio Asset	Framework Methodology	Queensland	




<sup>181</sup> Hawke’s Bay Regional Council (2016) Clifton to Tangoio Coastal Hazards Strategy 2120. [www.hbcoast.co.nz](http://www.hbcoast.co.nz)

<sup>182</sup> Boston, J., & Lawrence, J. (2017). The Case for Climate Change Adaptation Funding Instruments. In Change (Issue August).

<sup>183</sup> <https://knowledge.aidr.org.au/media/7710/03-vulnerability-guidance-strategic-decisions-climate-disaster-risk-2020.pdf>

Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
	<p>sources of funding. These can be targeted directly at the beneficiaries of the particular infrastructure.</p> <p>Value capture works through both funding and financing. Funding mechanisms are deployed to collect contributions from beneficiaries, sized to represent a fair portion of the incremental benefit they will receive. Financial arrangements are then constructed to use the revenues to provide committed capital to meet the costs of the project as they are incurred, which usually means up front during the construction and delivery phase.</p>					
B2.9	<p><b>Local Resilience Action and Investment Tool</b><sup>184</sup></p> <p>A sophisticated yet intuitive Excel tool is being developed to assist local governments in strategically enhancing resilience over time by identifying a suite of potential funding avenues for proposed actions. The output of the tool involves the automated population of a draft Resilience Action and Investment Plan.</p> <p>The tool uses criteria to collect information and categorise the proposed actions through five steps:</p> <ol style="list-style-type: none"> <li>1. Analyse the current state of actions taken to date</li> <li>2. Identify resilience goals</li> <li>3. Undertake a prioritisation review</li> <li>4. Allow the user to review previous funding approvals dating back to 2009</li> <li>5. Identify whether there is a need for funding requirements for each of the proposed actions.</li> </ol> <p>Data collected through these five steps are assessed and compiled to auto-fill a draft Resilience Action and Investment Plan to provide a consolidated record of all works and programs from across council that contribute to building community resilience.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p>	Portfolio	Tool	Queensland	





<sup>184</sup> Queensland Reconstruction Authority. (2020). Resilient Queensland in Action (Issue February). [https://www.qra.qld.gov.au/sites/default/files/2020-03/0501\\_Resilient\\_Queensland\\_in\\_Action\\_February2020\\_LR\\_0.pdf](https://www.qra.qld.gov.au/sites/default/files/2020-03/0501_Resilient_Queensland_in_Action_February2020_LR_0.pdf)

Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
B2.10	<p><b>Motivating Resilience Toolkit</b><sup>185</sup></p> <p>A toolkit of risk-sharing and financial interventions to motivate resilience is currently being developed through under the Economics Programme of the National Resilience Strategy. This includes work on alternative financial mechanisms to deal with residential insurance retreat due to sea-level rise, distributional impacts of earthquake insurance and how to prevent inequality in insurance-related financial transfers, the impacts of red-zoning, and financial incentives for earthquake strengthening outside main urban centres.</p>	Delivering flood and coastal resilience	Asset	Tool	New Zealand	
B2.11	<p><b>A Framework for Project Prioritization and Decision Making</b><sup>186</sup></p> <p>A prioritisation framework guiding optimal community level investments based on community engagement and practical lessons learned from adaptation.</p>	Delivering flood and coastal resilience Delivering adaptation	Portfolio	Tool	Louisiana	
B2.12	<p><b>Climate Change Adaptation Manual for Communities in Louisiana</b><sup>187</sup></p> <p>A climate change adaptation manual for Louisiana: Chapter 3 contains example tools and sources of best practice.</p>	Delivering flood and coastal resilience Delivering adaptation	Portfolio Asset	Tools Method Guidance	Louisiana	

<sup>185</sup> Building Urban Resilience in New Zealand: Lessons from our Major Cities. (2017). [www.cdrrr.auckland.ac.nz](http://www.cdrrr.auckland.ac.nz)

<sup>186</sup> [https://static1.squarespace.com/static/536d55f1e4b07afeea8cef61/t/5d405939d59c750001edd362/1564498272330/Decision-Making+Framework\\_1.pdf](https://static1.squarespace.com/static/536d55f1e4b07afeea8cef61/t/5d405939d59c750001edd362/1564498272330/Decision-Making+Framework_1.pdf)

<sup>187</sup> <https://indd.adobe.com/view/31a5da96-9fa2-4a77-8cab-67527094a2b7>



Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
B2.13	<p><b>LA SAFE<sup>188</sup></b>            LA SAFE is a state-wide resilience policy framework focused on helping communities plan for – and implement – safer, stronger, and smarter development strategies.</p>	Delivering flood and coastal resilience  Delivering adaptation	Portfolio	Framework	Louisiana	
B2.14	<p><b>Climate resiliency design guidelines<sup>189</sup></b>            Guidelines for planners, engineers, architects, and others involved in project delivery on how to use regionally-specific future climate projections in the design of New York City facilities.</p> <p>The guidelines are designed to be used throughout all stages of the project design process, starting with the initiation of capital planning and through final design. They detail how to interpret climate change data on increasing heat, precipitation, and sea-level rise, and how to consider design adjustments needed for resilience.</p>	Delivering flood and coastal resilience  Delivering adaptation  Responding to the climate emergency	Asset	Methodology	New York	
B2.15	<p><b>Finance Guide for Resilient By Design Bay Area Challenge Design Teams<sup>190</sup></b>            A funding and financing reference guide to assist integrated design team. The guide provides a strategic perspective and descriptive overview of funding and financing options to help orient design ideas towards more feasible, fundable projects.</p>	Delivering flood and coastal resilience  Delivering adaptation	Portfolio  Asset	Framework  Mechanisms  Guidance	California	
B2.16	<p><b>Strategies for funding San Francisco's seawall resiliency project<sup>191</sup></b>            A project and asset level guidance document for investigating investment options and developing solutions. Includes assessment</p>	Delivering flood and coastal resilience	Asset	Framework  Mechanisms  Guidance	California	

<sup>188</sup> [https://lasafe.la.gov/wp-content/uploads/2018/09/LASAFE\\_Guidelines\\_Operational\\_v1\\_09162018.pdf](https://lasafe.la.gov/wp-content/uploads/2018/09/LASAFE_Guidelines_Operational_v1_09162018.pdf)

<sup>189</sup> <https://www.adaptationclearinghouse.org/resources/new-york-city-climate-resiliency-design-guidelines.html>




<sup>190</sup> <https://www.adaptationclearinghouse.org/resources/finance-guide-for-resilient-by-design-bay-area-challenge-design-teams.html>

<sup>191</sup> <https://onesanfrancisco.org/sites/default/files/inline-files/Seawall%20Finance%20Work%20Group%20Report%20Final%20version.pdf>

Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
	methodologies and funding strategy heatmaps for aligning solutions with investment opportunities.					
B2.17	<p><b>Canada Infrastructure Bank</b><sup>192</sup></p> <p>Canadian Government initiative to invest \$35 billion in transformative infrastructure project. The design on the CIB includes \$5billion for investment in green infrastructure projects including projects directed at the mitigation of and adaptation to the impacts of climate change and disaster triggered by natural disasters.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p> <p>Responding to the climate emergency</p>	Asset	<p>Methods</p> <p>Mechanism</p>	Canada	
B2.18	<p><b>Canadian Disaster Mitigation and Adaptation Fund</b><sup>193</sup></p> <p>Guidance document setting out the operation of the Canadian Disaster Mitigation and Adaptation Fund (DMAF). The DMAF is aligned with the national climate policy objectives through the "The Climate Lens" requirements. The requirements includes GHG mitigation assessment, which will measure the anticipated Greenhouse Gas (GHG) emissions impact of an infrastructure project; and the climate change resilience assessment, which employs a risk management approach to anticipate, prevent, withstand, respond to, and recover from a climate change related disruption or impact.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering adaptation</p> <p>Responding to the climate emergency</p>	Asset	<p>Method</p> <p>Guidance</p>	Canada	

<sup>192</sup> <https://cib-bic.ca/en>




<sup>193</sup> <https://www.infrastructure.gc.ca/alt-format/pdf/dmaf-faac/dmaf-faac-guidelines-flat-e.pdf>

Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
B2.19	<p><b>The Climate Resilience Express program</b><sup>194</sup></p> <p>A streamlined process for developing climate resilience action plans for smaller communities. Through this program, communities identify climate risks and quantify relevant adaptation costs.</p>	Delivering adaptation	Portfolio	Methodology	Canada	
B2.20	<p><b>EcoAdapt's Climate Adaptation Kit</b><sup>195</sup></p> <p>A Climate Adaptation Starter Kit in six parts:</p> <ol style="list-style-type: none"> <li>1. Vulnerability Assessment - resources for climate change vulnerability, risk and impact assessment.</li> <li>2. Adaptation Frameworks - processes to guide the development of climate change adaptation strategies.</li> <li>3. Adaptation Portals and Tools - a sampling of climate adaptation portals, tools, and resources.</li> <li>4. Examples of Adaptation Projects - climate change adaptation case studies.</li> <li>5. Getting Started - where to begin, working with what you already have, and avoiding maladaptation.</li> <li>6. Evaluation and Monitoring - on how adaptation programs are succeeding.</li> </ol>	Delivering adaptation	Portfolio	Tools Guidance	Canada	
B2.21	<p><b>Coastal Response Contributory Fund</b><sup>196</sup></p> <p>Examples of long-term funding mechanisms for coastal adaptation to address intra and intergenerational equity and embrace current and future funding sources. Mechanisms include:</p> <ul style="list-style-type: none"> <li>o individual councils building and holding funds;</li> <li>o a collaborative council-owned entity;</li> </ul>	Delivering adaptation	Portfolio	Mechanism	New Zealand	

<sup>194</sup> <https://www.allonesky.ca/climate-resilience-express>

<sup>195</sup> <http://ecoadapt.org/programs/awareness-to-action/climate-starter-kit>

<sup>196</sup> [https://www.victoria.ac.nz/\\_data/assets/pdf\\_file/0005/1175243/WP17-05-Climate-change-adaptation.pdf](https://www.victoria.ac.nz/_data/assets/pdf_file/0005/1175243/WP17-05-Climate-change-adaptation.pdf)





Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
	<ul style="list-style-type: none"> <li>o a funding agency of shareholding councils as a council-controlled organisation.</li> </ul>					
B2.22	<p><b>Climate Action Regional Offices<sup>197</sup></b></p> <p>A framework for collaborative innovation for adaptation and developing adaptive capacity in the process. The framework coordinates engagement across the whole of Government, and drives practical policy and behavioural changes within communities to encourage both businesses and citizens to embrace the need for climate action.</p> <p>Central government has funded the creation of four CARO innovation hubs. Each CARO addresses a different climate change hazard and is Governed by a cluster of County Councils that are vulnerable to that hazard.</p>	Delivering Adaptation	Portfolio	Framework Methodology	Ireland	
B2.23	<p><b>Building Adaptive and Resilient Communities (BARC)<sup>198</sup></b></p> <p>BARC is a national programme run by ICLEI which aims to build the capacity of local government and support multi-stakeholder collaboration. BARC can be tailored to the needs of individual municipalities and provides innovation tools and resources for adaptation.</p>	Delivering flood and coastal resilience Delivering adaptation	Portfolio	Programme	Canada	
B2.24	<p><b>QCoast 2100 Programme<sup>199</sup></b></p> <p>This Queensland programme is described as an opportunity to “get on the front foot in adaptation planning to implement cost-effective measures over the medium and long term, plan for development and growth, budget for higher costs, collaborate regionally and seek investment opportunities”. The programme published minimum standards and guidelines for coastal hazard adaptation including socio-economic appraisal of adaptation options.</p>	Delivering flood and coastal resilience Delivering adaptation	Portfolio	Programme	Queensland	

<sup>197</sup> <https://www.climateireland.ie/#!/resources/caros>

<sup>198</sup> <https://icleicanada.org/barc-program/>





<sup>199</sup> <http://www.qcoast2100.com.au>



Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
B2.25	<p><b>Queensland Resilient Councils Programme</b></p> <p>The programme was established in 2016 by the Local Government Association of Queensland (LGAQ) and the Department for Environment and Science (DES) to strengthen decision-making capabilities to plan for and respond to the challenges and opportunities arising from climate change.</p>	<p>Delivering adaptation</p> <p>Responding to the climate emergency</p>	Portfolio	Programme	Queensland	
B2.26	<p><b>Alliance of Regional Collaboratives for Climate Adaptation</b></p> <p>This programme was established to build the capacity of local government by sharing best practices and resources, identifying strategies to overcome key barriers and challenges, and conducting joint campaigns and projects. ARCCA is also supporting two research projects that aim to define practical opportunities to overcome financial and institutional barriers to implementing local adaptation strategies as part of California's Fourth Climate Change Assessment.</p>	<p>Delivering adaptation</p> <p>Responding to the climate emergency</p>	Portfolio	Programme	California	
B2.27	<p><b>National Dialogue on Climate Action<sup>200</sup></b></p> <p>Tool to engage people with the challenge of climate change; motivate changes in behaviour; and create structures at local, regional and national levels to support the generation of ideas and their translation into appropriate cost-effective actions.</p>	<p>Delivering flood and coastal resilience</p> <p>Responding to climate emergency</p>	Portfolio	Tool	Ireland	
B2.28	<p><b>Community Rating System<sup>201</sup></b></p> <p>Method for rewarding effective community adaptation. The Community Rating System (CRS) is a programme to try and stimulate private sector investment by reducing insurance premiums by up to 50% if adaptation measures are beyond a given level, and increasing premiums if below it. The scheme is available for high flood risk communities.</p>	<p>Delivering adaptation</p>	<p>Portfolio</p> <p>Asset</p>	Method	Louisiana	

<sup>200</sup> <https://www.dccae.gov.ie/en-ie/climate-action/topics/national-dialogue-on-climate-action/Pages/default.aspx>

<sup>201</sup> [https://www.fema.gov/media-library-data/1535126505943-439b296e7778b037d05f698f65c7891b/2018NFIP\\_CRS\\_Brochure\\_June\\_2018\\_508OK.pdf](https://www.fema.gov/media-library-data/1535126505943-439b296e7778b037d05f698f65c7891b/2018NFIP_CRS_Brochure_June_2018_508OK.pdf)




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B2.29	<b>FAIR framework<sup>202</sup></b> The FAIR Framework ‘tactical handshake’ is a methodology for connecting strategic / policy decisions with delivery /operational practice. This was developed through an EU project and built on practical experience of managing an asset in Hamburg.	Delivering flood and coastal resilience	Portfolio Asset	Methodology	Germany	
B2.30	<b>Design-led decision support for regional climate adaptation<sup>203</sup></b> Outlines a decision support framework for policy makers to engage multiple perspectives in regional climate adaptation planning, and includes a project manual comprising both the methods used in the project and a how to guide for undertaking charrette-based, design-led decision support for climate adaptation planning.	Delivering flood and coastal resilience Delivering adaptation	Portfolio Asset	Framework Methodology Guidance	Victoria	
B2.31	<b>Resources for building waterfront resilience New York State Water Resources Institute<sup>204</sup></b> This is a web-based information page from NY state. It provides an overview of resources to help communities adapt to a changing climate.	Delivering Adaptation Delivering flood and coastal resilience	Portfolio Asset	Framework	New York	
B2.32	<b>Financing Urban Resiliency: Coastal Resiliency in Lower Manhattan<sup>205</sup></b> This applied research project market tested potential financing solutions for waterfront resiliency in Manhattan. Key recommendations included Improve Data Collection, Metrics,	Delivering Adaptation Delivering flood and coastal resilience	Portfolio Asset	Tools	New York	

<sup>202</sup> [https://northsearegion.eu/media/13662/fair\\_end\\_report-03-06-2020.pdf](https://northsearegion.eu/media/13662/fair_end_report-03-06-2020.pdf)

<sup>203</sup> <https://apo.org.au/sites/default/files/resource-files/2014-05/apo-nid234831.pdf>

<sup>204</sup> <https://wri.cals.cornell.edu/hudson-river-estuary/climate-change-hudson-river-estuary/resources-resilience>

<sup>205</sup> [https://milkeninstitute.org/sites/default/files/reports-pdf/FILAECOM\\_New%20York\\_Executive\\_Summary%20FINAL.pdf](https://milkeninstitute.org/sites/default/files/reports-pdf/FILAECOM_New%20York_Executive_Summary%20FINAL.pdf)




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	Quantification of Risk, Expand Municipal Bond Options, Design an Insurance Surcharge etc.					
B2.33	<p><b>An Inventory of State Coastal Resilience Authorities and Funding Mechanisms to Help Guide Virginia<sup>206</sup></b></p> <p>This is an inventory of governance of coasts across the US with useful discussion of funding mechanisms for adaptation and resilience. For example New Hampshire enacted legislation that allows municipalities to create a tax incentive program that will encourage coastal resilience. Localities can establish “Coastal Resilience Incentive Zones,” which provide homeowners with tax relief when they undertake resilience measures within those zones.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering Adaptation</p>	<p>Portfolio</p> <p>Asset</p>	Tools	New York	
B2.34	<p><b>Playbook 1.0: How Cities Are Paying for Climate Resilience<sup>207</sup></b></p> <p>The Playbook contains eight distinct strategies to financing resilience. It provides a foundation of an emerging financial capacity that cities are building in response to climate change. Some cities are already experimenting with strategies that could become part of Playbook 2.0. It gives a clear picture of how cities across the US are trying to fund resilience.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering Adaptation</p>	<p>Portfolio</p> <p>Asset</p>	<p>Methodology</p> <p>Tools</p>	USA	
B2.35	<p><b>New York Resilience Indicators and Monitoring Systems<sup>208</sup></b></p> <p>The New York Panel on Climate Change are currently developing a system to support the charting and monitoring of adaptive pathways. Indicators being explored include:</p> <ul style="list-style-type: none"> <li>○ data collection agencies</li> <li>○ NYC processing centres</li> </ul>	<p>Delivering flood and coastal resilience</p>	<p>Portfolio</p>	<p>Framework</p> <p>Methodology</p> <p>Tool</p>	New York	

<sup>206</sup> <https://www.epa.gov/waterfinancecenter/dc->

<sup>207</sup>

<https://static1.squarespace.com/static/5736713fb654f9749a4f13d8/t/5d275d9135b62f0001df44b5/1562860947122/Playbook+1.0+How+Cities+Are+Paying+for+Climate+Resilience+July+2019.pdf>

<sup>208</sup> <https://nyaspubs.onlinelibrary.wiley.com/doi/10.1111/nyas.14008>

Cat No	Title and details	Applicability: investment category	Applicability investment level	Resource type	Jurisdiction	Link
	<ul style="list-style-type: none"> <li>Urban decision makers</li> <li>Policies, projects and progress.</li> </ul>	Delivering Adaptation				
B2.36	<p><b>Lesson Management Framework<sup>209</sup></b></p> <p>This Queensland Framework is designed to drive continuous improvement and knowledge sharing across disaster prevention, preparedness, response and recovery. The framework consists of six key elements: governance, enabling environment, engagement, learning culture, tools and lessons management lifecycle.</p>	Delivering flood and coastal resilience	Portfolio	Framework	Queensland	
B2.37	<p><b>Rebuild by Design<sup>210</sup></b></p> <p>Rebuild by Design began as a design competition, launched by the U.S. Department of Housing and Urban Development (HUD) in partnership with non-profits and the philanthropic sector, in response to Hurricane Sandy's devastating impact on the eastern U.S. The premise was to raise the bar for response, preparedness, and resilience. Driven by innovation and collaboration, it became a model to help governments create research-based, collaborative processes that prepare communities and regions for future challenges.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering Adaptation</p>	<p>Portfolio</p> <p>Asset</p>	<p>Programme</p> <p>Methodology</p> <p>Tools</p>	New York	
B2.38	<p><b>City Labs<sup>211</sup></b></p> <p>The Danish Municipality of Vejle has established a series of City Laboratories to innovate through action learning to identify what optimal outcomes for resilience to climate change are, and how to fund them. Starting conditions assume that social cohesion is an important part of resilience. The Laboratory processes are designed to contribute to the development of social cohesion by directly engaging communities in the co-creation of resilience plans as well as the identification and design of optimal investments.</p>	<p>Delivering flood and coastal resilience</p> <p>Delivering Adaptation</p>	Portfolio	Programme	Denmark	

<sup>209</sup> <https://www.iggem.qld.gov.au/sites/default/files/2020-07/IGEM%20Lessons%20Management%20Framework.pdf>

<sup>210</sup> <http://www.rebuildbydesign.org/about>

<sup>211</sup> <https://www.arup.com/perspectives/publications/research/section/vejle-resilience-strategy>

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