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National Resilience Taskforce

Deconstructing Disaster

The strategic case for developing an Australian Vulnerability Profile to enhance national preparedness

March 2017

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Executive Summary

Overview

Australia has a history of natural hazards, climate variability and extreme weather events¹ the impacts of which have effected, and continue to effect, the health, safety and wellbeing of Australians. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BOM)^{2,3} conclude that a variable and changing climate will influence the frequency and severity of hazards in Australia.

The social and economic cost of past events has been considerable—with the total cost of disasters in Australia exceeding \$9 billion in 2015 or approximately 0.6% gross domestic product. Significantly, the economic costs of the social impact were at least equal to the physical costs. These costs, which do not consider the potential impacts of a variable and changing climate, are projected to rise to an average of \$33 billion per year by 2050 unless steps are taken to increase resilience⁴.

Disasters have caused suffering and loss, tested our resilience and put pressure on our ability to re-establish lives. The occurrence of disasters that are beyond our historical experience and test the limits of capacity and capability in Australia are rising. With increasing dependence on access to inter-connected systems to support our health, safety and wellbeing, any disruption or damage to these systems can exacerbate existing vulnerabilities and expose new ones. The underlying chronic, systemic and environmental stresses that feature in everyday life can also exacerbate the disruption from disasters and present ongoing resilience challenges.

In a global and domestic context of rapid urbanisation, population growth and a varied and changing climate, events are inevitable. Further, we cannot rely on previous experience as a predictor of future potential impacts. We do not know the exact nature of the problems that might arise in the future or, how and where they will impact, but we do know they will impact us and that we are vulnerable.

Recent severe weather events in Victoria⁵ which triggered wide-spread asthma attacks on 21 November 2016 and in South Australia on 28 September 2016 which shut down the power supply to the state demonstrate this limitation; both were unexpected and with consequences at a scale not previously experienced.

It is widely accepted no one jurisdiction, agency, or organisation has the capacity to identify or solve the problems alone. All levels of government, industry, academia and non-government sectors have a role to play in collaboratively and systematically reducing the impact of disasters and to:

- Reduce suffering and future loss
- Uphold public trust and confidence

This paper outlines the rationale for better understanding the drivers of disaster so that we can work together to determine where and how we can be better prepared as a nation to minimise harm to the safety and wellbeing of society.

Background

Consideration has been given to the information that currently exists including the global shift towards a comprehensive articulation of the drivers of disaster—hazard, exposure and vulnerability for severe to catastrophic events. The United Nations' Sustainable Development Goals 2015-2030 (SDGs), the Sendai Framework for Disaster Risk Reduction (2015-2030) and the Conference of Parties (COP21) Paris Agreement on Climate Change are converging into an integrated global approach to disaster and climate risk management and recognise the need for transformation. Australia is committed to these frameworks and is advanced in its approach to disaster resilience through the National Strategy for Disaster Resilience (NSDR). However, opportunities remain to improve our existing approaches for future challenges.

Information at the national level

The availability of information at the national level is important to Australia's overall ability to prepare for the impacts of, and disruptions caused by, severe to catastrophic events. Currently, official national information on hazard intensity, exposure trends and underlying vulnerability is not available. Further, little is known nationally about how values, places and people's experience influence people's perceptions of risk. The scarcity of information about loss and how disasters endanger what people value limits the overall understanding of the impacts on society.

Information for the severe to catastrophic context

In Australia, risk assessments undertaken by states and territories (states) in accordance with the National Emergency Risk Assessment Guidelines (NERAG) provide useful information to contribute to disaster management at the state level. The assessments establish for each state an important narrative about those hazards that have the greatest potential to cause harm and are used to guide operational and strategic disaster risk management activities. However, these assessments cannot be aggregated to the national level. Further, there is little benefit in attempting a national risk assessment at this point in time, as understanding vulnerability is a key part of any risk assessment and there is limited knowledge at the national level about vulnerability.

Severe to catastrophic events cause the greatest consequence to society. A problem that arises is that we tend to trade off in our minds any serious contemplation that severe to catastrophic events will actually occur, given their rarity. However, the rarity of an event does not reduce the potential impact on society⁶. Therefore, attaining a greater understanding of what is exposed, what is vulnerable, and what the consequences and cascading impacts might be is important. These are critical determinants of whether a hazard has the potential to trigger a disaster.

Creating a new national narrative

An opportunity exists to align, inform and shape national policy objectives through the research and construct of a realistic and accepted national narrative that helps to better understand a growing national problem: Australia's vulnerabilities to events described as severe to catastrophic.

Increasing efforts to better understand the current and future drivers of disaster will fill an identified gap in contemporary knowledge at the national level and lead to a broader range of options to lessen future suffering and loss and increase preparedness.

This paper asserts the new narrative will be created through the process of developing the 'Australian Vulnerability Profile' (the 'Profile'). The terms 'Profile' and 'narrative' are used interchangeably throughout this paper.

The new narrative will recognise the choices we make (as individuals, communities, institutions and governments) have the potential to collectively make us more vulnerable to disaster—or more resilient⁷. In developing a national narrative, the work will closely examine factors of vulnerability through the notion that vulnerability is a product of our expectations and what we value; and that how we live our lives plays a part in creating the environment for our vulnerability.

What we value varies; as individuals, communities, institutions and governments. However, the factors that determine scales of vulnerability, consequence and even resilience or coping capacity in this context are common. The factors include knowledge and understanding of potential problems faced, the ability to anticipate and reduce potential consequence, respond to an event, and to cope with and recover from consequence. Figure 1 is a simplistic representation of this relationship.

Preparedness measures can be employed across each stakeholder group to reduce vulnerability—enhancing preparedness at one level can reduce vulnerability (or enhance capacity) across others.

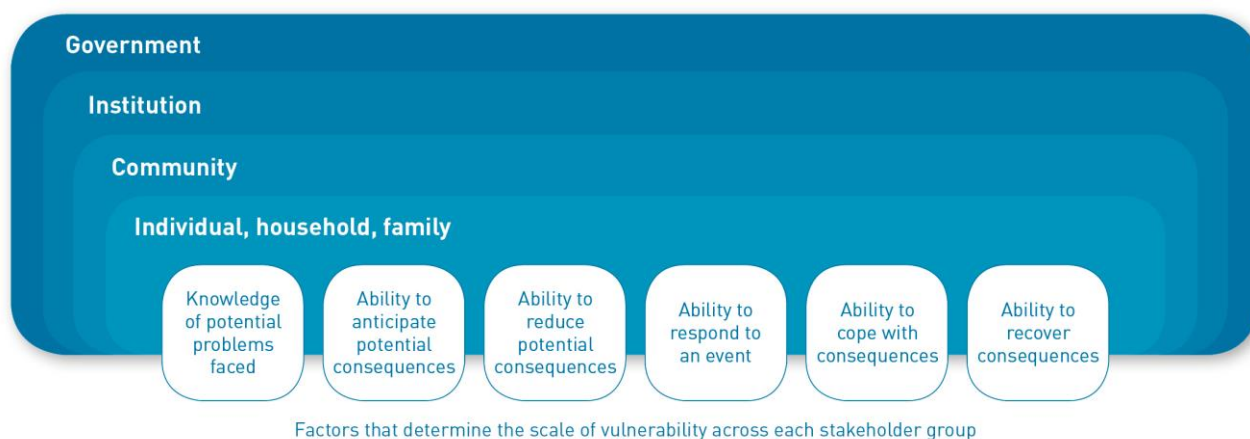


Figure 1: Lenses of national vulnerability and factors that determine the scale of vulnerability⁸

Benefits

The Profile will lay a foundation to unify efforts towards:

- Reducing harm, suffering and loss for Australians;
- Systematically advancing Australia's preparedness;
- Aligning international and national strategic commitments;
- Enhancing early warnings (red flags of emerging vulnerability);
- Avoiding hazards turning into disasters;
- Reducing disaster potential rather than letting it grow and accumulate;
- Avoiding new, and reducing and managing existing vulnerabilities; and
- Strengthening individual, community, government and institutional resilience.

The development of the narrative will support the priority actions of the NSDR, the Sendai Framework for Disaster Risk Reduction and the SDGs.

Further, it will create a connection between international commitments, the work of jurisdictions including the Commonwealth, and will provide guidance to the Australia-New Zealand Emergency Management Committee (ANZEMC) for determining national-level policy priorities.

The Profile will provide jurisdictions with a source of knowledge for the vulnerabilities that are beyond the capacity of each state to mitigate. It will support the concept of shared responsibility and benefit states through synthesising and raising collective knowledge at the national level to identify national policy challenges, inform future policy initiatives and better understand national capability gaps. It will also benefit stakeholders across all sectors that play a role in disaster resilience including business and community leaders and the not-for-profit sector.

Stakeholders engaged throughout the project will not only participate in the development of the Profile, but also be able to identify synergies with their own work, create links to other aligned projects, provide advice and guidance, and potentially collaborate on solving other complex national challenges related to disaster preparedness. In this way, we will collectively invest in resilience by re-imagining and better connecting existing activity, resources and investment streams.

1. Introduction

In May 2016, the need for a 'National Risk Statement' emerged from a sector-wide workshop⁹ to progress understanding of national emergency management and resilience capabilities necessary to deal with the consequences of severe to catastrophic events. In September 2016, the Australian Government, through Emergency Management Australia (EMA) began to investigate the need, purpose and scope of a National Risk Statement and asked the following questions:

- What purpose could national risk-based information serve and who would use it?
- If credible risk-based information already exists, then what is missing?
- Is national risk-based information what is needed to prepare for an uncertain future?

To explore answers to these questions within the strategic context of Australia's commitments to the international frameworks and the National Strategy for Disaster Resilience (NSDR) work commenced on a number of research activities, including:

- Analysis of global and international country-level risk statements (**Attachment A**)
- Analysis of risk statements published in Australia and by whom (**Attachment B**)
- Understanding roles and responsibilities in mitigating and managing risk in Australia (**Attachment C**)

This paper presents the findings and analytical thinking which led to the recognition there may be greater benefit in targeting efforts to understand the evolving drivers of disaster. The paper is not an exhaustive analysis and is intended to spark conversation.

2. The need for a national narrative

Australia has a long history of climate variability and extreme weather events¹; the impacts of which have affected the health, safety and well-being of Australians. Evidence is mounting that Australia's natural hazards are intensifying, with growing exposure to numerous risks and increasing potential for severe to catastrophic impacts on the nation. Natural hazards also extend beyond state and territory boundaries and test the limits of capacity and capability.

Australia has also committed to several important international frameworks which acknowledge greater coherence is needed across sustainability, disaster risk reduction and climate adaptation, and are together outlining an integrated global approach to disaster and climate risk management in the context of sustainable development.

2.1. Changing frequency and intensity of hazards

It is generally globally accepted that there is inter-connectivity between extreme weather events¹⁰ and climate, and that a variable and changing climate is a primary reason for rising frequency and severity of those extreme weather events. Globally it was found that¹¹:

- 91% of disaster events were weather related
- 51% of fatalities were caused by weather related extremes
- 79% of economic losses were related to weather extremes
- 90% of insured losses were caused by weather extremes

A changing climate is shifting the variability and intensity of hazard events, revealing vulnerabilities exacerbated by social and economic pressures, urbanisation, demographic changes and globalisation.

2.1.1. Outlook for Australia

As the global climate system has warmed, changes have occurred to both the frequency and severity of extreme weather. In Australia, the most obvious change has been an increase in the occurrence of record-breaking heat, and heatwaves account for more deaths than any other natural hazard.

The 2016 State of the Climate³ indicates Australia's climate has warmed, with around a 1 °C increase in both mean surface air temperature and surrounding sea surface temperature since 1910. The duration, frequency and intensity of extreme heat events have increased across large parts of Australia. The number of days per year over 35 °C has increased in recent decades, except in parts of northern Australia. Since the 1970s there has also been an increase in extreme fire weather, and a longer fire season, across large parts of Australia.

The 2016 State of the Climate³ also indicates Australian rainfall varies greatly from one year to the next and from one decade to the next, and is strongly influenced by phenomena such as El Niño and La Niña. Despite this large natural variability, underlying longer-term trends are evident in some regions. Since 1970 the May–July rainfall has reduced by around 19 per cent in the southwest of Australia and rainfall has increased across parts of northern Australia. Since the mid 1990's there has been a decline of around 11 per cent in the April–October growing season rainfall in the continental southeast.

A variable and changing climate is expected to further increase the severity and frequency (albeit not uniformly) of natural hazards in Australia. The fifth Intergovernmental Panel on Climate Change report¹² states with 'high confidence' that there will be an 'increased frequency and intensity of flood damage to settlements and infrastructure in Australia', and an increase in the 'number of days with... extreme fire weather' and 'greater frequency and intensity of droughts'.

Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BOM)² conclude that a variable and changing climate will almost certainly increase the frequency and severity of events in Australia. As temperatures rise, the atmosphere is able to hold more water, increasing the possibility of extreme rainfall events and flash flooding.

Global warming will lead to more heavy rainfall events, including rainfall from tropical cyclones, but also more rainfall from East Coast Lows and mid latitude storm systems. It also has implications for sea level rise that will in turn impact the severity and frequency of storm surge.

It is also projected that higher temperatures will further increase the number of days with harsh fire weather. The number of fire danger days is expected to increase by 15-65 per cent by 2020 relative to 1990 and as much as 100-300 per cent by 2050, with a lengthening of the fire season into spring and autumn already being observed¹³.

The number of tropical cyclones in the Australian region varies with El Niño and La Niña events. The frequency of tropical cyclones is largely anticipated to remain the same although the proportion of the most intense tropical cyclone activity may increase and the potential remains for systems to reach regions further south¹³. Geographical shifts in the distribution of natural hazards are likely too; potentially affecting communities not experienced in particular types of events. The climatological distribution of rainfall will change, which translates to a change in catchment hydrology and a change in the frequency and severity of river flood risks in Australia⁴.

Hazards such as tropical cyclone, flood, earthquake and bushfire are also important environmental phenomena and serve vital ecological functions. A variable and changing climate mainly affects the occurrence, frequency and intensity of meteorological hazards. The influence of climate on natural hazards is just one of many factors influencing disaster potential, often over emphasised. Human actions, rather than environmental phenomena, have long been recognised as the fundamental cause of disasters¹⁴. 'Vulnerability' is the main factor or driver of disasters¹⁵.

2.1.2. Growing social and economic cost of disasters

Natural hazards can have devastating impacts on individuals, families, local communities, business and governments. Economic costs of disasters are often reported although social impacts are complex, interrelated and difficult to quantify. Reports on the cost of disasters do not generally capture indirect social costs, non-commensurable loss or intangible loss that contributes to harm and suffering.

A recently published report⁴ which for the first time considers the economic cost of the social impact of disasters concludes that social impacts account for a substantial part of the total economic cost of disasters. Figure 2 illustrates the growing economic cost of disasters in Australia which is expected to reach an average of \$33 billion per year by 2050. At least 50 per cent of these costs arise from impacts of disasters on health and wellbeing, education, employment and community networks⁴.

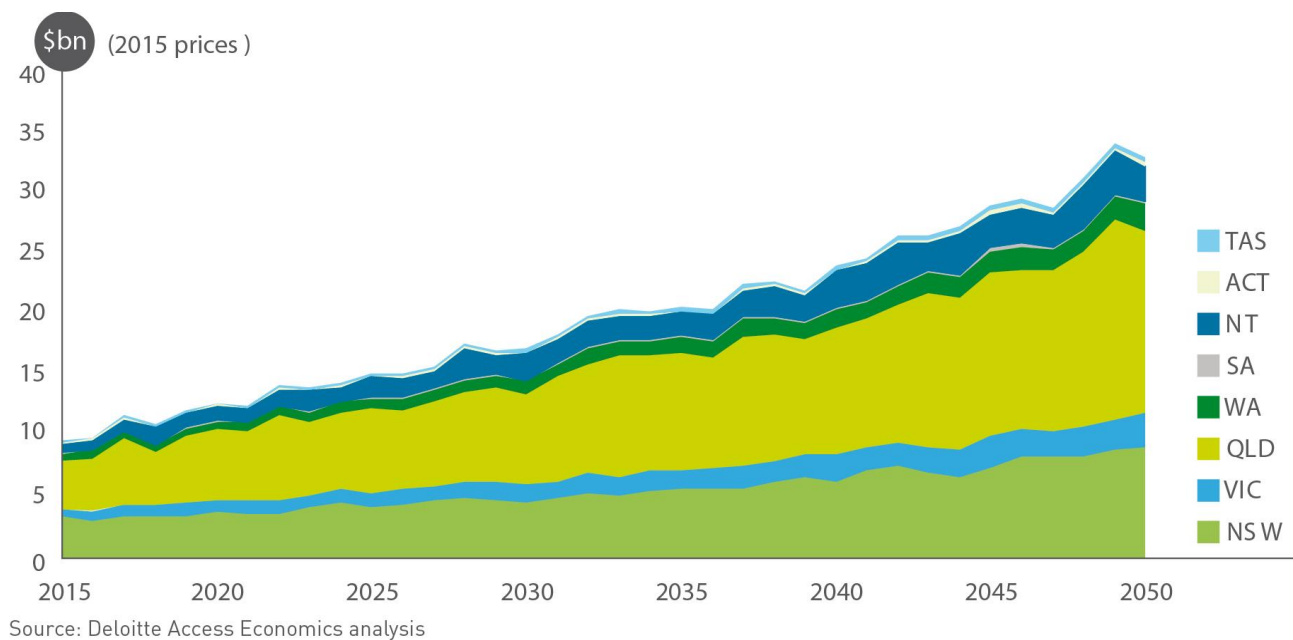


Figure 2: 2015-2050 forecast of the total economic cost of disasters triggered from natural hazards

Globally, it is recognised that loss associated with weather related extremes is on the rise¹⁶. “The loss trend can be attributed primarily to changes in exposure (e.g. population and also the value of assets), and to a smaller extent, to changes in vulnerability and hazards¹⁷”. For example, Figure 3 illustrates that over the next 50 years the economic disaster loss driven by socio-economic and demographic changes will be from 20 to 60 times greater than losses driven by climatic changes¹⁸.

This means that the number of people and assets exposed to natural hazards is continually growing, leading to the creation of new risks and a steady rise in disaster related losses¹⁹, with significant economic, social, health, cultural and environmental impact in the short, medium and long term—especially at the local and community levels²⁰.

With more people projected to be impacted in the future, reducing adverse impact and social vulnerability is of pressing need.

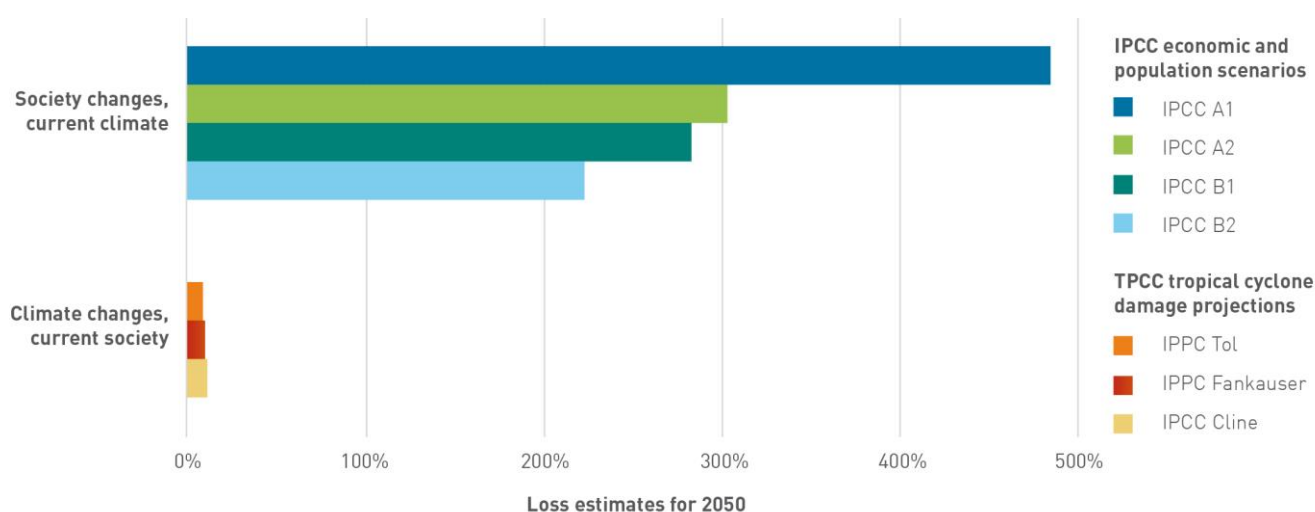


Figure 3: Comparison of tropical cyclone loss estimates from socioeconomic changes (top four bars) and climate changes (bottom three bars). Analysis is based on the Intergovernmental Panel on Climate Change (IPCC) Scenarios and Analysis. IPCC estimates of future loss from tropical cyclones are largely driven by the growth of society²¹

2.2. Australia's commitment to international frameworks

The United Nations recognises the high level of interconnectivity and inter-dependency between three international frameworks of significant relevance to reducing disaster risks:

- The Sendai Framework for Disaster Risk Reduction (Sendai Framework) (2015-2030)
- Conference of Parties (COP21) Paris Agreement on Climate Change
- United Nations Sustainable Development Goals (SDGs) 2015-2030

Australia is an active contributor and has made commitments to the three international agreements, and has made commitments to other related global initiatives including the World Humanitarian Summit and the New Urban Agenda.

2.2.1. Sendai Framework for Disaster Risk Reduction 2015-2030

The Sendai Framework builds on the achievements of the last decade of implementing the "Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters" (Hyogo Framework).

The implementation of the Hyogo Framework highlighted a number of gaps in addressing the underlying disaster risk factors. The Sendai Framework can have a profound impact on sustainable development because of its far-reaching inclusive nature. It resets the emphasis from disaster management to managing disaster risks, and acknowledges that far greater attention must be paid to social and health related issues in its implementation²².

Australia committed to the Sendai Framework in March 2015 at the Third United Nations World Conference on Disaster Risk Reduction (WCDRR). Along with other United Nations member states, Australia reiterated its commitment to address disaster risk reduction and the building of resilience to disasters and to integrate, as appropriate, both into policies, plans, programmes and budgets at all levels and to consider both within relevant frameworks²³.

In 2016, the Australian Government²⁴ reaffirmed its commitment to the Sendai Framework, which has seven global targets:

1. Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality rate in the decade 2020-2030 compared to the period 2005-2015;
2. Substantially reduce the number of affected people globally by 2030, aiming to lower average global figure per 100,000 in the decade 2020-2030 compared to the period 2005-2015;
3. Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030;
4. Substantially reduce disaster damage to critical infrastructure and disruption of basic services among them health and educational facilities, including through developing their resilience by 2030;
5. Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020;
6. Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this Framework by 2030;
7. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.

2.2.2. Paris Agreement on Climate Change

Australia signed the Paris Agreement on Climate Change on 22 April 2016, and the agreement came into force on 4 November 2016²⁵. The Agreement charts a new course in the global climate effort. The Agreement's central aim is to 'strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius'. The Agreement also seeks to 'strengthen the ability of countries to deal with the impacts of climate change to make finance flows consistent with a pathway toward low greenhouse gas emissions and climate resilient development'²⁶.

Addressing a varied and changing climate as one of the drivers of disaster risk represents an opportunity to reduce disaster risk in a meaningful and coherent manner throughout the interrelated intergovernmental processes.

2.2.3. 2030 Agenda for Sustainable Development

The report of the United Nations Conference on Sustainable Development, held in 2012, entitled "The Future We Want"²⁷ called for disaster risk reduction and the building of resilience to disasters to be addressed with a renewed sense of urgency in the context of sustainable development and poverty eradication.

The 'Transforming our world: the 2030 Agenda for Sustainable Development'²⁸ (2030 Agenda), builds on the Millennium Development Goals adopted in 2000. The 2030 Agenda includes 17 SDGs and 169 associated targets. It also includes the United Nations Addis Ababa Action Agenda on Financing for Development which sets out the different means necessary to implement the 2030 Agenda, including domestic resources, private finance and Official Development Assistance.

It is the first ever global agreement setting a universal, comprehensive agenda for action. This new agenda marks a step change for global development —it is universal in nature applying to both developing and developed countries. Australia agreed to the 2030 Agenda in September 2016. The 2030 Agenda has unprecedented support and legitimacy and provides a global roadmap for sustainable development over the next 15 years²⁹. Australia, along with 193 United Nation member states declared that "*On behalf of the peoples we serve, we have adopted a historic decision on a comprehensive, far-reaching and people-centred set of universal and transformative Goals and targets... We are committed to achieving sustainable development in its three dimensions —economic, social and environmental—in a balanced and integrated manner*"³⁰.

Australia considers the 2030 Agenda highly influential and actively participated in the design of the 17 interlinked SDGs which came into force on 1 January 2016. The SDGs aim to ‘improve the lives of people everywhere’ and call for action to promote prosperity while protecting the planet’. There are 17 Global Goals.

As characterised by the United Nations International Strategy for Disaster Reduction (UNISDR), progress in implementing the Sendai Framework is associated with progress in implementing the SDGs. The SDGs can substantially build the resilience of people and governments in the face of disasters³¹. Progress on the Sendai Framework contributes to all 17 of the SDGs.



Source: United Nations

2.2.4. World Humanitarian Summit

At the World Humanitarian Summit in Turkey in May 2016, Australia committed to 49 actions of which at least eight are directly relevant to disaster risk reduction and resilience.

Those of most relevance to the Australian strategic disaster risk reduction context are:

- Accelerating the reduction of disaster and climate-related risks through the coherent implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030, the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change, as well as other relevant strategies and programs of action, including the SIDS Accelerated Modalities of Action (SAMOA) Pathway.
- Reinforcing national and local leadership and capacities in managing disaster and climate-related risks through strengthened preparedness and predictable response and recovery arrangements.
- Improving the understanding, anticipation and preparedness for disaster and climate-related risks by investing in data, analysis and early warning, and developing evidence-based decision-making processes that result in early action.
- Increasing investment in building community resilience as a critical first line of response, with the full and effective participation of women.
- Along with our MIKTA colleagues—Mexico, Indonesia, the Republic of Korea and Turkey— action and advocacy to support accelerated implementation of the Sendai Framework within its regions.

- Investing in risk management, preparedness and crisis prevention capacity to build the resilience of vulnerable and affected people.
- Supporting and invest in local, national and regional leadership, capacity strengthening and response systems, avoiding duplicative international mechanisms wherever possible.
- Investing in risk analysis and to incentivize early action in order to minimize the impact and frequency of known risks and hazards on people.

2.2.5. New Urban Agenda

The New Urban Agenda (the Agenda)³² is a new global standard for sustainable urban development, designed to help rethink how we plan, manage and live in cities. The Agenda is a roadmap for building cities that can serve as engines of prosperity and centres of cultural and social well-being while protecting the environment. The Agenda aligns with many of the SDGs, provides guidance for achieving the SDGs and provides a foundation for actions to address a varied and changing climate.

Australia endorsed and committed to the Agenda at the United Nations Conference on Housing and Sustainable Urban Development (Habitat 3) Conference in Ecuador on 21 October 2016.

2.3. Integrated global approach to disaster and climate risk management

The intergovernmental negotiations on disaster risk reduction, climate change and sustainable development provide the international community with a unique opportunity to enhance coherence across policies, institutions, goals, indicators and measurement systems for implementation, while respecting sovereign mandates. Ensuring credible links, as appropriate, between these processes will contribute to building resilience.

In March 2015, at the opening of the Third WCDRR in Sendai, Japan, the former United Nations Secretary-General, Ban Ki-moon, stated that “sustainability starts in Sendai”. The United Nations recognised 2015 as the year of opportunity to make concrete progress on a universal vision and plan for sustainability. The Sendai Framework was recognised as the starting point, followed later in 2015 by agreements on climate change and a set of SDGs, which are critical to efforts to reduce disaster risk and to implementation of the Sendai Framework. All three agreements share a 2015-2030 timeframe and articulate the same fundamental ethos of sustaining human life without harming the planet or humanity³³.

The Sendai Framework is based on an all-encompassing approach to ensure disaster risk reduction is integrated into all areas of policy, investment and sustainable development. The UNISDR suggest the central aim of Sendai is to prevent activities in one sector from increasing risk in others, as well as making sure that all members of society, including the most vulnerable, are involved in crafting and implementing measures³⁴. Similarly, the central aim of the SDGs is to maintain the balance between economic development, social inclusion and environmental sustainability to maximise well-being for all and limit unsustainable paths of social and environmental trade-offs for economic growth. The central aim of the Paris Agreement is documented as strengthening the global response to the threat of climate change and increase capability to manage impact³⁵.

‘Sustainable development cannot be attained while disasters continue to undermine economic growth and social progress... simply preparing for disasters is not enough. To realise the transformative potential of the 2030 Agenda for Sustainable Development, governments and stakeholders have affirmed that disaster risk reduction needs to be at the core of sustainable development.’ – UNISDR³⁶

The frameworks are converging through greater recognition that the success of one framework is dependent on the success of another. One cannot be met if others are not met, in policy and in practice. Disaster risk reduction requires systematic efforts to analyse and reduce drivers of disaster risk. This includes reducing exposure to hazards, lessening and addressing vulnerability of people and property, sustainably managing land and environment, and improving preparedness and early warning for natural hazard events⁷. While

disaster risk reduction is most familiar to practitioners in fields like disaster management, disaster mitigation and disaster preparedness, it is also a central concept of sustainable development; in order for development activities to be sustainable, they must reduce disaster risk.

The domains of climate adaptation and disaster risk reduction have similar aims and mutual benefits—both aspire to achieve a state of resilience, both are integral components for sustainability, and both apply preparedness measures across a continuum, to address different parts of the problem (Figure 4). The two can be primarily distinguished by a different perception of the nature and timescale of the threat³⁷. Flood, weather and drought risk reduction enacted for climate change adaptation is exactly the same as that which is enacted for wider disaster risk reduction³⁸.

Actions or activities associated with a varied and changing climate provide little which is new in the context of sustainable development. Its two primary actions, mitigation and adaptation, are often separated even though they have much in common.

Therefore, the relevance of disaster risk reduction to the design and implementation of adaptation policies and measures cannot be over-emphasised.

‘To be effective, efforts to respond to the exceptional challenges posed by a changing climate must build on and expand the existing capability of disaster risk reduction, and should not be undertaken in isolation from this wider agenda³⁹’.

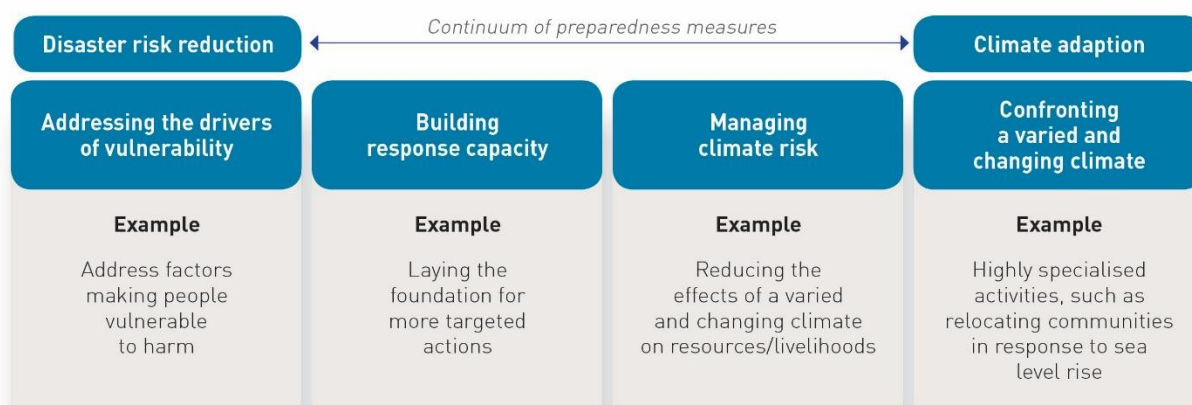


Figure 4: Continuum of preparedness measures across disaster risk reduction and climate adaptation activities⁴⁰

Nonetheless, to date, the climate risk and disaster risk management communities have largely operated in isolation from each other. Stakeholders in disaster risk reduction often struggle to consider risks that have yet to be experienced, although a focus on changing environmental conditions is a core component of adaptation strategies. Disaster risk reduction has been predominantly focussed on reducing foreseeable risks based on previous experience (such as seeking to influence land use development decisions or protecting development aspirations from environment related risk). Climate adaptation is about long term vulnerability and understanding how a varied and changing climate will manifest in a particular region over a longer time period—requiring the reshaping and redesigning of development, social and economic practices to respond effectively to new or anticipated environmental changes.

“Disaster risk can be managed only through the processes which create it⁴¹”.

Placing climate risk within disaster risk reduction, to achieve a wider sustainable development agenda, encourages a longer-term perspective where research can also better support policy and practice¹⁵. A longer term perspective further assists in addressing vulnerability and building resilience. It directs attention to the root causes and the fundamentals of vulnerability and resilience as long-term processes¹⁵.

Disasters, defined as ‘*a serious disruption of the functioning of a community or a society*⁴²’ follow natural hazards. The severity of disruption to society is influenced by choices made by society. The severity of a disaster is influenced by the degree of impact on society and the environment. The scale of the impact in turn depends on the choices we make for our lives and for our environment. Choices generally mean trade-offs. These choices relate to how we grow our food, where and how we build our homes, what kind of government we have, how our financial system works and even what we teach in schools. Each decision can make us more vulnerable to disasters—or more resilient to them⁷.

A comprehensive risk management approach for sustainable development at the local, national and international levels of government requires that policy makers, researchers and practitioners work together. Closer integration and collaboration would lead to increased ‘mainstreaming’ of disaster risk reduction into policies and objectives, as well as more efficient use of existing financial, human and natural resources.

2.4. An opportunity for coordinated leadership and national action

Australia’s international commitments to disaster risk reduction, climate change and sustainable development are inextricably linked, and provide a timely opportunity to reaffirm co-ordinated leadership and national action.

With the task of preventing natural hazards developing into disasters becoming more complex, it is widely accepted that no one jurisdiction, agency, or organisation has the knowledge or capacity to do this alone. We must all learn how to deal with circumstances that are moving beyond our imagination and experience.

As a nation, the challenges we face are complex, requiring a cross-discipline, collaborative approach to developing solutions. The closer integration of disaster risk reduction, sustainable development and climate risk adaptation will foster a greater coordination of effort to achieve common goals for humanity and the health, safety and wellbeing of the nation.

Society expects its governments and institutions to respond accordingly and overcome barriers that inhibit problem-solving and preparedness. They expect governments to lead, create knowledge and establish environments in which decisions and actions can be taken that minimise harm and reduce loss.

Following the devastating effects of the Victorian Black Saturday Bushfires of 2009 and the Queensland floods of 2010-11, the Council of Australian Governments (COAG) endorsed the NSDR in February 2011. The NSDR, the first of its kind for Australia, provides principles based direction and guidance to all jurisdictions, risk owners and communities on actions to reduce risk and build resilience—as a shared responsibility.

The priority actions of the NSDR are well aligned with the Sendai Framework priorities and targets. The pivot from *disaster response* (UNISDR: Hyogo Framework for Action) to *disaster risk reduction* is at the core of both the Sendai Framework and NSDR strategies.

The Sendai Framework priorities for action are:

1. Understanding disaster risk;
2. Strengthening disaster risk governance to manage disaster risk;
3. Investing in disaster risk reduction for resilience;
4. Enhancing disaster preparedness for effective response and to “build back better” in recovery, rehabilitation and reconstruction.

The NSDR actions are:

1. Leading change and coordinating effort;
2. Understanding risks;
3. Communicating with and educating people about risks;
4. Partnering with those who effect change;
5. Empowering individuals and communities to exercise choice and take responsibility;
6. Reducing risks in the built environment;
7. Supporting capabilities for disaster resilience.

Both are significant in the Australian context and provide a compelling framework, when combined with climate adaptation and sustainable development, in which to advance Australia's preparedness.

Australia is advanced in its approach to disaster resilience through the NSDR, however there remains scope for a focus on NSDR implementation at a national level. While Australia's domestic policy settings are consistent with the Sendai Framework, ANZEMC identified⁴³ gaps in existing approaches that can be addressed, described in Table 1.

The resolution of these gaps will benefit from recent revitalisation of the ANZEMC governance structure, the development of a broader strategic context within which to progress and prioritise activities nationally, a new narrative in how we think about severe to catastrophic events and the development of the Profile which will provide a baseline source of knowledge for how Australia is vulnerable.

Table 1: Six themes requiring attention identified in the ANZEMC review of the NSDR

1	Measurement, evaluation and strategic priority setting	Explore further developing the Strategy to consider measurable objectives and incorporate contemporary, broader resilience policy.
		Consider developing options for a measurement and evaluation framework for the Strategy, including options for the establishment of baseline data.
2	Improving cross-sectoral partnerships	Scope relevant non-traditional emergency management stakeholders and, where there is benefit at the national level; explore mechanisms to partner with them.
3	Improved community engagement	Analyse barriers to broader implementation of community engagement initiatives and continue to promote their update.
		Improve sharing of successful local initiatives to drive better community awareness.
4	Enhanced resilience in the built environment	Continue to promote enhanced disaster resilience in the built environment, and progress the objectives of the Roadmap.
5	Better risk awareness and risk mitigation	Continue to engage mitigation decision makers on the required information, tools and processes to support disaster mitigation investment, and share examples of successful jurisdictional approaches.
		Investigate how risk information and associated management techniques can be better delivered to communities, particularly through sharing of jurisdictions' experiences.
6	Improved capabilities for disaster resilience	Review the need and current approach to a national capability framework.
		Explore linking capability strategies to risk assessments, particularly in relation to developing capability for severe to catastrophic events.

3. The case for understanding drivers of disaster

Initial research highlighted that while there is extensive information at the state level, *official* information on national risk and risk reduction strategies for Australia is scarce and hard to locate. Whilst some Australian hazard information and hazard-specific risk assessments have been published (including by respected organisations such as BOM, CSIRO and Geoscience Australia), there is an opportunity to establish national-level information on drivers of disaster at the severe to catastrophic level.

Research also highlighted that work commissioned by a number of strategic think-tanks, industry leaders, academics and thought leaders (for example the Australian Business Roundtable, Insurance Council of Australia, Insurance Australia Group, Risk Frontiers and the National Climate Change Adaptation Research Facility) in part seek to fill this gap.

Consistently, their work calls for:

- recognition that any capacity to reduce or manage disaster potential is predicated upon the availability of relevant and fit-for-purpose information; and
- greater multi-sector policy response, advocacy and investment to mitigate, adapt to and prepare for the disaster potential.

Further, research revealed hazard-based and risk-based information may be of limited value at the national level to support preparedness at the severe to catastrophic scale. There is also consensus that vulnerability is the main cause of disasters and disaster risk⁴⁴, and societal and economic loss is the result of the human system interacting with the natural system. Better understanding the drivers of disaster may be more useful for identifying potential interventions that minimise harm, support efforts to enhance national capability and adjust national policy settings.

Subsequently, the analysis described in this section, led to the finding that there is greater benefit in building a knowledge base to better understand the evolving drivers of disaster. The analysis also identified the strategic context in which it fits and revealed another important gap, that Australia has yet to develop national goals and objectives that unify effort and direct priorities.

3.1. Analysis of global and international risk statements

A review of international approaches highlighted a significant and growing awareness of national threats and publication of official national risk information, not only by national governments but also internationally renowned economic and strategic fora. Although very few national-level profiles focus on severe to catastrophic disasters, global risk profiles focus on extreme hazard events and regional vulnerability.

The review found—as is the intent of the Sendai Framework—that focus is shifting from hazard management to mitigating and managing the risk of harm to the safety, security and wellbeing of society. Further there are signals at national and global levels that risk as a product of *likelihood* is no longer a useful picture upon which to build preparedness for the inevitability of severe to catastrophic events or to accurately reflect the evolving drivers of disasters of the future. In the international examples explored, assessing risk as a product of likelihood and consequence may not sufficiently provide those who create, own, manage and respond to disaster risk with the type of information they need to adapt, mitigate and prepare. Information is needed for how consequence manifests and what can be done to limit vulnerability.

Countries such as Norway and Denmark have identified their national risks as products of exposure and vulnerability to hazards—both natural and anthropological. Their national risk publications utilise this approach to identify a pathway to preparedness for natural hazards and the disasters they may trigger. Other countries, including the UK, have made explicit in their national risk publications the links between risk information, risk

ownership and management responsibilities. This is also important in the Australian context. States are maturing their ability to identify risks and there is a role for EMA to facilitate greater understanding of what the hazards, exposures and vulnerabilities look like at the national level that inform these risks.

3.2. Assessing severe to catastrophic risks at the national level

In Australia, risk assessments undertaken by states in accordance with the National Emergency Risk Assessment Guidelines (NERAG) have provided critical risk understanding at the state level. These risk assessments align to the NSDR priority action of 'understanding risk' and establish for each state an important narrative about those hazards that have the greatest potential to cause harm. They are used to guide operational and strategic disaster risk management activities and are effective in helping decision makers with a more informed basis for selecting one possible course of action over another.

It has become evident, through previous work undertaken by the Risk Management and Mitigation Sub Committee and additional review by EMA, that there is little benefit in attempting to assess risk at the national level at this point in time. This is principally for two reasons. First, the context in which the methodology used by the states, whilst generally informed by the NERAG framework, varies. This effectively prevents the ability to bring together the outcomes of these risk assessments in any meaningful way. Second, risk assessment is most effective when it is undertaken in the context of place and time, within a consistent framework and at the level closest to the hazard and risk (for example at the scale of catchment area to assess floodplain risk or at a site specific location for a given development—the scale and detail of the assessment needs to match the level at which the decision is being made). Aggregation of such assessments to a national level skews meaning and causes data to lose definition.

These state-wide risk assessments and the NERAG methodology have limitations for managing risks with low likelihood, high consequence and high levels of uncertainty (rare, catastrophic events). Although NERAG allows for rare, very rare and extremely rare events to be considered, it is often impractical or uneconomical to effectively mitigate these risks at a local scale. For these reasons, a national statement of risk or a national hazard-specific risk assessment does not appear to be useful for managing the vulnerabilities that drive disaster or managing the consequences emerging from severe to catastrophic events.

As a nation, establishing a sound knowledge base on the drivers of disaster, identifying what we value, determining how we are vulnerable and how communities are effected by disaster, is a critical first step to provide the context and objectives for assessing and managing risk.

3.3. Severe to catastrophic events are inevitable

Risk is sometimes expressed as a product of hazard, exposure and vulnerability, assessed and rated against the chance an event with adverse impacts will occur⁴⁵. These risk components when combined create the potential for loss and harm. Calculating the chance an event with adverse impacts will occur has limitations in informing preparedness for severe to catastrophic events.

Importantly, there are limits to the science available to forecast when or how often extreme events will occur. This is especially true within the national context and Australia's historical record. The UNISDR suggest '*historical analysis cannot be used for infrequent hazards, such as earthquake, and can be misleading by not revealing information about high-intensity events with low probability*'. Further, anticipating intensifying hazards and outcomes not yet imagined result in high degrees of uncertainty which render any calculation of likelihood near impossible²¹. A highly uncertain future due to drivers such as climate, technological or socio-economic change, has led to a realisation that traditional methods of dealing with uncertainty, based on probability distributions surrounding a 'best guess' of the future, might no longer be appropriate⁴⁶.

Significantly, the 'rarity' (likelihood) of a natural hazard occurring does not diminish potential consequence should that hazard manifest and impact people and assets; the rating of likelihood against consequence can mask a true articulation of the potential for harm.

Severe to catastrophic events present a substantial challenge for governments and emergency managers. A better understanding of the problems these events present is critical to improving our ability to mitigate their impact⁶. Unprecedented events often roll out from a confluence of trends and extremes. In thinking about the problems associated with severe to catastrophic events, simply applying more of the same is either not possible, not enough, or may make little impact; more people, more vehicles, more information, and more command and control does not necessarily mean more effective—more of the same may well be counter-productive to actual needs⁶.

Two of the most detailed, recent and relevant reviews of international catastrophic disaster effectiveness have taken place in the United States following the 9/11 terrorist attacks and Hurricane Katrina. The 9/11 terrorist attacks is described as ‘a failure of imagination’ and Hurricane Katrina is described as ‘a failure of initiative’. The review⁴⁷ states *‘Government failed because it did not learn from past experiences or because lessons thought to be learned were somehow not implemented. If 9/11 was a failure of imagination, then Katrina was a failure of initiative. It was a failure of leadership.’*

On this basis, preparing for disasters does not necessarily require predictions of when an event will occur. It requires a greater understanding of what is at stake when it does and what the cascading impacts might be. Therefore a premise for moving forward is—severe to catastrophic events are inevitable and the rarity of an event does not diminish its consequence⁴⁸.

3.4. Risk perception

‘How people ‘feel’ is as important to surviving disaster as what they ‘think’. That is, disasters are more often a matter of the heart than the head⁶’.

The desire to better understand risk emerges in part, from compassion for those who suffer⁴⁹. Understanding risk is connected with the perception of risk. Perception has long been recognised as a key influence on human behaviour. Whether associated with attaining a desired reputation, achieving financial status or simply in relation to a social situation, people will behave in a manner commensurate with their values and perceptions, regardless of whether these perceptions are right or wrong, well founded or misconstrued⁵⁰. Human behaviour regarding safety is no different in that it will be shaped by the moderating influence of perception⁵¹.

Changes in behaviour generally occur when an individual, household, family, community, institution or government is able to relate information to their own situation and what would happen to things that are valuable to them. Therefore, the production and transfer of knowledge to those who need it, in a way that resonates with them, is an important consideration for mitigating risk and building resilience.

"The more governments, UN agencies, organizations, businesses and civil society understand risk and vulnerability, the better equipped they will be to mitigate disasters when they strike and save more lives⁴¹".

3.5. Understanding loss

Disasters can impose significant economic, social, personal and environmental costs on governments, businesses, households and communities. However, our understanding of the cost of disasters is often limited to an understanding of the economic cost. Disaster costs are generally categorised as direct, indirect, tangible and intangible costs, or grouped as market and non-market cost (Table 2).

Disaster costs are often characterised in terms of fatalities and loss of property. This can be attributed to the relative ease with which this data can be captured. For example, insurance data is often used to determine costs; it is routinely captured in a standardised way. Insurance data however, only accounts for insured loss, and insured loss represents only a fraction of the total cost of a disaster⁵².

Table 2: Classification of Disaster Losses⁵³

Measurement	Type of loss	
	Direct	Indirect
Tangible (market value)	Damage to infrastructure, buildings and contents, vehicles, boats etc.	Loss of production, emergency response and relief, and clean-up costs.
Intangible (non-market value)	Death and injury, loss of items of cultural significance, losses to natural habitat and biodiversity, damages to national/state parks and natural infrastructure, and loss of personal memorabilia.	Inconvenience and disruption, especially to schooling and social life. Stress induced ill-health and mortality.

Additionally, in some circumstances risk-based approaches to covering the costs of extreme events do not necessarily need to reduce vulnerability to be successful. For example, *“insurers and others who seek to ‘manage probabilistic risk’ need nothing more than accurate (or inaccurate but conservative) information about incidence of extreme events to be successful; such information allows them to effectively manage outcome risks, that is, to redistribute the costs of the events”*⁵⁴.

Intangible, non-market or non-commensurable losses are difficult to measure, and human values can be overlooked where they cannot be captured by standard metrics. These include landscapes, places, cultures, social cohesion and ecosystem services. However, failing to account for intangible losses can distort the nature and extent of disasters through minimising the loss experienced by people. It can also suggest disasters cause greater damage to tangible and insurable objects such as infrastructure and buildings, and are correspondingly more significant⁵⁵. Indirect costs are likely to be felt the most at the community level¹. There is a risk that the absence of information about loss potentially skews strategic decision making⁵⁵.

Loss arises when people are dispossessed of things they value, and for which there are no commensurable substitutes⁵⁶. For example people value their family, health, personal safety, sense of belonging, esteem and their freedom. Natural hazards can amplify the risk of loss to things people value through a range of different pathways.

A varied and changing climate threatens to accelerate loss across the social and ecological domains and the United Nations Framework Convention on Climate Change established a mechanism to address these potential losses⁵⁶. The Warsaw International Mechanism for Loss and Damage is the main vehicle under the Convention to promote the implementation of approaches to consider loss and damage in a comprehensive, integrated and coherent manner. This work includes enhancing data on and knowledge of non-economic losses⁵⁷ associated with the adverse effects of a varied and changing climate and identifying ways forward for reducing and addressing the risk⁵⁸.

‘As humans settlements everywhere simultaneously swell in size due to urbanisation, and suffer the differential effects of a warming planet, taking into account the cultural as well as economic, social and environmental losses should be an essential part of disaster risk and impact assessment’⁵⁵”.

Existing methods to assess non-economic loss cannot adequately reveal what matters to people in their daily lives, neither today, or in the future. There is a need to engage more deeply with values, places and people’s experience and to place people’s thinking, emotions, decisions and actions at the heart of disaster risk management⁵⁹. Better understanding and taking into account what people value and what they may likely consider to constitute loss will enable a more complete picture of the disruption of disasters on society.

4. Aligning the narrative to the broader strategic context

The construct of a national narrative that helps to better understand a growing national problem—Australia's vulnerabilities to events described as severe to catastrophic—provides an opportunity to align, inform and shape national policy objectives.

4.1. National preparedness

Through a facilitated process of *'imagining the unimaginable'*⁹ in May 2016, it became apparent that—among all the challenges we faced—the scale of severe to catastrophic events has the capacity to shock the nation, its institutions and systems, placing stress on all aspects of society. It also became apparent that preparedness planning at all levels and across all sectors had not matured sufficiently to address severe to catastrophic events. Analysis of global and international risk statements revealed Australia's situation is not unique.

In most cases the global and international risk statements were used to inform preparedness planning, bringing people together to work towards a common vision and agreed national preparedness goals. Whilst Australia, through the NSDR, has identified a range of outcomes linked to each priority action area, the nation has not yet established a national preparedness vision or goal.

It is important to identify national goals to help shape perceptions and influence behaviour. The international frameworks recognise this, and those frameworks provide an opportunity for Australia to leverage this intent to inspire and guide collective action towards a common vision.

"Australia has significantly improved its ability to prepare for, respond to and recover from disasters. We have, however, reached a point of limitation in our capability to conventionally mitigate the consequences of severe to catastrophic events. Limitations exist in the physical world and also in our minds. Here is what we can do:

- *accept the inevitability of disaster as a premise*
- *understand our points of limitation, both externally and internally, in managing severe to catastrophic effects*
- *get better at improving our existing capabilities by reflecting on and implementing the outcomes of inquiries and other processes*
- *change our approach to residual risk by understanding that rarity does not diminish consequence*
- *explore residual risk as manifested consequence to identify complex problems and develop innovative, creative solutions well ahead of the event*
- *better understand how critical ethical aspects of leadership are in responding to the emotional and psychological effects of disasters.*

*Opportunities to close gaps of residual risk are available now. We must take them"*⁶.

Establishing national preparedness goals and key disaster risk reduction objectives—informed by the Profile and guided by the Sendai Framework—have the potential to inspire and galvanise the efforts of those who manage risk and can affect change.

4.2. National capability

In accepting the inevitability of severe to catastrophic events as a premise, the *Capability Roadmap*⁹ explored a range of scenarios considered to be severe to catastrophic events. Scientifically modelled, the scenarios revealed a high degree of similarity regarding impacts on society, including:

- The scale of the scenario will shock, be unexpected and have long-term impacts;

- The number of people (deaths, injuries, displaced) isolated and in need of care and assistance will be substantial. Mental and physical well-being will be affected;
- Local disaster and emergency response capacity will not be enough;
- Information management and communications will be seriously disrupted;
- Supply chains will be broken;
- Infrastructure and services will be affected and rendered un-serviceable or unreliable;
- Formal and informal systems may fail;
- Crisis leadership at local, state and national levels will be significantly tested in situations well beyond normal.

Some or all of these impacts already manifest during an emergency event and can mostly be managed within local or sector capacity. As the severity, intensity and frequency of events increases, so too is the pressure on capacity and capability of local resources. The point of limitation to conventionally mitigate the consequences of severe to catastrophic events has been acknowledged—it is only a matter of time before we are tested beyond these limitations—we have a responsibility to be better prepared.

With Constitutional responsibility to improve preparedness, capability and resilience of communities, states and territories are working extensively to deal with the challenges and risks faced. Sharing responsibility with the whole community, jurisdictions are progressively establishing collaborative, coordinated and capable systems to meet future needs.

The need to scale up to the national level, integrating capability and extending preparedness planning beyond traditional boundaries is growing in importance and urgency. Applying ourselves to preparedness planning and crisis management—scaled to severe to catastrophic levels —is thought to be advantageous, not only for known incident types, but also when faced with the unknown, unforeseen or unpredictable.

Understanding the core capabilities required to manage the risks associated with any hazard, is an essential element of a disaster risk reduction and resilience system —avoiding emergencies turning into disasters; systematically reducing risk, at the same time preparing for the inevitable.

Building upon the work of the *Capability Roadmap*, a frame in which to scale to the national-level and galvanise effort beyond traditional providers of emergency services has been identified as a future body of work.

Conclusion

As the global climate system has warmed, changes have already been observed to both the frequency and severity of extreme weather and further changes are expected. A changing climate is shifting the variability and intensity of hazard events, revealing vulnerabilities exacerbated by social and economic pressures, urbanisation, demographic changes and globalisation.

The number of people and assets exposed to disaster is growing, and as exposure to natural hazards across Australia increases, so too does the potential for harm. With increasing dependence on access to interconnected systems to support our health, safety and wellbeing, any disruption or damage to these systems can exacerbate existing vulnerabilities and expose new ones.

The task of preventing natural hazards developing into disasters is becoming more complex. While it is not possible to prevent natural hazards from occurring, it is possible to reduce disaster risk, enhance resilience, and improve preparedness. Australia's ability to do so is influenced by the availability of information at the national level.

An opportunity exists to better prepare for the future, by collaboratively developing an official, national narrative on the drivers of disaster to enhance Australia's preparedness for severe to catastrophic events. Narratives are often used to communicate complexity and bring a common understanding to people with diverse perspectives and experiences.

A national narrative that recognises the synergies between disaster risk reduction, climate adaptation and sustainable development efforts, will progress Australia's international commitments under the Sendai Framework, SDGs and COP21 and, domestically, towards national implementation of the NSDR.

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Attachment A – Analysis of global and international country-level risk statements

Risk communication/ outputs	Derivation	Features
World Risk Report	UN University	<ul style="list-style-type: none"> • Considers logistics, infrastructure and the disaster risks they pose. • Includes the World Risk Index, which is based on vulnerability of societies. • Provides a map of combined risk ratings for each country, rating according to level of risk. • Notes that low level vulnerability is not guaranteed protection against disasters but it can help reduce risk. • Calculates disaster risk in 171 countries by multiplying vulnerability with exposure to natural hazards. • Indicators relate to exposure, susceptibility, coping capacity, adaptive capacity.
Prevention Web	UNISDR	<ul style="list-style-type: none"> • Provides disaster and risk profiles for each country which set out population statistics, economic indicators, reported losses from previous disasters, risk ratings / rankings for hazard, vulnerability and coping capacity.
Global Risks Report 2016	World Economic Forum	<ul style="list-style-type: none"> • Provides matrix of impact and likelihood of risks related to natural hazards, man-made hazards, and terrorist events. • Divides risks into categories of economic, environmental, geopolitical, societal and technological. • Lists top 10 most likely events and top 10 risks with the greatest impact. • Based on data collected as part of the World Economic Forum's Global Risks Perception Survey which captures the perceptions of almost 750 experts and decision-makers in the World Economic Forum's multi-stakeholder communities.

Country	Risk communication output	Derivation	Features
United Kingdom	National Risk Register of Civil Emergencies	UK Cabinet Office	<ul style="list-style-type: none"> • Covers all civil emergencies—natural hazards, major accidents, terrorist and malicious attacks. • Sets out highest priority risks, newly assessed risks, emerging and longer term issues and provides a summary of each risk (risk outline, background, consequences). • Establishes how risk assessment is used to delegate responsibility for emergency preparations. • Used risk matrices to plot likelihood and consequence of events. • Considers risk ownership.

Country	Risk communication output	Derivation	Features
Denmark	National Risk Profile	DEMA – Danish Emergency Management Agency	<ul style="list-style-type: none"> • Focuses on catastrophic consequences, but is not scenario based. • Discusses connection between risk profile, preparedness and development of capabilities. • Based on qualitative data; quantitative data 'seldom exists for incident types it is dealing with'. • Assesses possible consequences of selected incident types rather than their likelihood (what may happen, not how likely it is to happen).

Country	Risk communication output	Derivation	Features
Ireland	National Risk Assessment 2015	Department of the Taoiseach	<ul style="list-style-type: none"> • Links identification of risks to ability to mitigate. • Very broad in scope; considers all national risks. • Categorises risks as economic, technological, environmental, social and geo-political. • Notes that lack of mitigation strategies or will to implement them are risks in their own right.
Switzerland	Natural Hazards Topic Brief and Dossiers	Federal Office for the Environment	<ul style="list-style-type: none"> • Explains hazard processes and how they are changing due to climate change, the pressures that hazards create, the risks, impacts and lessons to be learned, and what measures can be used to deal with natural hazards. • Additional hazard maps articulate where built up areas and transport routes are threatened by disasters. • Considers risk ownership.
Norway	National Risk Analysis 2014	Norwegian Directorate for Civil Protection	<ul style="list-style-type: none"> • Covers natural hazards, major accidents and malicious acts. • Articulates connection between risk awareness and capability to tackle crises and disasters. • Articulates that events are complex and transcend specialist fields and areas of responsibility. • Explains how risk assessment should be used by authorities and organisations. • Derived from qualitative risk analyses of very serious scenarios based on expert assessments.
Ghana	Disaster Risk Maps	<u>Community Resilience through Early Warning (CREW)</u> project, implemented by NADMO in collaboration with UNDP and funded by the Government of Norway.	<ul style="list-style-type: none"> • Assesses flood and drought hotspots and their early warning gaps. • Has been used to design appropriate warning systems.

Country	Risk communication output	Derivation	Features
Ethiopia	Disaster Risk Profiling	Federal Democratic Republic of Ethiopia	<ul style="list-style-type: none"> • Still in development. • Seeks to answer the questions: <ul style="list-style-type: none"> - Where are the hazards present? - Why are they present there? - Who gets affected? - What creates vulnerability to these disasters? • Intention is to use risk profiles to develop new disaster risk management framework for disaster risk reduction planning, early warning systems and contingency planning. • Risk is assessed from the lens of hazards, vulnerability and capacity.

Country	Risk communication output	Derivation	Features
Rwanda	National Risk Atlas	Co-financed by the EU-funded ACP-EU Natural Disaster Risk Reduction Program. Managed by the Global Facility for Disaster Reduction and Recovery. Financial and technical support provided by the United Nations Development Programme.	<ul style="list-style-type: none"> • Covers five major natural hazards—droughts, floods, landslides, earthquakes and windstorms. • Considers elements at risk: population, agriculture, health, education, housing and transportation. • Risk information is analysed and presented at national and district levels. • Provides economic cost profiles for each hazard.
South Africa	South Africa Risks 2016	Institute of Risk Management South Africa	<ul style="list-style-type: none"> • Establishes top country-level risks, top industry-level risks. • Looks at how top risks are likely to unfold over 18 month and 10 year horizons. • Does not consider natural hazards.

Country	Risk communication output	Derivation	Features
India	Vulnerability Profile	National Disaster Management Authority Government of India	<ul style="list-style-type: none"> • Articulates land area prone to cyclones and tsunamis, earthquakes, floods and river erosion. • Includes a statement of vulnerabilities to non-natural disasters (chemical, biological, radiological, nuclear). • Explains how disaster risks are compounded by vulnerabilities i.e. changing demographics, urbanisation.
Laos	National Risk Profile	Asian Disaster Preparedness Center	<ul style="list-style-type: none"> • Appears to be in progress, with no final output at this stage.
Pacific region	Pacific Disaster Risk Assessment	Pacific Catastrophe Risk Assessment and Financing Initiative	<ul style="list-style-type: none"> • Still in development • Intention is to include Pacific Risk Information System and risk- based framework to direct resources of countries and development partners.
Canada	AHRA All Hazards Risk Assessment	Public Safety Canada	<ul style="list-style-type: none"> • The AHRA is a methodology for conducting risk assessments for use by federal government institutions in fulfilling their legislative responsibility to conduct mandate-specific risk assessments as basis for EM planning. • Developed on assumption that risks are co-owned and co-managed. • It is intended the AHRA will facilitate production of a whole of Government risk picture to support EM planning.
US	Strategic National Risk Assessment 2011	DHS Office of Risk Management and Analysis in support of Presidential Policy Directive 8	<ul style="list-style-type: none"> • Explores natural hazards, technological / accidental hazards and adversarial / human caused hazards / threats. • Explicitly identifies that the purpose of the risk assessment is to contribute to development of the National Preparedness Goal. • Risks were assessed on scales of frequency and consequence.
Selected South American Countries	South American Risk Assessment	South American Risk Assessment project. Funded by SwissRe Foundation	<ul style="list-style-type: none"> • In progress. • Will calculate hazard and risk and estimate the compounding social and economic factors that aggravate the physical damage and decrease post-event capacity of population to respond to and recover from earthquakes.

Attachment A: Bibliography – Analysis of global and international country-level risk statements

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2. The Danish Emergency Management Agency 2013, *National Risk Profile*, [https://brs.dk/viden/publikationer/Documents/National_Risk_Profile_\(NRP\)_-_English-language_version.pdf](https://brs.dk/viden/publikationer/Documents/National_Risk_Profile_(NRP)_-_English-language_version.pdf) (accessed November 2016)
3. Federal Democratic Republic of Ethiopia (date unknown), *Disaster Risk Profiling in Ethiopia; The Stepping Stone to Disaster Risk Management*, http://www.preventionweb.net/files/28796_wdrpflyer.pdf (accessed November 2016)
4. Global Earthquake Model date unavailable, *South America: Integrated and collaborative seismic risk assessment*, <https://www.globalquakemodel.org/what/regions/south-america/> (accessed November 2016)
5. The Institute of Risk Management South Africa 2016, *IRMSA Risk Report South Africa Risks 2016*, 2nd ed. http://c.ymcdn.com/sites/www.irmsa.org.za/resource/resmgr/2016_Risk_Report/IRMSA_2016_Risk_Report.pdf (accessed November 2016)
6. Ireland Department of the Taoiseach 2015 *National Risk Assessment 2015 – Overview of Strategic Risks*, http://www.taoiseach.gov.ie/eng/Publications/Publications_2015/National_Risk_Assessment_2015.pdf (accessed November 2016)
7. National Disaster Management Authority, Government of India (date unknown), *Vulnerability Profile*, <http://www.ndma.gov.in/en/vulnerability-profile.html> (accessed November 2016)
8. Norwegian Directorate for Civil Protection 2014, *National Risk Analysis 2014*, https://www.dsb.no/globalassets/dokumenter/rapporter/nrb_2014_english.pdf (accessed November 2016)
9. Pacific Catastrophe Risk Assessment & Financing Initiative (date unavailable), *Pacific Catastrophe Risk Assessment & Financing Initiative (PCRAFI)*, <http://pcrafi.sopac.org/> (accessed November 2016)
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11. Rwanda Ministry of Disaster Management and Refugee Affairs 2015, *The National Risk Atlas of Rwanda*, http://reliefweb.int/sites/reliefweb.int/files/resources/National_Risk_Atlas_of_Rwanda_electronic_version.pdf (accessed November 2016)
12. Switzerland Federal Office for the Environment FOEN 2016, *Natural Hazards: In brief*, <http://www.bafu.admin.ch/naturgefahren/15218/index.html?lang=en> (accessed November 2016)
13. United Kingdom Cabinet Office 2015, *National Risk Register of Civil Emergencies*, 2015 ed., https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/419549/20150331_2015-NRR-WA_Final.pdf (accessed November 2016)
14. United Nations Development Program 2015, *Ghana launches disaster risk maps*, <http://www.gh.undp.org/content/ghana/en/home/presscenter/articles/2015/10/20/ghana-launches-disaster-risk-maps.html> (accessed November 2016)

Attachment B – Analysis of risk statements published in Australia

Risk communication / analysis outputs	Year	Derivation	Key Features	Links
Australian Government Threat and Risk Analyses				
Organised Crime in Australia – Unclassified	Biennial Latest 2016	ACIC Organised Crime Strategic Framework. This is one of three elements – Organised Crime Threat Assessment, Organised Crime response plan, multi-agency responses.	<ul style="list-style-type: none"> • Explanation of what organised crime looks like, including the key characteristics of organised crime. • Explanation of how organised crime affects us. • How Australia is currently responding. • Explanation of activities that enable organised crime. • Case studies. • Outlines illicit commodities and types of crime. • Outlook of what the organised crime environment will look like over the next two years. 	https://www.acic.gov.au/publications/intelligence-products/organised-crime-australia
National Terrorism Threat Advisory System	Ongoing; revised as necessary		<ul style="list-style-type: none"> • Scale of 5 levels: Certain, Expected, Probable, Possible, Not expected. • When the threat level changes, the Australian Government provides advice on what the threat level means, where the threat is coming from, potential targets and how a terrorist act may be carried out. • Explanation of current threat level (probable), where the threat comes from, what the likely targets are, how an attack would occur and Australia's response. 	https://www.nationalsecurity.gov.au/Securityandyourcommunity/Pages/National-Terrorism-Threat-Advisory-System.aspx
National Threat Assessment Centre		ASIO	<ul style="list-style-type: none"> • Case by case threat assessments, including for the purposes of planning security arrangements. • Assessments provide detail on individuals or groups that could threaten people, property or activities and assess the likelihood of threats being realised. 	https://www.nationalsecurity.gov.au/Pages/default.aspx
Natural Hazard Risk				

Risk communication / analysis outputs	Year	Derivation	Key Features	Links
'At what cost? Mapping where natural perils impact on economic growth and communities, Final Report'	2016	Insurance Australia Group Ltd (IAG)	<ul style="list-style-type: none"> Assessment of where natural peril risk is located (e.g. TC, flood, storm, bushfire, EQ). Assessment of risk in Economic Activity. Assessment of risk on the population. Implications for governments, communities and individuals and business. 	http://www.iag.com.au/share-d-value/what-cost
Climate Adaptation Synthesis Program	2013	National Climate Change Adaptation Research Facility	<ul style="list-style-type: none"> A synthesis and communication program to condense and translate technical research information into products suitable for a diverse audience of end users. Summaries of the risks posed by the six key threats: heatwaves, floods, cyclones and windstorms, bushfire, community vulnerability and resilience and terrestrial ecosystems. 	https://www.nccarf.edu.au/synthesis
Climate Change Risks to Australia's Coasts	2009	Australian Government Department of Climate Change	<ul style="list-style-type: none"> Discusses the risks posed to coastal areas by climate change including the scientific basis. The risks posed to built environment assets, to infrastructure and services, industry and community. 	https://www.environment.gov.au/system/files/resources/fa553e97-2ead-47bb-ac80-c12adffea944/files/cc-risks-full-report.pdf
Risk Assessment Example from Other Sectors				
National Risk Assessment into the not-for-profit sector	To be released in 2017	Australian Charities and Not-for-Profits Commission	<ul style="list-style-type: none"> To build a better understanding of the extent, nature and types of money laundering and terrorism financing risks that the sector faces. The risk assessment will be used to inform future outreach, ensuring monitoring and supervision is risk based and the coordination of information gathering. 	http://www.acnc.gov.au/nfprisk
State and Territory Risk Assessments				
State and Territory Risk Assessments	2012-2017	Relevant agencies	<ul style="list-style-type: none"> Risk Assessments conducted according to the National Emergency Management Risk Assessment Guidelines 	
Frameworks for Risk Assessment				

Risk communication / analysis outputs	Year	Derivation	Key Features	Links
National Emergency Risk Assessment Guidelines	HB 10 2015	Australian Institute of Disaster Resilience	<ul style="list-style-type: none"> • A contextualised, emergency related risk assessment method. • NOTE: The document is not a risk assessment 	https://www.aidr.org.au/media/1489/handbook-10-national-emergency-risk-assessment-guidelines.pdf
A National Risk Assessment Framework for Sudden Onset Natural Hazards: Draft prepared for the Australian Emergency Management Committee	2006	National Risk Assessment Advisory Group – Geoscience Australia	<ul style="list-style-type: none"> • Goal: to support the development of an evidence base for effective risk management decisions. • NOTE: The document is not a risk assessment 	http://www.ga.gov.au/webtemp/image_cache/GA10027.pdf

Attachment C – Understanding of roles and responsibility in mitigating and managing risk in Australia

This summary has been informed, in part, by Young, C.; Symons, J; and Jones, R (2015) Whose Risk is it anyway? (Bushfire and Natural Hazards CRC, 2015). The summary has been developed as a basis upon which to prompt and refine, with stakeholders, a collective understanding and perception of shared risk ownership for the purpose of co-designing and developing the Profile.

Stakeholder	Accountable for risk	Responsible for management of risk	Responsible for funding of risk	Responsible for responding to risk	Provides risk information
Commonwealth					
Various	National-level risk Social and economic security at a national level National coordination of events Maintaining Crisis Coordination abilities Protecting nationally significant environmental areas and ecological communities National infrastructure (national roads, railways, aviation services, telecoms)	Provision of economic and social security at a national level National coordination of events National-level disaster resilience Development of regulations and standards Reducing risk to Commonwealth through planning and policy development Establishing and coordinating partnerships between researchers and industry, government, community organisations and the international community	Disaster recovery (through NDRRA) Some national mitigation Non-financial assistance for states National level impacts of disasters (damage to national roads, railways, telecommunications)	Crisis and disaster response and information coordination Coordination of national mobilisation Non-financial assistance for states Non-financial assistance for other countries and Australians overseas Delivery of relief/ recovery payments Establishing and coordinating partnerships between researchers and industry, government, community organisations and the international community	Financial risk Hazard information – geological, climate / hydro-meteorological Social trends as they relate to disaster impacts Health and welfare trends relevant to disaster impacts Risk associated with climate and climate change

Stakeholder	Accountable for risk	Responsible for management of risk	Responsible for funding of risk	Responsible for responding to risk	Provides risk information
Research and Academia					
Various					Disaster risk, natural hazards, exposure, vulnerability, disaster impacts, climate risks and impact, disaster risk reduction, resilience, mitigation
Emergency Services					
Various				Responding to emergencies; supporting / representing responders	Insights into risk and vulnerability assessment
Industry					
Various	Insuring for disaster damage Provision of telecommunications services Planning for industry resilience and mitigation Business and service continuity Industry specific risk management and mitigation Functionality of trade inputs and outputs	Understanding risk and pricing insurance accordingly Complying with regulations and standards Maintaining viability and functionality of telecommunications services Evidence based planning Emergency management planning Maintaining own infrastructure/ service and business continuity	Insurance claims within limits of policies Failure of services and operations; service restoration Consequences of residual risk to business following disaster	Potential to support community responses to disasters, bolster recovery efforts Responding to/ restoring service/ business interruptions and failures Responding to agricultural threats/ losses	Insurance pricing (indicating high or low risk) Communicating disaster impacts for industry Identifying critical infrastructure risks Informing sustainable, resilient functional design and architecture Economic cost of disaster

Stakeholder	Accountable for risk	Responsible for management of risk	Responsible for funding of risk	Responsible for responding to risk	Provides risk information
		Protecting critical goods and products from disaster impacts			
Jurisdictions					
States and territories	Mitigation Preparation Planning Development of regulations and standards at state level Critical infrastructure – social, physical Protection of environmental assets Protection of environmental assets	Mitigation Preparation Planning Development of regulations and standards at state level Critical infrastructure – social, physical Protection of environmental assets Risk management plans Resilience measures	Mitigation Resilience Recovery	Emergency management activities - response, relief and recovery	State risk assessments
Local governments	Land use and social planning Maintaining infrastructure	Land use and social planning Maintaining infrastructure	Mitigation Resilience Recovery	Emergency management activities	Local area risk assessments
Community Sector					
Various		Working to reduce vulnerability of society, including particularly vulnerable groups		Responders/ Potential responders	Inform risks specific to community Advise on risks faced by society's most vulnerable

Footnotes

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- ¹ Australian Government Productivity Commission.2014, Natural Disaster Funding Arrangements Productivity Commission Inquiry Report Volume 1, No. 74
- ² CSIRO and BOM 2015, Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report, CSIRO and BOM, Australia
- ³ CSIRO and BOM 2016, State of the Climate, CSIRO and BOM, Australia
- ⁴ Deloitte Access Economics for the Australian Business Roundtable for Disaster Resilience & Safer Communities 2016, The economic cost of the social impact of natural disasters
- ⁵ Thunderstorm asthma had occurred in Victoria in the past, but the rapid onset of the event, the level of demand in a condensed time period and the dispersed nature of the demand over such a large geographical area had not been experienced. The scale of consequence was unprecedented.
- ⁶ Crowther, M. 2015 'How a change in thinking might change the inevitability in disasters', Australian Journal of Emergency Management, 30 (3)
- ⁷ UNISDR 'What is Disaster Risk Reduction'
- ⁸ Figure inspired by a characterisation of the implied relationship between vulnerability and resilience as defined by New Zealand Ministry of Civil Defence and Emergency Management in Fitzgerald and Fitzgerald 2005, Assessing community resilience to wildfires: concepts and approach.
- ⁹ In May 2016 the Commonwealth, in collaboration with the Australasian Fire and Emergency Service Authorities Council (AFAC), conducted a sector-wide workshop to begin to understand the points of limitation of preparedness at the national level and what capabilities might be needed to move past them. A Capability Roadmap: Enhancing Emergency Management in Australia was finalised and presented to ANZEMC at its meeting in September 2016.
- ¹⁰ Meteorological, hydrological and climatological events
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- ¹² The Intergovernmental Panel on Climate Change (IPCC) 2014, Working Group II Report, Climate Change 2014: Impacts, Adaptation, and Vulnerability
- ¹³ National Climate Change Adaptation Research Facility (NCCARF) 2016, Climate Adaptation Synthesis Program, Synthesis Summary 1-4
- ¹⁴ Kelman, I., Gaillard, J., Lewis, J., Mercer, J., 2016, Learning from the history of disaster vulnerability and resilience research and practice for climate change, *Natural Hazards* 85: 129-143. Further, the social and economic issues of disasters have been described as early as 1940, including through papers published by Henry Quarrantelli, Gilbert White and Gary Kreps for example.
- ¹⁵ Kelman, I., Gaillard, J., Mercer, J., 2015, Climate Change's Role in Disaster Risk Reduction's Future: Beyond Vulnerability and Resilience, *International Journal of Disaster Risk Science*, Vol. 6: 21-27
- ¹⁶ Insurance Australia Group, 2016, At what cost? Mapping where natural perils impact economic growth and communities
- ¹⁷ The Geneva Association, 2014, Climate Risk Statement of the Geneva Association
- ¹⁸ Pielke Jr, R. A., Klein R., & Sarewitz, D., 2000, Turning the big knob: Energy policy as a means to reduce weather impacts, *Energy and Environment*, 11 (3), 255–275
- ¹⁹ For example, although improved standards for the construction of buildings and infrastructure over time contribute to a reduction in vulnerability, it is not enough to offset the upward trend in loss from the growth of population
- ²⁰ Proceedings of the Third United Nations World Conference on Disaster Risk Reduction (WCDRR) held at Sendai City, Japan in March 2015
- ²¹ Sarewitz D., Pielke Jr, R., and Keykhah M., 2003, Vulnerability and Risk: Some Thoughts from a Political and Policy Perspective, Risk Analysis, Vol 23. No.4
- ²² Foreword by Margareta Wahlström (United Nations Special Representative of the Secretary-General for Disaster Risk Reduction) in the Proceedings of the Third United Nations WCDRR held at Sendai City, Japan in March 2015
- ²³ Sendai Declaration and the Proceedings of the Third United Nations WCDRR held at Sendai City, Japan in March 2015
- ²⁴ 7th Asian Ministerial Conference on Disaster Risk Reduction, 2016, Ministerial Statement
- ²⁵ Paris Agreement – Status of Ratification
- ²⁶ United Nations Framework Convention on Climate Change, 2014, The Paris Agreement
- ²⁷ United Nations Outcome document: The Future We Want. 2012
- ²⁸ Transforming Our World: The 2030 Agenda for Sustainable Development
- ²⁹ Australian Government Department of Foreign Affairs and Trade, date unknown, Global Development
- ³⁰ Transforming Our World: the 2030 Agenda for Sustainable Development – Declaration of Heads of State and Government and High Representatives on 25-27 September 2015

- ³¹ UNISDR, 2016, Implementing the Sendai Framework to achieve the Sustainable Development Goals. This publication explores the inter-linkages between the Sendai Framework and the SDGs. It describes every SDG and its contribution to preventing new- and reducing existing disaster risk, and strengthening resilience.
- ³² The New Urban Agenda is the outcome document agreed at the Habitat III cities conference in Quito, Ecuador in October 2016.
- ³³ Kelman, I., 2017, Linking disaster risk reduction, climate change, and the sustainable development goals, *Disaster Prevention and Management*, Vol. 26 (3) 254-258
- ³⁴ Margareta Wahlström, Special Representative of the UN Secretary-General for Disaster Risk Reduction (speech on 24 June 2015)
- ³⁵ United Nations Framework Convention on Climate Change, The Paris Agreement: Essential elements
- ³⁶ UNISDR 'Implementing the Sendai Framework to achieve the Sustainable Development Goals'
- ³⁷ Disasters caused by extreme environmental conditions tend to be fairly distinct in time and space (except for slow-onset disasters like desertification) and present a situation where the immediate impacts tend to overwhelm the capabilities of the affected population and rapid responses are required. For many hazards there exists considerable knowledge and certainty (based on historical experiences) about the event characteristics and exposure characteristics. Most impacts of climate change, meanwhile, are much more difficult to perceive and measure, since the changes in average climatic conditions and climatic variability occur over a longer period.
- ³⁸ Wisner, B., Blaikie, P., Cannon, T., and David I., 2004, *At Risk: Natural Hazards, Peoples Vulnerability and Disasters*, 2nd ed. Routledge, London
- ³⁹ Sperling, F., and Szekely, F., 2005, *Disaster risk management in a changing climate*, Washington, DC: VARG
- ⁴⁰ Table adapted from Klein, R.J.T., and Å. Persson., 2008, "Financing adaptation to climate change: Issues and priorities", in H. McGray, A. Hammill, R. Bradley, E.L. Schipper and J. Parry (eds.), *Weathering the storm: Options for framing adaptation and development*. Washington, DC: World Resources Institute; Brussels: Centre for European Policy Studies
- ⁴¹ United Nations General Assembly, 2016, Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030: Report of the Secretary-General (Ban Ki-moon, former United Nations Secretary-General)
- ⁴² United Nations International Strategy for Disaster Reduction (UNISDR) definition
- ⁴³ In July 2014 ANZEMC conducted a review into the implementation of the NSDR, evaluating progress and looking for emerging challenges and gaps in knowledge. Their review identified six themes requiring attention.
- ⁴⁴ Kelman, I., 2017, Linking disaster risk reduction, climate change, and the sustainable development goals, *Disaster Prevention and Management*, Vol. 26 (3) 254-258
- ⁴⁵ According to Wisner et al (2011) the characterisation of risk in this way ($R = H \times E \times V$) is meant as a mnemonic device, not necessarily a mathematical equation to be used for calculation. It is a reminder to enquire about both vulnerability and hazard.
- ⁴⁶ Maier et al., 2016, An uncertain future, deep uncertainty, scenarios, robustness and adaptation: How do they fit together? *Environmental Modelling and Software*, 81: 164-164
- ⁴⁷ Final Report of the Select Bipartisan Committee to Investigate the Preparation for and Response to Hurricane Katrina
- ⁴⁸ Previously, Emergency Management Australia had conducted a number of activities to open a national dialogue on Australia's preparedness to deal with severe to catastrophic disasters not previously experienced, or experienced in circumstances where exposure was low, such as thought leadership publications including How a change in thinking might change the inevitability of disasters (2015); Improving our capability to better plan for, respond to and recover from severe to catastrophic disasters (2015); A Capability Roadmap: Enhancing Emergency Management in Australia (2015) and exploration of the purpose and scope of a national statement of risk.
- ⁴⁹ Wisner, B., Gaillard, J., and Kelman, I., 2011, 'Framing Disaster' from: *The Routledge Handbook of Hazards and Disaster Risk Reduction*, Routledge, London
- ⁵⁰ Strickland, B., 2001, Gale Encyclopedia of Psychology
- ⁵¹ Wachinger, G., Renn, O., Begg, C. and Kuhlicke, C., 2013, The Risk Perception Paradox—Implications for Governance and Communication of Natural Hazards, *Risk Analysis*, 33: 1049–1065
- ⁵² Keating and Handmer, 2011, The cost of disasters to Australia and Victoria – no straightforward answers, Working Paper 3
- ⁵³ BTRE, 2001, Economic Cost of Natural Disasters in Australia, Report 103. p. 62
- ⁵⁴ For example, Sarewitz et al. (2003) assert that with respect to the attacks on the World Trade Centre, if insurers had managed to more accurately quantify event risk, they could have raised premiums to reflect that risk, spread their own outcome risk, and covered their losses, without requiring any reduction in vulnerability of the nation's air-travel infrastructure to terrorism.
- ⁵⁵ Magee, L., Handmer, J., Neale, T., Ladds, M., 2016, Locating the intangible: Integrating a sense of place into cost estimations of natural disasters, *Geoforum*, 77 61-72
- ⁵⁶ Barnett, J., Tschakert, P., Head, L., and Adger, N., 2016, A science of loss, *Nature Climate Change*, Vol 6
- ⁵⁷ Non-economic losses encompass a broad range of issues and therefore their understanding requires a range of expertise, and natural and social sciences including health, economics, human geography, anthropology, environmental psychology, amongst others.
- ⁵⁸ United Nations Framework Convention on Climate Change, 2013, Non-economic losses in the context of the work programme on loss and damage, Technical Paper

⁵⁹ Tschakert et al., 2017, Climate change and loss, as if people mattered: values, places and experiences, *WIREs Clim Change* 2017, e476