



Australian  
National  
University

# Submission: National Adaptation Plan Issues Paper

ANU Institute for Climate, Energy & Disaster  
Solutions

*This submission is the collated perspective of independent researchers that work at The Australian National University. The views and opinions expressed in this submission reflect those of the authors and contributors.*

Lead authors:

Jason Alexandra, Steven Crimp, Natali Heil Koerbel, Mark Howden, Kate Lawrence, Roslyn Prinsley, Anna Sanders and Liam Taylor.

10 April 2024

Senator the Hon Jenny McAllister  
National Adaptation Policy Office  
Department of Climate Change, Energy, the Environment and Water  
GPO Box 3090  
Canberra ACT 2601

**Re: National Adaptation Plan Issues Paper**

Dear the Hon Jenny McAllister,

Please find enclosed a submission by the ANU Institute for Climate, Energy and Disaster Solutions (ICEDS) for the National Adaptation Plan consultation process.

Based in the ACT, ICEDS connects industry, governments and communities with climate, energy & disaster-risk research from the Australian National University. Our goal is to advance innovative solutions to address climate change, energy system transitions and disasters. We facilitate integrated research, teaching and policy engagement across disciplines.

The enclosed submission contains contributions from experts in transformational adaptation, resilient food systems, climate science and disaster solutions.

Our network of ANU researchers will gladly offer further consultation.

Sincerely,

A handwritten signature in black ink, appearing to read 'M. Howden', written in a cursive style.

Professor Mark Howden  
Director, Institute for Climate, Energy and Disaster Solutions

## Table of Contents

Executive Summary.....	4
Recommendations .....	4
Introduction .....	5
Anticipating and Adapting to Complex, Compounding and Cascading Risk.....	6
Complex, Compounding and Cascading Climate Risk .....	6
Specific Risk Statements .....	6
Low-Likelihood Catastrophic Events.....	7
Residual Risk.....	7
Monitoring, Evaluating and Learning from Adaptation Action .....	7
Commonwealth Adaptation Responsibility.....	8
Reform as a Commonwealth Responsibility .....	8
Recommendation 5 Options: Reforming Institutional Arrangements for Adaptation.....	9
Adaptation as a Central Agency Function.....	9
Adaptation as an Independent Agency Function.....	9
Adaptation as a National Security Priority.....	9
Resourcing as a Commonwealth Responsibility .....	10
Recommendation 6 Options: Resourcing Priorities for Adaptation.....	11
Resourcing Research, Development and Education .....	11
Resourcing Public Health Institutions .....	11
Incorporating Strategic Relocation.....	12
Investing in Adaptation with Co-Benefits.....	12
References.....	13

# Executive Summary

The Institute for Climate, Energy and Disaster Solutions (ICEDS) appreciates the opportunity to provide feedback on the National Adaptation Plan Issues Paper (NAP-IP). As highlighted in the Australian National Climate Risk Assessment (First Pass Assessment) (NCRA 1), climate change poses significant risks that necessitate adaptation, emission-reduction by itself will not be sufficient to shield Australia from climate impacts.

## Recommendations

ICEDS has developed six key recommendations to support the national adaptation agenda focusing on the assessment of climate risk, monitoring of adaptation action, and institutional reform options to support an adaptive Australia. The recommendations include:

1. Inform anticipatory adaptation action in the first iteration of the NAP and future iterations of the NCRA by assessing, articulating and planning for the specific, complex, compounding and cascading nature of Australia's climate risk.
2. Consider the potential impact of low-likelihood catastrophic events in the context of adaptation action.
3. Articulate and plan for Australia's climate risk which will not be managed through adaptation, taking care to ensure that accepted residual risk does not disproportionately affect vulnerable populations.
4. Monitoring and evaluation:
  1. Adapt approaches from other jurisdictions and organisations for monitoring and evaluation of adaptation action to the Australian context.
  2. Reframe "monitoring and evaluation" to "monitoring, evaluation and learning" to explicitly call for future adaptation efforts to draw from data collected in past initiatives.
5. Use the development of a NAP as a leadership opportunity to design and implement ambitious adaptation policy reforms, in line with the Commonwealth's responsibilities described in the Council of Australian Governments 2012 Roles and Responsibilities for Climate Change Adaptation in Australia (COAG 2012).
6. Use the development of a NAP as an opportunity to design and implement resourcing arrangements for key sectors and industries in line with the Commonwealth's responsibilities described in COAG 2012.

# Introduction

The ICEDS welcomes the opportunity to comment on the current direction of the national adaptation agenda as outlined in the National Adaptation Plan Issues Paper.

The NCRA 1 and NAP-IP represent an important move towards recognising the risks posed by climate change that cannot be abated through emission-reduction efforts alone. According to the State of The Climate 2022 and the IPCC, Australia can expect continued warming, decreased cool season rainfall, longer periods of drought, longer fire seasons, more intense short-duration heavy rainfall events and associated flood and erosion and many more impacts.<sup>1</sup> For example, over the weekend (5<sup>th</sup>-7<sup>th</sup> April 2024), much of New South Wales and south-east Queensland experienced record-breaking rainfall and these regions are again recovering from major flooding.<sup>2</sup> The extreme rainfall has caused landslips cutting off roads, led to flash flooding, overwhelmed State Emergency Service crews with emergency rescues and led to at least one suspected death.<sup>3</sup> It is clear that climate change is a real, present and growing danger. While rapid, ambitious efforts in greenhouse gas emission reduction efforts may slow the pace of climate change, we are currently seeing unavoidable increases in multiple climate hazards, presenting multiple risks to ecosystems and humans that cannot be entirely eliminated through emission-reduction.<sup>4</sup>

The publication of NCRA 1 and NAP-IP mark the Commonwealth's renewed focus on climate adaptation. This is a valuable opportunity to reduce the risk Australians face from climate change through embedding improved risk assessment and management, developing new adaptation approaches and technologies, monitoring, evaluation and learning and Commonwealth commitment to institutional reform and adaptation resourcing into policy and planning. A robust and considered approach to Australia's adaptation planning is vital to ensure that jurisdictions, communities and individuals can continue to thrive in Australia as the climate changes.

---

<sup>1</sup> CSIRO and Bureau of Meteorology (2022)

<sup>2</sup> SBS News (2024)

<sup>3</sup> The Guardian (2024)

<sup>4</sup> Intergovernmental Panel on Climate Change (2022), p.13

# Anticipating and Adapting to Complex, Compounding and Cascading Risk

## Complex, Compounding and Cascading Climate Risk

The Intergovernmental Panel on Climate Change (IPCC) has noted that climate change risks and impacts are “becoming increasingly complex and more difficult to manage. Multiple climate hazards will occur simultaneously and multiple climatic and non-climatic risks will interact.”<sup>5</sup>

The complex, compounding and cascading nature of Australia’s climate risk is not reflected in the NAP-IP, despite NCRA 1 finding “all systems have cascading, concurrent and compounding risks, with strong interdependencies across multiple systems”.<sup>6</sup> By not including this in the NAP-IP, Australia runs the risk of downplaying the scale of the potential impact of climate-related hazards on critical values and systems.

We suggest, as in the NAP-IP, that the characterisation that adaptation could be “as complex as being prepared to maintain essential transport systems during a severe storm”<sup>7</sup> does not reflect the true complexity, scale and severity that climate hazards are likely to reach and, in some cases, already have reached. For example, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has detailed the nature of compounding events in the Bega Valley Shire — severe drought, followed by catastrophic bushfires, extreme rainfall, flooding and the COVID-19 pandemic within five years.<sup>8</sup> The cumulative impacts were significant, likely greater than the sum of its parts and difficult to predict. Fires burnt through 60% of the Shire’s bushland, destroying 600 dwellings. The extreme rainfall carried seeds from livestock feed into the natural environment causing a huge concentration of weeds. Water security was challenged as water treatment plants could not handle the volume of water and debris. The recovery workforce was unable to rebuild the community due to a lack of appropriate accommodation and COVID-19 restrictions. Effective adaptation strategies must address the multifaceted challenges posed by such compound and complex events, extending far beyond the maintenance of transport systems during storms.

## Specific Risk Statements

The benefit of a comprehensive climate risk assessment (which includes complex, compounding and cascading risk) is that it can inform anticipatory, rather than reactive, adaptation action. While changes to our climate have already occurred and some adaptation action will be reactive by necessity, the NAP marks an opportunity to identify impacts before they occur and shift to anticipatory decision-making. However, anticipatory decision-making should be driven by the most robust and fit-for-purpose understanding of climate risk possible. This requires a more pluralistic approach than just using GCMs which are now well-understood to be underestimating rates of change of many impacts.

NCRA 1 lacks specificity in describing hazards beyond “climate-driven extreme events,”<sup>9</sup> posing significant obstacles to anticipating appropriate adaptation actions. High-level or general statements do little to inform adaptation options at any scale, failing to identify tangible vulnerabilities on which to focus action.

---

<sup>5</sup> IPCC (2022), p.18

<sup>6</sup> Department of Climate Change, Energy, the Environment and Water (2024b), p.11

<sup>7</sup> DCCEEW (2024a)

<sup>8</sup> Dawkins, H. (2022)

<sup>9</sup> DCCEEW (2024c), p.1

*Recommendation 1: Inform anticipatory adaptation action in the first iteration of the NAP and future iterations of the NCRA by assessing, articulating and planning for the specific, complex, compounding and cascading nature of Australia's climate risk.*

## Low-Likelihood Catastrophic Events

The risk profile of climate change is, in some cases, characterized by unlikely but extreme outcomes. Given that there is a high degree of uncertainty when assessing the likelihood of climate outcomes, a precautionary approach that considers worst-case scenarios is a prudent inclusion in assessing and planning to adapt to climate change.<sup>10</sup> NCRA 1 and NAP-IP do not currently consider potential for system feedbacks that can contribute to elevated greenhouse gas emissions and climate changes (e.g. thawing of Arctic permafrost and loss of stratocumulus cloud decks) which could push warming levels to well-beyond the 3°C of warming considered by NCRA 1.<sup>11</sup>

*Recommendation 2: Consider the potential impact of low-likelihood catastrophic events in the context of adaptation action.*

## Residual Risk

Adaptation has the potential to decrease climate risk. However, it is generally accepted that some risks will remain despite adaptation efforts.<sup>12</sup> NCRA 1 and NAP-IP do not adequately cover residual risk. Adaptation plans should draw from an understanding of the residual risk the Commonwealth is willing to accept and how this residual risk will be managed. The United Nations Office for Disaster Risk Reduction states that residual risk necessitates the maintenance of emergency response and recovery capacities.<sup>13</sup> When considering residual risk, it should be noted that vulnerable populations (specified by the IPCC as women, youth, elderly, ethnic and religious minorities, Indigenous People and refugees) are likely to experience residual risk at disproportionately higher levels than the general populations.<sup>14</sup>

*Recommendation 3: Articulate and plan for Australia's climate risk which will not be managed through adaptation, taking care to ensure that accepted residual risk does not disproportionately affect vulnerable populations.*

## Monitoring, Evaluating and Learning from Adaptation Action

The NAP-IP call for input on the monitoring and evaluation of Australia's adaptation action is consistent with the IPCC Sixth Assessment Report, which states a "pressing need for more thorough monitoring and evaluation of adaptation to assess effectiveness."<sup>15</sup> A lack of consistent indicators or metrics to assess effectiveness of adaptation is a key challenge in learning from existing adaptation work and improving future projects.

Monitoring and evaluation frameworks should support adaptation actions that are efficient, just and equitable – for example, accounting for gendered impacts. The IPCC recommends that monitoring and evaluation frameworks link changing vulnerabilities and risks, established adaptation goals and targets and the adaptation efforts put in place.<sup>16</sup> To this end, establishing

---

<sup>10</sup> Kemp, L. et al. (2022)

<sup>11</sup> Kemp, L. et al. (2022)

<sup>12</sup> IPCC (2022), p.170

<sup>13</sup> United Nations Office for Disaster Risk Reduction (n.d.)

<sup>14</sup> IPCC (2022), p.170

<sup>15</sup> IPCC (2022), p.296

<sup>16</sup> IPCC (2022), p.980

what the objectives of adaptation in Australia are in tangible, measurable terms will be a foundational component of an effective monitoring and evaluation system. With this in mind, operationalising the abstract key objectives as described in the NAP-IP (*'mainstreaming' adaptation action, driving substantial uplift in private sector investment, establishing support for those in disproportionately vulnerable situations and climate risk management becoming part of business-as-usual for governments, organisations and communities across Australia*)<sup>17</sup> to have associated measurable targets should be a priority of the NAP.

The Commonwealth can look to and adapt current examples of monitoring and evaluation frameworks for adaptation action from other jurisdictions and organisations. For instance, the Global Covenant of Mayors for Climate and Energy sets out guidance for setting adaptation goals, key adaptation actions and action planning which is linked to related climate hazards.<sup>18</sup>

Given the NAP is informed in part by the NCRA, evaluation of risk after adaptation interventions, including measurement of vulnerability and exposure to hazards could be a core approach which can be enhanced through targets relevant to the other objectives articulated in the NAP-IP.<sup>19</sup>

Monitoring and evaluation frameworks are useful only when the outcomes are used to inform future interventions. Reframing 'monitoring and evaluation' to 'monitoring, evaluation and learning' may support translation of data collected into improved and increasingly informed initiatives. The Victorian State government has strong guidance to developing monitoring, evaluation and learning frameworks for place-based initiatives.<sup>20</sup>

*Recommendation 4.1: Adapt approaches from other jurisdictions and organisations for monitoring and evaluation of adaptation action to the Australian context.*

*Recommendation 4.2: Reframe "monitoring and evaluation" to "monitoring, evaluation and learning" to explicitly call for future adaptation efforts to draw from data collected in past initiatives.*

## Commonwealth Adaptation Responsibility

### Reform climate adaptation as a critical Commonwealth Responsibility

NAP-IP invokes the COAG 2012 delineation of local, State and Commonwealth government roles in climate adaptation. COAG 2012 places an emphasis on the implementation roles of local and State governments, limiting the Commonwealth's responsibility to broad issues of funding and coordination.<sup>21</sup> According to the parameters set by COAG 2012, the Commonwealth has a responsibility to provide leadership on national adaptation reform.

The NAP-IP is structured as a stocktake of existing policy that is relevant to adaptation (albeit with an aim of strengthening existing policy). This stocktake serves to highlight how disparate the existing policy suite is but does not articulate ambition to undertake reform. A NAP is an opportunity for ambitious institutional and policy reform to support the Commonwealth, State and local jurisdictions in fulfilling their COAG 2012 roles. The Commonwealth has an opportunity to transition from disparate policies and initiatives to a cohesive framework that can effectively address risks across jurisdictions and systems. These frameworks are present in other national risk-reduction areas that require intergovernmental collaboration. For example, the Australian Government Crisis Management Framework<sup>22</sup>, managed by the Department of the Prime

---

<sup>17</sup> DCCEE (2024a), p.10

<sup>18</sup> Global Covenant of Mayors for Climate and Energy (2023)

<sup>19</sup> DCCEE (2024b), p.4

<sup>20</sup> Victorian State Government (2023)

<sup>21</sup> Council of Australian Governments (2012)

<sup>22</sup> Commonwealth of Australia (2023)



Minister and Cabinet, is a revisable document that outlines the roles, responsibilities and collaboration of the Commonwealth, State and territory governments, Ministers, officials and different agencies in holistically managing disaster risk.

Such a cohesive framework could be created for the implementation of a NAP and managed by a central agency, allowing strategic intergovernmental and interdepartmental collaboration, clear lines of accountability and fostering a joint picture of the state of climate adaptation and risks associated with climate extremes and enhancing adaptation capacity nationally.

*Recommendation 5: Use the development of a NAP as an opportunity to design and implement ambitious adaptation policy reforms, in line with the commonwealth's responsibilities described in COAG 2012.*

## Options for Recommendation 5: Reforming Institutional Arrangements for Adaptation

### Adaptation as a Central Agency Function

By making climate adaptation the remit of the Department of Climate Change, Energy, the Environment and Water and then requiring each agency to report and manage their own climate risk through the Climate Risk and Opportunities Management Program,<sup>23</sup> the Commonwealth risks relegating climate adaptation to a lower priority than outcomes that are more aligned with the line agency remit. As found in other nations, a hybrid model involving a central agency (e.g. Prime Minister & Cabinet) to coordinate climate adaptation efforts across departments would be more effective given the cross-cutting nature of climate risk and adaptation.

### Adaptation as an Independent Agency Function

Political cycles currently have the potential to impact Australia's response to climate change risk. Establishing an independent agency to oversee climate adaptation is crucial for the kind of consistency and long-term planning that will see development of effective adaptation options, capacity-building and implementation of action across jurisdictions and sectors. Similarly to the reasoning in the Adaptation as a Central Agency Function section, it is important that this independent agency does not report to line agencies, as its adaptation remit should not have to compete with the priorities of a line agency. Instead, the agency should report to Parliament on an annual basis (with a similar model to the Climate Change Authority), elevating the status of climate adaptation alongside emissions reduction efforts.<sup>24</sup>

### Adaptation as a National Security Priority

The Commonwealth has an opportunity to consider climate adaptation as an essential element of Australia's national security and social cohesion.

Whilst the NAP-IP notes the impacts of climate extremes on critical infrastructure and the current reliance on the Australian Defence Force (ADF) during climate driven disasters, it could consider broader public security challenges posed by a lack of adaptation to future climate scenarios. Effective adaptation could help reduce expected social cohesion challenges driven by climate extremes in Australia.<sup>25</sup> Increased temperatures and more frequent and severe natural disasters have already been linked with higher rates of both domestic and non-domestic violence and strained law enforcement resources in Australia.<sup>26</sup> In this way, it is important to

---

<sup>23</sup> DCCEEW (n.d.)

<sup>24</sup> Climate Change Authority (2023)

<sup>25</sup> Ide, T. (2023)

<sup>26</sup> Blaustein, J. et al. (2023)

consider the need for adaptation planning in both Commonwealth and State law enforcement and social protection agencies to guard against deteriorating social cohesion due to climate change.

## Resourcing as a Commonwealth Responsibility

COAG 2012 also describes the Commonwealth responsibility to ensure that “resources are available to respond to climate change and can be deployed efficiently”.<sup>27</sup> While adaptation actions should be localised to ensure they are context-appropriate, it is not reasonable to expect local and State governments, businesses and research institutes to drive climate adaptation in the absence of strong Federal resourcing.

Adaptation efforts in Australia need to be able to withstand chronic climate hazards in addition to acute climate driven disasters. Resourcing for betterment works (rebuilding essential public assets to a more robust standard to withstand impacts of future disasters) is key in creating an adaptive Australia.<sup>28</sup> For the purposes of this submission, betterment is considered as adaptation action. The benefits of anticipatory investment in betterment rather than a reliance on recovery can be articulated in terms of return on investment.

In 2021, the cost of disasters to the Australian economy was AUD38 billion, this is projected to rise to at least AUD73 billion annually by 2060 under a low emissions scenario.<sup>29</sup> With these numbers in mind, Commonwealth funding to prepare Australia for disasters of AUD1 billion over five years (the Disaster Ready Fund)<sup>30</sup> is a significant underspend. The National Emergency Management Agency (NEMA) acknowledges the advantages of investing in risk reduction and adaptation including avoidance of loss and suffering, reductions of future disaster costs and realising economic opportunities and social benefits associated with effective adaptation.<sup>31</sup> While adaptation and risk reduction can be distinct concepts, it may be helpful to consider adaptation as a state and resilience as a trait where investing in climate adaptation activities is likely to enhance the resilience of assets, communities and other values.<sup>32</sup> The Queensland Reconstruction Authority (QRA) has estimated that betterment projects, with an initial investment of AUD174 million have generated approximately AUD397.5 million in savings or avoided costs.<sup>33</sup>

An increase in Commonwealth resourcing in anticipation of increased chronic and acute climate hazards would better account for the increasing cost of disaster recovery and potential to avoid at least some of these costs.

Further, the commonwealth has the opportunity to acknowledge the cross-sectoral nature of climate impacts by increasing the allocation of resources to bolster adaptation in research, education, businesses, public health and strategic relocation.

*Recommendation 6: Use the development of a NAP as an opportunity to design and implement resourcing arrangements for key sectors and industries in line with the commonwealth’s responsibilities described in COAG 2012.*

---

<sup>27</sup> COAG (2012), p.6

<sup>28</sup> Queensland Government (n.d.)

<sup>29</sup> National Emergency Management Agency (n.d., b)

<sup>30</sup> NEMA (n.d., a)

<sup>31</sup> NEMA (n.d., b)

<sup>32</sup> Wong-Parodi, G.; Fischhoff, B.; Strauss, B (2015)

<sup>33</sup> Queensland Government (n.d.)

## Recommendation 6 Options: Resourcing Priorities for Adaptation

### Resourcing Research, Development and Education

Our current adaptation options are unlikely to endure the climate extremes Australia is increasingly going to face. To accelerate the implementation of adaptation action, the Commonwealth has an opportunity to scale up investment in adaptation research funding. The Commonwealth can realise adaptation benefits by targeting the acceleration of the transition from research to practice. The Commonwealth can improve learning through practice by funding demonstration sites to enhance understanding of the implications of certain adaptation decisions.<sup>34</sup>

The accelerating frequency and intensity of natural hazards driven by climate change is outpacing our current disaster mitigation efforts. More ambitious research on disaster prevention is key to effective adaptation planning. The Commonwealth should consider enhancing understanding of disaster risk and possible interventions in natural hazards before they turn into disasters, as a key adaptation measure through enhanced resourcing of research and development.

Research has shown that early intervention in the formation of natural hazards, especially cyclones and bushfires, can reduce their impact on our communities and environment.<sup>35</sup> As a key research funder and coordinator of disaster risk reduction through NEMA, the Commonwealth has an opportunity to work with the university and private sectors to establish initiatives of national significance, expanding our science and technology capability to prevent the worst natural hazards.

Further, the Commonwealth has a responsibility to standardise learning curricula. Integrating climate change risk and adaptation into educational settings will enhance the readiness of the Australian populace to engage in personal climate adaptation efforts and to endorse and participate in adaptation initiatives introduced by various levels of government.<sup>36</sup>

### Resourcing Public Health Institutions

Currently, State and Territory governments are leading in health-related climate adaptation planning and assessment in Australia. With the introduction of the National Health and Climate Strategy, released in 2023, the Commonwealth laid out its approach to the increasing health impacts of climate change with a focus on embedding health into all policies. The strategy is encouraging as it covers adaptation action to avoid consequences of shocks such as extreme heat, air quality changes, increases in communicable diseases, mental health concerns and changes to food availability.<sup>37</sup> Actions such as improved monitoring of climate and health data and indicators and the development of a national health emergency response plan are positive steps towards better understanding and planning for the health risks of climate change. However, there is little discussion of improved resourcing in clinical settings where the acute health impacts of climate change will present and where substantial GHG emissions occur<sup>38</sup>

Even if the Strategy's actions are taken and climate change impacts are adapted to and mitigated against within the health sector, there will be residual human health risks of climate change. Given its responsibility for the Medicare system, the Commonwealth must enhance its capacity to adapt to the exacerbated health implications of climate change.

---

<sup>34</sup> Currie-Alder, B. *et al.* (2021)

<sup>35</sup> Miller, J. *et al.* (2023) and Yebra, M. *et al.* (2021)

<sup>36</sup> Harker-Schuch, I. *et al.* (2021)

<sup>37</sup> Department of Health and Aged Care (2023)

<sup>38</sup> Department of Health and Aged Care (2023)

## Resourcing for Strategic Relocation

Through its adaptation planning, the Commonwealth can lead the development of informed national strategies that are proactive in addressing the complex challenges of relocation.

The complex factors that influence decision-making on community relocation, including socio-economic diversity, property evaluation, insurance, community identity, as well as the crucial issue of First Nation's connection with country, demonstrate that relocation as an adaptation measure needs extensive government attention.<sup>39</sup> The Commonwealth has an opportunity in its adaptation planning to act proactively in facilitating research and community consultation on when, how and why communities relocate because of climate risks.<sup>40</sup> Better understanding of how to appropriately relocate communities in disaster-prone areas (for example, residential zones built upon floodplains) is important in the context of anticipatory adaptation. Resourcing to insulate at-risk communities from the financial burden of managed retreat should not fall solely to individuals, or the State, Territory or local governments.<sup>41</sup>

## Investing in Adaptation with Co-Benefits

The Commonwealth has an opportunity to plan for strategic investment in adaptation solutions that provide ecological, economic and social co-benefits, especially nature-based solutions. The NAP-IP does mention the importance of catalysing private sector investment in nature-based solutions. However, the Commonwealth could also play a role in facilitating the research, planning and financing of these solutions. Nature-based solutions can provide value for money for federal adaptation investment, delivering long-term net positive economic benefits as well as positive social and ecological impacts.<sup>42</sup> Such adaptation solutions could be highly aligned with the government's Nature Positive Plan and align with the NAP-IP's 'no regret actions' principle.

---

<sup>39</sup> Insurance Australia Group (2023)

<sup>40</sup> Dandy, J. & Leviston, Z. (2024)

<sup>41</sup> O'Donnell, T. (2023)

<sup>42</sup> Ruangpan, L. *et al.* (2024)

## References

- Blaustein, J., Miccelli, M., Hendy, R., Burns KH. (2023). "Resilience policing and disaster management during Australia's Black Summer bushfire crisis". *International Journal of Disaster Risk Reduction*, 95, 103848. <https://doi.org/10.1016/j.ijdrr.2023.103848>
- Climate Change Authority (2023). *2023 Annual Progress Report*. [https://www.climatechangeauthority.gov.au/sites/default/files/documents/2023-11/2023%20AnnualProgressReport\\_0.pdf](https://www.climatechangeauthority.gov.au/sites/default/files/documents/2023-11/2023%20AnnualProgressReport_0.pdf) accessed 9 April 2024
- Council of Australian Governments (2012). *Roles and Responsibilities for Climate Change Adaptation in Australia*. <https://www.agriculture.gov.au/sites/default/files/documents/coag-roles-responsibilities-climate-change-adaptation.pdf> accessed 25 March 2024
- CSIRO and Bureau of Meteorology (2022). *State of the Climate 2022*. <https://www.csiro.au/en/research/environmental-impacts/climate-change/state-of-the-climate>
- Currie-Alder, B., Rosenzweig, C., Chen, M., Nalau, J., Patwardhan, A., Wang, Y. (2021). "Research for climate adaptation." *Communications Earth & Environment*, 2, 220. <https://doi.org/10.1038/s43247-021-00294-5>
- Dandy, J. & Leviston, Z. (2024). "Climate change is forcing Australians to weigh up relocating. How do they make that difficult decision?". *ANU Institute for Climate, Energy & Disaster Solutions* <https://iced.s.anu.edu.au/news-events/news/climate-change-forcing-australians-weigh-relocating-how-do-they-make-difficult> accessed 9 April 2024
- Dawkins, Ruth (2022). *How to build resilience in the face of compounding extreme events*. <https://www.csiro.au/en/news/all/articles/2022/april/compound-risk-extreme-events> accessed 25 March 2024
- Department of Climate Change, Energy, the Environment and Water (2024a). *National Adaptation Plan Issues Paper* <https://consult.dcceew.gov.au/climate-adaptation-in-australia-national-adaptation-plan-issues-paper> accessed 25 March 2024
- Department of Climate Change, Energy, the Environment and Water (2024b). *National Climate Risk Assessment: First Pass Assessment Report*. <https://www.dcceew.gov.au/climate-change/publications/ncra-first-pass-risk-assessment> accessed 25 March 2024
- Department of Climate Change, Energy, the Environment and Water (2024c). *National Climate Risk Assessment: First Pass Assessment Report Appendix* <https://www.dcceew.gov.au/climate-change/publications/ncra-first-pass-risk-assessment> accessed 25 March 2024
- Department of Climate Change, Energy, the Environment and Water (n.d.). *Climate Risk and Opportunity Management Program*. <https://www.dcceew.gov.au/climate-change/policy/adaptation/climate-risk-opportunity-management-program> accessed 8 April 2024
- Department of Health and Aged Care (2023). *National Health and Climate Strategy*. <https://www.health.gov.au/sites/default/files/2023-12/national-health-and-climate-strategy.pdf> accessed on 8 April 2024
- Department of the Prime Minister and Cabinet (2023). *Australian Government Crisis Management Framework*. [https://www.pmc.gov.au/sites/default/files/resource/download/australian-government-crisis-management-framework\\_0.pdf](https://www.pmc.gov.au/sites/default/files/resource/download/australian-government-crisis-management-framework_0.pdf) accessed on 9 April 2024

Global Covenant of Mayors for Climate and Energy (2023). *Common Reporting Framework*. <https://www.globalcovenantofmayors.org/wp-content/uploads/2023/11/CRF7-0-2023-09-14-final.pdf> accessed 9 April 2024

Harker-Schuch, I., Lade, S., Mills, F., Colvin, B. (2021). "Opinions of 12 to 13-year-olds in Austria and Australia on the concern, cause and imminence of climate change." *Ambio*, 50, 644–660. <https://doi.org/10.1007/s13280-020-01356-2>

Ide, T (2023). "Climate change and Australia's national security". *Australian Journal of International Affairs*, 77:1, 26-44. doi: [10.1080/10357718.2023.2170978](https://doi.org/10.1080/10357718.2023.2170978)

Insurance Australia Group (2023). "Planned relocation: Protecting our communities." [https://www.iag.com.au/sites/default/files/Documents/About%20Us/Final%20report\\_0.pdf](https://www.iag.com.au/sites/default/files/Documents/About%20Us/Final%20report_0.pdf) accessed 9 April 2024

Intergovernmental Panel on Climate Change (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. doi:[10.1017/9781009325844](https://doi.org/10.1017/9781009325844)

Kemp, L., Xu, C., Depledge, J., Ebi, K.L., Gibbins, G., Kohler, T.A., Rockström, J., Scheffer, M., Schellnhuber, H.J., Steffen, W., Lenton T.M. (2022). *Climate Endgame: Exploring catastrophic climate change scenarios*. <https://doi.org/10.1073/pnas.2108146119>

Miller, J., Tang, A., Linh Tran, T., Prinsley, R., & Howden, M. (2023). "The Feasibility and Governance of Cyclone Interventions." *Climate Risk Management*, 41, 100535. <https://doi.org/10.1016/j.crm.2023.100535>

National Emergency Management Agency (n.d., a). *Progress on recommendations from Natural Disaster Royal Commission*. <https://nema.gov.au/about-us/media-release/Royal-Commission-Natural-Disaster201023> accessed 8 April 2024

National Emergency Management Agency (n.d., b). *Resilience investment*. <https://nema.gov.au/about-us/policies/resilience-investment> accessed 8 April 2024

O'Donnell, T. (2023) "Interrogating private property rights and path dependencies for coastal retreat." *Ocean & Coastal Management*, 231, 106379. <https://doi.org/10.1016/j.ocecoaman.2022.106379>

Queensland Government (n.d.). *About betterment*. <https://www.qra.qld.gov.au/betterment/about-betterment#Proven-success-of-betterment-programs> accessed 9 April 2024

Ruangpan, L., Vojinovic, Z., Plavšić, J., Curran, A., Rosic, N., Pudar, R., Savic, D., & Brdjanovic, D. (2024). "Economic assessment of nature-based solutions to reduce flood risk and enhance co-benefits." *Journal of Environmental Management*, 352, 119985–119985. <https://doi.org/10.1016/j.jenvman.2023.119985>

SBS News (2024). *Record rainfall and flooding in NSW force evacuations, rescues*. <https://www.sbs.com.au/news/article/record-rainfall-and-flooding-in-nsw-force-evacuations-rescues/xgk2o57vg> accessed 8 April 2024

The Guardian (2024). *Disaster assistance activated as Sydney 'blue sky flood' continues to threaten homes*. <https://www.theguardian.com/australia-news/2024/apr/07/hundreds-of-sydney-residents-forced-to-flee-after-heavy-rain-causes-flooding> accessed 8 April 2024

United Nations Office for Disaster Risk Reduction (n.d.). *Disaster Risk Reduction Terminology*. <https://www.undrr.org/terminology/residual-risk> accessed 8 April 2024

Victorian State Government (2023). *Monitoring, Evaluating and Learning for place-based approaches: A toolkit for the Victorian Public Service*. <https://www.vic.gov.au/place-based-approaches-monitoring-evaluation-and-learning-mel-toolkit/> accessed 9 April 2024

Yebra, M., Barnes, N., Bryant, C., Cary, GJ., Durrani, S., Lee, J., Lindenmayer, D., Mahony, D., Prinsley, R., Ryan, P., Sharp, R., Stocks, M., Tridgell, A., Zhou, X. (2021). "An integrated system to protect Australia from catastrophic bushfires." *Australian Journal of Emergency Management*, 36: 4, 20-22. [https://knowledge.aidr.org.au/media/9041/ajem\\_08\\_2021-04.pdf](https://knowledge.aidr.org.au/media/9041/ajem_08_2021-04.pdf)

Wong-Parodi, G., Fischhoff, B., Strauss, B. (2015). "Resilience vs. Adaptation: Framing and action". *Climate Risk Management*, 10, 1-7. <https://doi.org/10.1016/j.crm.2015.07.002>

Institute for Climate, Energy and Disaster Solutions

+61 2 6125 9757

[iced@anu.edu.au](mailto:iced@anu.edu.au)

The Australian National University

Canberra ACT 2600 Australia

[www.anu.edu.au](http://www.anu.edu.au)

TEQSA Provider ID: PRV12002 (Australian University)

CRICOS Provider Code: 00120C