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FINAL REPORT NO. FR 411

Improving Australian climate change adaptation strategies: learning from international experience

Authored by

Francesca Perugia, Curtin University

Steven Rowley, Curtin University

Mohammad Swapan, Curtin University

Publication Date October 2023

DOI 10.18408/ahuri8129101

Title

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Authors

Francesca Perugia, Curtin University
Steven Rowley, Curtin University
Mohammad Swapan, Curtin University

ISBN

978-1-922498-78-6

Key words

Urban adaptation, climate change, urban development, urban policies, cyclones, bushfire, flooding

Series

AHURI Final Report

Number

FR 411

ISSN

1834-7223

Publisher

Australian Housing and Urban Research Institute Limited
Melbourne, Australia

DOI

10.18408/ahuri8129101

Format

PDF, online only

URL

https://www.ahuri.edu.au/research/final-reports/FR411

Recommended citation

Perugia, F., Rowley, S. and Swapan, M. (2023) *Improving Australian climate change adaptation strategies: learning from international experience,* AHURI Final Report No. FR 411, Australian Housing and Urban Research Institute Limited, Melbourne, https://www.ahuri.edu.au/research/final-reports/FR411, doi: 10.18408/ahuri8129101.

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Acknowledgements

This material was produced with funding from the Australian Government and state and territory governments. AHURI Limited gratefully acknowledges the financial and other support it has received from these governments, without which this work would not have been possible.

AHURI Limited also gratefully acknowledges the contributions, both financial and in-kind, of its university research partners who have helped make the completion of this material possible.

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Acronyms and abbreviations used in this report

AHURI	Australian Housing and Urban Research Institute Limited
ACT	Australian Capital Territory
AIDR	Australian Institute for Disaster Resilience
BoM	Bureau of Meteorology
CCA	Climate Change Adaptation
COAG	Council of Australian Governments
CoP	Conference of Parties
CRS	Community Rating System
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Department of Agriculture Water and the Environment
DRR	Disaster Risk Reduction
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRMs	Flood Insurance Rate Maps
FMA	Flood Mitigation Assistance
GHG	Green House Gasses
IPCC	Intergovernmental Panel on Climate Change
LAKI	Lima Adaptation Knowledge Initiative
MSFH	My Safe Florida Home
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NSW	New South Wales
NT	Northern Territory
NWP	Nairobi Work Programme
QLD	Queensland
SA	South Australia
SDGs	Sustainable Development Goals
TAS	Tasmania
UK	United Kingdom
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
VIC	Victoria
WA	Western Australia
WSUD	Water-Sensitive Urban Design
WUI	Wildland Urban Interface

Executive summary

Key Points

- Adaptation is identified in the literature as bringing together interventions and decisions concerning climate change, disaster risk reduction (DRR), and sustainable development.
- In Australia, at the national level, adaptation policy frameworks rely on an aspirational strategic document, the 2021 National Adaptation Strategy. This strategy does not provide concrete guidance for action or link to structured financial mechanisms for its implementation.
- Across Australia's different states and territories, adaptation approaches vary; each jurisdiction adopts a different policy framework, with Victoria being the only state mandating adaptation plans.
- In the United States (US), the current federal administration has invested in strengthening federal standards and establishing long-term financial support for mitigation actions, shifting toward more nature-based solutions to protect cities and urban centres from the impact of natural disasters.
- The European (EU) roadmap to 2050 climate resilience, the Green Deal, frames the EU adaptation approach, which bridges national urban policies and interventions coherently.
- This study finds that substantial and long-term financial investments, community-based risk management, and nature-based solutions are common traits of effective mitigation strategies implemented internationally to effectively address natural disaster impact on cities.

- **A lack of leadership by the Australian Government, fragmentation of governance structure, and a tendency of 'business as usual' approaches has been highlighted by experts as undermining the opportunities to adopt discussed international strategies for effective adaptation in Australia.**

- **Further research to inform policy development is needed to improve the current governance model to align leadership, organisation, and policy through better coordination of actors, actions and regulations to increase institutional capacity.**

Key findings

At the national level, Australia lacks strong direction and action concerning adaptation relative to sustainable development. Even though adaptation is defined within the context of overarching sustainability goals (as partially implied in the definition provided in the 2021 National Adaptation and Resilience Strategy), it is addressed relative to the built environment through disaster risk reduction—mostly recovery. Australia lacks a strong overarching direction in climate change adaptation, including legislation and funding.

Based on analysis of international approaches to adaptation at the national level (in the US) and sub-regional scale (in the EU), adaptation emerges as a strong area of intervention to climate change, equivalent and complementary to Greenhouse Gas (GHG) emissions reduction. The US and the EU have established overarching policy frameworks, injected considerable funding through long-term financial commitment and developed mechanisms to support intervention in this area. The policy mapping and case studies present three main strategic approaches that guide effective intervention directed at adaptation in the context of mitigating the effects of natural disasters on urban and regional settlements: (i) long-term investment and holistic approach to addressing the issues; (ii) community resilience building as a pillar to sustain the resilience of our cities, especially enhancing the strength of community vulnerable to disasters; (iii) innovation in approach to structural solutions that rely on respecting and reinforcing the ecological system as a mean to build resilience, i.e. nature-based solutions.

From the interviews with experts, it emerges that the governance structure and distribution of roles and responsibilities among Australia's three tiers of government are barriers to adopting international strategies. Moreover, according to the interviews, there is good knowledge and understanding of the best practices identified in the case studies and policy mapping relative to climate change adaptation among Australian experts in sustainable development and DRR and policy makers. However, these best practices are implemented ad hoc, lacking an overarching plan that would make them more effective. The experts highlighted a reactive attitude to implementing natural disaster responses, which results in a 'business as usual' type of intervention. The experts pointed out that this way of operating is a barrier to innovation. Community-based models for risk reduction were also identified as an opportunity to build social resilience in disaster risk areas that would support structural interventions.

Policy development options

The overview of policy intervention in Australia shows how—in the absence of clear direction from the Australian Government—fragmentation in adaptation responses is inevitable. Without a national strategy, there is a multiplication of legislation and approaches developed by the individual state, territory and local governments. Specific policy approaches and strategies to overcome this key limitation to effective adaptation strategies could include:

- Amendment to the *Climate Change Act 2022* to include adaptation and to demonstrate a legislative commitment to tackle adaptation and recognise its role as to mitigation
- delivery of a more robust policy framework at the federal level, including the development of a national adaptation plan with concrete actions, timeframes and resources for implementation in the short and long-term
- revision of the Environment Protection and Biodiversity Conservation (EPBC) Act 1999 for stricter and more comprehensive consideration of the impact of existing and future development in relation to climate change
- development of financial mechanisms that provide ongoing financial support for adaptation initiatives, including insurance schemes
- building institutional capacity and better coordination of stakeholders and communication across different levels of government and other external actors
- ongoing investment in community resilience and engagement in adaptation to deliver more sustainable physical and social infrastructures.

The study

Government plays a crucial role in helping address the economic and social impacts of the increasing frequency, duration and intensity of extreme natural events and associated disasters caused by the shifting weather patterns linked to climate change. Governments at all levels implement policies and adopt strategies to protect and support communities through climate adaptation. The *2030 Agenda for Sustainable Development* identifies the urgent need to reduce the risk of natural disasters (United Nations 2015c). The 2020 inquiry on the *Current and future impacts of climate change on housing, buildings and infrastructure* identified the need to provide appropriate information about managing climate risks to all stakeholders for better decision making (Royal Commission 2020).

This research project analyses international practices and programs targeting natural disaster events associated with climate change, focusing on adaptation. It explores the limits and opportunities within current Australian policy to support the implementation of best practices and programs across Australian urban and regional cities. The following overarching research question guides the research:

What international best practices and policy approaches addressing resilience and adaptation to climate change could be translated into the Australian context to meet the 2030 Agenda for Sustainable Development goals?

This overarching research question addresses three sub-questions:

- **RQ1:** What policies exist in Australia and globally aimed at improving sustainable urban development and addressing climate change?
- **RQ2:** What evidence exists of the positive impact of best practices in lessening the impact of natural disasters on cities' liveability and dwelling supply?
- **RQ3:** How could the best practices identified in responding to RQ2 be incorporated into urban policy in Australia?

Using a mixed-methods approach, the project explores Australian and international policies addressing climate change adaptation (desktop and literature analysis). It then presents three international case studies of best practices addressing hazardous natural events experienced in Australia: flooding, cyclones and bushfires. It discusses the adaptation strategies in the context of policy, governance and leadership structure. Finally, in discussion with experts (interviews), it investigates how these best practices and policy approaches could be implemented in Australia.

1. Introduction

- Australian capital cities and regional areas have been heavily impacted by the escalating frequency, duration and intensity of natural hazards, such as bushfires, floods and cyclones.
- Existing research highlights the importance of implementing adaptation strategies to reduce the risk and impact of natural disasters and changes in weather patterns on our cities.
- This research explores how climate change adaptation practices, strategies and policies implemented internationally could be adopted to support the sustainable development of cities and towns across Australia.
- The research adopts a case study approach to investigate the benefits and positive outcomes of implementing various adaptation measures. Three case studies were identified using a criterion sampling approach. Each case study addresses the most common climate change-related natural disasters experienced in Australia: flooding, cyclones and bushfires.
- Identified international best practices were discussed in interviews with experts in urban policy and governance, sustainability and housing. These experts, working within different levels of government, were asked to explore barriers and opportunities to implement such practices in Australia.

1.1 Climate change and sustainable urban development

The increasing frequency, duration, and intensity of extreme weather events are heavily impacting Australian capital and regional urban centres. According to the *State of Climate Report* (BoM Bureau of Meteorology and CSIRO Commonwealth Scientific and Industrial Research Organisation 2022), the southern part of Australia has recorded a decrease in rainfall since the 1970s, and the fire season has extended. At the same time, the northern part of the country has seen an increase in rainfalls. These changes in the Australian weather are linked to global warming (Trewin et al. 2021). The 2022 United Nations Intergovernmental Panel on Climate Change (IPCC 2022) report states that global temperatures will rise to at least 1.5°C above pre-industrial levels within the next two decades without significant decarbonisation. Current interventions put in place will have the capacity to reduce future increases in temperatures. However, the rise in temperature we are currently recording, due to the heat inertia of the oceans, is already locked in regardless of the mitigation strategies implemented globally to control and reduce greenhouse emissions (Woetzel et al. 2020). This means that weather-related disasters—including bushfires and flooding caused by heavier rainfalls and cyclones—will continue to impact cities around the globe, Australia included.

In the last 10 years, the Australian Government and state and territory governments have been increasingly called upon to help communities recover from natural disasters. During the bushfire season of 2019—20, dubbed the Black Summer, 3,500 dwellings were affected in New South Wales (NSW). In the regional town of Kalbarri in Western Australia (WA), 70 per cent of houses were damaged in April 2021 by the unexpected change in the direction of hurricane Sejora. At the beginning of 2022, the flooding caused by the La Nina weather cycle devastated parts of NSW and Queensland (QLD), impacting an estimated 10,500 properties (Department of Premier and Cabinet NSW 2022). The Deloitte (2021) report *Special report: Update to the economic costs of natural disasters in Australia*, forecasts that the impact of natural disasters will cost Australia $73 billion by 2060 under a low emissions scenario. This is significantly higher than the $39 billion by 2050 that Deloitte estimated four years earlier (Deloitte 2017). However, there is no clear picture of the long-term impact of natural disasters on urban development (Athukorala et al. 2016; Eriksen et al. 2020).

Given that natural disasters are likely to become increasingly common events, urban systems need to be resilient to be sustainable. As such, responding to environmental changes related to climate change (adaptation) is essential and complementary to efforts to reduce GHG emissions (mitigation). While mitigation efforts are needed to minimise further damage to our planet, these are insufficient because of the significant time lag between the action and the results observed. In the next 30 years, we will experience climate changes linked to emissions released in the past 30 years (Trewin et al. 2021). Adaptation approaches addressing the inevitable change in the weather patterns and intensity need to go hand-in-hand with the Australian government's internationally agreed objective to reach net-zero emissions by 2050.

Australia's national science agency—the Commonwealth Scientific and Industrial Research Organisation (CSIRO)—puts adaptation at the top of the seven megatrends with the potential for substantial transformative impact in addressing climate change (Naughtin et al. 2022). The sixth assessment report of the IPCC (Pörtner et al. 2022:20) states that: 'Adaptation can generate multiple additional benefits such as improving agricultural productivity, innovation, health and wellbeing, food security, livelihood, and biodiversity conservation as well as reduction of risks and damages'.

This is not a new recommendation. At the beginning of the new century, the Panel had already identified the development of adaptation response and a better understanding of the barriers to adaptation as one of the top priorities for closing the gap between knowledge of climate change and policy making addressing it (McCarthy et al. 2001). However, it was not until the 2015 Paris Agreement that adaptation was recognised as an equal priority to mitigation in the global fight against climate change (Lesnikowski et al. 2017).

Urban planning and policies are regarded as crucial instruments to promote adaptation; they facilitate decisions on the future use of space and management of infrastructure (planning and delivery), which can reduce the likelihood and impacts of disasters on the built environment. Alan and Jorge (2013: 1) point out:

> *Urban planning has developed from a range of disciplines including design, health, law, social reform and economic management. With its grounding, at least in most developed countries, in legislative agency, governmental and professional fundamentals, it has established legitimacy as a base for actions.*

Moreover, Smit et al. (2001: 879) notice that the positive effect of adaptation policies is immediate—contrary to mitigation measures—and their cost is often 'marginal to other management or development costs'.

Given the importance of urban planning in adaptation, our research assumes a global perspective in scoping successful urban adaptation best practices. It explores how these could be adopted in Australia to support the sustainable development of cities and towns across Australia.

1.2 Adapting to climate change: an international policy framework

From a policy standpoint, the response to climate change is framed as a global response (goals and targets) under individual responsibilities—that is, national and local actions taken to meet international commitments. Therefore, understanding the international policy framework in which these national and local responses operate is essential. This includes defining adaptation, what it entails, and how responses to climate change align with disaster risk management and sustainable development.

The journey toward international cooperation to address the damage of anthropogenic climate change started in the mid-1980s with the Vienna Convention and the declared intention of the global community to work together towards reducing GHG emissions to protect the ozone. This initial step was followed in 1992 by the drafting and consequent adoption of the United Nations Framework Convention on Climate Change (UNFCCC), also known as The Convention. This legally binding document was the first to directly acknowledge climate change and call for international collaboration to address it. Five years later, the Kyoto Protocol was developed to operationalise the UNFCCC, followed in 2015 by the Paris Agreement.

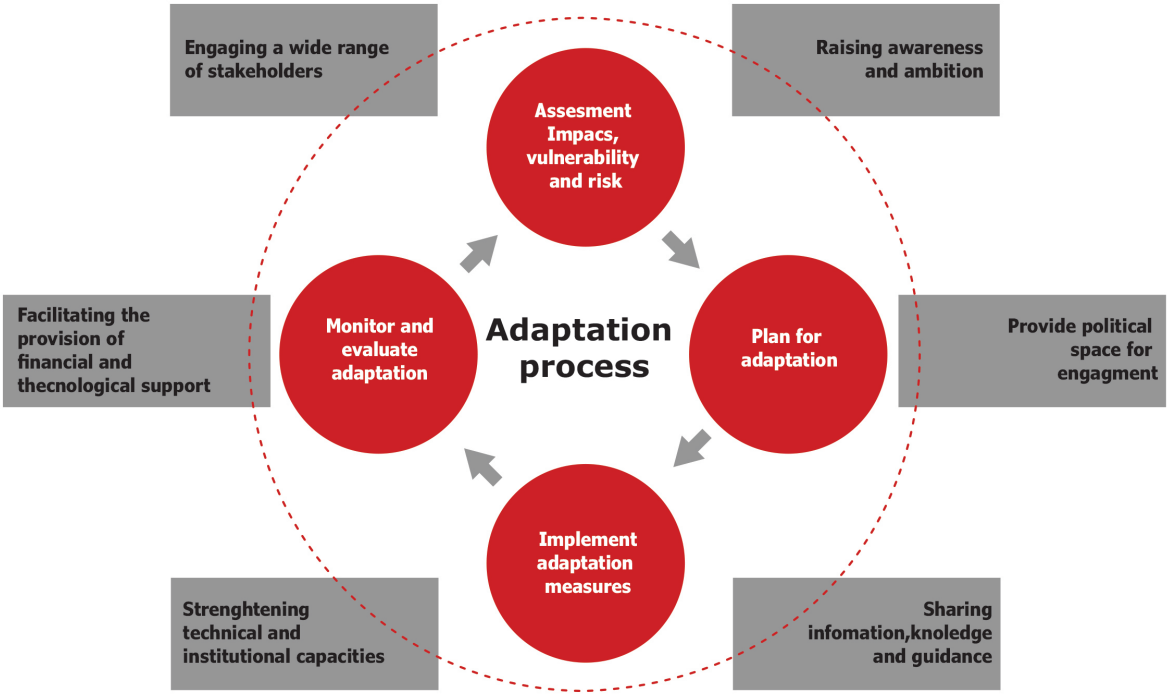
Since 1992, the international community has increased its cooperation and updated its commitments to address issues related to climate change while evolving its legislative and governing structure to guarantee the achievement of agreed goals and targets. However, while the commitment of the international community to address climate change has grown and strengthened since the adoption of the UNFCCC, the overall narrative of the actions identified to tackle climate change has remained intact over the last three decades. In particular, two focus areas emerge in the legal documents produced by the United Nations (UN): the enhancement and sharing of knowledge and the financial commitment needed to adapt to climate change. The work accomplished under the Convention is also characterised by an underlying narrative that divides the responsibilities and actions of developed and developing countries[1]. Developed countries are asked to reduce emissions, invest in knowledge, and identify financial mechanisms for supporting developing countries to adapt to the new global climate. Developing countries are called upon to enhance their capacity to adapt through knowledge sharing and technological advancement.

1 Developed countries refer to 'developed economies', while 'developing countries' refer to 'developing economies' only and exclude economies in transition as defined by the UN. https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/WESP2022_ANNEX.pdf

1.2.1 Understanding adaptation

While the roles, actions and responsibilities expected by developing and developed countries have remained a constant in the evolving international climate change agenda, what adaptation entails and its role in addressing climate change has evolved,[2] especially concerning mitigation. The narrative on the relationship between mitigation and adaptation was first set with the 1992 Convention. The UNFCCC (United Nations 1992) identifies adaptation and mitigation as the two main approaches to tackling climate change, focusing mainly on mitigation strategies and framing adaptation as their by-product. Within the document, mitigation involves the reduction of GHG emissions, while climate change adaptation (CCA) encompasses all those changes in the ecological, social, and economic systems facilitated by the implemented mitigation strategies, reducing exposure to climate changes related risks (Dupuis and Biesbroek 2013; Termeer et al. 2017) (Figure 1).

Figure 1: Adaptation Process



Source: adapted by authors from https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/what-do-adaptation-to-climate-change-and-climate-resilience-mean

2 Refer to Appendix 1 Table A1 for a timeline of international policy framework for a complete mapping of adaptation in international agreements and documents.

This central narrative is paired with a secondary storyline, which identifies adaptation as a need for developing countries to cope with and respond to climate change's adverse effects. In particular, the Convention recognises the cost associated with climate change and calls for financial support to help developing countries adapt. This approach to adaptation remains unchanged with the successive operational translation of the UNFCC with the Kyoto Protocol. It is then reinforced through the work initiated in 2005 at the Conference of Parties (CoP) Nairobi (CoP11). The CoP11 concluded with the launch and implementation of three main initiatives: the Nairobi Work Programme on Adaptation (NWP), the UNFCCC Knowledge-to-Action Hub for Climate Adaptation and the Resilience Lima Adaptation Knowledge Initiative (LAKI). All these initiatives address developing countries' adaptation to climate change, focusing on knowledge building and information exchange.

With time passing, adaptation slowly emerged as a concept independent of mitigation strategies. Compared to the Convention, the Kyoto Protocol already shows a step in this direction. Article 10 (b) of the Protocol distinctively calls for 'measures to mitigate climate change and the measures to facilitate adequate adaptation to climate change' (United Nations 1998). However, it was not until the Paris Agreement (United Nations 2015a) that the understanding and role of adaptation changed significantly. In the context of the Paris Agreement, adaptation emerges as an independent strategy for addressing climate change that is equal to mitigation (Craft and Fisher 2018). CCA is conceptually reframed, shifting from 'understanding vulnerabilities to climate change, and therefore where, and why adaptation is needed' to be defined as a 'global goal' for all parties to work towards (Singh et al. 2021:1).

The Paris Agreement expands the definition of CCA by assuming a global perspective and articulating global targets, demanding accountability, and mandating the review of the adequacy and effectiveness of adaptation measures implemented by individual countries. This shift in the definition of the role of CCA also impacted the implemented funding mechanisms and allocations, resulting in a reduced gap between financial investment in mitigation and adaptation actions (Ileana et al. 2022).

1.2.2 Adaptation: linking climate change, risk reduction and sustainable development

The year 2015 marked a change towards framing adaptation as a global issue in three important documents: the Paris Agreement, the Sustainable Development Goals (SDGs)— as part of the 2030 Agenda for Sustainable Development—and the Sendai Framework for Disaster Risk Reduction 2015—2030.

- **Paris Agreement**

The Paris Agreement set the definition of adaptation and responsibilities. It recognises, in principle, the importance of 'enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change' and 'contributing to sustainable development' (United Nations 2015a, Art. 7, par 1). However, it frames climate change as separate from processes aimed at achieving sustainability and managing natural disaster-related risks (Kelman 2017).

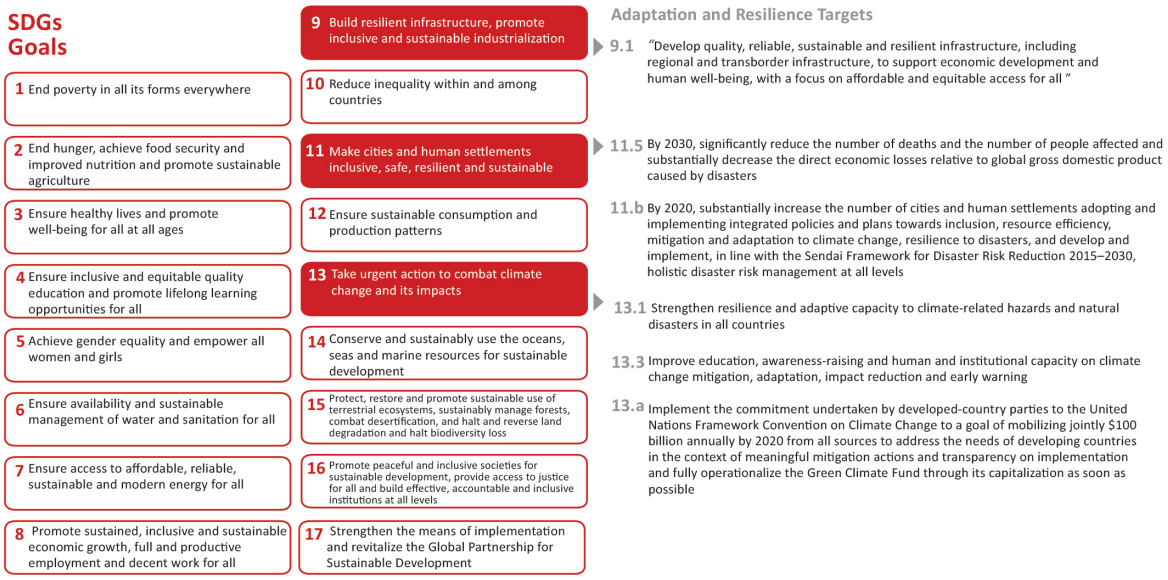
- **Sustainable Development Goals**

The SDGs outline key integrated actions within the three pillars of sustainable development[3]—economic, social, and environmental— articulated in 17 goals and 169 targets for global action (Figure 2). The preamble to the SDGs (United Nations 2015c:9) recognises adaptation at the same level of mitigation in achieving sustainable development, calling for international cooperation 'accelerating the reduction of global greenhouse gas emissions and addressing adaptation to the adverse impacts of climate change'. SDG13 calls explicitly for climate change action. This goal directly refers to the commitment to address climate change and related risks made by the international community under the UNFCCC and the Sendai Framework. Moreover, it supports the Convention's lead role in driving national policies and strategies addressing climate change in its second target. SDG13 also directly refers to the Sendai Framework in the first target, which reads: 'Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries' (United Nations 2015c:23). In addition, it identifies the number of DRR strategies implemented at a national level as an indicator of successful advancement towards reaching the goal. Overall, the 2030 Agenda for Sustainable Development acknowledges the need to urgently reduce the risk of disasters applicable to urban and regional cities and address it in SDG9, 'Industry, innovation and infrastructure', and SDG11, 'Sustainable cities and communities'.

- **Sendai Framework**

The Sendai Framework set the international agenda on disaster risk, including seven main targets to be achieved by 2030, four priorities for action, and a set of guiding principles. This recognised the importance of sustainable development and adaptation to climate change in DRR under section VI, International Cooperation and Global Partnership (United Nations 2015b). The Framework acknowledges that climate change is linked to disaster risk while specifying that managing risk remains the central mandate of the Convention. It identifies a need for 'interrelated intergovernmental processes' to achieve the goals set by both documents (United Nations 2015b:11).

Figure 2: SDGs goals and targets related to adaptation and resilience

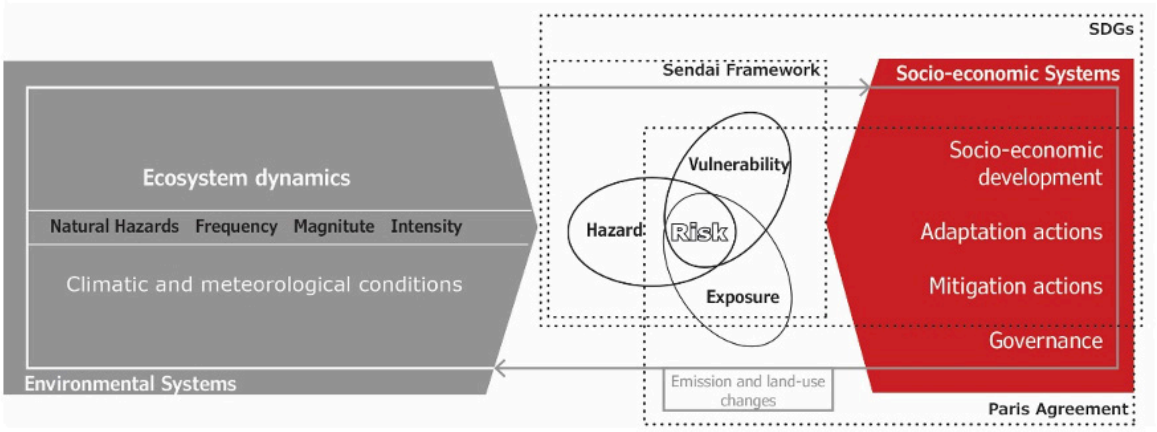


Source: author from United Nations (2015c).

3 Sustainable development is defined as a development that 'meets the needs of the present without compromising the ability of future generations to meet their own needs' (UN 1987, Secl/3, par.27).

The adoption of these documents opened a discussion on the relationship between climate change, disaster risk reduction (DRR), and sustainable development, with adaptation presenting as the most suitable approach to bring together interventions and decisions concerning the three areas of intervention. The endorsement of these three documents recognises the interconnection between them and highlights the need for synergised actions (UN Secretariat 2017). Accastello et al. (2021) provide a conceptual framework of the climatic, ecological, economic and social impacts of climate and natural hazard risks (Figure 3) and identify the connection between the areas of concern of these three documents. In this context, risk is identified as the combined action of natural hazards, exposure and vulnerability and is influenced by climatic conditions and actions implemented in the socio-economic and environmental system. Each document regulates and provides direction in one of these areas, seeking to link to the others by direct acknowledgement or objectives alignment.

Figure 3: Risk management, SDGs and adaptation linking framework



Source: adapted by authors from Accastello et al. (2021: 2)

Within these documents, adaptation is the common denominator within the strategies identified to tackle climate change, achieve sustainable development, and reduce disaster risk. Although the objectives identified within each document overlap in their intent, Cubie and Natoli (2022:46) warn not to be tempted to read them as 'a comprehensive and unified system', as their legal relationship is not determined. The authors also highlight that while these documents use consistent language and approach, an equivalent action cohesion is not possible due to the international legislative framework and the lack of legal accountability—as treaties are actioned voluntarily (Cubie and Natoli 2022).

1.2.3 Defining and assessing climate change adaptation strategies

Despite the growing commitment toward adaptation, conceptual and methodological challenges remain in its definition and measurement. Within the context of this research, adaptation strategies refer to all urban policies and programs that reduce immediate risks posed by natural events (triggered or exacerbated by climate change) while promoting sustainable development. Compared to mitigation, adaptation strategies present a higher level of complexity due to the range of values involved, from collective to personal (Waters et al. 2014); therefore, their benefits 'will be valued differently depending on the social, economic and political contexts within which they occur' (Klein et al. 2005:581).

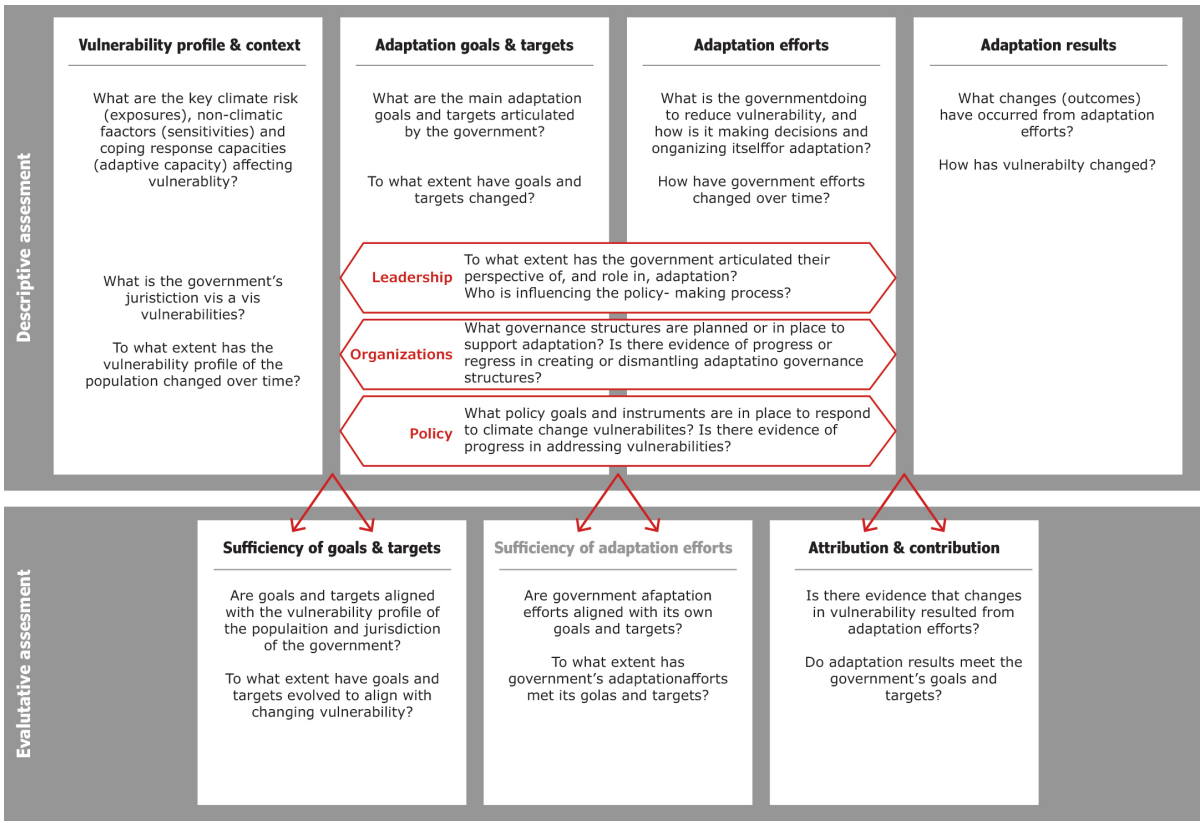
This higher level of complexity makes it difficult to identify a consistent and systematic process that can be applied across different local contexts while recognising their uniqueness (Berrang-Ford et al. 2019). According to Craft and Fisher (2018:1204), the challenges include:

designing a system that can aggregate results; managing the dual mandate of reviewing collective progress and informing the enhancement of national level actions; methodological challenges in evaluating adaptation; and political challenges around measurement in the climate regime.

The Productivity Commission (2012b:5) also points out that challenges in measuring adaptation arise from the fact that adaptation can be the by-product of activities motivated by reasons other than climate change. As such, adaptation can occur being formally identified as 'adaptation'.

However, as Schipper and Langston (2015) affirm, this should not discourage the assessment of actions implemented; on the contrary, adaptation needs to be measured to evaluate progress and effectiveness. The importance of the assessment phase is recognised internationally within the 2018 Katowice Climate Package (United Nations 2018). The Katowice Climate Package calls for the development of an assessment and evaluation tool to document the progression and implementation of National Adaptation Plans, which considers 'countries' overall objectives for adaptation, and of considering the benefits and drawbacks of quantitative and qualitative indicators when developing methodologies' (United Nations 2018, Decision9/CP.24/14 (a)).

Figure 4: Adaptation assessment framework

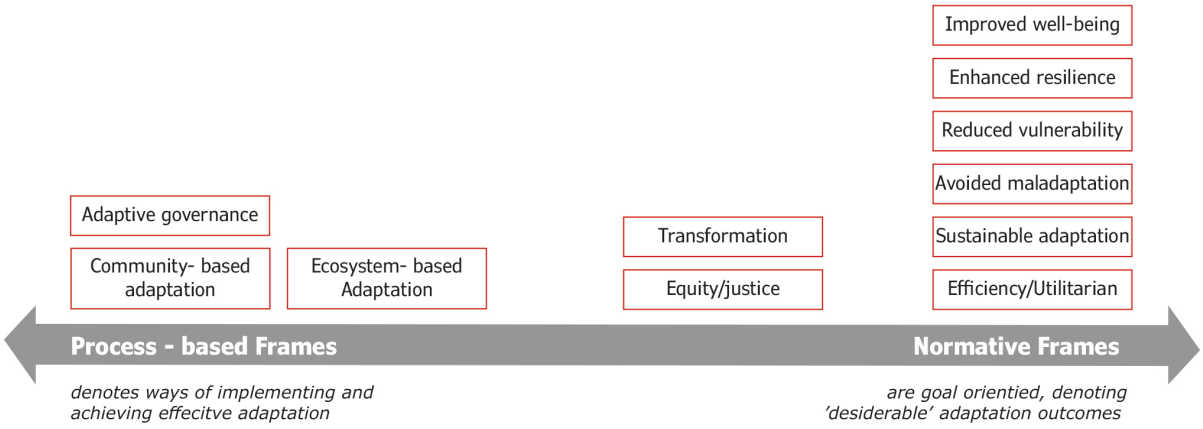


Source: author adapted from Berrang-Ford et al. (2019: 44)

Research looking to reconcile the need for comparative assessment that respects local context is slowly emerging. This literature primarily aims to provide an overarching working framework. Berrang-Ford et al. (2019:441) developed a tool based on descriptive and evaluative assessments. This tool outlines a methodology to discuss government decision alignments using four main categories: 'vulnerability profile and context, adaptation goals and targets, adaptation efforts, and adaptation results' and which analyses leadership (stakeholders involved in the decision making), organisations (governing structure) and policy mechanism (delivery) (Figure 4).

Owen (2020:11) has identified and grouped activities that effectively address adaptability under several indicators: 'collaborative decision-making; sharing physical, financial, and informational resources; and techniques that simultaneously enhance human wellbeing, institutional relations, and environmental security'. Finally, Singh et al. (2021) have refined Owen's (2020) findings by classifying the methods applied to define and measure adaptation effectiveness within different scales of intervention and contexts. They identified 11 adaptation frames organised along a continuum that measures their overall approach, from normative- to process-based interventions (Figure 5).

Figure 5: Adaptation effectiveness continuum



Source: author adapted from Singh et al. (2021: 2)

1.3 Research methods

This project is a scoping study, aimed at examining, providing evidence of, and determining the value of further research or policy development into, the implementation of internationally-adopted urban policy in the Australian context. Scoping projects aim to clarify complex concepts and guide the identification of policy research priorities. Specifically, this scoping project presents successful international sustainability strategies addressing natural disasters, and discusses opportunities and challenges in implementing such strategies in Australia.

The overarching research question guiding the project is:

What international best practices and policy approaches addressing resilience and adaptation to climate change could be translated into the Australian context to meet the 2030 Agenda for Sustainable Development goals?

This question is addressed by responding to the following sub-questions:

- RQ1: What policies exist in Australia and globally aimed at improving sustainable urban development and addressing climate change?
- RQ2: What evidence exists of the positive impact of best practices in lessening the impact of natural disasters on cities' liveability and dwelling supply?
- RQ3: How could these best practices identified in responding to RQ2 be incorporated into urban policy in Australia?

Following the structure of the three identified sub-questions, the study is designed around three main scoping exercises.

1.3.1 Research approach

Scoping existing policies and practices addressing climate change adaptation

Head (2009:15) identifies the main areas related to climate change requiring adaptation: biodiversity and ecological systems, water resources, primary industries, human health, coastal regional vulnerability, infrastructure and urban planning, and disaster and emergency management. As this scoping project is concerned with exploring adaptation strategies for urban sustainability, its focus is the last two areas. It examines how these areas are addressed in Australia, the US, and EU concerning sustainable urban development (Chapter 2). A review of academic and grey literature was conducted to map how CCA is defined and translated into action. This scoping exercise aims to provide overarching context to the case studies and a framework for discussion in policy engagement. Within the research, the policy analysis is discussed using the categories for intervention identified in the UN-Habitat New Urban Agenda (UN 2017: 8): planning, financing, developing, governing and managing (see definition in Table 1). These four categories are associated with eight UN-Habitat (2020) actions for resilience and adaptation to climate change in urban contexts (Figure 6).

Figure 6: Actions for environmental sustainability: resilience and adaptation to climate change

Source: UN- Habitat (2020:35)

Table 1: Interventions and policies category definition

Type	Aims
Planning	Set targets and identify an overall strategic framework to address climate change
Financing[4]	Establish and articulate financial mechanisms to fund organisations, programs or direct interventions addressing climate change
Developing	Sustain and articulate arrangements to advance knowledge sharing and assessing tools to improve intervention effectiveness
Governing	Establish decision-making systems and processes, including accountability frameworks
Managing	Allocate resources and defines operational frameworks overseeing the delivery of the planned intervention

Source: Authors

Scoping evidence to establish the effectiveness of adaptation policies

The research identifies three relevant case studies:

1. Tulsa flood management plan (Oklahoma, US)
2. My Safe Home in Florida (US)
3. GUARDIANS project in Riba-roja de Túria (Spain).

The case studies were chosen using the following criteria:

a. one for each main category of a natural disaster most affecting Australia (flooding, cyclones, and bushfires)

b. a mix of examples to represent urban and regional settings

c. interventions implemented fall into one or more categories of action addressing environmental sustainability for resilience and adaptation identified by the UN-Habitat (2020) framework (Figure 6).

The case studies are analysed using Berrang-Ford et al. (2019) adaptation descriptive assessment framework (Figure 4).

Scoping industry and policy perspectives

Interviews with experts were conducted to explore the perceived barriers and opportunities to implementing identified international best practices and approaches in urban policies in Australia. The interviews also discussed the appropriateness and feasibility of implementing adaptation strategies identified in the international policy review. The interviews targeted consultants and state, territory and local government experts involved in developing and implementing policy and planning strategies relative to climate change, sustainability, and housing.[5]

1.3.2 Limitations of this research

As a scoping project limited in time, extent and depth, the research specifically focused on analysing policy and program relative to adaptation in urban planning and intervention, aiming to increase the built environment's overall resilience. In the context of this project, the discussion was limited to urban interventions and their effectiveness in reducing risk and helping cities to adapt better to climate change.

4 In this context, financing is used as an overarching label referring to financial support (direct or indirect) to deliver interventions and/or implement policies. Specific sources and financing models are discussed ad hoc when discussing projects and policies.

5 Details of the experts and methods for data analysis of interviews are discussed in Chapter 6.

As demonstrated in the literature, local conditions, including community perception of the problem, level of magnitude of the issues addressed and political decisions, are interrelated and impact the advancement and implementation of policy (Folwey 2019). However, given this project's time and resource constraints, the political and social context analysis has been limited to the case study discussion concerning its impact on the projects examined.

Only systematic action towards adaptation is explicitly considered in this report. The discussion does not focus on the role of grassroots movements or industry champions leading the way towards adaptation. Nevertheless, we acknowledge the importance of these processes. The role of the community has been considered and discussed concerning bottom-up approaches as drivers for change—linked to people's perception of issues as well as leadership and action—such as in the Tulsa (US) case study.

Lastly, in discussing the overarching policy approach to adaptation in the context of Australia, US and EU, the scope of the project was limited to the intervention planned—aiming at assessing their effectiveness. As such, only the current policy (2022—23) is considered, not how the climate change policy approach has shifted according to the government in charge (i.e., conservative versus liberal).

Directions for future research arising from the limitations of this study are discussed in the conclusion of this report (Chapter 7).

2. Climate change adaptation and resilience: urban policies and programs

- **At the national level, Australian adaptation policies and investments related to urban development are strongly linked to recovery post-disaster DRR programs.**
- **Across Australian states and territories, policy frameworks related to climate change adaptation and resilience vary greatly. For example, Victoria has the most comprehensive approach to adaptation, while Queensland focuses on resilience to natural disasters.**
- **The US Government has recently reformed and strengthened its climate change policy framework. Adaptation efforts have focused on establishing federal standards and increase the use of nature-based solutions to mitigate the impact of natural disasters on cities.**
- **The EU climate change legislation frames the role of adaptation as part of strategies for reaching climate resilience by 2050. The EU's adaptation strategy, funding mechanisms, and supporting information-sharing platform guide implementation at the national level in the context of varying government jurisdictional responsibilities and civil actions.**

The international policy framework built in the past three decades to create a cohesive action to tackle climate change has been shaped by an increased understanding and knowledge of its complexity and the growing urgency to act. The global responses to climate change can be grouped into two broad categories: mitigation and adaptation. Mitigation focuses on tackling the causes of climate change, while adaptation focuses on reducing the impact of its effects. As previously discussed, the work of the UNCCP has contributed to international agreements setting overarching goals and governing structures, and defining financial mechanisms to support intervention.[6] These agreements are actioned through protocols, which establish and articulate the governing systems and the management of resources. This international framework sets the parameters for mitigation and adaptation climate policies at the national and sub-regional scale discussed in this chapter.

6 Please refer to Table A2 in Appendix 1, for a full mapping of categories of major decisions taken in international binding agreements.

This chapter presents an overview of the CCA and resilience policy frameworks and programs implemented in Australia, the US and EU with a focus on the built environment, particularly the urban context. This review provides background for the discussion on international adaptation best practices examined in Chapters 3, 4, and 5.

2.1 Australia

In Australia, climate policy has been inconsistent, fragmented and contested (Jotzo and McKibbin 2021; Morton 2018; Talberg et al. 2016; Trater 2011; Hamilton 2001). Nevertheless, Australia has made progress concerning mitigation strategies under both Liberal and Labour Governments (He 2018). Australian climate change actions, framed within the context of the international obligations under the Paris Agreement, relate mainly to the regulation, reduction and reporting of GHG emissions. The latest progress in this direction is the *Climate Change Act 2022*, which outlines Australia's pathway to net zero by 2050.

However, existing literature discusses how the Australian Government has made little concrete progress relative to adaptation. In the peer-reviewed assessment of adaptation plans across 54 countries conducted by Morgan et al. (2019), Australia was the lowest performer. Australia scored zero in eight of the 20 areas evaluated, including participation, identification of vulnerable communities and ecosystems, prioritisation, monitoring and evaluation of actions and economic diversification (Morgan et al. 2019). This poor performance can be linked to the narrow scope of Australia's approach to adaptation. According to Pearce et al. (2018:2), Australia's adaptation actions have mainly focused 'on capacity development and support', investing in initiatives that advance scientific knowledge rather than implementation. The authors have drawn these conclusions from the systematic literature review of Australian statutory and institutional frameworks and policies on CCA implemented up to the first decade of the 2000s. This section provides an overview of current adaptation policies and programs implemented at the federal, state and territory levels, focused on urban policies.

2.1.1 National level

Policies and programs

The conversation around adaptation in Australia has been initially driven by the 2007 national adaptation framework (COAG 2007), with the main initiatives delivered under this framework including the Climate Adaptation Flagship (2007) and the National Climate Change Adaptation Research Facility[7] (NCCARF) (2008—13) (Productivity Commission 2012a). Currently, we have three main documents addressing adaptation: the National Resilience and Adaptation Strategy 2021, the National Disaster Risk Reduction (DRR) Framework 2021 and the First National Action Plan 2019-20.

National Resilience and Adaptation Strategy 2021

The 2021 National Resilience and Adaptation Strategy (the Strategy) sets Australia's position on CCA. Three main objectives underpin the Strategy: 'drive investment and action through collaboration, improve climate information and services and assess progress and improvements' (DAWE 2021b:6). Six main actions, working across four main interconnected domains (natural, economic, social and built environment) are identified to 'better anticipate, manage and adapt to climate change' (DAWE 2021b:20).

7 https://nccarf.edu.au/nccarf-publications/

The Strategy defines adaptation as 'the process of adjusting to actual or expected changes in climate to reduce or avoid climate impacts or exploit beneficial opportunities' (DAWE 2021b:8). It frames the stakeholder's responsibilities around *risk reduction* concerning 'prosperity, security, and continued economic growth' (DAWE 2021b:4). This is a change in direction compared to previous national adaptation policies, in particular the 2007 National Adaptation Framework. The 2007 document defined adaptation as 'a mechanism to manage risks, adjust economic activity to reduce vulnerability to improve business certainty' (COAG 2007:3). The 2007 definition seeks opportunities to minimise risk to improve certainty of outcome. While both definitions refer implicitly or explicitly to risk management, the 2021 document moves away from framing adaptation as a tool only for risk reduction, recognising it as a process and acknowledging that it could bring forward positive impact—besides risk reduction—which could be leveraged *(exploited).*

National Disaster Risk Reduction (DRR) Framework 2021

The Framework sets clear actions to address DRR. It is organised around four main priorities: understanding risk *(develop)*, making accountable decisions *(plan)*, governance *(govern)* and investments *(finance)*. These priorities work across four domains: built environment, social, nature, and economic (National Resilience Taskforce 2019)—coinciding with the one defined in the 2021 adaptation Strategy. The DRR Framework identifies climate adaptation as one of the 20 strategic policy areas that link back to DRR (National Resilience Taskforce 2019:20). The strong relationship between these two policy areas is reinforced in the choice of programs and interventions identified to support DRR financed at national and state governments level in the DRR Framework *First National Implementation Plan* (Home Affairs 2020).

The First National Action Plan 2019-20

The Action plan implements the National Disaster Risk Reduction Framework. The document identifies actions taken by the Australian Government to tackle the four main priority areas identified in the DRR framework. Overall, the initiatives executed under the plan focus on institutional capacity development through knowledge building. The most significant government investment in DRR in the first implementation plan is in *Priority 1, understanding disaster risk* at $815 million, half the total investment across all priorities (Home Affairs 2020). Under this category sits all research projects aimed at improving the understanding of adaptation, identifying barriers, building knowledge-sharing platforms, and developing policies and strategies (such as the 2021 National Adaptation Strategies).[8] At the time of writing, the government is consulting stakeholders to design the second national DRR action plan (AIDR 2022).

Urban policies

Adaptation and resilience building sits at the intersection of risk reduction and sustainable development. As such, urban policies play an important role. While the Australian Government has limited constitutional power over cities and urban development, it has historically shown an interest—and intervened—in urban issues. For instance, the Australian Government regularly invests in infrastructure and development projects driven by its constitutional mandate to oversee economic growth (Dodson 2013).

8 Please refer to Appendix 2 Table A3 for the mapping of intervention.

The Australian Government's Smart Cities Plan—and its implementation through the City Deals program—is the most recent national urban policy. The policy focuses on 'infrastructure, innovation and place making – interlocked to underpin the central goal of economic growth' (Hu 2020: 211). Sustainability is mentioned in the plan, with support for projects aimed at: 'reducing emissions and pollutants or improving the sustainability performance of buildings and infrastructure', as well as 'integrating environmental criteria into decision making—such as green coverage to minimise urban heat island impacts, reducing localised air pollution from investments, reducing waste and increasing recycling' (Australian Government 2016:22). *The Global State of National Urban Policy report (OECD*/UN-Habitat/UNOPS (2021) emphasises that the Australian Government's Smart Cities Plan does not explicitly refer to—or aim to—contribute to overarching international frameworks set within the New Urban Agenda, the Paris Agreement, or the Sendai Framework for Disaster Risk Reduction. However, a handful of projects implemented via the City Deals program address issues related to climate change, including: Darwin's Cool and Green the City project (DIRC 2018), South East Queensland Green Urban Infrastructure and the Resilient Rivers Initiative (Commonwealth of Australia 2022) and the Western Sydney South Creek corridor restoration (Commonwealth of Australia et al. 2018).

However, a new National Urban Policy is on the horizon for Australia. Within the 2023—24 Federal Budget, the Australian Government, led by Prime Minister Anthony Albanese, announced the $687.4 million plan to finance interventions to support 'sustainable urban development in Australia' (Chalmers and Gallagher 2023:176). This plan includes the establishment of the Cities and Suburbs Unit (CSU), which will deliver the National Urban Policy and report on the State of Australian Cities. The National Urban Policy will work in combination with two other initiatives: the Thriving Suburbs Program and the Urban Precincts and Partnerships.

To understand the 2023—24 Federal Budget, we need to review the first action undertaken by the Albanese Government through their first Federal Budget in 2022—23 (Chalmers and Gallagher 2022). The initiatives financed in the 2022—23 Federal Budget related to the urban built environment were mainly directed towards strengthening institutional capacity within the three levels of government. These also included financing hazard risk prevention projects managed at the state level and delivered by local governments. Actions specifically related to the built environment include the urban river program and the support of the infrastructure project to strengthen water management (refer to Table 2). In particular, the urban river program is the only one that refers to a holistic approach to water, aiming to finance local activities that restore waterways and looking at nature-based approaches to water management (Butler 2021). Water management is also addressed with the funding of six National Water Grid Fund projects to enhance water supply and support sustainable water security for communities, industry and the environment.

The most significant investment relates to mitigation, specifically building retrofitting for energy efficiency based on solar and green energy. This is part of the Australian Government's Powering Australia program, fulfilling an election promise to reduce emissions by increasing renewable energy. The Australian government also supports the Powering Australia Program through funding for setting up financial mechanisms such as the Community Solar Bank. Moreover, using ad hoc funding, the Australian Government has budgeted for ongoing funding mechanisms to support GHG reduction and disaster risk. The Emissions Reduction Fund, enacted through the *Fund Carbon Credits (Carbon Farming Initiative) Act 2011* and the *Carbon Credits (Carbon Farming Initiative) Rule 2015*, finances private stakeholders to implement changes in their businesses or projects that reduce GHG.

There is no explicit funding mechanism for adaptation measures to improve our cities and prevent and lessen the impact of natural disasters. However, funding has been made available for emergency responses through the Emergency Response Fund, established by the *Emergency Response Fund Act 2019*. The Act allows the Australian Government to access up to $200 million annually to supplement other emergency funds. In early September 2022, the Minister for Emergency Management, Hon. Watt (2022), announced the submission to parliament of a Bill to amend the Act—passed just two months later by both houses on 27 November 2022—that commits to providing a 'dedicated ongoing source of funding for natural disaster resilience and risk reduction initiatives'.

The 2023—24 budget (Chalmers and Gallager 2023) reinforces and follows the path set by its 2022—23 predecessor. Climate change issues are still framed under the net zero and decarbonisation goals. Resilience and climate adaptation issues continue to be addressed relative to water management with funds to continue delivering the National Water Grid Project. However, the 2023-24 budget has withdrawn or paused decisions on previously approved projects. Moreover, within this budget, the Australian Government has committed to the investment in consultation with First Nation People to deliver a National Water Reform aimed at establishing arrangements for them 'to own, access and manage water in Australia' (Chalmers and Gallager 2023:75). Together with these actions the Australian Government has also budgeted for the delivery over the following two years of the 'Australia's first National Climate Risk Assessment and a National Adaptation Plan to understand the risks to Australia from climate change, invest in a plan to adapt to those risks and commission an independent review of the Australian Climate Service' (Chalmers and Gallager 2023: 73) (see Table 3 for a more comprehensive overview of 2023—24 Federal Budget initiatives).

Table 2: 2022—23 Federal Budget: funded built environment resilience and climate change actions and programs

Type	Actions and programs	
Hazard risk	Improving Drought Readiness, Resilience and Preparedness	Delivery of the National Drought Agreement and National Drought Plan
		Implementation of drought resilience research
	Disaster Ready Fund	Co-funding of resilience projects with the states and territories
		Support disaster resilience initiatives at the local government level (30 projects).
Adaptation funding	Powering Australia	Establish Powering the Regions Fund and Community Solar Banks program
Recovery funding	Disaster Support	Account for potential future expenditure on floods or other disaster response payments, including demand-driven disbursements
Institutions	Water for Australia Plan	Expert legal support to deliver national water reform commitment and scoping work for setting up a National Water Commission
	Climate Risk and Opportunity Management Program	Build climate risk management capabilities and systems across the Australian Public Service and design of National Climate Risk Assessment
	National Health Sustainability and Climate Unit	Address emerging health risks related to climate change and coordinate responses across the health system
	Climate Change Authority	Restoring the Climate Change Authority and delivering Annual Climate Change Statements to parliament
	Disaster Relief Australia	Expand its capacity to deliver disaster relief and recovery activities
	Murray-Darling Basin	Updating information on the impacts of climate change and water management
Built environment	National Water Grid	Expand investment in nationally significant, transformational water infrastructure projects.
	Urban Rivers and Catchments Program	Restore the natural habitats of aquatic species and create recreational spaces for local communities
	First Nations Community Microgrids Program	Develop and deploy microgrid technology across First Nations communities to increase access to cheaper, cleaner, and more reliable energy
	Powering Australia	Community Batteries for Household Solar
	Energy Security and Reliability	Greenhouse Energy Minimum Standards program and Nationwide House Energy Rating Scheme

Source: developed by Authors based on Chalmers and Gallagher (2022)

Table 3: 2023—24 Federal Budget: funded built environment resilience and climate change actions and programs

Type	Actions and programs	
Hazard risk	Flood Warning Infrastructure Network Remediation	To remediate high-priority flood warning infrastructure and address critical reliability risks. The Bureau of Meteorology will acquire, upgrade and integrate local and state government-owned rain and river gauges into its existing flood warning network.
	Disaster Ready Fund	Co-funding of resilience projects with the states and territories.
		Support initiatives addressing natural hazards, infrastructure needs, and systemic risk reduction projects.
Recovery funding	Disaster Support	Supplement and maintain NEMA funding for disaster response.
		Provide financial assistance for Aus and NZ residents following a disaster.
		Establish and maintain a Disaster Recovery Management System.
Institutions, Policies and reforms	National Climate Adaptation and Risk Program	Deliver plan to adapt to climate relates risks and establish a commission to carry out an independent review of the Australian Climate Service.
	National Water Reform	Consult and design arrangements for First Nations peoples to own, access and manage Australian waters.
	Future-proofing the Murray-Darling Basin	Statutory review of the Murray-Darling Basin Plan 2012.
Built environment	National Water Grid	Expand investment in nationally significant, transformational water infrastructure projects.
	Urban Rivers and Catchments Program	Restore the natural habitats of aquatic species and create recreational spaces for local communities (Additional funding).
	ACT Sustainable Household Scheme	Household Scheme, which provides concessional loans to households to electrify or improve the efficiency of their homes.

Source: developed by Authors based on Chalmers and Gallager (2023)

2.1.2 State and territory level

Climate change and adaptation legislation, policies and programs

While national frameworks establish important (primarily strategic) mandates for action on climate change, the heterogeneous nature of climate risk means that 'national policy cannot simply be generalised for local implementation' (Gurran 2013:101). States and territories are called to lead the conversation on CCA and provide overarching regulatory frameworks (He 2018:357). Each state and territory has a different policy program outlining the position on CCA, resilience building and DRR.

Legislation

Only four states in Australia address Climate change in legislation (Acts). These are:

- **Victoria** *Climate Change Act 2017*
- **South Australia** *Climate Change and Greenhouse Emissions Reduction Act 2007*
- **Tasmania** *Climate Change (State Action) Amendment Bill 2022*
- **Australian Capital Territory**- *Climate Change and Greenhouse Gas Reduction Act 2010*.

Each of these documents addresses adaptation and mitigation—contrary to the federal legislation, the *Climate Change Act 2022*, which only addresses mitigation. Each act recognises the responsibility of the climate change minister to support actions aimed at implementing adaptation measures. However, they do not define or establish specific processes for action, except for the Victorian Climate Change Act 2017. This is the only legislative document to identify strategies for intervention by mandating climate change adaptation plans. Each plan relates to one of the seven identified systems, including the built environment. The legislation requires these plans to be delivered on a five-year cycle.

Policies and programs

All states and territories have developed climate change strategies, policies and frameworks. With regards to overarching framework, these address mainly risk management for natural disasters. The strategies instead aim at increasing resilience to climate change and identify adaptation measures. However, only VIC and QLD have developed sectoral adaptation strategies and implementation plans addressing the built environment separately. The NT, instead, has specifically designed a heat adaptation plan for Darwin (part of the city deals financed projects).

Table 4 offers an overview of the policy and legislative framework at the state level relative specific to climate change adaptation, resilience and DRR.

Table 4: States and territories: climate change adaptation and resilience and DRR policy framework

	Legislation	Framework	Strategies	Policy	Plans
VIC	Climate Change Act 2017	Victorian Preparedness Framework (2018)	Climate Change Strategy (2021) SV 2030: A Decade of Action (2022) Building Victoria's Climate Resilience (2022) Critical Infrastructure Resilience Strategy (2015) Victoria's Resilient Coast – Adapting for 2100+		Built Environment Climate Change Adaptation Action Plan 2022–26 Health and Human Services Climate Change - Adaptation Action Plan 2022–26 Natural Environment Climate Change Adaptation Action Plan 2022–26 Transport Adaptation Action Plan 2022–26 Water Cycle Climate Change Adaptation Action Plan 2022–26 State Emergency Management Plan (SEMP) DRR implementation Plan (2020)
NSW		CC Policy Framework (2016) NSW Coastal management framework (2016)	Climate Change Adaptation Strategy (2022)	EPA Climate Change Policy (2023)	DRR implementation Plan (2020) Climate Change Action Plan 2022–25 (2022) State Emergency Management Plan
QLD		Queensland Flood Risk Management Framework	Climate Adaptation Strategy 2017–2030 Pathways to a clean growth economy Queensland Climate Transition Strategy Queensland Strategy for Disaster Resilience (QSDR) 2022-2027 (2022) Regional Resilience Strategies Burdekin and Haughton Flood Resilience Strategy Burnett Catchment Flood Resilience Strategy		Built Environment and Infrastructure Sector Adaptation Plan (2017) Emergency Management Sector Adaptation Plan (2018) Biodiversity and Ecosystems Climate Adaptation Plan (2017) Human Health and Wellbeing CC Adaptation Plan State Disaster Management Plan (2018) Resilient Queensland 2018—21 QLD recovery plan (and event specific) Queensland Strategic Flood Warning Infrastructure Plan

Climate change adaptation and resilience: urban policies and programs

	Legislation	Framework	Strategies	Policy	Plans
SA	CC and Greenhouse Emissions Reduction Act 2007		South Australia's Climate Change Strategy 2015–50 SA Disaster Resilience Strategy 2019—24		CC Action Plan 2021—25 State Emergency Management Plan
WA		State Emergency Management Framework	Community Disaster Resilience Strategy (consultation) Climate Resilient WA Directions for the state's Climate Adaptation Strategy (2022) Climate Adaptation Strategy (2023) WA Coastal Zone Strategy (2021)	Western Australian Climate Policy (2020)	DRR Implementation Plan 2020 Coastal hazard risk management and adaptation planning guidelines July 2019
TAS	Climate Change (State Action) Amendment Bill 2021		Tasmanian Disaster Resilience Strategy 2020—2025 (2020) Natural Values CCA Strategy		Climate Action 21: Tasmania's Climate Change Action Plan 2017—21 DRR Implementation Plan 2020
NT		NT Natural Hazards Risk Assessment Framework (under development)	NT CC Response: Towards 2050 Darwin Heat Mitigation and Adaptation Strategy (2021)		DRR Implementation Plan 2020 Territory Emergency Plan (2021)
ACT	Climate Change and Greenhouse Gas Reduction Act 2010		CC Strategy 2019-2025 (2019) Canberra's Living Infrastructure Plan: Cooling the city (2019)		DRR Implementation Plan 2020 ACT Emergency Plan

Source: Authors.

To understand their content these state policies have been mapped against the UN-Habitat (2020) actions for implementing environmental sustainability in urban contexts for resilience and adaptation to climate change.[9] The top three actions emerging from the mapping are (in order) built environment, land use (and planning) and institutions.[10] The implementation measures falling within these three overarching actions categories can be grouped in:

- **urban policy development, improvement, and integration** relative to planning and land use, building codes and risk management plans. This group also includes all activities that support aligning of actions taken in different contexts and decisions taken within different policy frameworks
- **dwelling retrofitting for improved thermal performance**, better infrastructural design, and delivery of building with an emphasis on achieving higher thermal performance, targeting emission reduction and climate resilience (heat control)
- **building institutional and sectorial capacity** within this category falls all action implemented for education and training, improving government capacity to lead the conversation on climate change through research and the use of up-to-date technologies and information.

In particular, regarding the built environment, building retrofitting for energy efficiency and transport are the two main areas of focus. For example, VIC, SA, WA, and ACT have pledged to improve social housing by upgrading performance standards in new delivery and retrofitting current stock and other government assets, including civic buildings and essential services (such as hospitals and aged care facilities). These interventions aim to simultaneously address mitigation (emission reduction) and adaptation (managing increasing temperatures). In regional areas, retrofitting programs aims specifically at public building and facilities, the focus of the retrofitting is to maintain the buildings functionality in case of an emergency caused by a natural disaster events. Pledged transport interventions aim to strengthening the public transport system, including widening public transport networks to facilitate access and improve integration with active forms of transport. Improving transport infrastructure as part of the response to climate change is central to VIC, WA and ACT climate and adaptation policies and plans.

These mapped actions in the built environment are supported by another category of activities: community resilience building and preparedness. These activities include:

- awareness of climate change for households (house performance and energy savings) and communities (disaster risk preparedness)
- strengthening of stakeholders' networks between different sectors and between institutions and community settings
- Australian traditional owners' self-determination relative to land management and implementation of traditional land management methods for hazard mitigation, particularly flood and bushfire.

Urban planning policies and programs

At the time of writing, only a few states have included climate change in their strategic planning considerations. These are:

- SA which has a specific policy, the State Planning Policy 5 (SPP5): Climate Change
- VIC, which addresses climate change together with natural hazards under Victoria Planning Provision 13 (VPP13) Environmental Risks and Amenity
- WA and ACT, both of which manage climate change under State Planning Strategies (Table 5).

9 In this mapping exercise, only the action explicitly addressing the built environment and infrastructures, such as transport and water were included.
10 See Table 4A in Appendix 2, mapping of action identified within these strategic documents.

All these policies refer to risk management mitigation and consideration of local vulnerabilities to inform development and land use. The SA SPP5 is the only policy that mentions the design dimension of mitigation, which refers to green infrastructure and water-sensitive urban design (WSUD). The literature recognises that WSUD is an integral part of strategic intervention in urban environments for climate change adaptation (Almaaitah et al. 2021).

These actions and the broad areas of intervention identified in the policy frameworks are reflected in the type of project delivered with the financial support of grants and programs offered across the different states. There are three types of funding distributed by state governments:

- **community adaptation and climate funding**, which delivers small projects led by community organisations and mainly involve education projects for climate change awareness and preparedness, including programs targeting households
- **regional adaptation funding** directed at land and water restoration projects or support risk mitigation (drought and bushfire)
- **recovery and emergency funding** aimed at helping individuals, communities and local and state governments affected by natural events, including infrastructure upgrades.

These funds have helped deliver hundreds of projects across Australia, most in regional areas. Among the projects funded, those related to the built environment are primarily concerned with developing hazard mitigation plans and energy efficiency upgrades. However, most projects support community awareness of climate change.[11]

11 Within the mapping exercise in Table 5A in Appendix 2, these have been mapped as part of the institutional capacity building.

Table 5: State planning policies provision on climate change

VIC	***VPP 13 Environmental Risks and Amenity***
	Planning should strengthen the resilience and safety of communities by adopting a best practice
	13.01 Climate Change Impact
	Respond to the risks associated with climate change in planning and management decision making processes.
	Identify at risk areas using the best available data and climate change science.
	Integrate strategic land use planning with emergency management decision making.
	Direct population growth and development to low risk locations.
	Develop adaptation response strategies for existing settlements in risk areas to accommodate change over time.
	Ensure planning controls allow for risk mitigation and climate change adaptation strategies to be implemented.
	Site and design development to minimise risk to life, health, property, the natural environment and community infrastructure from natural hazards. (DLWP 2022: 13.01-1S)
	13.2 Bushfire
	13.3 Floodplains
NSW	***State Environmental Planning Policy (Resilience and Hazards) 2021***
QLD	***Planning for safety and resilience to hazards***
	Natural hazards, risk and resilience
SA	***State Planning Policy 5: Climate Change***
	5.1 Create carbon-efficient living environments through a more compact urban form that supports active travel, walkability and the use of public transport.
	5.2 The good design of public places to increase climate change resilience and future livability.
	5.3 Facilitate climate-smart buildings to reduce our demand for water and energy.
	5.4 Mitigate the impacts of rising temperatures by encouraging water sensitive urban design, green infrastructure and other design responses.
	5.5 Avoid development in hazard-prone areas or, where unavoidable, ensure risks to people and property are mitigated to an acceptable or tolerable level through cost-effective measures.
	5.6 Facilitate green technologies and industries that reduce reliance on carbon-based energy supplies and directly or indirectly reduce our greenhouse gas emissions.
	5.7 Protect and enhance areas that provide biodiversity and ecological services and maximise opportunities for carbon storage.
	5.8 Encourage decision-making that considers the impacts of climate change and that draws on the best available information.
	5.9 Encourage development that does not increase our vulnerability to, or exacerbate the impacts of climate change and which makes the fullest possible contribution to mitigation.
	5.10 Support the transition of traditional industries that rely on fossil fuels to climate smart initiatives to reduce greenhouse gas emissions.
	5.11 Regional Plans should include performance targets for urban greening and tree canopy enhancement in Greater Adelaide and regional townships (SA State Planning Commission 2019: 38-39)
	State Planning Policy 13: Coastal Environment
	State Planning Policy 15: Natural Hazards

WA	***SPP.3 Urban growth and settlement***
	3.4 - Natural hazards and disasters
	State Planning Strategy 2050
	5. Security approach - Climate change aspirations
	Special controls continue to be in place for vulnerable species and areas most affected by climate change
	Climate change adaptation and mitigation strategies continue to be developed and implemented to minimise impacts on the State's key assets
	Vulnerable areas continue to be secured and managed to foster ecosystem resilience
	Risk management strategies continue to be developed and adopted for natural hazards in the context of climate change patterns and trends (WAPC 2021:103)
ACT	***ACT Planning Strategy 2018***
	Sustainable and resilient territory
	Direction 3.1 Transitioning to a net zero emissions city through the uptake of renewable energy, improved building design and transport initiatives.
	Direction 3.2 Reduce vulnerability to natural hazard events and adapt to climate change
	Direction 3.3 Integrate living infrastructure and sustainable design to make Canberra a resilient city within the landscape
	Direction 3.4 Plan for integrated water cycle management to support healthy waterways and a liveable city.
	Direction 3.5 Protect biodiversity and enhance habitat connectivity to improve landscape resilience.
	Direction 3.6 Reduce waste, improve resource efficiency and decrease our ecological footprint.
	(ACT Government 2018)

Source: Authors from cited in-text documents.

2.2 United States (US)

Climate adaptation initiatives in the US are mainly delivered by the states, local governments and tribal leaderships (Lioubimtseva and da Cunha 2021). The Environmental Protection Agency (EPA) and the Federal Emergency Management Authority (FEMA) oversee the financial and technical support to advance these local adaptation efforts. The current US administration is investing in climate change, initiating policy and investment, and increasing institutional capacity in mitigation, adaptation and DRR. The core of the US presidential stance on climate change revolves around three pieces of legislation:[12]

Executive Order (EO) number 14008, Tackling the Climate Crisis at Home (2021)

This document aims to position climate change as central to national and international US policy. With the 2021 EO 14008, the White House established six new agencies to assist the government in making decisions related to climate change adaptation. It nominated agencies to develop tools and provide data to inform government decision-making on climate change risk assessment and forecasting capacity. It enforced the development of adoption plans across all federal agencies. It established the *Justice 40 initiatives* aimed at federal identity investments that can provide 40 per cent of the benefit towards disadvantaged communities and which consider affordable and sustainable housing as well as clean water initiatives.

12 Please see Table A7 Appendix 4 for the overall mapping of US climate adaptation policies initiatives relative to the built environment.

Executive Order (EO) number 14030, Climate-Related Financial Risk

The OE 14030 addresses the consideration of financial risk linked to climate change by nominating federal financial agencies to develop assessments of climate-related financial risk for lending operators. The policy also reinstates Executive Order 13690, establishing a Federal Flood Risk Management Standard to ensure the resilience of government assets and projects in floodplains. As a result of the assessment report required by the policy, the government developed an overarching financial strategy that includes:

- supporting community financial resilience and a platform for sharing information (NOAA Climate Resilience Toolkit)
- FEMA Hazard Mitigation funding opportunities (Building Resilient Infrastructure and Communities, Hazard Mitigation Grant Program and Flood Mitigation, Assistance)
- Building Code Adoption Tracking (BCAT) (The White House 2021c).

The tracking system is implemented through a WebGIS-based portal. The portal tracks five types of hazards and overlays data on building Code adoption, Census information, laws and regulations (FEMA 2022b). Moreover, the EO mandates FEMA to update the Flooding National insurance Program rating system and flood management standards. FEMA has developed Risk Rating 2.0, which calculates insurance premiums using a new methodology incorporating flood risk variables such as flood frequency, type, and house characteristics (FEMA 2021).

Bipartisan Infrastructure Law (BIL)

The BIL is the US national infrastructure policy (IIJA 2021). It guides the delivery of a five-year investment plan in transport, energy and water infrastructure. The *Guidebook to the bipartisan infrastructure law for state, local, tribal, and territorial governments, and other partners* (The White House 2022) identifies all the federal government-supported programs across the 2022—23 financial year under the BIL. In addition, the Guidebook specifies hundreds of projects, such as retrofitting buildings, advancing thermal performance, improving the resilience of the energy grid for an emergency, and providing financial assistance for low-income households. The Guidebook also includes transport planning projects and delivery for resilience in natural hazards and water management projects.

2.3 Europe (EU)

Since the 1970s, the EU has worked on developing environmental policies and strategies, developing one of the highest standards globally, and playing a leading role in international climate negotiations (Selin and VanDeveer 2015). Four main documents underpin the EU work on adaptation these are:

Treaty on the Functioning of the European Union

As Cifuentes-Faura (2022) explains, the *Treaty on the Functioning of the European Union* is at the core of the EU's achievement, particularly articles 11, 191 and 192. Article 11 places environmental protection aimed at sustainable development at the heart of all policy activities of the EU. Article 191 identifies an objective of the EU policy as 'promoting measures at the international level to deal with regional or worldwide environmental problems, and in particular, combating climate change' (EU, 2012: 132). Lastly, article 192 allows the EU to adopt decisions affecting urban planning, land use and water management. The EU has achieved this status by targeting climate change multi-laterally through policies and programs that complement each other, namely (i) the enforcement of the *European Climate Law*[13] targeting GHG reduction and legally mandating adaptation measures (EU 2021b), (ii) the consolidation of the f the Green Deal (the EU climate adaptation strategy) objectives, and (iii) the establishment of the knowledge sharing *climate-ADAPT* platform and strategies (*Climate-ADAPT strategy 2022-2024*).

13 Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law').

Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change

Forging a climate-resilient Europe is the 2021 EU Strategy on Adaptation to Climate Change (2021a). This Strategy aims to deliver a more innovative, faster and systemic adaptation. The delivery of the Strategy is grounded in the acknowledgement that while adaptation issues manifest at the local scale, the 'solutions are often widely transferable and applicable on a regional, national or transnational scale' (EU 2021a: 4). Amongst the action for intervention identified in the policy are climate data collection and analysis processes to improve decision-making, collaboration, and simplification of governance processes to facilitate the implementation of adaptation strategies, including across borders, implementation of adaptation in building construction and renovation and critical infrastructures. To deliver its climate change commitments, the EU relies on the Multiannual Financial Framework (MFF) 2021—2027. The MFF is a long-term budget that provides financial support to programs aligned with EU policy priorities. The 2021- 2027 MFF invests 25 per cent of the EU budget in climate change and related funding mechanisms.

LIFE Program

The LIFE Program supports most of the adaptation intervention in the built environment domain delivered at the national and local levels. The program co-finance urban adaptation projects aimed at improving adaptation policies, land-use planning, infrastructure resilience, sustainable resilience, sustainable development water management (drought), and flood and coastal management. The project supported by this program mostly addresses the delivery of blue and green infrastructure and nature-based solutions for hazard mitigation based on strategic and land use planning and infrastructural project implementations.[14]

The European Climate Adaptation Platform

The platform, also known as Climate-ADAPT, collates and shares information on adaptation projects financed and delivered by different EU countries through the various EU programs. The platform provides one-point access to information related to the EU climate adoption policies and tools. In addition, it acts as a networking hub to collate and share knowledge and projects across the EU members.

2.4 Overview

The review and mapping of policy and programs related to CCA and resilience policy frameworks in the urban context in Australia, the US and the EU highlight that:

- At the federal level, Australia has progressed in legislating on mitigation, committing to achieve net zero by 2050 and implementing concrete action to reduce GHG emissions. However, there is no legislative commitment to adaptation.
- Adaptation is addressed in the context of DRR recovery programs. While projects delivered under the DRR provide opportunities to build resilience in communities and infrastructure, this way of framing adaptation is limiting. This is because it does not consider the overall urban sustainability of both the outcome and the responses provided.
- The Australian Government provides ad hoc funding to support the implementation of state, territory and local government adaptation initiatives.
- Mirroring the federal approach, climate policy at the state and territory level remains strongly dominated by the GHG emission reduction agenda, and resilience is framed in the context of recovery from natural disasters.

14 A list of projects delivered between 2015 and 2022 retrieved from the climate adapt database is provided in Appendix 4 Table A 9.

- However, progress has been made at the state and territory level in adaptation. Several states' legislation covers CCA and mitigation, particularly in Victoria, which mandates system-based adaptation plans on a five-year cycle.
- In the US, adaptation responses are driven by bottom-up processes, implemented locally in the context of federal environmental laws and disaster risk management frameworks, and financed by national grant schemes managed by federal government agencies.
- The current US administration has pushed the climate agenda, resulting in an influx of available funding programs, a revision of building standards and risk assessment mechanisms, and digitalisation and sharing of information.
- Long-term budgets and funding mechanisms support the EU adaptation strategy. Projects funded under these programs include ongoing research to support institutional capacity to make better decisions and implement projects related to building environmental resilience, including natural disasters.
- The Climate-ADAPT's supporting information-sharing platform to track progress and understand and bridge local actions between the different EU countries.

3. Adapting to flooding: a lesson from Tulsa (US)

- **Tulsa's flood management plan is based on a comprehensive long-term strategy for mitigation. It relies on a combination of structural and non-structural intervention measures.**
- **The nature-based approach to structural intervention and implementation of an integrated blue-green urban infrastructure is central to the flood management plan.**
- **Policy innovation in this case study has been driven by the community pushing political leaders to investigate innovative and more sustainable approaches to flood mitigation.**
- **While reiterating the importance of the local context, Tulsa's story of flood management demonstrates the critical role of overarching policy frameworks and programs in supporting, guiding and shaping local actions.**

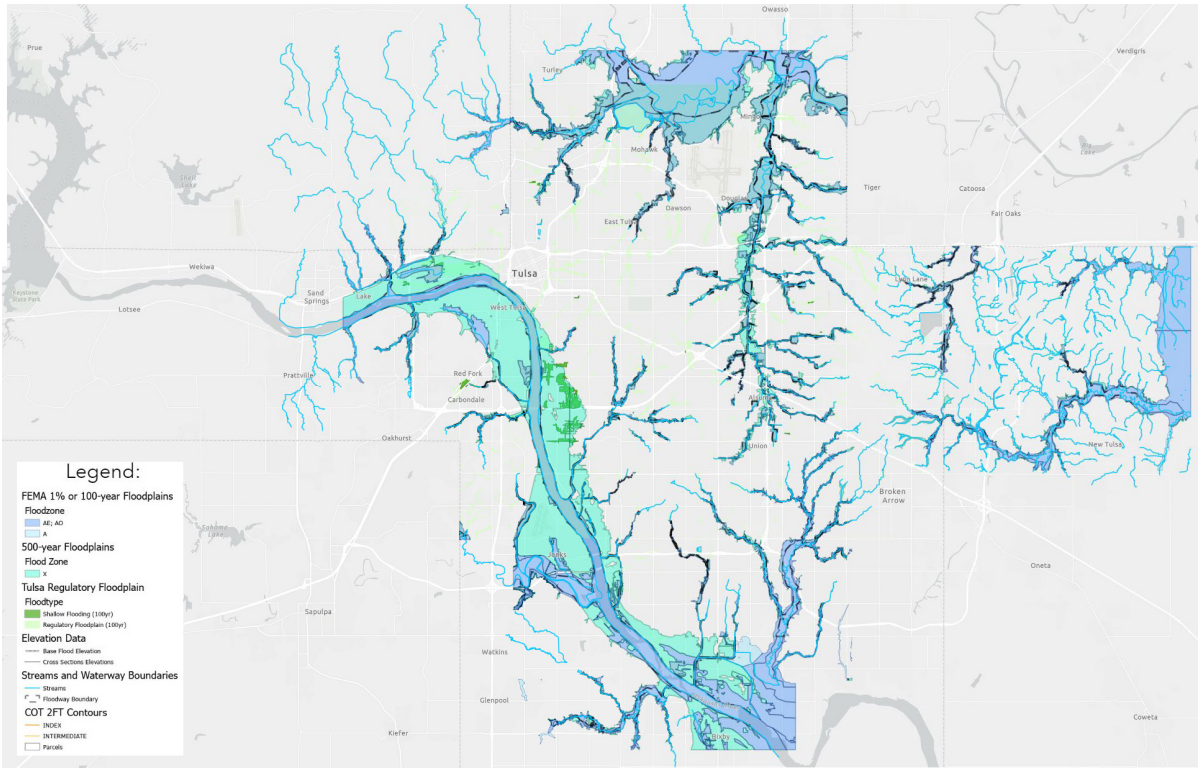
Floods are among Australia's costliest natural disasters. The delivery of logistic support to the flooded area of NSW and QLD in early 2022 caused an increase in the Australian national defence spending of almost 6 per cent in the first quarter of the year (ABS 2022). This cost added to the 197,000 filed insurance claims worth $3.35 billion in insured losses (Insurance Council of Australia 2022). Due to Australia's different climatic zones and characteristics, different parts of the country experience different types of flood events. However, the eastern states, particularly NSW and QLD, are the most affected. While floods are part of the Australian natural ecology—with records dating back to the early 1800s—in recent years, there has been an escalation in their frequency, intensity and impact. This can be linked to changes in weather patterns and atmospheric conditions (Seneviratne et al. 2012); in particular the Bureau of Meteorology has recorded a shift in cyclones patterns that causes more frequent and intense rain periods (BoM and CSIRO 2020).

With the escalation of heavy rains and a consequent increased risk of flooding, there is pressure to identify strategies that will help adapt to this new condition, minimising the impact on our urban settlements. Similarly to Australia, the US has a long history of dealing with flooding. However, amongst the many stories of devastation, the city of Tulsa (Oklahoma) in the US stands out as an exemplary flood management case. In this chapter, we describe Tulsa's current flood management model, contextualising it within the US policy and programs on flood management, including a discussion on the policy innovation aspects. In conclusion, we review the lessons learned.

3.1 Case study: Tulsa flood management model (US)

Located along the banks of the Arkansas River, the city of Tulsa has historically suffered from flooding. Nevertheless, it has moved from being the most flood-prone city in the 1970s to leading the conversation on floodplain management in the US. The current approach to flood mitigation, which has seen Tulsa securing national headlines for being the city with the lowest insurance cost among all vulnerable areas in the US, is the outcome of a four-decade-long journey (FEMA 2022b). There is extensive literature offering an in-depth understanding of the mitigation strategies implemented in time in Tulsa. In particular, this body of work examines policy innovation relative to governance and regulatory framework for land use and water management.

Figure 7: Tulsa (US) floodplain map



Source: https://maps.cityoftulsa.org/floodplains/

Table 6: Tulsa population and land overview

People (2017—21)	
Population estimates, July 1, 2021 (V2021)	411,401
Number of households	167,948
Persons per household 2017—21	2.42
Language other than English spoken at home, % (age 5yrs+)	18.8%
Geography (2020)[15]	
Population per Km^2	806.21
Land area in Km^2	511.60

Source: US census data accessed 24/04/2023 https://www.census.gov/quickfacts/fact/table/tulsacityoklahoma#

3.1.1 Goals and targets

As Waite (2011: 90) points out, historically, flood management activities in Tulsa have been linked to urban growth objectives and goals divided into four periods:

- *Low-density post WWII (1970s)* - Suburban lifestyle
- *Balanced growth (1970s—90s)* - Renewal and redevelopment of the city centre
- *Infill development (1990s—2008)* - Suburban revitalisation
- *Sustainable development (2008 onwards)* - Growth through intensification and densification.

Current urban development is framed within the *2010 Tulsa Comprehensive Plan*.[16] The city's growth is planned around the concepts of stability and growth. Stability involves the consolidation of existing neighbourhoods through an increased mix of use and activities (intensification), while growth tackles under-developed areas on the fringes of the city (densification) (PLANiTULSA 2010). This vision is underpinned by the city's *All Hazard Mitigation Plan*, which identifies interventions to improve safety and wellbeing to reduce vulnerability and manage risks (Meshek and Associate 2019). Actions identified leverage existing local and federal frameworks, guiding land use management (planning and regulatory), administrative and technical competencies, financial systems and community involvement (Meshek and Associate 2019) (Table 7).

3.1.2 Efforts

As Meo and Ziebro (2002) recount, no effective actions to systematically address the recurring flooding events in Tulsa were taken until after the 1976 Memorial Day flood. After the devastating floods, citizen-led groups partnered with representatives of the US government to lobby for substantial investment in a floodplain acquisition program, eventually leading to several policy innovations (Meo et al. 2004).

15 Measures converted from original imperial system units (miles) to metric system (Km).
16 Updated in 2016.

Flood management

It was not until the 1984 flood that a 'paradigm shift' occurred in how flood management was understood and tackled in Tulsa (Meo and Ziebro 2002: 45). The new approach to flooding entailed a 'comprehensive, regional, long-term strategy […] through a combination of structural and non-structural measure' and involved 'partnerships amongst agencies at all levels of government' (Meo and Ziebro 2002: 45). This initial stage of significant innovation was signed by the delivery of the Mingo Creek Local Flood Control Project in 1999. This Project transformed the area that was the centre of attention in the 1984 flood into a facility that protects and gives back to the community. The flood management plan included the delivery of a blue-green infrastructure through stormwater management and the floodplain's restoration (Patton 2009). The firm R.D. Flanagan & Associates supported the City with designing and delivering the Mingo Creek Project and several more, including a Multi-Use Maintenance Trail Plan and several urban and regional stormwater detention facilities (Flanagan & Associates 2014).

Table 7: Tulsa All Hazard Mitigation Plan (2019): goals and action alignment

High level	Policy level	On the ground
Goals		
General idea	Objectives	Specific targets
Strategic vision	**Mitigation goals**	**Goals outcome**
Create a disaster-resistant community and improve the safety and wellbeing of Tulsa by reducing deaths, injuries, property damage, and environmental and other losses from natural and technological hazards in a manner that advances community goals, quality of life and results in a more liveable, viable, and sustainable community (1-1).	Reduce risk and future losses stemming from natural and technological hazards that are likely to impact the community (5-1)	Minimise loss of life and property from natural hazard events Protect public health and safety Increase public awareness of risks from natural hazards Reduce risk and effects of natural hazards Identify hazards and assess risks for local area Ascertain historical incidence and frequency of occurrence Determine increased risk from specific hazards due to location and other factors Improve disaster prevention Improve forecasting of natural hazard events Limit building in high-risk areas Improve building construction to reduce the dangers of natural hazards Improve government and public response to natural hazard disasters
Means		
Capabilities	Type of action	Action
Planning and regulatory	Preventative activities	Evaluate, upgrade and maintain outdoor warning systems. Purchase and distribute NOAA weather radios Develop and implement an air conditioner program
Administrative and technical, financial	Floodplain management regulatory current and future conditions	Develop a city-wide disaster recovery and reconstruction plan. Update Master Drainage Plans when conditions warrant.
Education and outreach	Property protection activities	Acquire properties in the FEMA Floodplain, Tulsa Regulatory Floodplain and Repetitive Loss/Severe Repetitive Loss properties
	Emergency Services Activities	Inventory and maintain an active list of disaster resources available in Tulsa Maintain debris management plan and update as required/needed Maintain GIS database Install generators at critical facilities Enhance emergency plan for the Arkansas River Corridor
	Structural Projects	Implement recommendations of the City of Tulsa Master Drainage Plans Repair the levees based on recommendations from USACE

High level	Policy level	On the ground
	Public Information Activity	Develop and fund hazard preparedness, education, information, and awareness programs
		Develop an emergency preparedness and mitigation website
		Educate the general public on the benefits of disaster resistant construction
		Provide training and education on disaster resistant techniques to local builders
		Educate the public on the importance of flood insurance
		Notify the general public of the risk of living within the floodplain, levee, or dam inundation area
		Resilience Hubs

Source: Adapted from Meshek & Associates (2019) using Berrang-Ford et al. (2019) policy alignment framework

Table 8: Tulsa flood hazard mitigation model overview

Element	Policies	Principles
Comprehensive watershed management	Channelling and other structural modifications should be used as corrective measures only	Respect natural systems
Alert/warning system	Acquisition and relocation should be used to reduce the occupancy and value of exposed property	The urban environment and each watershed form a single, interactive system
Floodplain land use reserved for parks, sports facilities, greenway trails	Flood insurance and flood-proofing	Floodplains and stormwater are resources
Comprehensive Drainage Regulations and Master Drainage Plan	All development within the Tulsa Regulatory Floodplain requires a permit	Floodplain and stormwater management programs should serve multiple purposes and multiple means
Capital Projects (ex. Mingo Creek project with U.S. Army Corps of Engineers)	Flood hazard information should be disclosed to purchasers and renters	Changes in the natural balance require compensation
Public acquisition of floodplain residences	Development of a post-flood recovery program	
Stormwater Management Fee		

Source: Waite (2011: 5)

Tulsa continued to improve and refine flood control methods with each flood (Lyles et al. 2021). However, Tulsa's current integrated approach to flood management is imprinted in the interventions planned in the early 1990s. Raynolds (1994) identifies the four pillars of the project as:

- land use and planning, including basin drainage plans, citywide drainage plans, and planning regulations for land use and building construction
- capital improvements, including redesign (and maintenance) of the drainage system
- multi-objective management, including merging of the water management system and park and recreational infrastructure
- planning partnerships, including active community participation in devising and delivering the new systems and leadership in flood awareness and preparedness.

Table 9: Tulsa flood hazard mitigation framework

National Flood Insurance Program (NFIP)		
Minimum requirements	**PART 60-Flood plain management regulations**	Minimum compliance with flood plain management criteria
		Floodplain management criteria for flood-prone areas
		Floodplain management criteria for mudslide (i.e., mud-flow)-prone areas
		Flood plain management criteria for flood-related erosion-prone areas
		Designation, duties, and responsibilities of state coordinating agencies
	PART 65-Identification and mapping of special hazard areas	Mapping of areas protected by levee systems
		Evaluation of sand dunes in mapping coastal flood hazard areas
		Remapping of areas for which local flood protection systems no longer provide base flood protection

Source: FEMA (2011)

Community Rating System (CRS)		
CRS credited activities	**Public information**	Elevation certificates
		Map information service
GOALS		Outreach projects
Reduce and avoid flood damage to insurable property		Hazard disclosure
		Flood protection information
Strengthen and support the insurance aspects of the NFIP		Flood protection assistance
		Flood insurance promotion
	Mapping and regulations	Floodplain mapping
Foster comprehensive floodplain management		Open space preservation
		Higher regulatory standards
		Flood data maintenance
		Stormwater management
	Flood damage reduction	Floodplain management planning
		Acquisition and relocation
		Flood protection
		Drainage system maintenance
	Warning and response	Flood Warning and Response
		Levees
		Dams

Source: FEMA (2017)

Adapting to flooding: a lesson from Tulsa (US)

Planning			
Overarching tools	**Arkansas River Corridor Master Plan**		
	Master drainage plan Stormwater management plan	Identifies recommendations, goals, objectives, and priority projects according to their flood risk reduction potential. GIS system to collect information that is shared with the public.	
	Repetitive Loss Area Plans (RLAP)	Includes properties that received payments on two or more NFIP claims of $1,000 or more in a 10-year period. The scope of the plan is to evaluate and determine the best alternative for each property.	
Other tools	**Park Masterplan**		
	Long Range Transportation Plan **Major Street and Highway Plan**	Major transport exiting route and emergency access.	
Watershed wide regulation	**Ultimate Watershed Urbanisation (UWU)**	The city enforces its own more extensive maps and regulations, which are based on ultimate watershed urbanisation.	
Watershed wide regulation *Floodplains are only part of flood-management considerations. Water gathers and drains throughout entire watersheds, from uplands to lowlands.*	**Stormwater detention**	New or substantially improved developments must detain the excess stormwater on site.	
	Valley storage	Compensatory excavation if a development - including a flood control project - would reduce valley storage Some developments are allowed to pay a fee in lieu of on-site detention. The in-lieu fees are allocated for regional detention facilities.	
Building codes	**Watershed development permits**	Any development within city limits requires a permit before building, excavating paving, grading, or landfilling. Permits are based on floodplain maps and watershed wide master drainage plans	*Floodway (FW) Watershed Development Permit* *Floodplain (FP) Watershed Development Permit* *Stormwater Drainage (SD) Watershed Development Permit*
	Engineering analysis of all construction in floodplain	Special regulations apply to construction within the floodway portion of the floodplain No construction, including filling, is allowed in the floodway without an engineering analysis that shows the proposed project will not increase flood levels and cause damages elsewhere	*Stormwater Connection (SC) Watershed Development Permit*

Adapting to flooding: a lesson from Tulsa (US)

Planning			
Building codes	**Elevation**	Elevation for all new builds 2 foot above regulatory flood elevation based on UWU maps	*Earth Change (EC) Watershed Development Permit*
		Elevation or floodproofing prior to renovation improvement or add-on is 50% of value of the existing building	
		Permits for major repairs in post-disaster events	

Source ESD (2019)

Capital improvement projects		
Buyout and relocation *voluntary acquisition program*	**Updates and shared in formations**	Moratorium of buildings and identification of repetitive loss area plans
	Acquisition	Value of purchase at pre-flood market value
	Funding	Federal Emergency Management Agency (FEMA)
		US Department of Housing and Urban Development (HUD)
		Municipal admin fees
Stormwater system upgrade and maintenance *Funding*	**Stormwater fee**	Maintenance of stormwater detention facilities, stream channels, pumping stations, culverts, ditches and other drainage facilities
	Federal grants	Maintenance of stormwater detention facilities, stream channels, pumping stations, culverts, ditches and other drainage facilities
		Hazard Mitigation Assistance (HMA) FEMA
		Public Assistance (PA) FEMA
		Flood Mitigation Assistance (FMA) Grant FEMA
		Community-Based Restoration Program NOAA

Source: Authors from sources cited in-text in table

Policy frameworks and programs

Throughout its evolution, Tulsa's flood management responses remained linked to the opportunities and constraints set by the flood control national policy framework (Meo and Ziebro 2002). The city floodplain management strategies are framed within the US National Flood Insurance Program (NFIP) and aligned with the four categories of intervention identified by the US Community Rating System (CRS) program (Headwaters Economics 2020). The NFIP was set up to respond to the heavy cost of post-disaster recovery in 1968 (CRS 2022). The program's access to insurance is linked to risk mitigation activities. Communities adhere to the program to obtain reduced flood insurance premiums. The local government participating in the NFIP must develop Flood Insurance Rate Maps (FIRMs) and implement minimum floodplain standards. Moreover, the NFIP program is designed so that the insurance payments finance a Flood Mitigation Assistance (FMA) grant program (CRS 2022). In the case of Tulsa, experience proved that the minimum measures required by the NFIP relative to land use control were insufficient, and the city developed stricter regulations and more refined maps to control development (Meshek & Associate 2019). Tulsa also participates in the National Community Rating System (CRS) program. Communities participate in the CRS program voluntarily to achieve a discount on their flood insurance premium. The rating system includes four areas of intervention: public information activities, mapping and regulations, flood damage reduction and flood preparedness (Headwaters Economics 2020).

Funding and financial support

Funding to implement Tulsa's planned structural activities comes from local and federal resources. The municipal budget includes a stormwater fee, local option sales tax and an in-lieu fee for on-site retention, which is redirected towards the delivery of regional detention basins (Headwaters Economics 2020; Meshek & Associate 2019; Peterson et al. 2020; Raynolds 1994) (see Table 10).

Table 10: Funding highlights: stormwater maintenance

Local	State	Federal
$8.35 monthly stormwater utility fee	Oklahoma agencies have funded projects with mitigation co-benefits (e.g., OK Dept. of Transportation)	Hazard Mitigation Grant Program funding

Source: Headwaters Economics (2020: 2)

In addition, federal grant programs have helped deliver structural and non-structural projects in Tulsa. Structural interventions were supported initially by FEMA recovery grants. Over time, federal grant schemes have increased, with many considering mitigation and resilience building over post-disaster recovery. For example, at the end of August 2022, FEMA announced that Tulsa had passed the second selection round of the Building Resilient Infrastructure and Communities (BRIC) grant—delivered as part of the 2021 BIL. According to the American federal emergency agency, the fund will be used by Tulsa to continue work on its integrated approach to flood management:

> *To reduce flooding, Tulsa's project submission will allow the city to make infrastructure enhancements along Fulton Creek by increasing the capacity of the storm sewer system and constructing two detention ponds and culverts. Stormwater runoff prevention will also be enhanced by adding trees to reduce heat and limiting development (FEMA Federal Emergency Management Agency 2022c).*

Federal funding also plays a crucial role in delivering non-structural projects, such as the buyout of properties along the floodplain. To implement buyout schemes, local governments can access two primary federal funding programs managed by FEMA and the US Department of Housing and Urban Development (HUD). Tulsa has also used part of the stormwater fee revenues (usually directed for upgrading and maintaining the stormwater and drainage system) to contribute to the 25 per cent cost match required by the FEMA's Hazard Mitigation Grant Program (HMGP) (Peterson et al. 2020: 10). Following the 2019 floods, Tulsa's commissioner approved a voluntary buy-out plan of US$14.75 million funded by HUD through the Community Development Block Grant Disaster Recovery funding (Bishop-Baldwin 2023).

3.1.3 Adaptation results

The collective efforts to improve Tulsa's flood resilience have brought many benefits to the city, its residents and other communities living in flood-prone areas. The flood mitigation literature uses the *Tulsa Model* (Waite 2011) to describe the city's novel approach to flood mitigation. In early 2022 Tulsa was awarded a class one rating under the CRS (FEMA 2022a). Tulsa residents who live in flood-prone areas receive the highest discount on their insurance in the US; this is in recognition of the above-average standard of flood mitigation measures implemented by the city and supported by the community. With the plan's implementation, the city has achieved more than the financial benefits of insurance discounts.

As part of the overall plan, the city has seen the construction of a flood control system based on a network of landscaped detention basins (blue-green infrastructure). The Mingo Creek Stormwater Detention Facilities and the other retention basin structures that followed within the city and in its surroundings are designed to serve as public spaces (Headwaters Economics 2020). Providing such areas increases water retention capacity on-site and off-site, enhancing the community's wellbeing, positively impacting water quality, and restoring wildlife habitats (Naturally Resilient Communities n.d.). Tulsa's flood management plan can be defined as ecosystem-based as it is centred around the sustainable use of natural resources with a deep understanding that nature-based solutions benefit not just disaster management but ecological and social sustainability.

3.2 Learning from Tulsa

Community and local networks

The effectiveness of Tulsa's flood management can be attributed to the implementation and investment in innovation to deliver a successful community-based risk management program. Singh et al. (2021:6) define community-led adaptation as one that 'ensures participation of multiple stakeholders and enables devolution of decision-making authority and administrative control'. This model of effective adaptation has been at the centre of the development and success of Tulsa's floodplain management decision-making process. Since its inception, residents' commitment to addressing recurrent damaging floods has pushed political leaders to take action and investigate innovative approaches, encouraging an overall trend towards sustainability on a large scale in Tulsa (Meo and Ziebro 2002; Meo et al. 2004).

As Lyles et al. (2021:1) point out, literature recounting Tulsa's experience 'regularly emphasise the importance of human dimensions of long-term risk reduction through natural hazard mitigation—leadership, staffing, and expertise'. Their work offers a clear overview of the policy innovation embedded in the city's response to flood mitigation concerning entrepreneurship and the stakeholder network model. Their analysis of changes in the key players' roles, responsibilities and relationships during the development and delivery of the project shows that while the dimensions and external forces involved in the process align with standard hazard mitigation models, '[t]he loose but close connections among the champions have allowed the network to adapt through myriad changes locally and nationally' (Lyles et al. 2021:12). So, in the context of a highly volatile political scene, both at the local and national level, the experts' network and the local community have remained the driving force of the process and the project pushing for innovation.

Policy innovation

Tulsa's project presents two types of policy innovation. The first relates to governance and administrative processes, which Meo and Ziebro (2002) name policy entrepreneurship. The second relates to environmental policy, driven by these governance and administrative processes. The ecological side of the policy innovation refers specifically to the implementation of the nature-based approach to the drainage basin plan and the investment in building an integrated blue-green infrastructure. The floodplain clearing and removing existing dwellings through buyouts financed under national schemes and investment programs are essential to delivering such infrastructure.

Meo (2001) points out that literature discussing the Tulsa project has highlighted that local adaptation actions have been implemented in the context of, and supported by, overarching national policy and funding frameworks. Tulsa has found the sweet spot between bottom-up and top-down intervention and processes. Genovese and Thaler (2020:459) explain that responses to floods increase their effectiveness 'when integrated approaches are implemented. In particular, the combination of top-down and bottom-up solutions can provide the best results in terms of socio-economic assessments'.

In conclusion, the effectiveness of Tulsa's flood adaptation strategies is linked to:

- long-term and structured support to resilience building
- improved governance and stakeholders' collaboration, particularly community-driven processes,
- community-based risk management
- a nature-based and integrated approach to mitigation.

4. Adapting to Bushfire: GUARDIANS Riba-roja de Túria, Spain (EU)

- **Riba-roja de Túria co-responsive model undertakes long-term comprehensive and integrated disaster risk management of bushfires concerning their impact on biodiversity, infrastructure and properties.**
- **The case study integrates structural intervention with a nature-based solution, effectively reducing fire risk by implementing low-flammable vegetation fire breaks at the Wildland Urban Interface (WUI).**
- **An integrated policy agenda developed in this project critically highlights how the role of the empowered citizen is critical in self-defence and practising adaptive urban design.**

Australian bushfire season has lengthened, with fire events being more frequent, intense and unpredictable (Metcalfe and Costello 2021). As Norman et al. (2021:1) point out:

> *[t]he Australian bushfires brought in the 2020s with a global sense of apocalypse. The extent, timing and intensity of the fires dramatically demonstrated how climate change is already driving catastrophic impact.*

The bushfire season of 2019—20 was devastating. More than 30 people lost their lives, as well as countless native animals. According to the NSW Rural Fire Service, on 13 February 2020, over 3,000 homes were impacted by the bushfire (NSW RFS 2020) and all kinds of facilities and businesses. Images of red smoky skies in Sydney quickly reached every corner of the planet, reminding us that the impact of bushfires is not only felt in regional areas. According to Koo and Liang (2022), increasingly, wildfires are affecting the ever-expanding urban fringes, which are pushing closer to, or are located in, bushfire-prone areas. Published literature shows that property prices in natural disaster-affected areas will likely recover if no major natural disasters occur in the next few years. However, in time, the increase in natural disasters is reflected in housing values (Athukorala et al. 2019). Athukorala et al. (2016) have revealed that in areas where these events are increasingly frequent, property values cease to increase in the short-term and then decrease in the long-term. This poses a question about the long-term impact of bushfires and the sustainability of the current model of urbanisation.

This chapter will discuss the project GUARDIANS: Green Urban Actions for Resilient Fire Defence of the Interface Area in Riba-roja de Túria (Spain). GUARDIANS was designed to improve the fire resilience of the city while preserving the Natural Park of Túria and La Vallesa in Riba-roja. Following the same structure as the previous two chapters, we will start by presenting the case study and then close with the lessons learned from this Spanish project that will contribute to the discussion around Australia's bushfire adaptation (Chapter 6).

4.1 Case study: GUARDIANS Riba-roja de Túria (Spain)

Spain is facing increased fire risk due to expanding urban sprawl, higher intensity of fires related to climate change and lack of fuel management in the Wildland Urban Interface (WUI) (Pastor et al. 2020). To tackle these challenges, the Natural Park of Túria and La Vallesa in Riba-roja led the GUARDIANS project in 2018. The aim of the GUARDIANS project is to protect nature and the residents living around the 2,000 hectares of forested land (Pastor 2020).

4.1.1 Vulnerability and context

Riba-roja de Túria is one of the many small municipalities in the National Park of Túria, less than 100 kilometres inland from the south-eastern Spanish coastal city of Valencia, halfway between Barcelona and the Strait of Gibraltar. The small town (60km2) is home to just over 22,000 residents. Like most of southern Europe, the municipality has been facing aggravated bushfire risk due to physical and climatic impacts associated with decreasing precipitation and water scarcity (Pastor et al. 2020). An annual precipitation reduction rate of 5.5 per cent was recorded between 1830 and 2013, which caused a significant challenge to the water regime (Alonso et al. 2015). Furthermore, the sprawling of urban settlements up to the margins of the forestlands is increasing the city's vulnerability and the risk posed to human life and properties alike in case of a bushfire. The situation worsens during summer with a high risk of fire from enhanced human activities due to the holiday season. The municipality has already suffered from 40 devastating bushfire events between 2000—2016, triggering the search for better protection measures and resilience building for the communities living in the WUI (Pastor 2020). Two other factors contributing to the vulnerability of this area are the weak legislative framework and the lack of risk culture in the local community (Pastor 2020).

Table 11: Riba-roja de Turia population and land overview

People	
Population Estimates 2021 census	22, 931
Median age	38.2
Geography	
Population per Km^2	398.9
Land area in Km^2	57.49

Source: https://citypopulation.de/en/spain/comunitatvalenciana/valencia/46214__riba_roja_de_t%C3%BAria/

4.1.2 Goals and targets

The Riba-roja de Túria project has two main objectives: (1) to protect natural habitats and (2) to lower community vulnerability to bushfire hazards through the application of sustainable water management principles. In addition, the project aims to improve ecosystem conditions and raise community fire risk awareness (Pastor 2020).

Table 12: GUARDIANS project mitigation goals and action alignment

High level	Policy level	On the ground
Goals		
General idea	Objectives	Specific targets
Strategic vision	**Mitigation goals**	**Goals outcome**
Pioneering a model of sustainable and innovative management of the natural environment, which will ensure the safety of the citizens of Riba-roja and contribute to the preservation of the Natural Park of Túria and La Vallesa (11)	Protect biodiversity	Improve ecosystems conditions.
	Lowering communities vulnerability	Raising risk culture and communities' fire risk awareness.
Capabilities	Type of action	Action
Nature-based strategies	Creating green fire breaks	Use of irrigation to soak WUI automatically as a preventive and pre-suppression strategy.
		Multi-layered low-flammable vegetation strips at WUI served by artificial water inputs.
Water recycling	Preventive irrigation and fire suppression	Sprinkler towers sourced from recycled water treatment plants.
		Hydraulic infrastructure to connect WUI areas with the city wastewater treatment plants.
Community resilience	Training and education	Programs to raise awareness and self-defence • Risk awareness gatherings • Creative workshops for training and education • Home assessment through door-to-door visits

Source: Authors, adapted from Pastor (2020) and Pastor (2023)

4.1.3 Efforts

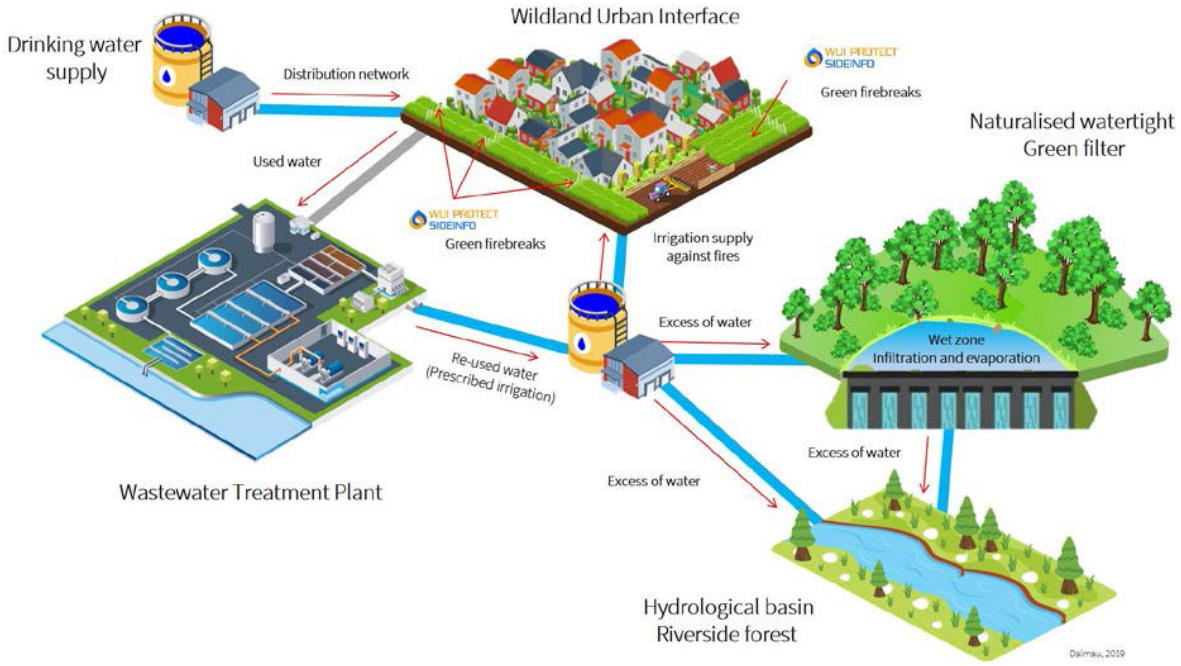
The GUARDIAN project applies a sustainable water management principle to protect natural habitats and the residents of Riba-roja de Túria from bushfires and mitigate these hazards. The project, the largest firefighting infrastructure in Europe, commenced in 2018 and officially opened in early 2022 (UIA 2022). The two municipalities of Riba-roja de Túria and Paterna, the local water corporation, a private consulting engineering firm, and three research institutions worked together to deliver this infrastructure.

The integrated fire management design revolves around three main strategies:

- **Use of nature-based solutions:**
  The project implemented over 35 hectares of multi-layered, low-flammable vegetation strips at WUI, served by artificial water inputs. It has created a micro-climate that lowers downwind temperatures and enhances humidity.
- **Water recycling:**
  In response to water scarcity experienced in the region, the project uses recycled water to protect the city from fire hazards. A hydraulic infrastructure was installed to connect WUI areas with the city wastewater treatment plants to support the use of recycled water in the system. The automated system includes a 500m3 water tank connected with 42 water cannons to spray water at strategic locations. The automatic system can identify soil moisture deficit and self-engage to soak the areas (see Figure 8).

- **Community resilience:**
  Awareness-building campaigns were undertaken for the citizens and school-age children. The topics discussed in these engagement events included: understanding the role of the newly installed hydraulic system, prevention and emergency irrigation management, self-defence, and practising fire-resilient gardening.

Figure 8: GUARDIAN hydraulic system



Source: https://climate-adapt.eea.europa.eu/en/metadata/case-studies/building-fire-resilience-using-recycled-water-in-riba-roja-de-turia-spain

Empowering local communities

Building community resilience is at the heart of the GUARDIAN program through increased community fire risk preparedness and awareness. Based on international experience, including the Victoria Safer Together state-wide initiative, the Spanish program distinguishes itself from its international predecessor by focusing on *wildfire resilience* over *resilience*. As Pastor (2023) explains, the conceptual framework developed by the GUARDIAN project partners Medi XXI combines Porrit's resilience capital concept and Oladokun and Montz (2019) disaster resilience capacities (Figure 9). This conceptual approach is paired with four main principles guiding action:

- long-term thinking (25 years)
- working across different domains, actors and scales
- a focus on learning by doing (training and risk awareness)
- use of various outlets for divulgation (Pastor 2023).

Figure 9: GUARDIAN project resilience conceptual framework

Source: Authors, adapted from Pastor (2023)

Policy frameworks and innovation

This EU Green Deal urban policy considers a forestry strategy as part of its sustainable urban development agenda (EU European Commission 2019:12) and calls for working toward 'reduc[ing] the incidence and extent of forest fires'. The EU traditionally focused on fire suppression, which typically fails to reduce casualties to lives and properties (Vacca et al. 2020). The existing legal framework enables autonomous regions to establish co-responsible fire protection and defence, integrating associated laws, guidelines and community awareness beyond the classic fire management approach that favours fire suppression. However, according to fire experts and research, to effectively tackle bushfires in Mediterranean-type regions, there is a need to move away from suppression strategies aimed at reducing the area burned—which can worsen the situation under extreme weather circumstances—to targeting reduced damage (Moreira et al. 2020). According to Moreira et al. (2020: 4), in the context of WUI, effective strategies to achieve damage reduction are: 'land use planning (location, infrastructure design), landscape management (land use surrounding the WUI, asset protection zones) structure hardening to promote self-protection'. The Riba-roja de Túria project falls into these categories of intervention.

Funding and costing

The project was delivered with the support of EU funding through Urban Innovative Actions, a program specifically designed to support the delivery of sustainable urban development projects funded through the European Regional Development Fund (City of Riba-Roja de Turia 2022). The EU funding covered 80 per cent of the project's total cost (€5.5 million).

While the first part of the project has been delivered, neighbouring cities and villages have expressed interest in developing a GUARDIAN system within their jurisdictions. So in looking at upscaling the project, the challenges are presented even before funding is secured. These challenges relate to developing parameters that can effectively capture—in economic terms—the social and environmental benefit of such a project (Pastor 2021b). In particular, the researchers at the University of Valencia are looking at quantifying four main costs to assess the project's financial viability for replicability and scalability. These are acquisition, operation, maintenance and withdrawal costs (Pastor 2021a).

4.1.4 Adaptation results

According to Pastor (2020), the novel approach of Riba-roja de Túria delivered several tangible and environmental benefits. A comprehensive action plan has contributed to the resilience of the communities living in bushfire risk-prone areas in many ways. The hydraulic system ensured the availability of sufficient water to accommodate development at the WUI. The defensive mechanism of establishing water-related infrastructure added to this. For example, the ecological condition of the area has increased as abandoned agricultural land use and wetlands were recharged with recycled water. Citizens are now more capable of self-protecting from any fire hazard.

4.2 Learning from Spain

The Riba-roja de Túria project demonstrates a multi-lateral approach to disaster risk management, with the development of a model of intervention that sits halfway between the process-based and normative adaptation frames along the Singh et al. (2021) adaptation effectiveness continuum.[17] The Spanish model of a co-responsive and comprehensive mitigation intervention to tackle bushfire risks is a demonstration of what Djalante et al. (2013) define as an adaptive and integrated risk resilience (AIDR) approach focused on sustainable development. According to the authors, the sustainable development components of AIDR support the critical areas of: 'governance and institutions; education, awareness and capacity building; social and economic development; the built-environment (physical infrastructure); and the natural environment (ecosystems)' (Djalante et al. 2013: 2110). In the case of Riba-roja de Túria, the project uses intervention based on the built environment, education, and ecosystem and, in return, increased resilience in all areas of sustainable development.

Wamsler and Johannessen (2020) identify that one of the critical issues in bushfire risk reduction policy development is breaking the silos approach for institutions and stakeholders. Paton and Buergelt (2019) call for promoting inclusive practices based on collaborative action involving government, policymakers, experts, scientists and the community. This project demonstrates a collaborative process that breaks the silos mentality. It showcases effective collaboration, with city authorities and research institutes working with citizens to develop an integrated self-defensive strategy to face fire risks (actor-based integration), which operates across multiple legal frameworks (local and EU). However, the project's progress report highlighted issues related to smoothly running the system, impacting the relationship amongst stakeholders and how the bureaucratic and administrative times connected to government funding and procuring methods negatively impact the collaboration between different sector operators (Pastor 2023).

Lastly, the project assumes an integrated fire management approach with a synergetic combination of hard infrastructural intervention (firefighting structure), community resilience building and nature-based solutions. Through a complex network of water tanks, regeneration stations, wireless sensors, pipes and water towers, the project presents a new method of sustainable forest management that improves the resilience of the natural habitat and the neighbouring urban centres. Cartalis (2022) defines this mechanism to 'exploit green sectors in city resilience plans'.

17 Refer to Figure 5 in Chapter 1.

In conclusion, the Spanish case study has implemented three critical strategies to increase adaptation to bushfires:

- improved governance through stakeholders' collaboration
- community resilience building
- nature-based and integrated approach to mitigation.

5. Adapting to cyclones: My Safe Florida Home program (US)

- **Application of the latest technology to building construction, reflected in building codes, is the best way to minimise damage and disruption to everyday life in hazard-prone areas.**
- **Home inspection to identify possible improvements provides an opportunity to strengthen the resilience of homes and create a culture of mitigation by informing homeowners of ways to increase their safety.**
- **Investment in retrofitting grants provides positive economic benefits while increasing resilience.**
- **Reduction of loss and damage decreases disruption in homeowners' lives that can be longstanding in the case of the most vulnerable groups.**

In April 2021 an unexpected change in the direction of hurricane Sejora damaged 70 per cent of houses in Western Australia's regional town of Kalbarri, located approximately 250 kilometres north of Perth. Cyclones are a recurrent event in northwest Western Australia (AIDR n.d.). However, the Category 3 tropical cyclone crossing the state in April 2021 moved along the coastline, reaching further south than typical to a region that had never been affected and, therefore, was not ready for such an event (Boughton et al. 2021). The Insurance Council of Australia (2021) estimated that since 1967, the costs of damage caused by cyclones in Australia amounted to $23 billion.

According to the latest science, the changing climate impacts cyclones' intensity. Meteorological projections show that cyclones are becoming stronger and wetter, with the proportion of cyclones classified as category four and above expected to increase, with extended precipitation periods, increasing the likelihood of flooding events (Knutson et al. 2021). Moreover, as we have seen in Kalbarri, there is evidence that the warming of global temperature is also causing a shift in cyclones' trajectory. These are worrying signs as the increased intensity will cause more destruction.

Florida is the US State most affected by hurricanes[18] due to its unique geography. However, due to its long history of dealing with such events, Florida has developed several programs to support its residents in building more resilient homes and mitigating the effect of cyclones. This chapter will discuss the state program named My Safe Florida Home.

5.1 Case study: My Safe Florida Home (US)

The My Safe Florida Home (MSFH) program, first offered in 2009, supports households (and in particular low-income households) to assess the condition of their homes and support them financially to carry the structural improvements needed to benefit from insurance discounts.

5.1.1 Vulnerability and context

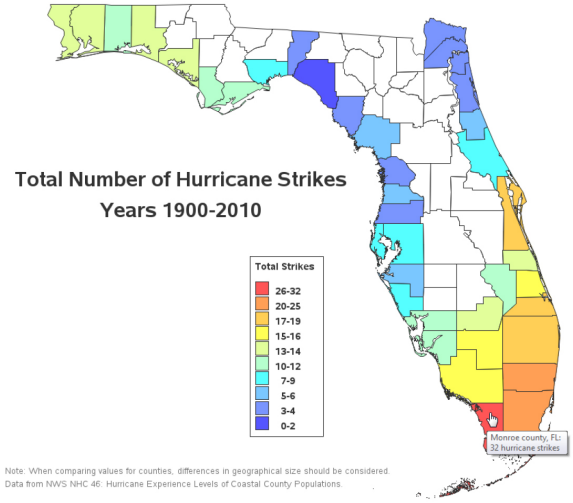
The state of Florida is a peninsula located on the east coast of the US. Connected to the mainland on the north side, the state is characterised by a thin strip of land, around 150 kilometres in width, which extends south for 700 kilometres and divides the Gulf of Mexico from the Atlantic Ocean. The state has a total of over 2,000 kilometres of coastline.

Florida is affected by tropical cyclones (or hurricanes) yearly, occurring between June and November. However, the hurricane seasons intensify in mid-August and late October. Hurricanes form in the middle of the Atlantic Ocean and are pushed towards Florida's coastline by the strong west and north-west winds (Florida Climate Centre n.d.; Her et al. 2018). Hurricane Katrina in 2005 is a prime example, which remains as one of the deadliest and most expensive hurricanes (US$161 billion) in modern US history (NOAA Office for Coastal Management 2022).

In September 2022, Hurricane Ian was the last hurricane to touch land in Florida. It is estimated that Ian was the 121st hurricane since 1851 to have devastated the state, pushing Florida to the top of the list of the most impacted states in the US (Ajasa and Patel 2022). According to analysis of historical tropical storm and hurricane data in Florida conducted by Emrich et al. (2017), the majority of the state is at medium to high risk for tropical storm force winds, with the highest risk being for the east coast and the most intense being on the west.

18 A hurricane is " A tropical cyclone with maximum sustained winds of 74 mph (64 knots) or higher. In the western North Pacific, hurricanes are called typhoons; similar storms in the Indian Ocean and South Pacific Ocean are called cyclones" NOAA National Oceanic and Atmospheric Centre (n.d.) *Tropical Cyclone Climatology*, https://www.nhc.noaa.gov/climo/, Accessed 3/12/2022.

Figure 10: Florida: number of hurricanes strikes 1900—2010



Source: https://blogs.sas.com/content/sastraining/2017/09/12/where-do-hurricanes-strike-florida-110-years-of-data/

5.1.2 Goals and targets

The MSFH program aims to improve the resilience of Florida's homes to strong winds by identifying the structural work needed to mitigate hurricane damage. In addition, the program intends to strengthen the homes' resilience and create a culture of mitigation by informing homeowners of ways to increase their safety.

Table 13: My Safe Florida Home program mitigation goals and action alignment

High level	Policy level	On the ground
Goals		
General idea	Objectives	Specific targets
Strategic vision	**Mitigation goals**	**Goals outcome**
Develop and implement a comprehensive and coordinated approach for hurricane damage mitigation	Strengthen the home resilience	Encourage owners to retrofit their properties to make them less vulnerable to hurricane damage
	Create a culture of mitigation	
Means		
Capabilities	Type of action	Action
Hurricane mitigation	Inspections	Determine mitigation measures needed
		Provide cost estimates for improvements
		Identify insurance premium discounts available
	Grants	Contribution of up to $10,000 toward the actual cost of the mitigation project
	Education and consumer awareness	Multi-media public outreach
		Advertising campaign

Source: Authors, adapted from (State of Florida 2022)

5.1.3 Efforts

The state of Florida offered the first MSFH Program following the 2004—05 hurricane storm season; it was launched in 2007 and closed in 2009. The program was reinstated in May 2022 through legislation. It was launched officially in September 2022 and is planned to run until 2024 or until the funds cease. According to the state's legislation, the Florida Department of Financial Services (DFS) is in charge of running the program and has 'fiscal accountability, contract management, and strategic leadership' (State of Florida 2022).

The program has three main components:

- **Hurricane mitigation inspections:** Inspections are offered to all homeowners of site-built, single-family residential homes and are provided at no cost to the homeowners. To receive an inspection, the homeowners need to submit an application, which is reviewed and approved by the Florida DFS. The inspections are carried out by licenced inspectors assigned by the Florida DFS. The inspectors provide a report identify mitigation and retrofitting measures needed to reduce the dwelling vulnerability to wind damage, including an estimated cost, and identifies insurance premium discounts associated to the suggested the mitigation strategies (State of Florida 2022).
- **Mitigation grants:** grants are offered to implement building retrofitting recommended by the inspection report. Grants are available for homeowners meeting the legislative requirement to financially support the retrofit of their dwelling to decrease their vulnerability to hurricane damage (see Table 14 for details).
- **Education and consumer awareness:** the legislation includes the launch of an awareness campaign to publicise the program and inform residents of the benefits of retrofitting their homes.

The MSFH program works in conjunction with other state-based programs and federal funds aimed at mitigation and is managed through the State Emergency Response Team (SERT).

Table 14: My Safe Florida Home (MSFH) program mitigation grants overview

Eligibility criteria	Homeowner must have been granted a homestead exemption[19]
	Dwelling insured value of $500,000 or less (or) Homeowners are low-income as defined by Florida Statutes Title XXX. Social Welfare § 420.0004[20]
	Have undergone a mitigation inspection after 2008
	Home must be located in the wind-borne debris region[21]
	Home should be built before 2008
Mitigation action covered	Opening protection Exterior doors, including garage doors Brace gable ends Reinforcing roof-to-wall connections Improving the strength of roof-deck attachments; Upgrading roof covering from code to code plus Secondary water barrier for the roof
Funding	The government matches $2 for each $1 spent by the homeowner up to a maximum of $10,000 toward the actual cost of the mitigation project
	No state sales tax (6%) on retail purchases of impact-resistant doors, impact-resistant garage doors and impact-resistant windows from 1 July 2022, through 30 June 2024

Source: Authors, adapted from State of Florida (2022)

Funding

The State of Florida funds the program. The first MSFM program allocated US$250 million, of which US$93 million was provided for the grant component (Young 2009). The second round of the program allocates US$150 million from the General Revenue Fund to the DFS, including: US$25 million towards the inspection program; US$115 for the mitigation grants; US$4 million for the educational and awareness campaign; US$1 million for public outreach to contractors, real estate brokers, and sales associates; and $5 million for administrative costs (FAIA 2022).

19 The term refers to an increase in property taxable value up to US$50,000 when the property is a permanent residence of the owner or one of their dependants (https://floridarevenue.com/property/pages/taxpayers_exemptions.aspx)

20 "Low-income persons mean one or more natural persons or a family, the total annual adjusted gross household income of which does not exceed 80 percent of the median annual adjusted gross income for households within the state, or 80 percent of the median annual adjusted gross income for households within the metropolitan statistical area (MSA) or, if not within an MSA, within the county in which the person or family resides, whichever is greater" (Title XXX. Social Welfare § 420.0004 (11)).

21 These are defined in Chapter 2 of the 2017 Florida Building Code "Areas within hurricane-prone regions located:1. 1. Within 1 mile (1.61 km) of the coastal mean high water line where the ultimate design wind speed, Vult, is 130 mph (58 m/s) or greater; or 1.2. In areas where the ultimate design wind speed is 140 mph (63.6 m/s) or greater" (https://codes.iccsafe.org/content/FBC2017/chapter-2-definitions)

5.1.4 Adaptation results

The program's first round provided 400,000 free inspections and 35,000 grants (Young 2009). Based on current funding, the 2022 MSFH program expects to complete between 140,000 and 145,000 initial home inspections and approximately retrofitting 12,000 grants (Florida CFO 2022). Following the program's conclusion in 2009, the Florida DFS engaged with the company Risk Management Solutions (RMS) to conduct an independent review of the program. The impact analysis of the MSFH program found that overall the retrofitting component of the program 'reduced the state-wide economic liability and the risk carried by the homeowners in Florida' (Young 2009: 3).

In particular, according to Young (2009), calculations and modelling of different possible mitigation scenarios, the MSFH program generated a saving of US$136 million in the state-wide 100-year probable maximum loss (PML). This translates into US$1.46 savings per dollar spent on grants. However, this calculation considers the minimum scenario of retrofitting that includes only upgrading funded in the grant program (openings) and no other upgrades that the homeowners could have done as a result of the analysis report. Furthermore, according to the various scenarios, these savings increase with the number of home improvements implemented. For example, roof retrofitting achieves the maximum investment-to-savings ratio, where the cost savings could increase to almost 80 per cent reaching US$2.40 per each dollar invested (Young 2009). Moreover, the report mentions that a previous study conducted by the company on insurance claims in Florida observed that buildings in compliance with the most up-to-date codes endured up to a 50 per cent lower damage loss than older properties (Young 2009).

5.2 Learning from Florida

The Florida approach to adaptation can be defined as a normative-based intervention. It relies on strengthening dwellings' capacity to withstand strong winds. The model of effectiveness is measured on the economic return of investment generated by the retrofitting interventions. However, the opportunity to strengthen housing resilience is also leveraged to build community resilience and awareness.

The project also addresses issues of urban liveability and housing affordability. The impact of hurricanes not only includes the immediate destruction caused by the strong winds and heavy rainfalls, but also impacts housing sustainability and affordability. According to Zivin et al. (2020) analysis of the housing market in Florida between 2000 and 2016, market response to natural disasters caused a decrease in transactions in the affected areas lasting up to three years after the events. Furthermore, the authors noticed that these events also caused a change in demographic characteristics of the first home buyer towards higher income groups shifting the economic profile of these areas (Zivin et al. 2020). Markhvida et al. (2020) also highlighted that reducing loss and damage has other non-directly quantifiable benefits. In particular, the authors point out how mitigating damage to the dwelling reduces the stress of displacement caused by home loss for the hit households, which is particularly traumatic for lower-income households. Moreover, Taylor (2020:1144) warns us that in the context of Florida the insurance-linked securitisation (ILS) has created system in which 'local political and economic structures evolved in response to specific geophysical vulnerabilities and particular entanglements with the real estate–finance system'. Taylor (2020:1144) calls for further research on how risk governance strategies are used to manage property regimes in the context of different 'local geographies of risk governance to produce other fixing formations, which operate beyond re/insurance securitisation'.

Concluding, the Florida program adopts two critical strategies to increase adaptation to cyclones:

- long-term and structured support to building dwelling resilience
- community resilience building.

6. Implementing international lessons learned in the Australia context

- **The lack of leadership impacts and slows down the building of opportunities for a multi-lateral and collaborative process, which are needed to achieve effective outcomes in complex interventions such as those aimed at adaptation.**
- **The complexity of Australia's decision-making process and system of governance—in which the identification of responsibilities becomes unclear—contribute to the lack of leadership.**
- **A 'business as usual' mentality is a barrier to innovation and the use of nature-based solutions to hazard management and mitigation.**

In 2012 Australia's Productivity Commission published the outcome of its inquiry into *Barriers to Effective Climate Change Adaptation*. The scope of the inquiry was to support the Council of Australian Governments (COAG)[22] in advancing climate change adaptation policies and identifying regulatory and policy barriers to implementing effective adaptation strategies and policies (Productivity Commission 2012b). Within the inquiry, barriers to adaptation are defined as all those elements that:

> *…restrict people's ability to identify, evaluate or manage climate risks in a way that would deliver net benefits to the community. A barrier can be anything that prevents the community from using its resources — natural, financial, human, social and physical capital — in the most advantageous way to respond to climate change (Productivity Commission 2012b: 74).*

In this chapter, we have used this definition of barriers to adaptation to frame the discussion around implementing the international strategies for effective adaptation in the Australian context discussed in Chapters 3, 4 and 5. Specifically, in this chapter, we discuss the case study findings and interviews with experts to identify the main issues that require further investigation. We use interviews with consultants and government experts at the state, territory and local levels as a starting point to draw a connection between the different parts of the scoping project. The expert interviewed were selected for their knowledge in preparing and implementing policies and planning strategies related to climate change, sustainability, housing, or a combination thereof.

22 This intragovernmental forum was active until 2020, when the new National Federation Reform Council (NFRC) was formed.

Interview protocols

All experts interviewed have experience working in government departments at the state and local level, including in SA, WA, VIC and NSW. However, all are currently based either in WA or VIC. All the experts are, or have been, responsible for making decisions within their relevant institution or providing support for policy development or implementation. One of the experts also has extensive professional experience in water management in the US. Two experts currently work in private consultancy, one had previously worked for a state government in infrastructure delivery, and the other has experience in adaption plan development at the local government level. All experts are familiar with international practices in the field of urban adaptation.

We conducted six in-depth semi-structured interviews with experts to identify directions for further research and policy development based on the interviewees' knowledge of the Australian built environment, land use and management and environmental policies and governance systems. Their profile is mapped in Table 15.

Table 15: Domains, skills and network of interviewees

	Experts	E1	E2	E3	E4	E5	E6
Domains	Environment and sustainability	●	●	●	●	●	
	Policy development and implementation		●	●	●		●
	Urban planning	●	●	●	●	●	●
Skills	Policy drivers and players		●	●	●	●	●
	Asset management and delivery	●	●	●	●		
Network	Consultancy	●				●	
	Government	●	●	●	●		●
	National		●		●		●
	State	●	●	●	●	●	●
	Local	●	●	●	●	●	●

Source: Authors

The three case studies presented in Chapters 3, 4 and 5 were discussed with the experts during the interviews. The interviews were held online and recorded.[23] At the beginning of the interview, the findings of the desktop analysis relative to each of the three case studies were discussed with the experts, one at a time. Then, for each case study, following the discussion of the projects, policies and implementation plans and measures adopted, interviewees were asked to articulate what, according to their experience and understanding of the Australian context, were the possible challenges and opportunities for implementing the presented strategies.

The interviewees' recordings were manually coded and analysed inductively to identify emerging issues and opportunities relative to implementing adaptation policies. The recordings were categorised and are presented in this chapter using the three broad areas of impact in measuring adaptation efforts identified by Berrang-Ford et al. (2019): leadership (who is driving the policy, program or project), organisation (governance structure) and policy (mechanism and actions).

6.1 Leadership

In the context of the applied framework for understanding the effectiveness of adaptation, leadership refers to:

23 Except for one interview, which was conducted in-person.

- the governing structure's ability to clearly articulate its role in adaptation and provide guidance for action
- identifying the main stakeholders involved, including the one driving the decision-making process (Berrang-Ford et al. 2019).

Framing context

In Australia, adaptation is framed as a shared responsibility between 'governments at all levels, businesses, communities and individuals' (COAG 2012:13). The COAG selected Council on Climate Change has articulated the individual roles and responsibilities of these actors concerning their sphere of influence in the 'management of climate-change risks' (COAG 2012:1). According to COAG (2012) individuals are responsible for managing their risk in the context of the regulatory system and knowledge provided by government institutions. Within this overarching framework, each level of government has a specific role. The role of the Australian Government is to support, coordinate and monitor policies and programs delivered at the state, territory and local levels, facilitate knowledge sharing and establish financial incentives to encourage private sector investment relative to risk reduction (COAG 2012).

State, territory and local governments have a central role in adaptation due to the distribution of powers between the three tiers of government (Smith et al. 2011). In addition, as a signatory party to many international conventions grounded in sustainable development principles and environmental protection, the Australian Government primarily performs and legislates in these areas to adhere to these international obligations (Standing Committee on the Environment 2014). Within the Australian Constitution, however, environmental law falls under the jurisdiction of individual states and territories; this includes land-use planning, water management, coastal protection, and all aspects related to natural hazards management (floods, bushfires, cyclones). Consequently, each state and territory autonomously legislates on these matters and has its institutional governing structure, with different arrangements in place relative to the distribution of responsibilities.

State, territory and local governments are responsible for implementing and coordinating adaptation efforts at their respective levels. They legislate on environmental issues and develop planning frameworks addressing adaptation measures within their jurisdictions. As identified in Chapter 2, state and territory governments also support the development of regional adaptation plans and allocate funding for implementing risk reduction measures, including managing emergency services. Local governments are responsible for overseeing decisions regarding local planning and development, infrastructure management, and community engagement to integrate climate change considerations into their policies to reduce vulnerability to climate risks.

Barriers

Experts pointed out the lack of leadership as a barrier to adaptation. They identified the division of powers and allocation of responsibilities in the three tiers of government and the legislative autonomy of the states and territories as being at the core of the problem.

> *Because we are a federation and because we have different pieces of legislation, they are all interpreted and enacted in different ways. So while the federal intent is for consistency, the practicality is in a federated Commonwealth, you don't get consistency. (E2)*

> *It's true that the resources exist at the local and state level, the planning and integration strategy needs to happen at the national level to create appropriate interactions between states and local governments; of course, there is an issue at the state level, as we have different states that do different things differently. (E3)*

Experts argued that this fragmentation is exacerbated by the limited and unclear position of the Australian Government on environmental policies and the limited support offered to states. Using their words from a state-level agency perspective:

> *We still tend to look for a government entity as where is the singular point as opposed to the integrated response. (E3)*

These issues are especially evident at the local government level (LGA). One of the experts gave the example of water management processes relative to river basins and pointed out that even when an overarching catchment authority is in place, the coordination and responsibilities are unclear:

> *As a local government identifies the most cost-effective, environmentally appropriate way to deal with [river water] in that location, that is not the full solution as it's only part of the catchment. So, I think one of the things we get caught is local council boundary…It would be better [having] state government boundary as opposed to a catchment boundary so we don't get whole of catchment planning where all it is exacerbated because, in the case of all of the catchment approach, you might suddenly be dealing with 20 local councils. You might be dealing with two states. And to try and wrangle all that in a timely fashion?[…] and if there are so many people involved, then no one is really taking the lead. (E2)*

They identified this fragmentation as a barrier to achieving comprehensive and integrated responses to hazard mitigation, such as the one implemented in the Tulsa case study of flood management.

> *City governments are very powerful [in the US]. They run all the infrastructure, they run the planning, and they run the police, so they have a much more holistic control of what goes on in their cities than we do in Australian cities, where the local government […] with the possible exception of Brisbane City Council which has more overarching responsibility. (E5)*

Other experts echoed this sentiment, calling for a model of governance that reduces the number of local authorities, citing Brisbane as a model.

The lack of leadership also resulted in the misalignment of financial support and funding availability, as well as administrative processes—between and within—the different stakeholders:

> *Because you don't get that alignment with the budgeting process that each of those elements deals with, which then gives you a timing disconnect, which means that the outcome isn't what you originally aspired to achieve. (E2)*

> *We're not sure of you know what's [support is] available and what isn't. To be perfectly honest hasn't been conveyed to us from there were or who do we speak to at the federal government level. (E4)*

Opportunities

The experts interviewed recognised the importance of the centralised local government structure of the US in the Tulsa case study and pointed out the amalgamation of local governments as a possible area of investigation. Lembcke et al. (2016) acknowledge that 'a large number of municipalities in metropolitan areas can complicate policy coordination among local governments'. However, specific Australian-based literature discussing the model of local authorities concludes that the amalgamation model is not an efficient way to improve governance structures from an economic, political and democratic point of view (Khandakar Farid Uddin 2019; McQuestin et al. 2021). Furthermore, the discussion around the effectiveness of the water management model in Tulsa pushed the conversation towards the need to unpack further complexity and uncertainty around the decision-making process at the local government level. Agreeing with COAG (2012:8), interviews recognised LGAs are 'on the frontline in dealing with the impacts of climate change' (COAG 2012:8). This is because LGAs are responsible for linking an overarching legislative framework with urban development management, understanding local characteristics, and responding to community needs—all while considering how their individual action impacts urban adaptation at the larger scale.

> *It's a very complex puzzle matter of tiny little bits and putting them all together. It's a very complex exercise and I feel like then local government is often left to try to pull them all together. (E3)*

So, while the reduction of local government in charge would streamline the homogeneity of the process across jurisdictions, we argue that it would neither impact the number of actors involved in the decision network nor diminish the number of stakeholders involved. In addressing adaptation, both the EU countries and the US have shifted the focus of the interventions toward clarifying and experimenting with different decision-making processes and stakeholders' network improvements. In particular, they have supported facilitating alternative intervention models, such as in the case of the GUARDIANS bushfire risk reduction project in Spain.

Chapter 2 highlights that at a larger scale of government—both jurisdictional and territorial—interventions and financial investment are directed towards facilitating knowledge-sharing and funding initiatives to promote cooperation across sectors and levels of governance.[24] It also entails providing financial resources to support structural intervention and building ad hoc governing bodies to guide adaptation efforts at the local level. This includes allocating funding and expertise and building the capacity of individuals and institutions engaged in adaptation planning and implementation.

The Spanish case study highlights the importance of the financial benefit that such mechanisms provide. In addition, they are still working on quantifying the cost and benefit linked to these leadership models for replicability and scalability. In the US case study of flood management, the overarching governance structures guide action, acknowledging and understanding the drivers for decision-making, and enabling pathways to guide and support local leadership networks. The analysis of current policies and practices in Australia[25] shows that overarching models to empower leadership in adaptation are still in their infancy:

> *That's gonna take time. Still, because in Australia, we're behind compared to the rest of the world! (E5)*

6.2 Organisation

According to Berrang-Ford et al. (2019: 442), organisation refers to the governance structures 'planned or in place to support adaptation'. In analysing organisation, we move from the process put in place to facilitate leadership to the governing systems responsible for supporting and driving climate adaptation. In Australia, adaptation is framed as a shared responsibility between 'governments at all levels, businesses, communities and individuals' (COAG 2012:13). The Council of Australian Governments (COAG)[26] selected Council on Climate Change has articulated the individual roles and responsibilities of these actors, concerning their sphere of influence in the 'management of climate-change risks' (COAG 2012:1). According to COAG (2012) individuals are responsible for managing their risk in the context of the regulatory system and knowledge provided by government institutions. However, within this overarching framework, each level of government has a specific role.

24 We acknowledged that the federal US model is comparable to the AUS model, the EU is different, with national power being stronger than the overarching regional direction provided by the EU. However, in the context of this discussion, we refer to the overarching spatial relevance of the initiatives and the role of intervention that aims to connect the local intervention at the larger spatial scale to increase coordination and, therefore impact of individual local action.

25 See Chapter 2.

26 This intragovernmental forum was active until 2020, when the new National Federation Reform Council (NFRC) was formed.

Framing context

National level

The role of the national government is to support, coordinate and monitor policies and programmes delivered at the state and local levels, facilitating knowledge sharing and establishing financial incentives to encourage private sector investment relative to risk reduction (COAG 2012). In addition, the government is responsible for ensuring that the decisions made and do not impact 'national prosperity and security' (COAG 2012: 4). The 2021 National Adaptation and Resilience Strategy (DAWE 2021b) endorses the role and responsibility of stakeholders as articulated by COAG and acknowledges the need for national leadership within shared responsibilities.

A continuing evolving governing structure is responsible for acting on such responsibilities—framed in the larger context of addressing Climate Change. At the time of writing, the most recent restructuring of the Machinery of the Government is dated 23 June 2022.[27] According to this new departmental structure, the climate change responsibilities are shared between four different government portfolios: (1) *Climate Change, Energy, Environment and Water*, (2) *Agriculture, Fisheries and Forestry*, (3) *Foreign Affairs and Trade* and (4) *Home Affairs* (Table 16).

Table 16: Australian Government portfolios: climate change responsibilities distribution

Portfolio	Matters dealt
Agriculture, Fisheries and Forestry	Rural adjustment and drought issues
Climate Change, Energy, the Environment and Water	Development and coordination of domestic community and household climate action
	Climate change adaptation strategy and coordination
	Greenhouse emissions and energy consumption reporting
	Coordination of climate change science activities
	Greenhouse gas abatement programmes
	Development and coordination of international climate change policy
	International climate change negotiations
	Energy policy
	Renewable energy
	Renewable energy target policy, regulation and co-ordination
	Industrial energy efficiency
	Energy efficiency
	Energy-specific international obligations and activities
Foreign Affairs and Trade	International climate diplomacy
	Implementation of Australia's international climate finance commitments
Home Affairs	All hazard relief, recovery and mitigation policy and financial assistance, including payments to the States and Territories and the Australian Government Disaster Recovery Payments

Source: Authors.

27 Administrative Arrangements Orders (AAOs) commencing on 1 July 2022, and amended by the AAOs dated 13 October 2022, commencing 14 October 2022.

The agencies involved in managing climate change are:

- **Department of Climate Change, Energy, the Environment and Water** *(DCCEEW)*. Following the Administrative Arrangements Orders (AAOs) DCCEEW is responsible for all matters related to climate change. The department also inherited the Energy portfolio, including the related agencies and institutions previously sitting under the Department of Industry, Science, Energy and Resources (DISER) as well as the Bureau of Meteorology (BOM), which was previously the responsibility of the Department of Agriculture, Water and Environment (DAWE).
- **National Adaptation Policy Office** *(NAPO)*. NAPO is a part of the Climate Change Adaptation division of DCCEEW. NAPO is responsible for implementing the National adaptation strategy, coordinating federal, state and local government adaptation policy and intervention, and reporting Australia's adaptation progress (DCCEEW n.d.).
- **Department of Agriculture, Fisheries and Forestry** *(DAFF)*. This new department established under the AAOs is responsible for agricultural, fishing, and forest industries. It upholds climate change responsibilities related to rural and remote environments, specifically concerning draught.

The international climate change portfolio is divided between achieving international obligations relative to carbon reduction, managed by the DCCEEW, and implementing international financial commitment and negotiation addressed within the Foreign Affairs portfolio.

Disaster risk management has also changed governance with this restructuring of government responsibilities and agencies:

- **National Emergency Management Agency** *(NEMA)*. This agency stems from merging the National Recovery and Resilience Agency (NRRA),[28] which was responsible for recovery, and the Emergency Management Australia (EMA), dealing with emergency response. This new agency will manage the two sides of disaster risk management—responses and recovery—knowledge and responsibility together, directly responding to the Minister of Emergency Management in the Department of Home Affairs.[29]

State level

Local governments are 'on the frontline in dealing with the impacts of climate change' (COAG 2012:8) as they are responsible for linking an overarching legislative framework with the management of urban development, understanding local characteristics and responding to community needs Australian states and territories are responsible for environmental law, including land-use planning, water management, and coastal protection, which are crucial areas of legislation relative to adaptation. Every state has different institutional structures governing these areas, with different arrangements of responsibilities distribution within the various ministerial portfolios, departments, agencies and corporations. Overall, the built and natural environment governance is fragmented, with many actors involved. In all states, except for NSW and QLD, there is a dedicated ministerial portfolio for climate change (or climate action), which is often paired with the environment portfolio and managed in government departments responsible for environment, land, water and planning. In QLD and NSW, there is no specific portfolio, but climate change is listed as a responsibility of the minister of the environment. Together with the department, each state has several agencies overseeing particular aspects related to these areas, particularly environmental authorities, redevelopment agencies, and water corporations (VIC, for example, counts nine different water corporations).

28 NRRA was only established in 2020 in response to the 2020 Inquiry on the disaster.
29 Please refer to Figure A1 in Appendix 1 for the organisational structure of National Government climate change governance.

Barriers

The *2021 National Adaptation and Resilience Strategy* (DAWE 2021b) endorses the role and responsibility of stakeholders as articulated by COAG and acknowledges the need for a national leader guiding adaptation efforts in the context of shared responsibilities. However, from a desktop analysis research, it appears that the organisation in charge, NAPO, has not taken any action to implement the new *National Resilience and Adaptation Strategy*. This lack of action is concerning. According to the experts:

> *We hide behind the fact that [adaptation] is a local issue, not to provide an overarching [national] framework for intervention. I think it's the planning and integration strategy that needs to happen at the globe at the national level (E1)*

The experts linked the lack of action in adaptation at the national level to the detachment between the long-term plan needed to address adaptation and the shorter timeframe of political appointments. This temporal misalignment was pointed out as one of the significant barriers to long-term commitment:

> *There's this kind of disconnection between what is the real-time frame to address the issues and the political life path to make those decisions […] and politicians are focused on the next election, not what's happening in 2030 or 50 years. So it's very hard to make those difficult decisions which will turn out to have been the best decision. (E1)*

This point is made clear when we also look back at the many changes within the governmental responsibility of climate change since climate change was first established as a separate portfolio in 2007 (Smith et al. 2011). Between 2007 and 2019, the climate portfolio responsibilities were transferred between different government departments five times, translating into a system disruption happening on average every two years. To this, we have to add all the other changes at the state and territory level within disaster risk management organisations following each inquiry conducted following each natural disaster. So inevitably, we can say, using the words of the experts:

> *The politics do slow things down. (E4)*

> *So it's not just the governing structure is also the overlapping of the political willingness madness with the government structure. Because you can create a structure that it's independent of the political world. But then the political will come in and changes the structures of funding differently or whatever. (E3)*

The issue of discrepancy between politics and interfering with delivery presents not only at the national but also at the local levels. One of the experts reflected:

> *The issue is what does the governance structure look like and how it can deliver? So if we sort of think around three to four-year political cycles—pushing local government, they have essentially two-year political cycles. That's a very short time to have a target for building a sponge city and actually build it too. (E3)*

Opportunities

The experts discussed the need to establish a politically independent authority as the institution steering the process of adaptation:

> *Body like the EPA, the Environmental Protection Authority. You need an authority that goes beyond political cycles to actually address these long-term issues because it's longer than I'll be alive. It's longer than you'll be alive. We'll still be battling to get people to recognise that. (E5)*

This was justified by the need for continuity of process management and recognition that it is a technical matter requiring personnel with specialised skills and for such processes to be overseen to evaluate progress and impact in time.

> *It's harder to take decisions and put rules and regulations around it [adaptation], especially if you're a politician, not an engineer, not a planner. Not a landscape architect. Not an architect. You don't even ask the right question. (E5)*

This was raised in the discussion of the US model and how, even in the case study of Tulsa and Florida, the American Environmental Protection Agency (EPA) had represented a point of continuity in a time when the political scene was changing.

However, this was a point of disagreement among the experts. Some pointed out that establishing a new government agency does not directly translate into functioning and efficient processes and that even an independent authority is strongly linked to political commitment and reliance on political support.

> *You think you will need a correct like 'matching kind of office' and national level that directs those conversations or streamline them? But I haven't seen any evidence so far of a national department streamlining a process in Australia. Simple as that. (E2)*

There was scepticism around the ability of these agencies to be independent of political action and willingness to action.

> *It will be a government that appoints whoever runs it. It'll be a government that funds it […] you can establish an independent agency as a coordinating agency. But then, when it comes to making actual decisions or making changes, they will then end up being flipped back to other parts of government anyway, you know, whoever is running the planning system or whoever is in control of Emergency Management at the state level. [So], I can see how this kind of agency can have a coordinating strategic planning and coordination role, but I can't see easily how you could give it all the levers that it would need to be effective, particularly for natural disaster type situations. (E2)*

The conversation around the need for an independent authority overseeing environmental matters can be contextualised within the 2020 Independent Review of the Environment Protection and Biodiversity Conservation Act (EPBC) Act (Samuel 2020). The review assesses the effectiveness of the EPBC Act in protecting the environment and biodiversity, concluding that the Act is complex, inefficient and ineffective. The recommendations suggest a significant review of the EPBC Act to strengthen environmental protection and a shift towards a more strategic and outcome-focused approach. Moreover, the review recommended the establishment of an independent regulatory agency and a system of consultative committees to guide government decision-making on environmental matters. In December 2022, Minister for the Environment and Water, the Hon. Tanya Plibersek, announced the intent of the Australian Government to establish a new environmental protection agency and new national standards to assess significant developments.

Discussion

Supporting the adaptation for planning and delivering sustainable urban development requires advancement in protection and respect for natural conservation, risk management, and emergency control. In Australia, we have seen consolidation and action only around emergency management at state and territory, and national levels of government. Therefore, there is a need to create a decision-making process to articulate how the different pieces of this puzzle come together.

The US model of organisational structure revolves around two leading federal agencies, the EPA and FEMA. These agencies provide leadership and guidance. EPA focus is to preserve and protect the natural environment, and work in partnership with FEMA support vulnerability reduction to better manage disaster risk, both in post-disaster and as an ongoing commitment. Since 2016, the two agencies have established a commitment to work collaboratively in recognition of the intersection of their mandate aiming to guide:

> *Smart growth approaches, and mitigation measures applied to pre-and post-disaster development and redevelopment are a major part of ensuring that investments and future growth improve environmental, economic, and public health outcomes (EPA 2016: 3).*

The original memorandum of agreement has been updated in 2023 to expand the area of joint efforts to include 'climate change adaptation, equity, disaster debris planning, external trainings for water utilities on planning for resilience, and resilient green infrastructure design assistance' (EPA 2023: 6).

This brings the conversation to the alignment between leadership and organisation, where intervention demonstrates success thanks to the coordination of actors—as a preferred path over the simplification and centralisation of decisional systems. From the scoping analysis, this model seems to be delivering the flexibility needed to respond to the uniqueness of the local conditions.

6.3 Policy

Policy refers to the tools and processes put in place to address climate change and reduce risk and vulnerabilities.

Framing context

The 2021 National Resilience and Adaptation Strategy frames Australia's position on climate change adaptation. The document identified six main actions for intervention, working across four main interconnected domains. These actions describe the role of the Australian Government in facilitating adaptation, reinforcing what was already elaborated in the COAG (2012) document. However, given its strategic nature, the 2021 National Resilience and Adaptation Strategy does not describe how the identified actions will be implemented and the objective achieved. Within this overarching strategic approach, the document suggests a change in direction relative to (1) defining climate change adaptation and (2) how the measure of progress is understood.

National frameworks provide strategic mandates for addressing climate change. However, the complex nature of climate risk reduction and management of vulnerabilities means that national policies require local level responses. Therefore, states and territories are responsible for taking the lead in climate change adaptation and establishing comprehensive regulatory frameworks. Each adopts a different approach and response to climate change adaptation and resilience building. While all have developed climate change strategies or frameworks, the Victorian Climate Change Act 2017 is the only legislation that mandates adaptation plans. In contrast, legislation in the other states and territories acknowledges the responsibility of the climate change minister to support adaptation actions but does not specify the implementation of specific adaptation measures.

Barriers

As one of the experts explains, the issue is not the understanding or knowledge of best practices, but the inconsistency and fragmentation in the application of such practices:

> *we have a lot of measures in place similar to the ones in the case studies, but they're not consistent, for example, from one local authority to another local authority (E3)*

> *We've got to merge all these measures that we have got in place, including data and information. Sea level rise, for example, bushfires or flooding, will not respect your local government boundaries (E2)*

One example given by the experts is the work done in Australia on bushfires. The Australian disaster risk reduction paradigm has been criticised for lack of institutional coordination to reduce bushfire risks (Gonzalez-Mathiesen et al. 2021). Past policy signified an instrumental solution to reduce bushfire risks such as zoning, firebreaks, vehicle access and water supply. The National Disaster Risk Reduction Framework (2018) called for a more institutional integration that fostered '[i]nfrastructure, land use and development planning and practices must be integrated, strategic and adaptive to avoid creating new disaster risk'. In line with the national mandate, the *Living in Safer Places 2015* policy reform package of the Western Australian Government encouraged a comprehensive outlook of bushfire risk management. In other states, the legal framework for fire management sought opportunities to integrate with local government and town planning legislation. However, the National Disaster Risk Reduction Framework cautioned about the challenges of policy integration, such as vertical and horizontal governance, cultural compatibility among actors and coherence of policy goals. One of the experts also pointed out that a national approach to intervention, also in standards, supports the legislative framework:

> *I think the consistency of standards between the emergency services is getting better, so you know the equipment being used in a Victoria is same as the equipment being used in a NSW. So you've got that sort of interchange component. I think there's more work to do in that space, but I'm seeing more collaboration on those things in spite of the federal government almost. But there's something in there about the leadership. I think there's the governance issue is probably a constraint. (E2)*

Another expert explained that in terms of adaptation, Australia is failing the long-term approach and adopting more innovative responses, such as nature-based water management solutions. An immediate response shows political power and action. The need for a quick response creates an impediment to change. This was pointed out to be particularly true in the case of emergency responses:

> *In a way we all agree that we are doing better in responsiveness as we have been forced to do so due to recent events. However, we are still looking at post-recovery in a reactive way, missing the long-term goals. (E1)*

This goes back to the previously discussed point regarding the challenges of reconciling the overarching long-term timeframe needed to create a holistic response with the shorter governments' mandate and instability in governance structures, as well as the substantial economic investment that requires ongoing financial mechanisms. An example is flood management. Historically, Australia's approaches to flood management are linked to the use of structural interventions: such as levees to protect urban areas or farmland, dams to control water flows, retarding basins to store excess water temporarily, flood bypasses to redirect water, and so on (NSW Government 2005; The Geneva Association 2020). As one of the experts pointed out, changing their entire consolidated system would require substantial investment and hard thinking to address the changes needed in the consolidated urban form.

Opportunities

Other experts pointed out that a solution to strengthen adaptation is to move away from strategic frameworks and consider legislation:

> *There needs to be political courage to legislate requirements (E4)*

> *The [national] government should also take some sort of legislative and financial commitment in terms of environmental law not just coordination. Can you imagine trying to fix the Great Barrier Reef without the help of a national environmental body that is across all of the stakes that this encompasses? (E5)*

Building codes were pointed out as an important tool to increase building resilience to climate change. However, concern was raised with regards to the level of standards used

and now they're not, because there's not sufficient inspection of buildings after they're built to ensure that they have done the things they said they do and haven't cut corners or made changes that undermine their quality. (E4)

Therefore, the experts recognised inspection and programs like the one implemented in Florida as strategies that could be easily implemented at the state level with the right national support.

In terms of innovation, community-based risk mitigation strategies were well received by all of the experts. These were identified as an effective approach to improve the current lack of understanding and awareness of risk associate with natural hazards amongst the Australian population. The expert saw a community-based approach to risk mitigation and management as an untapped opportunity in the Australian context that could widen the current narrow approach to DRR and adaptation and improve the built environment resilience by strengthening social resilience.

Discussion

If, as Hussey et al. (2013:30) point out, 'policy-making for climate adaptation is very much influenced by how "climate adaptation" is framed as a policy problem', then according to the experts, one of the barriers to effective adaptation policy lies in the way in which adaptation to climate change is framed as an economic problem. According to the national Adaptation strategy, the Australian government is responsible for ensuring that the 'decisions made […] do not increase climate risk' (DAWE 2021:7) and do not impact 'national prosperity and security' (COAG 2012:4). Consequently, the national government actions have been concerned with economic growth. Smith et al. (2011: 69), writing over a decade ago, discuss Australian adaptation policies: 'adaptation has been framed within an economic rationalist paradigm, rather than a quality-of-life paradigm, and consequently there are challenges and potential paradoxes associated with achieving overriding goals such as short-term economic growth'. In particular, a detachment emerges between the long-term and holistic vision and actions needed to achieve sustainability goals and the urgency of immediate response to disasters—framed in the context of economic disruption. This has also been highlighted by the expert:

…short term economics is a big part of the problem. (E2)

…there's never any real analysis of whether this is long-term. is because you know everything in the modern world is driven around economic growth. what's the impact on housing asset values? They're all economic questions rather than what about the safety of people? And what about their long-term economic interests? (E5)

We frame our environments as a commodity. (E1).

6.4 Overview

Summarising the interviews with experts has identified the following barriers and opportunities for the adoption of more effective adaptation strategies as identified though the scoping of international policies and case studies:

- Most of the experts identified the governance structure relative to adaptation as fragmented and lacking coherence, comprehensiveness and consistency.
- There is a misalignment between the time needed to devise and implement adaptation strategies and the political life of leaders called to support such long-term projects.
- This results in either lack of action or a preference for a business as usual approach that will deliver an immediate short-term solution but lacks innovation.

- Some experts pointed out that there is a need to shift values when considering strategies of intervention, moving away from short-term economic stability and prosperity and looking at long-term benefits connected to human health and wellbeing and preservation and consideration of our ecosystem at large for current and future generations.
- Unanimously, the experts pointed out the value and agreed on the positive impact of the opportunity that a community-based risk management approach could be in the Australian context.

7. Policy development options

Like many other developed—and developing—countries around the globe, Australia is grappling with the response needed to address climate change. Although there is an established international and national effort to tackle climate change by reducing carbon emissions (mitigation), we are still working to understand how to build more comprehensive frameworks that would help us adapt to our new climate in the long-term and how this translates into a sustainable approach to urban development. The inclusion of Article 7 of the Paris Agreement (UN 2015) marks the first step in internationally recognising the need to adapt to such climate changes, framing adaptation as our current and future biggest challenge. Adapting and building more resilient urban environments necessitates a holistic approach linking sustainable development and disaster risk reduction. Within this context, this scoping project has sought to explore the following:

- What has been done in Australia and globally regarding adaptation and building resilience to climate change with a focus on sustainable urban development?
- What are the most effective international approaches and projects that address adaptation in the context of reducing disaster risk?
- What can we learn from these best practices, and how can these be implemented in the Australian context?

This concluding chapter brings together all the findings, discusses the implication for policy development and identifies where further research is needed.

7.1 What lessons can Australia learn from adaptation policies and programs delivered internationally?

At the national level, Australia has no strong direction concerning adaptation relative to sustainable development. Reference to sustainability goals is made in the definition of adaptation provided in the 2021 National Adaptation and Resilience Strategy. However, financial support and planned intervention are primarily directed towards disaster risk reduction. Australia lacks a strong overarching direction in climate change adaptation, with legislation and funding concentrating on recovery and mitigation.

From the analysis of the international approaches to adaptation at the national (US) and sub-regional (EU) scale, adaptation emerges as a strong area of intervention to climate change equivalent and complementary to GHG emissions reduction. The US and the EU have established overarching policy frameworks, injected considerable funding through long-term financial commitments and developed mechanisms to support intervention in this area. From the policy mapping and the case studies analysed in this research emerge three main strategic approaches that guide effective adaptation intervention:

- long-term investment and holistic approaches to addressing the issues
- community resilience building as a pillar to sustaining the resilience of cities, with communities vulnerable to disasters provided with effective tools to devise strategies for enhancing their resilience
- innovation in approaches to structural solutions that rely on respecting and reinforcing the ecological system as a means to build resilience, implementing structural approaches that value nature-based solutions.

From the six interviews with experts, it emerges that the governance structure and distribution of roles and responsibilities among the three government tiers are major barriers to adopting international strategies.[30] Experts highlighted the importance of shifting approaches when planning intervention, moving away from solutions aimed at short-term economic stability and prosperity. Instead, they pointed out the need to invest in projects that bring long-term benefits related to human health and wellbeing, and preserve our ecosystem for present and future generations. Community-based models for risk reduction were identified as an opportunity to build social resilience in disaster-prone areas that could support structural interventions such as nature-based flood control projects or housing retrofitting. However, the reactive approach to natural disaster responses that requires immediate action creates a barrier to innovation.

7.2 What policy reform could support the implementation of more effective adaptation strategies?

The effectiveness of climate change policies is underpinned by, and relies upon, effective governance structures. However, this scoping project highlights how the divide between the levels of interest and the impact of the decisions taken at different levels of government presents challenges in managing the complexity of governance networks and decision-making processes (Di Gregorio et al. 2019). The overview of policy intervention in Australia shows how fragmentation in response to adaptation is inevitable in the absence of clear direction from the Australian Government—as also pointed out by Smith et al. (2011). The policy mapping at the state and territory level shows how each state and territory has developed its response and how these vary considerably, spanning from strict legislation to strategies. While this inconsistency in the policy framework (and, therefore, outcomes) can be linked to how the Constitution divides powers and responsibilities within the three tiers of government, there is room for creating more decisive national directions and a holistic approach to sustainable development. In particular, as highlighted by the expert interviews, there is an urgency to detach this type of strategic framework and subsequent actions (including financing and planned intervention) from the short political cycle.

Specific policy approaches and strategies to address this could include:

- integration of climate change adaptation into the national climate change bill to demonstrate a legislative commitment to tackle issues of adaptation and recognise the role of adaptation as complementary to mitigation
- delivery of a more robust policy framework at the national level by considering the development of a national adaptation plan identifying concrete actions, timeframes and resources for implementation in the short and long-term
- revision of national environmental policy for stricter and more comprehensive consideration of the impact of existing and future development of climate change
- development of financial mechanisms that provide ongoing financial support for adaptation initiatives, including insurance schemes
- building institutional capacity and better coordination of, and communication between, stakeholders across different levels of government and other external actors
- ongoing investment in community resilience and engagement in adaptation to deliver more resilient and sustainable infrastructures.

30 The expert interviews highlighted issues related to the impact of politics versus policy. However, the discussion has been retained in the space of the governance system and not government or politics.

While it is out of this project's scope to map local government initiatives, it is worth remembering that local governments play an important role in adaptation. In their strategic and statutory documents, many local governments have implemented adaptation and sustainability plans and engaged in local actions toward adaptation. For example, initiatives such as the Queensland Climate Resilient Councils (QCRC) program and the Cities Power Partnership—which networks LGAs across Australia who have pledged to take action on climate change—could support building institutional capacity and emphasise the importance of networks and knowledge sharing. These local and voluntary networking initiatives could be leveraged to create a more comprehensive national platform similar to the EU climate adapt.

7.2.1 Further research

The study focused on analysing policy and programs relative to adaptation in the context of urban planning and intervention, aiming to increase the built environment's overall resilience. We recognise that such policies and decisions for intervention are implemented in response to the local context. Context refers not only to the condition that determines the need for intervention (flooding, bushfire and cyclones) but also to socio-economic factors, governance structures as well as government (the people governing) and politics (processes used to attain and exercise power). This is particularly true for environmental-related policy. Flowley (2019) conducted a longitudinal study the implementation of three different environmental acts in the US. The study demonstrates that implementation and outcome of the acts depends on the link between: (i) policies advancement, (ii) problem conditions (worsening or ameliorating of the issue addressed by the policy) and (iii) public opinion. Therefore, understanding people's perceptions of climate change adaptation issues (public opinion) and the governmental context relative to party in charge and its politics (policies advancement) offers important information for policy design and implementation.

One identified barrier to adaptation is the complexity of the governing structure and the lack of leadership, which is connected to the fragmentation of the jurisdictional responsibilities as well as inconsistency across states and territories of urban regulations and policies. Therefore, it is crucial to map the decision-making process to overcome these barriers as a first step. Two important aspects of the decision-making mapping need addressing and would benefit from further research. Firstly, there is a need to understand better how data and information are shared and used at the different stages of each stakeholder's decision-making process. Secondly, there is a need to conduct further research to understand how climate change and climate risk evaluation in urban development relative to disaster relief are considered, both from a policy point of view and from private stakeholders' perspective (including financial institutions and insurers).

Further research into these two areas to map the decision-making processes relative to consideration of climate change issues in urban development—as well in all four phases of the disaster relief cycle—could improve the delivery of more integrated policy and support the identification of better mechanism to improve stakeholder coordination and increase institutional capacity.

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Appendix 1: UN Climate Change Adaptation policy mapping

Table A1: Adaptation definition: UN policy framework timeline

	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
1985 *1988 Enforced*	**Vienna Convention**	Promote international cooperation in exchange of information on the effects of human activities on the ozone layer to inform policy aimed at controlling and regulating such activities.			Focus on reduction of greenhouse emission
1989 *Enforced* *2009* *universally ratified*	**Montreal Protocol**	Regulates the production and consumption of artificial chemicals causing and damaging the ozone.		establishment of **Intergovernmental Panel on Climate Change IPCC**	

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	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
1992 *50 ratifications* *1994* *Enforced*	**UN Framework Convention on Climate Change** *(UNFCCC)*	First International Agreement directly addressing climate change. It concerns greenhouse emissions (not included in the Montreal Protocol). *stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner* (UN 1992, Art 2)	Adaptation is identified in the principles of the Agreement as a tool to mitigate the effect of climate change. *[…] policies and measures should take into account different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors (UN 1992, Art.3)* As part of the listed commitments, adaptation is framed as an outcome of the development, implementation and sharing of interventions aimed at the reduction of gas emissions (UN 1992, art 4.1b) and it is outlined as a goal driving cooperation (UN 1992, Art 4.1e). *Formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to climate change (UN 1992, Art 4.1b)* *Cooperate in preparing for adaptation to the impacts of climate change (UN 1992, Art 4.1e)* Adaptation is also mentioned in Art 4.4 concerning the financial support commitment of developed to developing countries. *The developed country Partil[…] shall also assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects (UN 1992, Art 4.4e)*	establishment of Supreme Bodies **Conference of the Parties (CoP)** *The decision-making body of the Convention comprising of representatives of all the countries that have ratified the document.* **UNFCCC Secretariat (UN Climate Change)** *facilitate the intergovernmental negotiations related to climate change, and support the implementation of international climate change agreements.* Subsidiary bodies **Subsidiary Body for Scientific and Technological Advice (SBSTA)** *Scientific advisory bodies for the CoP* **Subsidiary Body on Implementation (SBI)** *Assist with the implementation of the UNFCCC* **Financial Mechanism (art 11)** *Reports to the COP, assisting on climate change policies and priorities and funding criteria.*	Adaptation is considered a **byproduct of mitigation strategies** Focus on the **financial support of developing countries** to sustain the cost of climate change adaptation

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	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
1992	Agenda 21 Rio Declaration	The declaration recognises the linked destiny between the planet Earth and its inhabitant and establishes sustainable development in international law.		Establishment of **Global Environment Facility (GEF)** Financial entity	
1992	**UN Convention Biological Diversity** *(CBD)*	It aims at protecting biological diversity, calling on each state to monitor and prevent human activities from damaging the environment.	Adaptation is not mentioned.		
1994 *Adopted*	UN Convention Combat Desertification *(UNCCD)*	Framed within the UNFCCC, it calls for international support and partnership to prevent desertification and mitigate the effects of drought.	Adaptation is only mentioned regarding technologies and practices for tackling desertification and drought.		
1997 *adopted* *2005* *enforced*	**Kyoto Protocol**	The scope of this document is to put the intention included in the UNFCC into action. It holds the developed country accountable for the emission of GHG.	The Kyoto Protocol presents adaptation strategies as independent of mitigation (art 10 b) and identifies spatial planning and technology as contributing strategies to adaptation *Formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change and measures to facilitate adequate adaptation to climate change (Art 10 b)*	**Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP)** **Clean Development Mechanism (CDM)** **Adaptation fund (AF)**	The concept of adaptation starts to emerge as an **independent strategy for mitigation** Still focus on supporting the financial burden of adapting for developing countries

	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
			Such programmes would, inter alia, concern the energy, transport and industry sectors as well as agriculture, forestry and waste management. Furthermore, adaptation technologies and methods for improving spatial planning would improve adaptation to climate change; (Art 10 b i) The CoP calls on reporting the measurls put in place to reduce emissions as well as adaptation strategies: Parties shall seek to include in their national communications, as appropriate, information on programmes which contain measures that *the Party believes contribute to addressing climate change and its adverse impacts, including the abatement of increases in greenhouse gas emissions, and enhancement of and removals by sinks, capacity building and adaptation measures; (Art 10 b ii)* The protocol call the financial responsibility of the CoP to support the adaptation cost of developing countries *ensure that a share of the proceeds from certified project activities is used to cover administrative expenses as well as to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation (art 12 par 8)*		

	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
2001	Marrakesh accords	It establishes the framework for implementing the Kyoto Protocol, focusing on developing countries. The document sets up new funding and planning instruments for adaptation and establishes a technology transfer framework.	The document identifies the scope of the area that needs strengthening in capacity building ***Developing countries** (2/CP.7.C 15)* *(f) Vulnerability and adaptation assessment;* *(g) Capacity building for implementation of adaptation measures;* With a particular scope to *Developing and enhancing technical capacities and skills to carry out and effectively integrate vulnerability and adaptation assessments into sustainable development* *programmes and develop national adaptation programmes of action (2/CP.7.17 c)* *Strengthening the capacity of meteorological and hydrological services to collect, analyse, interpret and disseminate weather and climate information to support implementation of national adaptation programmes of action (2/CP.7.17 e)*	establishment of **Expert group on technology transfer to advise the SBSTA.** Setting of **International Emission Trading** **Clean Development Mechanism (CDM)** **Joint implementation**	**focus on developing countries'** capacity to adapt to climate change focus on assessment and capacity buildings including technological advancement. Focus on dissemination and exchange of information and resources

	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
			Economies in transition *(2/CP.7.C 20)* *(d) Impact assessment and adaptation;* The decision 4/CP.7. sec C.1.par 3. call the individual nation to be responsible for setting activities and technological priorities with regards to both mitigation ad adaptation, including capacity building and cost: *Technology needs and needs assessments are a set of country-driven activities that identify and determine the mitigation and adaptation technology priorities […] These activities may address soft and hard technologies, such as mitigation and adaptation technologies, identify regulatory options and develop fiscal and financial incentives and capacity building.*		
2005	Nairobi Work Programme on Adaptation (NWP)	Focusing on developing countries, the programme supports the building and exchange of knowledge related to assessment and decision-making processes concerning adaptation and vulnerability. The programme is the outcome of the mandate to the SBSTA by the CoP meeting (CoP 11).		establishment of **UNFCCC Knowledge-to-Action Hub for Climate Adaptation and Resilience** **Lima Adaptation Knowledge Initiative (LAKI)** *"Targets knowledge gaps which can be bridged using existing data, information and knowledge" ((UNFCC and UN Environment 2018)p 5;*	Still **aiming at developing countries**. Engagement initiative to understand adaptation issues. Research dissemination and exchange of information and resources

Appendix 1: UN Climate Change Adaptation policy mapping

	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
2005	Hyogo Framework for Action	10- year plan establishing responsibilities for action in natural disaster risk reduction.	Adaptation is related to resilience and risk reduction in the context of natural disaster response. *Promote the integration of risk reduction associated with existing climate variability and future climate change into strategies for the reduction of disaster risk and adaptation to climate change,*		Adaptation is linked to risk reduction and natural disaster.
2007	Bali Action Plan *(CP13)*	Framed within the UNFCCC goal the documents sets goal for Long-term plan to address climate change.	The plan identifies adaptation as one of the 5 areas to be enhanced to achieve the objectives sets by the UNFCCC. Action on adaptability include: *vulnerability assessments, prioritisation of actions,* *financial needs assessments, capacity-building and response strategies, integration of adaptation actions into sectoral and national planning (IP131 (c) i)* The focus shift from developing countries, and the document identifies the *implementation of adaptation actions, and other ways to enable climate-resilient development and reduce vulnerability of all Partiel1/CP131 (c) i)* The plan calls for a more integrated approach to activities and processes aiming *To support adaptation in a coherent and integrated malr (1/CP131 (c) v)*	establishment of **Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA)**	Adaptation is link to **vulnerability and risk** management. Need for adaptation for **all Parties** but still focus on the role of Parties to support Developing country in the journey to adaptation, which an emphasis on financial support Continue to highlight the need and importance of technological advancement and the exchange of information.

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	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
2009	Copenhagen Accord	Reinforces the commitment taken with the Kyoto Protocol by the CoP.	While it recognised adaptation as a challenge for all countries: *Adaptation to the adverse effects of climate change and the potential impacts of response measures is a challenge faced by all countries (2)* It still emphasises the need to support developing countries in adapting: *enabling and supporting the implementation of adaptation actions aimed at reducing vulnerability and building resilience in developing countries(2)*	establishment of **Green Climate Fund** *Building financial capacity to deliver activities and policies related to mitigation and adaptation for developing countries*	Reinforces the need for financial support for developing countries.
2010	Cancun Agreements	It formalises the pledge to emission-cutting financial and technological mechanisms and formal processes to mitigation commitment and action by the Parties, including monitoring, reporting and verification.	Establishes a long vision for international cooperation that includes adaptation: *the vision addresses mitigation, adaptation,* *finance, technology development and transfer, and capacity-building in a balanced, integrated and comprehensive manner to enhance and achieve the full, effective and sustained implementation of the Convention, now, up to and beyond 2012 (2)* Adaptation is recognised as equal mitigation *Adaptation must be addressed with the same priority as mitigation and requires appropriate institutional arrangements to enhance adaptation action and support (3)*	establishment of **Adaptation Committee (AC)** *"promote the implementation of enhanced action on adaptation" (5)* **Techno** **logy Mechanism** **Cancun Adaptation Framework (CAF)** *which established the* ***National Adaptation Plan (NAP)***	**Adaptation is recognised as a priority equal to mitigation** However, still framed within the support of developing countries.

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	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
2011	Durban Platform for Enhanced Action	Articulate the intention of Extending the commitment to the Kyoto Protocol beyond 2012 and officially launching the Green climate fund. All activities focus on enhancing action on mitigation.	The document recognises the leading role of the adaptation committee in all matters related to adaptation (sect III) and reinforces their advisory role concerning technical support and building and sharing knowledge capacity on climate Change issues.	establishment of **Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP)** **Workstream I and II** (work concluded) Articulation of the role and responsibilities of the AC established under the Cancun agreement.	
2012	**Doha Amendment to the Kyoto Protocol**	Establishes a second commitment period (2013-2020) to the Kyoto Protocol.			
2013	Warsaw Outcomes	Setting up the establishment of the Paris agreement in 2015. Further advancement of the Durban Platform.	Call for cooperation on adaptation and implementation of adaptation strategies to reduce vulnerability with a focus on Developing countries: *Emphasising that enhanced action and international cooperation on adaptation is urgently required to enable and support the implementation of adaptation actions aimed at reducing vulnerability and building resilience in developing country Parties (Cop 2014: 3)* Adaptation is still framed as a byproduct of mitigation: *Intensifying, as from 2014, the technical examination of opportunities for actions with high mitigation potential, including those with adaptation and sustainable development co-benefits (Cop 2014: 5)*	2013 establishment of **Long-Term Finance Warsaw International Mechanism for Loss and Damage** **the executive committee of the Warsaw international mechanism**	Emerging of mitigating financial impact concerning loss and damage caused by climate change adaptation as part of the risk management strategies

	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
			Asks to redirect climate change funding towards adaptation *Calls on developed country Parties to channel a substantial share of public climate funds to adaptation activities; 9. Recalls that a significant share of new multi-lateral funding for adaptation should flow through the Green Climate Fund (Cop 2014: 9)* *Requests the Green Climate Fund: (a) To balance the allocation of resources between adaptation and mitigation, and ensure an appropriate allocation of resources for other activities; […](c) In allocating resources for adaptation, the Green Climate Fund will take into account the urgent and immediate needs of developing countries that are particularly vulnerable to the adverse effects of climate change (Cop 2014: 9)*		
2014 *2015 finalised*	Lima Call for Action	Builds on the Durban Platform for Enhanced action and calls for the institution of a new legal tool to address "mitigation, adaptation, finance, technology development and transfer, and capacity-building, and transparency of action and support"(1) concerning climate change. Establish the foundation for the 2015 Paris agreement.			

	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
2015 *2020 takes legal effect*	**Paris Agreement**	The document acknowledges that the work done so far in greenhouse emission reduction was not sufficient, and further reduction of GHG is needed. It, therefore, provides a financial, technical and knowledge-building framework to achieve the objective set in the UNFCCC.	Article 7 of the Agreement establishes global goals specific to adaptation recognising adaptation as a global challenge that needs to consider sustainable development: *enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response (7.1)* *recognise that adaptation is a global challenge faced by all with local, subnational, national, regional and international dimensions, and that it is a key component of and makes a contribution to the long-term global response to climate change to protect people, livelihoods and ecosystems, taking into account the urgent and immediate needs of those developing country Parties that are particularly vulnerable to the adverse effects of climate change (7.2)* it also recognises in art 7.5 the need for a localised approach to adaptation strategies that respect local conditions and knowledge, including traditional knowledge. Although, in art 7.7, the Agreement reinforces the Cancun adaptation framework and the need for supporting developing countries to adapt. It requires all Party to assume a long-term vision on adaptation issues and work on developing and communicating *adaptation planning processes and the implementation of actions, including the development or enhancement of relevant plans, policies and/or contributions (7.9)*	establishment of **Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA)** **Nationally Determined Contributions (NDCs)** **long-term low greenhouse gas emission development strategies** **Enhanced transparency framework (ETF)** Sign the conclusion of the **Ad Hoc Working Group on the Durban Platform for Enhanced Action**	Adaptation is presented separately from mitigation. Adaptation is a global issue not only for developing countries. It strengthens the need to continue addressing the risk management aspects of climate change.

Appendix 1: UN Climate Change Adaptation policy mapping

	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
2015	Transforming our world: the 2030 Agenda for Sustainable Development	Set 17 Sustainable Development Goals and 169 targets to guide the international community to collectively works toward global sustainable development.	SDG 11 aims at the implementation of adaptation policies by 202) framed in the context of risk management: *By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and* *develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels* Goal 13 directly acknowledges the need for action on climate change and frames action needed in relation to adapting to climate change reducing the exposure and vulnerability to natural hazards and risks.		**Adaptation is linked to risk reduction** and prevention of natural disasters caused by climate change.
2015	**Sendai Framework for Disaster Risk Reduction 2015–2030**	It addresses the prevention and reduction of disaster risk and sets 4 priority areas which are knowledge, management, governance and reduction of risk.	It only mentions adaptation once concerning the need for an integrated approach to risk management policies with programmes addressing sustainable urban development and adaptation to climate change.		
2018	Katowice Climate package *(Paris rulebook)*	Operazionalised the Paris agreement, with a focus on climate finance.			

Appendix 1: UN Climate Change Adaptation policy mapping

	Documents	Objectives	Adaptation definition and role	Governing bodies and actions	Evolution of adaptation role
2020	Glasgow Climate Pact		Section II addresses adaptation directly, acknowledging the adaptation plan submitted and reminding parties that have not done so to act. It also: *Urges Parties to further integrate adaptation into local, national and regional planning (SectII.9)* And *Calls upon the research community to further the understanding of global, regional and local impacts of climate change, response options and adaptation needs (Sect II. 13)*	Launch of the **Glasgow–Sharm el-Sheikh work programme** **global stocktake**	**Reinforces the role of adaptation as key to addressing climate change,** and the need for further reach in this are relative to the different geographical scales. Call for further financial support to climate adaptation to support developing countries.

Legend: Legally binding documents on climate change

Other non-legally binding documents on climate change

Legally binding documents on environmental protection and risk management

Other not binding documents on environmental protection and risk management

(Source: Authors)

Table A2: International climate chance intervention mapping

	Action, intervention, and decisions	Plan	Develop	Finance	Govern	Manage	Note
UN Framework Convention on Climate Change 1992	Plan policy development at national and regional levels (Art 4,12)						Communication, collecting information, tech. Advancement, resource management, impact assessment, education training
	Research and systematic observation (Art 5)						Financing of research and data collection
	Education training and Public Awareness (Art 6)						Public awareness and participation, Public access to information, specialised training, knowledge exchange
	Financial mechanisms (Art 11)						Conference of Parties, secretariat, subsidiary body for scientific and technological advice, SBI
	UNFCCC governing and subsidiary bodies establishment (art 7-10)						changes and amendments to the convention, interaction between parties
	Protocols and rules (Art 12-19)						
Kyoto Protocol 1997	Intervention for GHG reduction and targets (Art 2-5)						Management is defined in the annex FCCC/KP/CMP/2005/8/ Add.3
	Accountability and management of GHG reduction (Art 4-10)						
	Adaptation Funds (art 11, annex II)						Link to mitigation via financing mechanisms
	Clean development mechanism (art 12)						Management is defined in the annex FCCC/KP/CMP/ 2005/8/ Add.3
	Joint implementation (Art 6)						Management is defined in the annex FCCC/KP/CMP/ 2005/8/ Add.3
	Governing bodies of protocol (Art 13-15)						Management is defined in the annex FCCC/KP/CMP/2005/8/ Add.3
	Protocols and rules (Art 16-28)						Parties of the Protocols

Appendix 1: UN Climate Change Adaptation policy mapping

	Action, intervention, and decisions	Plan	Develop	Finance	Govern	Manage	Note
Marrakesh accords 2001	Identification of intervention for GHG reduction and targets						The guidelines to implement the Kyoto Protocol: first commitment period
	Developing Communication strategies and knowledge for capacity-building activities						
	Development and transfer of technologies (decisions 4/CP.4 and 9/CP.5)						Expert group on technology transfer to advise the SBSTA
	Emission targets (Decision 14/CP.7)						
	Adaptation Funds (Decision 10/CP.7)						
Bali Action Plan 2007	Long-term global goal for emission reductions						
	Enhanced national/ international action on mitigation						
	Enhanced action on adaptation						
	Technology development and transfer to support action on mitigation and adaptation						
	Financial resources and investment to support action on mitigation and adaptation and technology cooperation						

Appendix 1: UN Climate Change Adaptation policy mapping

	Action, intervention, and decisions	Plan	Develop	Finance	Govern	Manage	Note
Copenhagen Accord 2009	Financial support for adaptation in developing countries						Defined in the annex FCCC/CP/2009/L.7 CP/15 3
	Deadline for submission of emissions targets						Defined in the annex FCCC/CP/2009/L.7 CP/15 4 & 5
	REDD-plus, financial resources from developed countries						
	enhanced action on mitigation and adaptation, technology for dev countries						
	High-level panel to study the contribution of the potential sources of revenue						
	Establish a Technology Mechanism ™						
Cancun Agreements 2010	Reestablish the Cancun Adaptation Framework						
	Subsidiary Body for Scientific and Technological Advice (SBSTA)						
	ToR for Green Climate Fund						
	Technology Executive Committee (TEC)						
	Establish an adaptation committee						
Durban Deal 2011	Establishment of an Ad Hoc Working Group on the Durban Platform for Enhanced Action						
Doha Amendment 2012	New quantified emission targets						
Warsaw Outcomes 2013	International Mechanism for Loss and Damage associated with Climate Change Impacts (MLDCCI)						
	Rulebook for reducing emissions from deforestation and forest degradation						

Appendix 1: UN Climate Change Adaptation policy mapping

	Action, intervention, and decisions	Plan	Develop	Finance	Govern	Manage	Note
Paris Agreement 2015	Nationally Determined Contributions (NDC) (Art 4)						Defined in the annex FCCC/CP/2015/10/Add.1
	Long-term low greenhouse gas emission development strategies (Art 4)						
	Technology Mechanism (Art 10)						
	Establish the Paris Committee on Capacity-building (Art 11)						
	Enhanced transparency framework (ETF) (art 13)						Communication of action on climate change
Katowice Climate package 2019	Clarification on mechanisms established in the Paris agreement art 4,6,7,9,10,12,13,14,15						
Glasgow Climate pact 2020	Finance for climate adaptation						
	Transparency and reporting						
	Market mechanisms and non-market approaches						

Legend

- *Mitigation*
- *Adaptation*
- *General/both*

Source: Authors.

Appendix 2: Australian climate change adaptation policy mapping

Table A3: First national DRR implementation plan actions intervention mapping

		Type							
	Actions or Program	Resilience strategy	Land use	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Understand disaster risk	New National Climate and Disaster Intelligence Capability							•	
	World Heritage Climate Vulnerability and Adaptation assessments							•	
	The National Environmental Science Program (NESP)							•	
	Regional Land Partnerships							•	
	Climate Science Advisory Group							•	
	Electricity Sector Climate Information Project						•		
	Open Geocoded National Address File						•		
	Bushfire Natural Hazards Cooperative Research Centre							•	
	Australian Flood Risk Information Portal						•		
	Assessing climate risks in the regulated financial sector							•	
	Council of Financial Regulators (CFR) CC working group							•	
	Listed company disclosure and governance of CC risks and opportunities							•	
	Foundation Spatial Data Network							•	
	Special Research Initiative – Health Threats in Environmental Change							•	

Appendix 2: Australian climate change adaptation policy mapping

	Actions or Program	Type							
		Resilience strategy	Land use	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Accountable decisions	Guidance for Strategic Decisions on Climate and Disaster Risk							●	
	Improving Building Resilience							●	
	Bushfire Mitigation								●
	Compliance Framework Estate Governance and Integrity System							●	
	Defence Estate Climate Adaptation Partnership							●	
	Climate Compass Climate Risk Framework for Commonwealth Agencies							●	
	Infrastructure Investment Program								●
	Strengthening telecommunications emergency resilience						●		
	Organisation for Economic Co-operation and Development (OECD) Report							●	
	Healing and Rebuilding from the 2019–20 Bushfires								
	Reef Restoration and Adaptation Program	●							
	Development of climate change financial risk guidance				●				
	Climate change financial risk vulnerability assessment							●	
Investment	Disaster Risk Reduction Funding				●				
	National Water Grid Authority							●	
	Future Drought Fund				●				
	Resilience Investment pilot project and vehicle								

Appendix 2: Australian climate change adaptation policy mapping

		Type							
	Actions or Program	Resilience strategy	Land use	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Governance, Ownership and responsibility	Monitoring, Evaluation and Learning framework (MEL)						•		
	Communications Sector Group						•		
	Australia New Zealand Emergency Management Committee						•		
	Trusted Information Sharing Network for Critical Infrastructure Resilience					•			
	Strategy for long-term recovery and strengthen resilience	•							
	Asia-Pacific Ministerial Conference on Disaster Risk Reduction 2020	•							
	National Climate Resilience and Adaptation Strategy	•							
	National Freight and Supply Chain Strategy and National Action Plan	•							
	Australian Government Disaster and Climate Resilience Reference Group						•		
	Urban Water Reform			•					
	City Deals								•

Source: Authors, adapted from Home Affairs (2020)

Table A4: Climate change adaptation policies action by states: built environment domain

Name	Priorities and principles	Capacity and areas	Actions	Type: Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Victoria											
Victoria's Climate Change Strategy (2021)	Address current climate change impacts	Governance and strategic planning	Embed climate change adaptation into emergency management and disaster preparedness, response and recovery, particularly to protect the most vulnerable								
	Reduce barriers to adaptation		Monitor, evaluate, report and improve climate change adaptation by developing and implementing along-term framework based on state-wide risk assessments			●				●	
	Lay the foundations for transformational adaptation		Ensure relevant legislation, standards and codes support the use of best available climate change data and adaptive planning principles as part of decision making, particularly as it relates to infrastructure, development and land use changes							●	
		Sustainable adaptation finance	Address gaps in insurance coverage for public assets and key infrastructure at risk from climate change impact					●			
			Integrate climate change risk management into investment decisions, particularly for large and long-lived investments								
			Support the development of new and innovative climate change adaptation finance models				●				
Built Environment CC Adaptation Action Plan 2022–26	Governance and regulation		Update planning provisions to respond to climate change based on the most current advice from relevant natural resource and emergency management authorities	●	●						
			Review bushfire provisions in planning schemes and building standards when bushfire risk modelling that accounts for climate change or localised bushfire risk modelling is available	●	●	●					

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
			Update building standards relevant to flood, heatwaves and storm exposure to account for projected climate change hazards, consistent with the typical asset lifecycle, location and use	•	•						•
			Pursue opportunities for upgrades of existing building stock, with a focus on improvements to housing for low-income and vulnerable Victorians to enhance resilience to increasing heat and other climate-related hazards								•
			The Distribution Network Resilience Review will examine strengthening energy infrastructure resilience including reviewing adequacy and robustness of existing frameworks	•							
			Develop support programs for vulnerable persons and communities highly exposed to climate change impacts to improve hazard resilience			•					
			Improve the skills and capacity of practitioners, industry and community organisations to understand and implement climate change management responses							•	
			Extend spatial mapping and hazard exposure modelling to support land use and infrastructure planning, design and investment		•	•					
			Support decision making by practitioners working in planning, infrastructure and building development and approval		•						
	Placed based		Prepare measures to help local government update planning scheme instruments (zones and overlays) to reflect climate change risks based on the best-available data and climate change science, including flood and sea level rise responses as priorities		•						

Appendix 2: Australian climate change adaptation policy mapping

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
			Support climate change adaptation, risk reduction, response and recovery plans for the most exposed regional cities and towns	•		•					
			Review strategic planning responses to elevated bushfire risk due to climate change based on advice from natural resource and emergency management authorities	•		•					
			Support drought resilience planning for regional cities and towns	•	•						
			Support development of place-based resilient energy generation	•							
			Develop approaches for ongoing management of culturally significant and heritage places in risk-exposed locations, including emergency management activities during a hazard event			•					
			Develop program options to support local climate adaptation initiatives				•				
	Harness economic, financial and legal tools: see actions		Assess options to use economic tools to facilitate climate change adaptation outcomes				•				
			Assess financial measures and insurance responses to support adaptation							•	
			Review legal mechanisms to support climate resilient urban development		•		•				

Appendix 2: Australian climate change adaptation policy mapping

				Type							
Name	Priorities and principles	Capacity and areas	Actions	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Health and Human Services Climate Change Adaptation Action Plan 2022–2026	Addressing climate change impacts that are already severely affecting Victoria Reducing barriers to climate change adaptation planning and action Laying the foundations for transformational adaptation	Infrastructure resilience	Reduced asset and resident risk exposure through considered management of high-risk stock			•					
			Develop and maintain a risk assessment framework for social housing assets			•					
			Improved thermal safety, improved heating and cooling energy efficiency, and affordability for social housing residents								•
			Complete 35,000 energy efficiency and thermal comfort upgrades of social housing stock under the Energy Efficiency in Social Housing Program. This includes targeting heat risk in the state's hottest climate zone								•
			All newly constructed homes meeting a minimum average 7star NatHERS energy efficiency standards								•
			Many larger developments meeting the Five-Star Green Star standard, representing a national leadership level of sustainability and including requirements for climate adaptation outcomes								•
			Developments on Director of Housing Land being all-electric in specification, including reverse-cycle air conditioning and solar photovoltaic systems where feasible								•
			Social housing development occurring in locations providing good access to services and facilities and where the long-term climate risks are managed		•						•
			Increased sector understanding of how health and social housing infrastructure contributes to urban heat, its impact on users and the local community, and practical measures that can be applied to reduce urban heat							•	

Appendix 2: Australian climate change adaptation policy mapping

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
			Aligned and consistent health and housing infrastructure guidelines balance the needs of climate change adaptation, emissions reduction and service delivery	•						•	
Natural Environment Climate Change Adaptation Action Plan 2022–2026			Incorporate future weather scenario in bushfire and forest modelling and planning		•	•					
			Considered in the development of the Whole of Sector Bushfire Strategy and the renewal of the Victorian Waterway Management Strategy	•		•					
Transport Adaptation Action Plan 2022–2026			Map climate change projection data against the statewide transport system			•				•	
			Analyse the current approaches, gaps and barriers to adaptation planning in transport policies, plans and procedures		•					•	
			Facilitate emerging and innovative technologies, market responses, and funding models				•				
			During decision making, take a broader view of environmental impacts			•				•	
Water Cycle Climate Change Adaptation Action Plan 2022–2026		Diverse water supplies	Investigate ways to enable greater uptake of stormwater and recycled water								
			Consider all water supply options in updates to relevant water supply planning and use guidelines								
			Deliver feasible water infrastructure projects in collaboration with community, water customers and government partners								•
			Investigate augmentation options to secure water supplies for greater Melbourne and surrounds								•

Appendix 2: Australian climate change adaptation policy mapping

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
		Resilient infrastructure and natural assets	Enhance climate-related hazard and risk assessment capabilities to inform water infrastructure planning, design and investment			•	•				
			Review Victoria's emergency water supply point network every five years and clarify the responsibility of regional agencies to provide operations and maintenance of any new or upgraded emergency water supply points prior to state government investment			•					•
			Support the built environment system to reflect fit for purpose flood risk data across relevant planning mechanisms		•	•					
			Consistently incorporate climate adaptation and land use planning into integrated water management plans		•						
			Support the natural environment system to consider a climate adaptation lens in the renewal of the Victorian Waterway Management Strategy							•	
		Operational resilience and efficiency	Identify opportunities to strengthen the water sector's emergency capability, systems and processes for resource sharing							•	
			Trial the application of a framework to understand future changes in algal risks across Victorian water bodies and centralise knowledge sharing to manage these risks							•	
			Develop a framework to support the embedment of climate change within water sector decisions								•
			Define, benchmark and monitor resilience of the water sector over time							•	

Appendix 2: Australian climate change adaptation policy mapping

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
			Develop a monitoring, evaluation, reporting and improvement framework for the water cycle AAP program							•	
		Engaged community	Support opportunities for Traditional Owner self-determination in climate adaptation planning and implementation across the water cycle system							•	•
		Orderly transition	Promote innovation and learning across the water cycle system that accelerates low-carbon adaptation and progresses Victoria's transition to a circular economy								•
			Investigate a framework to better recognise complementary benefits in water sector adaptation projects							•	
Building Victoria's Climate Resilience (2022)		Built Environment Adaptation Action Plan	Updating building standard		•						
			Pursuing further upgrades to existing buildings								•
			Partnering with social services, government agencies and people							•	
			Examining options to improve energy infrastructure resilience								•
			Continuing to support hazard-exposed communities in developing place-based resilient energy generation,								•
			Upskilling and training for community leaders and industry professionals							•	
			Supporting highly exposed regional cities and towns	•		•					
			Expanding spatial mapping and hazard exposure modelling							•	
		Natural Environment Adaptation Action Plan	Assisting regional fire planners to include the climate adaptation lens in bushfire recovery planning	•		•					

Appendix 2: Australian climate change adaptation policy mapping

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
			Considering the climate adaptation lens in the whole-of-sector bushfire management strategy and renewal of the Victorian Waterway Management Strategies		•	•				•	
New South Wales											
NSW Climate Change Policy Framework (2016)	Reduce risks and damage to public and private assets in NSW arising from climate change		Manage the impact of climate change on its assets and services by embedding climate change considerations into asset and risk management			•				•	
NSW Climate Change Adaptation Strategy (2022)	Develop robust and trusted metrics and information on climate change risk		Establish a set of specific, measurable and timebound metrics to measure progress toward climate change resilience and adaptation for all of NSW by the end of 2023							•	
			Publish regularly updated and improved local level climate change projections			•					
			Undertake the first climate change scenario analysis for NSW by the end of 2024 and update it periodically to align with the latest evidence		•	•					
			Engage in ongoing research on priority climate change risks, opportunities and adaptation option							•	
			Engage in ongoing research and modelling to translate climate change projections into real-world socio-economic impacts and address priority knowledge gaps								
	Complete climate change risk and opportunity assessments		Publish NSW climate change risk and opportunity assessments at least every 5 years, with the first assessment to be published in 2023								
	Develop and deliver adaptation action plans		Publish a NSW adaptation action plan at least every 5 years based on the latest climate change risk and opportunity assessment, with the first plan to be published in 2023								

Appendix 2: Australian climate change adaptation policy mapping

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Queensland											
Queensland Climate Adaptation Strategy 2017-2030			Develop a climate risk toolkit			•					
		State Government	Develop a Government Adaptation Action Plan								
			Manage risks to property, assets, infrastructure and services					•			
			Incorporate sustainability objectives into infrastructure projects								•
		Local Governments and Regions	Support local government climate adaptation planning		•						
			Facilitate coastal hazard adaptation planning			•					
			Provide regionally-specific information and tools							•	
		Sectors and Systems	Investigate finance and insurance options								
Built Environment and Infrastructure Sector Adaptation Plan (2017)			Identify incentives to encourage and facilitate the BE&I sector to adapt to climate change and to design and build assets to go beyond minimum standard requirements								•
			Build climate risk awareness and capacity among BE&I sector practitioners, stakeholders and the wider community							•	
			Develop a report that explores and documents the intra- and inter- dependencies within and between the BE&I sector and other societal and economic sectors							•	
			Engage the financial sector on how to develop financial and insurance mechanisms that incentivise the provision of climate-resilient products and services from the BE&I sector and their demand from consumers				•				
			Create an inventory of climate change adaptation information, tools and guidelines for the BE&I sector							•	

Appendix 2: Australian climate change adaptation policy mapping

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Emergency Management Sector Adaptation Plan *2018)	Increasing the resilience of infrastructure critical to the sector and community		Influence the incorporation of climate scenarios into land-use planning for essential infrastructure and communities		•					•	
			Foster partnerships and joint planning between the sector and infrastructure operators and owners								
			Where possible, ensure sector organisations are involved in land-use and infrastructure planning processes and are resourced to effectively contribute		•					•	
	Promoting and enabling community resilience building and self-reliance		Influence land-use and urban planning through incorporation of climate change scenarios and risk information		•						
Human Health and Wellbeing Climate Change Adaptation Plan	Services are provided to those most vulnerable to reduce their exposure to risks		Heatwaves—developing community-wide and facility-level heatwave plans; expanding the reach of heatwave warnings to vulnerable populations and groups; identifying publicly accessible facilities for respite during heatwaves; and promoting changed work practices in increasingly heat affected locales						•		•
			Air quality—; collaboration between planning and health agencies to reduce environmental triggers		•						•
	Policy, regulation and legislation		Preventing development in areas which place communities or community services at risk		•						
			Providing guidance and practical support to help community support organisations undertake risk assessment and adaptation planning			•					
			Exploring initiatives that provide energy and water security (e.g. solar power and rainwater tanks)								•
			Providing amenities to encourage low carbon transport options								•

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
	Infrastructure, technology and service delivery		Retrofitting service infrastructure such as hospital, emergency, aged care and early childhood centres to improve climate resilience, enhance energy and water security, and improve capacity to continue providing essential and emergency services								•
			Investing in communications technologies that can withstand climate shocks and stresses to support service coordination during disasters and reduce vulnerability of isolated or remote communities								•
South Australia											
South Australia's Climate Change Strategy 2015 – 2050		South Australia leading on climate change action	Incorporating ecologically sustainable development principles in planning legislation		•						
		Carbon Neutral Adelaide	Increasing Adelaide's green infrastructure								•
		Creating a prosperous and resilient state	Building coastal resilience	•							
			Implementing water sensitive urban design								•
			Managing bushfire risk			•					

Appendix 2: Australian climate change adaptation policy mapping

				Type							
Name	Priorities and principles	Capacity and areas	Actions	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
South Australian Government Climate Change Action Plan 2021 – 2025	Low emissions transport	Align transport and urban planning with low emissions transport outcomes	Plan for development and urban renewal that creates walkable, connected neighbourhoods and reduces the need for car journeys		•						
	Climate smart built and urban environments	Provide for development and design that is low emissions and climate resilient	Strengthen climate smart planning, building and design policies and their implementation in the planning system		•						
			Embed strategic climate impact assessment into Regional Plans			•					
			Support development and implementation of stronger climate smart standards in the National Construction Code								•
			Promote opportunities to encourage the private and public sector to go 'beyond compliance' in climate smart design								•
			Support climate smart development for public housing, affordable private dwellings and urban renewal projects								•
			Assess climate change risks on development applications referred to the Environment Protection Authority for direction		•						
		Accelerate strategic urban greening	Identify strategic opportunities for urban greening in metropolitan Adelaide		•						
			Develop improved policies, tools and guidance for the new planning system to achieve greener and cooler neighbourhoods		•						
			Increase implementation of green infrastructure through capacity building and incentives		•						

Appendix 2: Australian climate change adaptation policy mapping

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
		Understand and reduce climate change risks to infrastructure	Implement the National Disaster Risk Reduction Framework and Stronger Together: South Australia's Disaster Resilience Strategy			•					
			Support Regional Climate Partnerships to deliver local adaptation and mitigation projects								•
	Resilient Communities	Provide high-quality and accessible climate change science and information	Integrate future climate change risk into hazard mapping and information			•					•
	Government leading by example	Embed climate change risk and opportunity into government policy and practice	Explore innovative financing and investment approaches for adaptation and emissions reduction			•					
South Australia Disaster Resilience Strategy			Develop innovative insurance initiatives for businesses and households					•			
Western Australia											

Appendix 2: Australian climate change adaptation policy mapping

				Type							
Name	Priorities and principles	Capacity and areas	Actions	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Western Australian Climate Policy	Lower-carbon transport	Improved public transport, freight transport and active transport options	METRONET								•
			Additional cycling infrastructure								•
	Resilient cities and regions	Increased adaptive capacity across our communities.	Climate Resilience Action Plan 2022–25	•							
			Pilot Sectoral Adaptation Plan	•							
		Improved understanding and management of climate risks and natural hazards	CoastWA			•					
			Coastal Adaptation and Protection Fund				•				
			Develop and implement UNHaRMED for risk reduction			•					
			Enhance resilience to bushfire risk			•					
		Enhanced water security and certainty for water users.	Waterwise Perth Action Plan	•							
			Water Resources Management Bill								
		More resilient and better prepared regions	Regional water infrastructure								•
	Government leadership		Energy-efficient social housing								•
			Climate resilient water supplies								•
Tasmania											

Appendix 2: Australian climate change adaptation policy mapping

				Type							
Name	Priorities and principles	Capacity and areas	Actions	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Climate Action 21: Tasmania's Climate Change Implementation Plan 2017-2021	Reducing our transport emissions		Support public transport uptake							•	
	Building climate resilience		Work with local government and regional bodies to embed climate change adaption into strategic and financial decision making	•					•		
			Understand and manage the impacts of coastal hazards to existing settlements		•					•	
			Examine the impacts of climate change on bushfire risk in the TWWHA and consider appropriate firefighting responses		•						
			Mitigate risks from bushfire by delivering a targeted program of burns to reduce fuel in areas that pose the greatest risk to the Tasmanian community		•						
	Supporting community action		Deliver a home energy savings program							•	

Appendix 2: Australian climate change adaptation policy mapping

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Northern Territory											
Northern Territory Climate Change Response: Towards 2050	Ensure a targeted and strategic approach to building resilience in the Territory		"Deliver an overarching strategy for the Territory to increase its preparedness to respond and adapt to climate change in the immediate and long-term futures."	•							
			Deliver a 10-year Emergency Response Strategy to address the risks of extreme weather events and climate change on our remote communities			•					
			"Identify and prioritise Territory Government infrastructure, assets and services at risk from impacts associated with climate change."							•	
			Deliver Agency specific infrastructure, assets and services climate adaptation frameworks.							•	
			Identify and prioritise risks to human health associated with climate change.			•					
			Work with the community services sector to develop climate change risk adaptation and response frameworks.								
			Incorporate climate responsive designs and initiatives into our urban and community landscapes.								•

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Australian Capital Territory											
ACT Climate Change Strategy	Transport	Plan for a compact and efficient city	Plan for a compact and efficient city with improved access to sustainable transport options by delivering up to 70% of new housing within our existing town and group centres and along key transit corridors								•
		Increase use of public transport	Prioritise improving public transport services and supporting infrastructure, including buses, light rail stage two and connecting services								•
			Maximise accessibility to the rapid bus and light rail networks through feeder services and expanding the Park and Ride network.								•
		Encourage active travel	Expand and promote the Active Travel Office and schools-based active travel initiatives.							•	
			Finalise an active travel strategic plan and update the Active Travel Framework to provide coordinated active travel networks across the Territory		•						
			Implement the Municipal Infrastructure Standards for Active Travel and develop best practice guidance for industry and stakeholders to inform better design outcomes for active travel infrastructure.							•	
			Prioritise walking and cycling and enhance active travel infrastructure to improve safety and connectivity of the active travel network								•
			Finalise and implement the End-of-Trip Facilities General Code to encourage improved bicycle parking and end-of-trip facilities in commercial developments								•

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
		Reduce car use	Trial and evaluate innovative approaches to planning and development that prioritise active travel and public transport		•	•					
			Implement car free days and consider car free areas, shared zones and traffic calmed streets			•					
			Investigate and implement options for encouraging a shift to public transport and active travel through planning and a smarter approach to parking			•					
		Smarter use of roads	Explore and implement new approaches to improving the productivity of key transport corridors through prioritisation of public transport and/or active travel.		•						
			Improve efficiency and usability of public transport through the adoption of emerging smart cities technologies such as smart street lights, congestion monitoring, real time data and optimisation of timetables to reduce journey times.								•
			Investigate options for dedicating a greater proportion of road space and public realm space to sustainable transport modes								•
		Encourage zero emissions vehicles	Amend road rules to facilitate the safe use of new sustainable personal mobility options, such as electric scooters.		•						

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
	Energy, buildings and urban development	Reduce emissions from gas	Amend planning regulations to remove the mandating of reticulated gas in new suburbs.		•						
		Climate-wise, zero emissions rental homes	Introduce mandatory disclosure of energy performance for all rental properties								•
			By 2021 introduce legislation for staged minimum energy performance requirements for rental properties to come into force in 2022–23.								•
			Expand the Actsmart Home Energy Program to provide free, tailored in-home energy assessments for renters								•
		Climate-wise, zero emissions public housing	Continue to upgrade to efficient electric appliances in existing public housing properties where technically feasible and assess the costs and benefits of shifting to all-electric public housing								•
			Ensure all newly constructed public housing properties are all-electric (fitted with efficient electric appliances) from 2019								•
		Climate-wise, zero emissions low income homes	Continue to deliver the solar for low income program and investigate options for providing solar to public housing								•
			Trial facilitating access to interest free loans or other innovative finance for gas to electric upgrades and deep retrofits of low income homes				•				
		Climate-wise, zero emissions homes	Provide information and training tailored to first home buyers, home owners and owner-builders to support higher awareness of zero emissions, climate-wise homes.								•
			Facilitate demonstration projects showcasing zero (or negative) emissions climate-wise homes.								•

Name	Priorities and principles	Capacity and areas	Actions	Type							
				Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
		Climate-wise, zero emissions buildings	Design, and commit to a timeframe for implementing, higher minimum energy performance and climate resilience standards for new buildings that will deliver efficient, zero emissions buildings								•
			Provide information and facilitate education and training of developers and design and construction practitioners in zero emissions technologies and systems and climate-wise design.								•
			Develop a new residential energy assessment tool that adequately assesses the year-round thermal performance of buildings in the Canberra climate		•						•
			Trial incentives and other measures to encourage all-electric, high efficiency apartment and commercial buildings.								•
			Expand the Energy Efficiency Improvement Scheme to increase support for low income priority households and further encourage a shift from gas to high efficiency electric appliances								•
		Climate-wise built environment	Review planning regulations and identify opportunities to require sustainable, climate-wise built environment including through developing a Climate-wise Code.		•						•
		Reduce urban heat and improve liveability	Implement Canberra's Living Infrastructure Plan to work towards 30% urban canopy cover and 30% surface permeability, account for the value of living infrastructure and assess local needs for managing heat								•
				17	37	41	9	3	1	34	63

Please note the table only includes action within the policies that refer to the built environment.

Some actions have been mapped in more than one category to fit the description of the action .

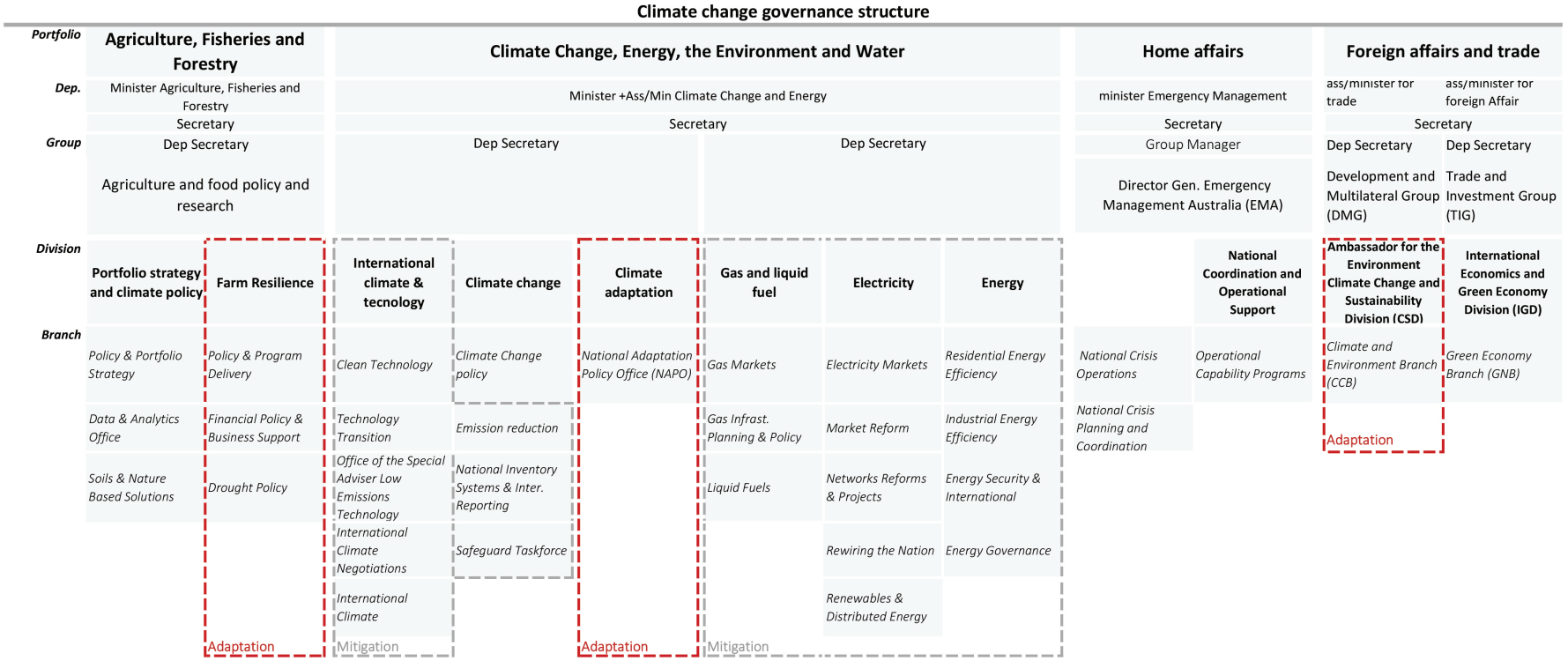
Appendix 3: AUS Climate Change governance and leadership

Table A5: Australian Government portfolios: climate change responsibilities distribution

Portfolio	Matters dealt
Agriculture, Fisheries and Forestry	Rural adjustment and drought issues
Climate Change, Energy, the Environment and Water	Development and coordination of domestic community and household climate action
	Climate change adaptation strategy and coordination
	Greenhouse emissions and energy consumption reporting
	Coordination of climate change science activities
	Greenhouse gas abatement programmes
	Development and coordination of international climate change policy
	International climate change negotiations
	Energy policy
	Renewable energy
	Renewable energy target policy, regulation and co-ordination
	Industrial energy efficiency
	Energy efficiency
	Energy-specific international obligations and activities
Foreign Affairs and Trade	International climate diplomacy
	Implementation of Australia's international climate finance commitments
Home Affairs	All hazards relief, recovery and mitigation policy and financial assistance, including payments to the States and Territories and the Australian Government Disaster Recovery Payments

Source: Authors, adapted from Hurley (2022)

Figure A1: Climate change: AUS government organisational structure



Appendix 4: US climate change adaptation policy initiatives

Table A6: US climate adaptation policies initiatives relative to the built environment

Executive Order number 14008, Tackling the Climate Crisis at Home (2021)		
Institutional capacity building		
sec	*initiative*	
102	**Special Presidential Envoy for Climate**	Advice president on climate change related issues
202	**White House Office of Domestic Climate Policy (Climate Policy Office)**	Coordinate domestic climate-policy advice to the President; Ensure that domestic climate-policy decisions and programs are consistent with the President's stated goals and that those goals are being effectively pursued; and Monitor the implementation of the President's domestic climate-policy agenda.
203	**National Climate Task Force**	Facilitate planning and implementation of key Federal actions to reduce climate pollution; Increase resilience to the impacts of climate change; Protect public health; Conserve our lands, waters, oceans, and biodiversity; Deliver environmental justice; Spur well-paying union jobs and economic growth.

Executive Order number 14008, Tackling the Climate Crisis at Home (2021)			
215	**Civilian Climate Corps**	Formed within existing staff cross federal agencies; Upskilling accessible training opportunities and jobs; Conserve and restore public lands and waters, Bolster community resilience, Increase reforestation, Increase carbon sequestration in the agricultural sector, protect biodiversity, Improve access to recreation, and address the changing climate.	
220	**White House Environmental Justice Interagency Council**	Develop a strategy to address current and historic environmental injustice; Clear performance metrics to ensure accountability; Publish an annual public performance score-card on its implementation.	
221	**White House Environmental Justice Advisory Council.**	Within the Environmental Protection Agency Provide recommendations to the White House Environmental Justice Interagency Council.	
Information and data			
sec	*initiative*		*agencies responsible*
103 (c)	**Climate Risk Analysis**	Analysis of the security implications of climate change.	*Defence, Commerce, National Oceanic and Atmospheric Administration Council on Environmental Quality, Environmental Protection Agency, National Intelligence, Office of Science and Technology Policy, National Aeronautics and Space Administration*
211 (d)	**Data and Information Products to Improve Adaptation and Increase Resilience**	Report on ways to expand and improve climate forecast capabilities and information products for the public. Report on the potential development of a consolidated Federal geographic mapping service that can facilitate public access to climate-related information.	*Secretary of Commerce, National Oceanic and Atmospheric Administration, Homeland Security, Federal Emergency Management Agency, Office of Science and Technology Policy*
216	**Conserving Our Nation's Lands and Waters.**	Recommending steps to preserve at least 30 per cent of our lands and waters by 2030. Guidelines for determining whether lands and waters qualify for conservation, and it also shall establish mechanisms to measure progress toward the 30-per cent goal.	*Secretary of the Interior Secretary of Agriculture, the Secretary of Commerce, the Chair of the Council on Environmental Quality*

Executive Order number 14008, Tackling the Climate Crisis at Home (2021)			
222	**Geospatial Climate and Economic Justice Screening Tool**		*Council on Environmental Quality*
Policies and programs			
sec	*initiative*	*objectives*	*agencies responsible*
211 (a)	**Climate Action Plans**	Mandate of federal agencies' adaptation plan and annual progress reports. Describe the agency's climate vulnerabilities and describe the agency's plan to use the power of procurement to increase the energy and water efficiency of United States Government installations, buildings, and facilities and ensure they are climate-ready.	*Head of each agency*
222 (c) (iii)	**Environmental Justice Enforcement Strategy**	Provide timely remedies for systemic environmental violations, contaminations, and natural resource injury.	*Environmental Protection Agency, Office of Enforcement and Compliance Assurance*
223	**Justice40 Initiative**	Identify how Federal investments might be made toward a goal that 40 per cent of the overall benefits flow to disadvantaged communities and recommendations on any legislation needed to achieve the 40 per cent goal. The recommendations shall focus on investments in clean energy and energy efficiency; clean transit; affordable and sustainable housing; training and workforce development; the remediation and reduction of legacy pollution; and the development of critical clean water infrastructure.	*Council on Environmental Quality, Office of Management and Budget, National Climate Advisor, Advisory Council*

Executive Orders number 14030, Climate-Related Financial Risk (2021)

Information and data

sec	*initiative*			*agencies responsible*
3	**Assessment of Climate-Related Financial Risk**		Assessing climate-related financial risk across government operations. Facilitating sharing climate-related financial risk data and information among FSOC member agencies. Issuing a report on how (iii) "FSOC member agencies integrate consideration of climate-related financial risk in their policies and programs". Identify (A) "actions to enhance climate-related disclosures by regulated entities to mitigate climate-related financial risk".	Treasury, Financial Stability Oversight Council
4	**Federal Lending, Underwriting, and Procurement.**	(a)	recommendations for the National Climate Task Force on approaches related to the integration of climate-related financial risk into Federal financial management and financial reporting, especially as that risk relates to Federal lending programs. The recommendations should evaluate options to enhance accounting standards for Federal financial reporting where appropriate and should identify any opportunities to further encourage market adoption of such standards.	OMB, National Economic Council, Treasury,

Policies, processes, and programs

sec	*initiative*		*objectives*	*agencies responsible*
2	**Climate-Related Financial Risk Strategy**	(a)	Measurement, assessment, mitigation, and disclosure of climate related financial risk to Federal Government programs, assets, and liabilities in order to increase the long-term stability of Federal operation.	Economic Policy , National Economic Council, National Climate Advisor, Treasury, Office of Management and Budget (OMB)
		(b)	Financing needs associated with achieving net-zero greenhouse gas emissions for the U.S. economy by no later than 2050, limiting global average temperature rise to 1.5 degrees Celsius, and adapting to the acute and chronic impacts of climate change;	
		(c)	Areas in which private and public investments can play complementary roles in meeting these financing needs—while advancing economic opportunity, worker empowerment, and environmental mitigation, especially in disadvantaged communities and communities of color of climate change.	

Executive Orders number 14030, Climate-Related Financial Risk (2021)			
4	**Federal Lending, Underwriting, and Procurement**	(e)	Reinstatement of the Executive Order 13690 of January 30, 2015 (Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input), Federal Flood Risk Management Standard (FFRMS).

Source: developed by Authors using The White House (2021a) and The White House (2021b)

Appendix 5: EU Climate Change Adaptation initiatives and projects

Table A7: EU programs and funding for adaptation relative to cities and built environment

Programs		Source
Recovery and Resilience Facility	Europe's recovery plan from COVID-19 (Next GenerationEU) includes the target of climate neutrality by 2050	https://ec.europa.eu/
LIFE Programme for Environment and Climate Action **2021-2027**	Sub-programmes include climate change mitigation and adaptation Standard action projects (SAPs); Strategic Integrated Projects (SIPs); Technical Assistance (TA); capacity development.	https://cinea.ec.europa.eu/programmes

Appendix 5: EU Climate Change Adaptation initiatives and projects

Programs		Source
About the Horizon Europe Work Programmes	Funding programme for research and innovation. Mission areas include adaptation to climate change, including societal transformation and Climate neutral & smart cities. Programmes: European Research Council (ERC); Joint Research Centre (JRC); European Innovation Council (EIC); European Defence Fund; Euratom Research and Training Programme.	https://research-and-innovation.ec.europa.eu/
EU Cohesion Policy	Funding programmes: European Regional Development Fund	https://climate-adapt.eea.europa.eu/en/
	Cohesion Fund Investment in the environment and Trans-European Transport Networks (TEN-T)	https://ec.europa.eu/regional_policy
Just Transition Mechanism	Addresses the social and economic effects of the transition, focusing on the regions, Just Transition Fund InvestEU "Just Transition" scheme Public Sector Loan Facility	https://ec.europa.eu/info/strategy/

Source: Authors see ref. in table

Table A8: EU adaptation projects

Name		Adaptation sectors	Climate impacts	Countries	Implemented adaptation option	Websites	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Paris Oasis Schoolyard Programme, France	2022	Health, Ecosystem-based approaches (GI), Urban	Extreme Temperatures	*France*	Water uses to cope with heat waves in cities, Water sensitive urban and building design, Green spaces and corridors in urban areas	https://www.paris.fr/								•
The integrated system of Nature-based Solutions to mitigate floods and drought risks in the Serchio River Basin	2022	Biodiversity, DRR Ecosystem-based approaches (GI), Forestry, Water management, Agriculture	Flooding, Droughts, Water Scarcity	*Italy*	Rehabilitation and restoration of rivers and floodplains, Improved water retention in agricultural areas, Establishment and restoration of riparian buffers	https://phusicos.eu/			•					•
Building fire resilience using recycled water in Riba-roja de Túria, Spain	2022	Agriculture, Biodiversity, DRR, Urban, Water Ecosystem-based approaches (GI), management, Forestry	Extreme Temperatures, Water Scarcity, Droughts	*Spain*	Adaptation of fire management plans, Awareness campaigns for behavioural change, Water recycling	https://proyectoguardian.com/en/			•					•
New North Zealand Hospital: A resilient acute care hospital for the future, Hillerød, Denmark	2022	Water management, Health, Buildings	Storms, Flooding	*Denmark*	Water sensitive urban and building design	https://www.regionh.dk/								•

Appendix 5: EU Climate Change Adaptation initiatives and projects

Name		Adaptation sectors	Climate impacts	Countries	Implemented adaptation option	Websites	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Natural Water Retention Measures in the Altovicentino area (Italy)	2020	Urban, Agriculture, DRR, Water management, Ecosystem-based approaches (GI)	Droughts, Flooding, Water Scarcity	*Italy*	Improved water retention in agricultural areas, Water sensitive urban and building design	http://www.lifebeware.eu/en			•					
Mainstreaming climate change adaptation into urban planning: greyfield land redevelopment in Jena (Germany)	2020	Urban, Buildings	Extreme Temperatures	*Germany*	Adaptation of integrated land use planning, Green spaces and corridors in urban areas	https://base-adaptation.eu/								•
Adapting to heat stress in Antwerp (Belgium) based on detailed thermal mapping	2020	DRR, Health, Buildings, Urban	Extreme Temperatures	*Belgium*	Climate proofing of buildings against excessive heat, Establishment of early warning systems, Monitoring, modelling and forecasting systems, Green spaces and corridors in urban areas, Water uses to cope with heat waves in cities, Awareness campaigns for behavioural change	https://gt20.eu/					•	•		
Use of insurance loss data by local authorities in Norway	2020	Buildings, Water management, DRR, Urban	Storms, Flooding	*Norway*	Capacity building on climate change adaptation	https://www.finansnorge.no/						•		

Appendix 5: EU Climate Change Adaptation initiatives and projects

Name		Adaptation sectors	Climate impacts	Countries	Implemented adaptation option	Websites	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Insurance company supporting adaptation action in small and medium size enterprises in Turin	2020	DRR, Urban	Water Scarcity, Flooding,Storms, Extreme Temperatures	*Italy*	Crises and disaster management systems and plans	http://www.derris.eu https://cram.derris.eu				•				
Multifunctional water management and green infra-structure development in an ecodistrict in Rouen	2016	Urban, Water management, Ecosystem-based approaches (GI), Buildings	Storms, Flooding, Extreme Temperatures	*France*	Water sensitive urban and building design, Green spaces and corridors in urban areas, Adaptation of urban planning: water and energy	http://www.future-cities.eu/							•	
Climate adapted management of the Kis-Sárrét area in the Körös-Maros National Park	2016	Ecosystem-based approaches (GI), Biodiversity, Water management	Droughts, Flooding, Extreme Temperatures, Water Scar-city	*Hungary*	Improve the functional connectivity of ecological networks, Rehabilitation and restoration of rivers and flood-plains, Awareness campaigns for behavioural change, Adaptive management of natural habitats	http://www.habit-change.eu http://www.kmnpi.hu						•	•	
White roof, innovative solar shadings and bioclimatic design in Madrid	2016	Urban, Water management, Energy, Buildings	Storms, Water Scarcity, Extreme Temperatures	Spain	Climate proofing of buildings against excessive heat, Water sensitive urban and building de-sign, Adaptation of urban planning: water and energy, Water recycling	http://www.energy.imdea.org http://www.construction21.org/							•	

Appendix 5: EU Climate Change Adaptation initiatives and projects

Name		Adaptation sectors	Climate impacts	Countries	Implemented adaptation option	Websites	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Supporting urban greening and social justice in the city of Barcelona	2016	Health, Urban Biodiversity, Ecosystem-based approaches (GI),	Flooding, Extreme Temperatures	*Spain*	Green spaces and corridors in urban areas, Urban farming and gardening	https://www.barcelona.cat/							•	
Amphibious housing in Maasbommel, the Netherlands	2016	DRR, Water management, Buildings	Flooding	*Netherlands*	Floating and amphibious housing	https://www.factorarchitecten.nl/p							•	
Urban river restoration: a sustainable strategy for storm-water management in Lodz, Poland	2016	Urban, DRR, Water management, Health, Biodiversity, Ecosystem-based approaches (GI)	Storms, Droughts, Flooding, Extreme Temperatures	*Poland*	Green spaces and corridors in urban areas, Rehabilitation and restoration of rivers and flood-plains, Water sensitive urban and building design	http://www.en.arturowek.pl https://uml.lodz.pl/ekoportal	•		•					
Storm water management in Växjö - the Linnaeus canal and Växjö lake lagoons, Sweden	2016	Water management, Urban	Flooding	*Sweden*	Water sensitive urban and building design				•					
Saltmarsh recreation by managed realignment, Hesketh Out Marsh – UK	2016	Ecosystem-based approaches (GI), DRR, Biodiversity, Coastal areas	Flooding, Sea Level Rise	*UK*	Restoration and management of coastal wetlands	https://www.rspb.org.uk/reserves-and-events/reserves-a-z/hesketh-out-marsh							•	

Appendix 5: EU Climate Change Adaptation initiatives and projects

Name		Adaptation sectors	Climate impacts	Countries	Implemented adaptation option	Websites	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Room for the River Waal – protecting the city of Nijmegen	2016	Water management, Urban, Ecosystem-based approaches (GI), DRR	Flooding	*Netherlands*	Adaptation or improvement of dikes and dams, Rehabilitation and restoration of rivers and floodplains	https://www.urbanclimateadapta-tion.net/ezine1/ https://goexplorer.org/		•					•	
Room for the River Regge, Netherlands - restoring the river dynamics	2016	Agriculture, DRR, Water management, Ecosystem-based approaches (GI)	Flooding, Water Scarcity	*Netherlands*	Rehabilitation and restoration of rivers and floodplains	https://www.landschapoverijssel.nl/ https://youtu.be/_SzBeOYP7sQ							•	
Regional flood management by combining soft and hard engineering solutions, the Norfolk Broadlands	2016	DRR, Coastal areas, Water management, Ecosystem-based approaches (GI)	Sea Level Rise, Flooding	*UK*	Adaptation or improvement of dikes and dams, Rehabilitation and restoration of rivers and floodplains	https://www.ice.org.uk/			•				•	
Lower Danube green corridor: floodplain restoration for flood protection	2016	DRR, Water management, Forestry, Biodiversity, Ecosystem-based approaches (GI)	Flooding	*Bulgaria Romania*	Rehabilitation and restoration of rivers and floodplains, Improve the functional connectivity of ecological networks, Adaptive management of natural habitats, Afforestation and reforestation as adaptation opportunity	http://danube.panda.org/wwf/web/search/details.jsp?pid=41 http://iopscience.iop.org/1755-1315/6/40/402002							•	

Appendix 5: EU Climate Change Adaptation initiatives and projects

Name		Adaptation sectors	Climate impacts	Countries	Implemented adaptation option	Websites	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
A transboundary depoldered area for flood protection and nature: Hedwige and Prosper Polders	2016	DRR, Water management, Coastal areas, Biodiversity, Ecosystem-based approaches (GI)	Sea Level Rise, Storms, Flooding	*Netherlands, Belgium*	Adaptation or improvement of dikes and dams, Rehabilitation and restoration of rivers and floodplains, Restoration and management of coastal wetlands	https://www.sigmaplan.be/en/projects/hedwige-prosper-project/ https://www.sigmaplan.be/en/			•				•	
Kruibeke Bazel Rupelmonde (Belgium): a controlled flood area for flood safety and nature protection	2016	Water management, Biodiversity, Ecosystem-based approach-es (GI), DRR	Sea Level Rise, Flooding, Storms	*Belgium*	Adaptation or improvement of dikes and dams, Rehabilitation and restoration of rivers and floodplains	https://www.sigmaplan.be/en/ https://www.sigmaplan.be/en/projects/polders-of-kruibeke/			•				•	
Isar-Plan–Water management plan and restoration of the Isar river, Munich (Germany)	2016	Water management, Ecosystem-based approaches (GI), Biodiversity, Urban	Flooding	*Germany*	Rehabilitation and restoration of rivers and floodplains, Improve the functional connectivity of ecological networks, Green spaces and corridors in urban areas	https://restorerivers.eu/wiki/index.php?title=Case_study%3AIsar-Plan https://www.yumpu.com/en/document/read/3768185/a-new-lease-of-life-for-the-isar-river-wasserwirtschaftsamt-munchen			•				•	

Appendix 5: EU Climate Change Adaptation initiatives and projects

Name		Adaptation sectors	Climate impacts	Countries	Implemented adaptation option	Websites	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Implementation of the integrated Master Plan for Coastal Safety in Flanders	2016	Ecosystem-based approaches (GI), DRR, Urban, Coastal areas	Sea level rise, flooding, storms	*Belgium*	Beach and shoreface nourishment, adaptation or improvement of dikes and dams, storm surge gates / flood barriers, adaptation of integrated coastal management plans, dune construction and strengthening	https://www.afdelingkust.be/nl/masterplan-kustveiligheid		•	•					
Berlin Biotope Area Factor – Implementation of guidelines helping to control temperature and runoff	2016	Buildings, Biodiversity, Urban	Flooding, extreme temperatures, water scarcity	*Germany*	Water sensitive urban and building design, green spaces and corridors in urban areas	http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/bff/index_en.shtml							•	
An integrated plan incorporating flood protection: the Sigma Plan (Scheldt Estuary, Belgium)	2016	Water management Biodiversity, Ecosystem-based approaches (GI), Coastal areas, DRR	Sea level rise, flooding, storms	*Belgium*	Adaptation or improvement of dikes and dams, restoration and management of coastal wetlands, adaptation of flood management plans, rehabilitation and restoration of rivers and floodplains	https://www.sigmaplan.be/en/		•	•					

Appendix 5: EU Climate Change Adaptation initiatives and projects

Name		Adaptation sectors	Climate impacts	Countries	Implemented adaptation option	Websites	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Stuttgart: combating the heat island effect and poor air quality with ventilation corridors and green-blue infrastructure	2016	Ecosystem-based approaches (GI), Health, Urban, Buildings	Flooding, extreme temperatures	*Germany*	Green spaces and corridors in urban areas, water uses to cope with heat waves in cities, climate proofing of buildings against excessive heat, adaptation of integrated land use planning	http://www.stadtklima-stuttgart.de/index.php?climate_climate_atlas_2008	•						•	
Urban stormwater management in Augustenborg, Malmö	2016	Buildings, Water management, Urban, Ecosystem-based approaches (GI)	Flooding	*Sweden*	Climate proofing of buildings against excessive heat, water sensitive urban and building design, green spaces and corridors in urban areas	https://naturvation.eu/location/europe/se/malmo.html https://malmo.se/		•					•	
The refurbishment of Gomeznarro park in Madrid focused on storm water retention	2016	Ecosystem-based approaches (GI), Urban, Water management	Droughts, flooding, extreme temperatures	*Spain*	Water sensitive urban and building design, green spaces and corridors in urban areas	https://mirror.unhabitat.org/		•					•	
Zaragoza: combining awareness raising and financial measures to enhance water efficiency	2016	Water management, Urban	Droughts, water scarcity	*Spain*	Economic incentives for behavioural change, awareness campaigns for behavioural change, water restrictions and consumption cuts	https://www.zaragoza.es/		•				•		

Appendix 5: EU Climate Change Adaptation initiatives and projects

Name		Adaptation sectors	Climate impacts	Countries	Implemented adaptation option	Websites	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Green roofs in Basel, Switzerland: combining mitigation and adaptation measures	2016	Buildings, Energy, Biodiversity, Urban, Ecosystem-based approaches (GI)	Flooding, extreme temperatures	*Switzerland*	Climate proofing of buildings against excessive heat, economic incentives for behavioural change, green spaces and corridors in urban areas	http://www.greenroofs.org http://urbanhabitats.org/								
A flood and heat proof green Emscher valley, Germany	2016	DRR, Water management, Biodiversity, Urban, Ecosystem-based approach-es (GI)	Flooding, extreme temperatures, droughts	*Germany*	Establishment and restoration of riparian buffers, rehabilitation and restoration of rivers and flood-plains	http://www.future-cities.eu http://www.eglv.de/emschergenossenschaft			•				•	
New locks in the Albert canal in Flanders, Belgium	2015	Water management, Energy, Transport	Water scarcity, droughts	*France, Belgium, Netherlands*		https://www.vlaamsewaterweg.be			•				•	
Addressing coastal erosion in Marche region, Italy	2015	Disaster Risk Reduction, Coastal areas	Sea Level Rise, Flooding, Storms	*Italy*	Beach and shoreface nourishment, cliff stabilisation, adaptation of integrated coastal management plans, groynes, break-waters and artificial reefs	https://www.regione.marche.it/								
Integrating adaptation in the design of the metro of Copenhagen	2015	Disaster Risk Reduction, Transport, Ur-ban, Coastal areas	Sea level rise, flooding, storms	*Denmark*	Operation and construction measures for ensuring climate-resilient railway infrastructure	https://ramboll.com/projects/							•	

Appendix 5: EU Climate Change Adaptation initiatives and projects

Name		Adaptation sectors	Climate impacts	Countries	Implemented adaptation option	Websites	Resilience strategy	Land use/ urban planning	Hazard Risk	Adaptation Funding	Recovery Funding	Early Warning system	Institutions	Built environment
Implementing climate change allowances in drainage standards across the UK railway net-work	2015	DRR, Transport	Storms, flooding	*UK*	Operation and construction measures for ensuring climate-resilient railway infrastructure	https://www.networkrail.co.uk/								
Tatabánya, Hungary, addressing the impacts of urban heatwaves and forest fires with alert measures	2015	Health, Urban, DRR, Forestry	Droughts, extreme temperatures	*Hungary*	Adaptation of fire management plans, establishment of early warning systems, heat health action plans, awareness campaigns for behavioural change, capacity building on climate change adaptation, monitoring, modelling and forecasting systems	http://www.tatabanya.hu	•		•		•	•		

Source: Retrieved from Climate-ADAPT database

Australian Housing and Urban Research Institute
Level 12, 460 Bourke Street
Melbourne VIC 3000
Australia
+61 3 9660 2300
information@ahuri.edu.au
ahuri.edu.au
twitter.com/AHURI_Research
facebook.com/AHURI.AUS
Australian Housing and Urban Research Institute