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Special report: Update to the economic costs of natural disasters in Australia

Australian Business Roundtable for Disaster Resilience & Safer Communities

2021

Deloitte Access Economics

Foreword to ABR Report on the costs of natural disasters

Since 2012, the Australian Business Roundtable for Disaster Resilience & Safer Communities (the Roundtable) has been advocating for greater action and investment in mitigation to protect Australians from the economic, emotional and social impacts of natural disasters.

Our purpose has been to understand and bring to light the true cost of natural disasters to make a clear economic case for building Australia's resilience.

The latest research tells us that severe weather events are becoming more frequent and severe in a changing climate and will have a greater economic impact, so it's critical that building resilience across the nation is a priority.

The Roundtable has released five independent research reports that quantify the financial and social costs of disasters and recommend national investment in disaster resilience and mitigation activities as the most effective way to protect people and communities.

We're pleased that this evidence-based research and our recommendations have helped to inform and drive actions that governments are now implementing, including the establishment of the National Recovery and Resilience Agency to build Australia's resilience, and the Australian Climate Service to better understand the threats posed by a changing climate and natural disasters.

At a time when Australia is facing more frequent, more severe weather events, and the country is looking more deeply than ever at the importance of resilience following the devasting Black Summer bushfires, our latest research strengthens our case for an increased focus on building resilience in communities across the country.

This special report: *Update to the economic costs of natural disasters in Australia*, builds on our previous reports and draws on the latest climate science. It uses comprehensive estimates of insured losses at a local level to provide a more granular understanding of damage costs and examines the costs of natural disasters under different climate change scenarios.

The report estimates that natural disasters will cost Australia $73 billion by 2060, under a low emissions scenario. This is significantly higher than the $39 billion by 2050 we reported in 2017.

Action to limit climate change must be coupled with interventions to better prepare communities. This continues to require a collective effort from all levels of government, businesses and the community, and we're encouraged by governments at all levels taking actions to integrate natural disaster resilience into the future planning for Australia's cities, towns and regions.

The Roundtable members are seeing firsthand the impacts of more extreme, more frequent weather events on Australians, and this latest report provides further evidence that we must all continue to invest in increasing resilience to protect communities and ultimately, save lives.

Nick Hawkins
IAG Managing Director and CEO
Chair, Australian Business Roundtable for Disaster Resilience & Safer Communities

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Glossary

Terminology	Definition
Average Annual Damages (AAD)	The expected average replacement value of insured and uninsured asset losses per year. Expected value is calculated as the average yearly losses measured over a very long period of time.
Social costs	The costs of damages that cannot be easily priced such as death and injury, impacts on health, wellbeing and community connectedness. The social costs quantified and included in this report are the costs to the person and the community associated with: • Fatalities • Injuries • Mental health impacts • Alcohol and drug misuse • Exacerbation of chronic disease • Family violence. Other social costs not quantified and therefore not captured in the cost estimates include: permanent unemployment, education disruptions, loss of social cohesion, costs associated with higher crime rates, environmental degradation and loss of animal lives.
Natural disasters	Natural disasters occur when natural hazards - such as bushfires, floods, tropical cyclones, severe storms, hail, heatwaves, earthquakes, costal inundation and tsunamis – impact what people value.[1] Disaster risk is a product of the type and intensity of the natural hazard event, the extent to which communities and other assets are exposed to a natural hazard event, and the vulnerability or ability of communities and other systems to cope with and recover from the impacts of the natural hazard event.[2] In this report, 'natural disasters' include bushfires, tropical cyclones, floods, severe storms and hail, and coastal inundation. This reflects the underlying Insurance Australia Group hazards data and previous Australian Business Roundtable for Disaster Resilience & Safer Communities reports.
Present value	Present value is often used for economic costs to summarise future cashflows in a manner that represents their value today. Specifically, present value is the sum of future cash flows discounted to reflect diminishing value of future cash flows and adjusted for inflation. Present value estimates allow comparisons between different scenarios where there are future cash flows.
Representative Concentration Pathway (RCP)	A RCP is a greenhouse gas concentration (not emissions) trajectory adopted by the Intergovernmental Panel on Climate Change (IPCC). The pathways describe different climate futures, all of which are considered possible depending on the volume of greenhouse gases (GHG) emitted in the years to come.

Natural disasters currently cost the Australian economy

$38

billion per year

This cost will rise to at least

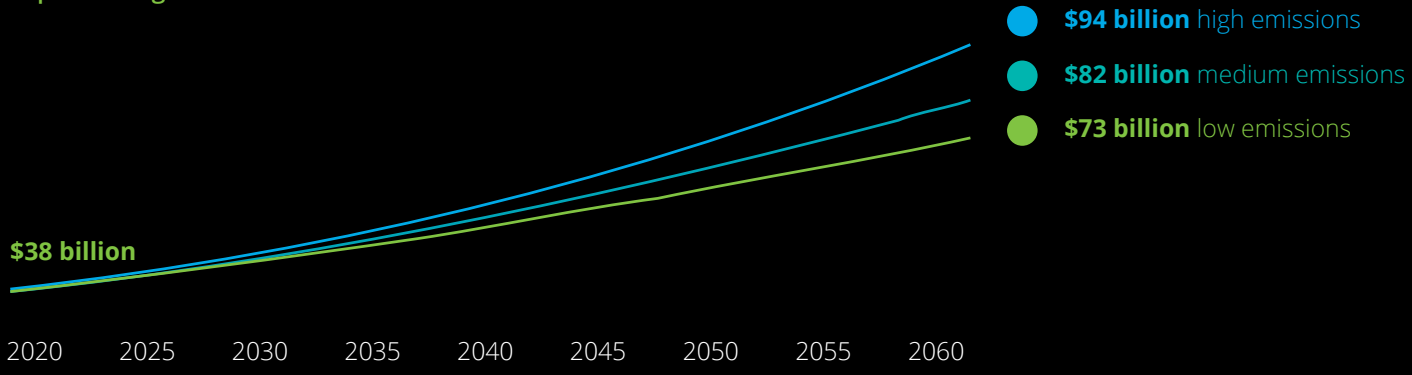
$73

billion per year by 2060

The three drivers of growth in costs of natural disasters are:

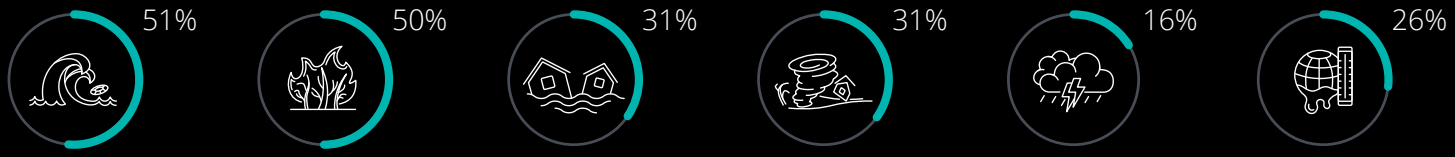
- **POPULATION GROWTH**
- **CLIMATE CHANGE**
- **PROPERTY VALUE GROWTH**

By 2060, costs in the high emissions scenario reach $94 billion, respresenting a 29% increase relative to the low emissions scenario.



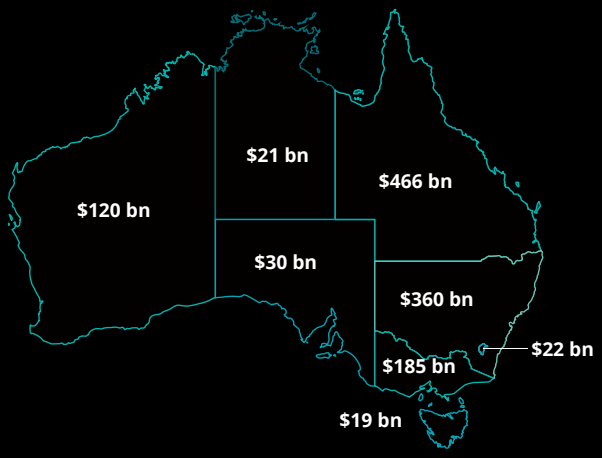
A high emissions scenario would see climate change **double the costs of coastal inundation and bushfires**

Contribution of climate change to total costs in 2060 in a higher emissions scenario



These costs estimates account for **asset losses** and their **flow on financial and social impacts** on affected communities

Total costs of natural disasters under a low emission scenario over the next forty years



Executive summary

Natural disasters in Australia have devasting financial and social impact on individuals, families, local communities, businesses and governments. A deeper understanding of these costs informs better decision making around investments in resilience, mitigation and post-disaster recovery.

That is why the Australian Business Roundtable for Disaster Resilience & Safer Communities (ABR) has previously commissioned Deloitte Access Economics to estimate these costs and identify opportunities to improve the disaster resilience framework in Australia.

Since the last report, the unprecedented 2019-20 bushfire season led to the loss of over 24 million hectares of land and the deaths of 33 people across Australia. The subsequent Royal Commission into National Natural Disaster Arrangements in 2020 recognised the contribution of climate change to that event and that the 2019-20 bushfire season may have "provided only a glimpse of the types of events that Australia may face in the future."[3]

This report updates the previous estimates of the costs of natural disasters with new data and extends the analysis to consider how climate change will affect costs under three different climate change scenarios based on the United Nations' Intergovernmental Panel on Climate Change (IPCC).

Today, natural disasters cost the Australian economy $38 billion per year on average, representing approximately 2% of Australia's Gross Domestic Product (GDP) in 2020. Even under a low emissions scenario – whereby timely action will see emissions start to fall and reach zero by 2100 – **this cost will rise to at least $73 billion annually by 2060,** or 4% of Australia's GDP in 2020.

Increasing costs will be driven by a combination of climate change, growth in population in exposed areas and the real value of property.

These costs will increase significantly under the alternative emissions scenarios modelled in this report.

A high emissions scenario – where emissions continue to rise across the 21st century, reaching 3º Celsius above pre-industrial levels just after 2060 – sees a significant increase in costs over time. **In 2020 annual average costs of natural disasters are only 0.02% larger than the low emissions scenario. By 2060 costs reach $94 billion, representing a 29% increase relative to the low emissions scenario.** Over the next 40 years the different trajectories will lead to a $125 billion difference in cumulative cost in present value. Even if a low emission scenario is achieved, the cost of natural disasters is forecast to be $1.2 trillion in cumulative costs over the next forty years.

Using new data which reports damage costs at a more granular level, this report finds that **coastal population centres in South East Queensland and North East NSW will experience some of the highest increases in costs** as they become more exposed to tropical cyclones and floods, as warming oceans enable tropical cyclones to move further south.

Costs in Melbourne and Brisbane will also increase significantly, as major rivers in these cities alongside growing populations will lead to greater costs associated with flooding for Melbourne and tropical cyclones and floods for Brisbane.

The estimated costs and identification of regions most exposed to climate change highlight the value of continued investment in improving Australia's disaster resilience, an agenda at the centre of previous ABR

reports. There are benefits to mitigating the costs of natural disasters by pursuing a lower emissions future. There are also benefits to investing in resilience to natural disasters more generally.

Governments at all levels have responded to the significantly higher costs from natural disasters by looking to integrate natural disaster resilience into the future planning for Australia's cities and regions. Many have established agencies to coordinate responses to natural disasters and target investment efforts at improving resilience such as the Queensland Reconstruction Agency's (QRA) Repeat Event and Dollars Index (REDI) which provides local governments with a heat map of historical damage and reconstruction spending.

This report suggests that scaling up investments in both physical (such as infrastructure) and community (such as preparedness programs) resilience will be required to reduce the significant anticipated costs from natural disasters, even under a low emissions future. These investments could also lead to additional co-benefits beyond avoided impacts such as employment opportunities, improved service reliability, greater business confidence and incentives for innovation. The remainder of the report presents the approach to estimating costs under different climate scenarios before outlining the implications for investments in resilience.

1.
A focus like never before

As the frequency and severity of natural disaster events increase, it is critical to identify opportunities to mitigate future costs through continued investment in disaster resilience.

Australia is vulnerable to a range of natural hazards including bushfires, storm and hail, tropical cyclones, floods, coastal inundation and earthquakes. Yet, natural hazards on their own are not disasters. Disaster occurs when natural hazards intersect with people and things of value, and when the impacts of hazards exceed our ability to avoid, cope or recover from them.[4]

Natural disasters have devastating financial and social impacts on individuals, families, local communities, businesses and governments.[5] As well as large upfront recovery costs, natural disasters have long-term impacts on the wellbeing of communities and individuals.[6]

Since its formation, the Australian Business Roundtable for Disaster Resilience & Safer Communities (ABR) has commissioned Deloitte Access Economics to produce five independent reports providing clear evidence of the increasing economic and social costs from natural disasters and recommendations that, if implemented, would help minimise the devastation and costs of disasters and make Australian communities more resilient.

The 2017 ABR estimate of total costs of natural disasters was $18 billion per year and forecast to rise to $39 billion per year by 2050.[7] Distinct from most other efforts at quantifying costs, this estimate included those social costs which were able to be quantified.

However, these past estimates of total economic costs assumed natural disasters in the future would occur at a frequency similar to the past.

There is now a significant body of evidence demonstrating that climate change is already well underway and is impacting the severity and frequency of weather events here in Australia like tropical cyclones, hailstorms, extreme heat events and rainfall. Meanwhile, rising sea levels will escalate the impact of flood and storm surge events and bushfire risk is likely to increase in almost all locations across Australia.[8]

The 2019-20 bushfire season led to over 24 million hectares of land being burnt and the deaths of 33 people.[9] The economic costs of this event were estimated at over $100 billion to the Australian economy.[10]

This event was a catalyst for government and sector-specific efforts to make communities more resilient. This response includes the *Royal Commission into National Natural Disaster Arrangements* and the recent establishment of a number of state and commonwealth agencies such as the National Recovery and Resilience Agency, the Australian Climate Service, Resilience NSW (an agency within the NSW Department of Premier and Cabinet) and Bushfire Recovery Victoria. These organisations can strengthen the efforts of existing framework and organisations – such as the Queensland Reconstruction Agency – and present a positive shift towards a more resilient Australia.

We are experiencing a focus like never before on disaster resilience. Now is the time to refresh the ABR's previous work by providing an up-to-date estimate of the costs of natural disasters in Australia and identifying costs under different climate change scenarios.

2.
New approach to estimating costs

The true cost of natural disasters includes both the financial and social impacts. This report extends the analysis from previous ABR and Deloitte Access Economics reports by using new data to re-examine the drivers of economic costs under different climate change scenarios.

Previous ABR reports provided the most comprehensive estimates of the total costs of natural disasters possible at the time. Baseline insurance loss data from the Insurance Council of Australia's (ICA) Catastrophe Database was scaled up to estimate total economic costs, leveraging leading academic research on the subject for Australia, and two detailed case studies on significant natural disaster events (the Black Saturday bushfires in 2009 and the South East Queensland floods in 2010-11).[11]

ABR member, Insurance Australia Group (IAG) has since developed detailed modelling of Average Annual Damages (AAD) for domestic homes across Australia. Additionally, IAG applied joint research with the National Center for Atmospheric Research (NCAR)[12] to develop estimates of AAD at different temperatures rises. This new data is a significant improvement on the previous baseline as it:

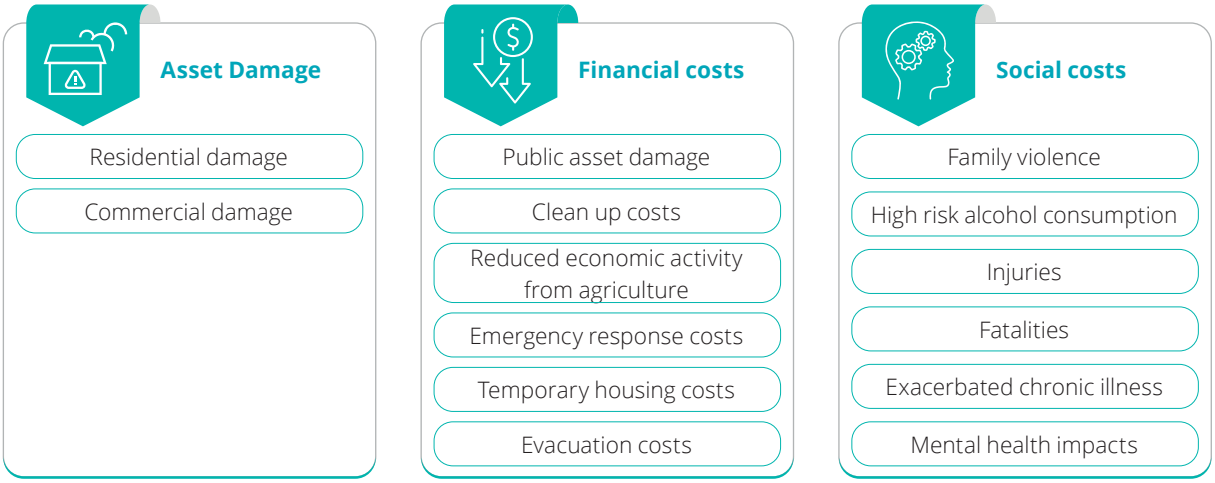
- provides estimates of costs at a local level which allow for a more granular understanding of the impact of natural disasters
- includes both **insured and uninsured** losses in its estimates of housing asset losses
- includes **smaller natural disaster events** that are not captured by the ICA database
- considers how **costs vary under different future temperatures scenarios,** which can be used to predict future damages under different climate scenarios.

The AAD data combined with other sources to estimate commercial losses were used to estimate **asset losses** associated with disasters. That is, the damage to residential and commercial private property caused by natural disasters.

There are, of course, many other costs from natural disasters beyond property damage. The flow-on **financial** and **social costs** associated with asset damages are estimated using a set of ratios developed in academic literature. These ratios were adjusted by Deloitte Access Economics following analysis of the actual costs associated with three historical Australian natural disaster reference events and to reflect updates in the underlying dataset – which now includes uninsured losses and smaller disaster events.

The total economic cost of natural disasters is the sum of the asset losses, and the associated financial and social costs (Figure 2.1).

Figure 2.1: Quantified economic and social costs of natural disasters in Australia



Source: Deloitte Access Economics 2021

The new modelling approach was applied to the old data to confirm that the results were in line with the 2017 ABR report (see box below). This means that the results in this report are a reflection that better data is available and that real-world costs have increased – not just that the methodology has changed.

Comparison with previous modelling results

Deloitte Access Economics last estimated the economic costs of natural disasters in 2017. In that modelling, the total economic cost of natural disasters was forecast to reach $39 billion per year by 2050.* In comparison, the modelling in this report estimates that, under a low emissions scenario, the total economic cost of natural disasters will reach $63 billion per year by 2050. This estimate includes the $9 billion in cost associated with climate change.

The difference between the current and previous estimates is due to two factors. The first is that the current estimates use newly available AAD estimates from IAG, where the previous work relied on simulations of costs using data on historic events from the publicly available ICA database.[13] The use of AAD allows the modelling to incorporate the effect of the large number of smaller events, which are not captured by the ICA database.

Second, the current modelling incorporates the effects of climate change on the growth in costs of natural disasters. Even under a low emissions scenario, which provides the closest approximation to previous modelling, climate change still leads to an increase in the economic costs of natural disasters.

* Comparison of costs is shown for the year 2050; this was the end point for the modelling in 2017. This year's modelling using AAD data allowed modelling up to 3 degrees warming, which occurs under the high emissions scenario in 2060. For that reason, this years modelling presents costs up for this additional decade.

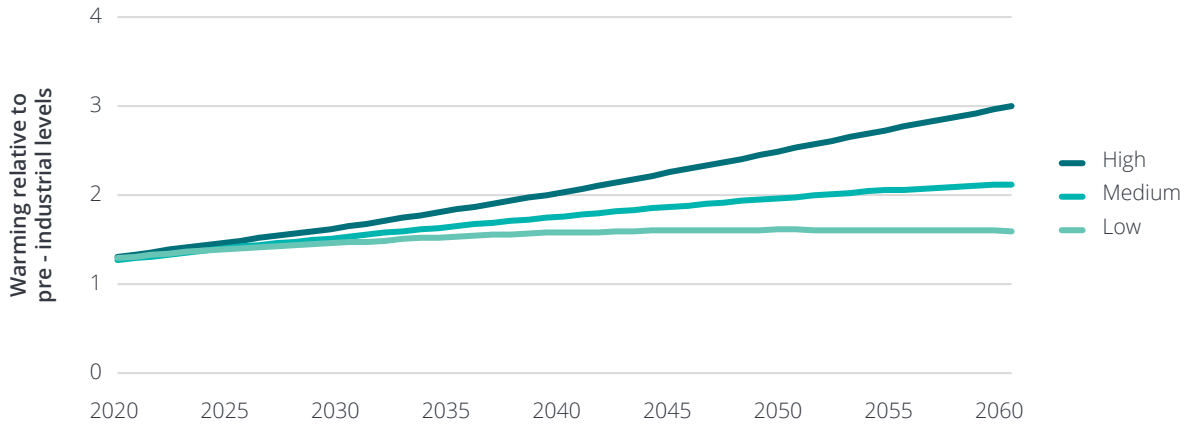
Enabled by the new data, the impact of climate change on the rising costs of natural disasters has been incorporated for the first time. To do this, IAG estimates of AAD data at different temperature increases, was aligned with three emissions scenarios drawn from the United Nations' Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report (AR5).[14] This allows for three 'cost pathways' to be developed, so that the future costs in different emissions scenarios can be compared.

Each of the three scenarios sets out a different expected increase in the concentration of greenhouse gases in the atmosphere during the 21st century:

- **A low emissions scenario** in which net carbon dioxide (CO2) emissions start to decline by 2020 and fall to zero by 2100. This scenario can be interpreted as one where timely action is taken to prevent further emissions and warming. In this scenario, temperatures do not rise to more than 1.7ºC above pre-industrial levels.*
- **A medium emissions scenario** in which net emissions start to decline by approximately 2045. While identified as a 'medium' scenario, this is not necessarily the 'most likely' out of the three scenarios considered. In this scenario, temperatures increase to above 2ºC above pre-industrial levels by around 2050.
- **A higher emissions scenario** in which net emissions continue to rise throughout the 21st century. This scenario is one where limited action is taken to reduce emissions and prevent global warming.** In this scenario, temperatures rise 2ºC above pre-industrial levels by around 2040 and 3ºC just after 2060.

The expected increase in global temperatures associated with these scenarios is shown in Chart 2.2.[15]

Chart 2.2: Forecast global warming, degrees Celsius



Source: IPCC RCP via KNMI Climate Change Atlas[16]

* The Paris 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 2ºC above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5ºC. For the scenarios considered in this report, no scenario achieves the objective of limiting increases to temperatures above 1.5ºC. The only emissions scenario that achieve the less stringent objective of 2ºC increases in temperatures is the low emissions scenario.

** This report uses RCP 2.6 as a 'low emissions scenario', RCP 4.5 as a 'medium emission scenario' and RCP 8.5 as a 'higher emissions scenario'.

Recently, the IPCC has released its 6th Assessment Report (AR6). The findings contained in AR6 broadly align with findings from this report (see box below). AR6 also provides evidence that temperature increases have been higher than previously estimated in AR5 and future increases could occur earlier than previously expected. This means that costs could rise faster than the modelling for this report indicates.

Interpreting our results in context of the IPCC's Sixth Assessment Report (AR6) on climate change

This report has modelled the costs of natural disasters based on three temperature trajectories in Australia aligned to the fifth United Nations IPCC Assessment Report (AR5). Even under a low emissions future, climate change will contribute to the costs of natural disasters. The temperature trajectories contained in the recent 6th IPCC Assessment Report (AR6) aligns with the findings from this report, estimating that global surface temperatures are forecast to rise at least to 2050 under all emission scenarios.

The AR6 report finds that climate change is already having material impacts on the frequency and severity of weather-related natural disasters in Australia. The impact, frequency and severity of disasters all worsen at higher levels of warming.

While the approach has improved, there remain some limitations. As with previous modelling results, distributional costs or short-term costs, such as the costs of disrupted supply chains or lost tourism in a disaster affected region, are not included in the cost estimates. This is due to a lack of good information on whether losses in one region would be offset by spending in another. The modelling approach excludes the costs of these 'transfers', to avoid overestimating the costs of disasters.

The approach to estimating costs from a natural disaster is based on events occurring separately. Recent analysis suggests that increasing frequency of natural disasters and shortening time for recovery after an event could amplify the impacts from natural disasters, labelled as compound disasters.[17] This effect is likely to become more common with climate change. Additional information around the impacts of compound events would be required to incorporate them into future estimates.

As with previous reports, the results account for the costs associated with six disaster types - bushfires, floods, tropical cyclones, severe storms and hail, coastal inundation and earthquakes. The costs associated with heatwaves and drought are not included in the estimates, as data on asset damage is not available.

While Australia's resilience to natural disasters is expected to improve in the future, the pace at which this will occur is uncertain. The modelling assumes that Australia's investment in resilience towards natural disasters will mean that the asset damages associated with natural disasters is partially offset over time. This captures the effect of resilience measures, like improving building codes to reduce or mitigate the extent of damage over time.

Further detail about the approach used for the modelling contained in this report is available in the technical appendix to this document.

3.
A future of rising costs

Today, natural disasters cost the Australian economy $38 billion per year on average. A high emissions scenario could see annual costs rise to $94 billion by 2060.

Over the next forty years, the cost of natural disasters to the Australian economy is expected to be at least $1.2 trillion in present value terms (Table 3.1). This cumulative cost would potentially increase by $125 billion if a higher emission scenario eventuates. While the cost difference between the low and high emissions scenarios can be attributed to climate change, the 'baseline costs' reiterate the value from continual investment in resilience from natural disasters.

Further, the difference in costs between the low emissions scenario only represents the costs avoided by reducing the impact of climate change on natural disasters and does not include other potential benefits from maintaining a low emissions trajectory.

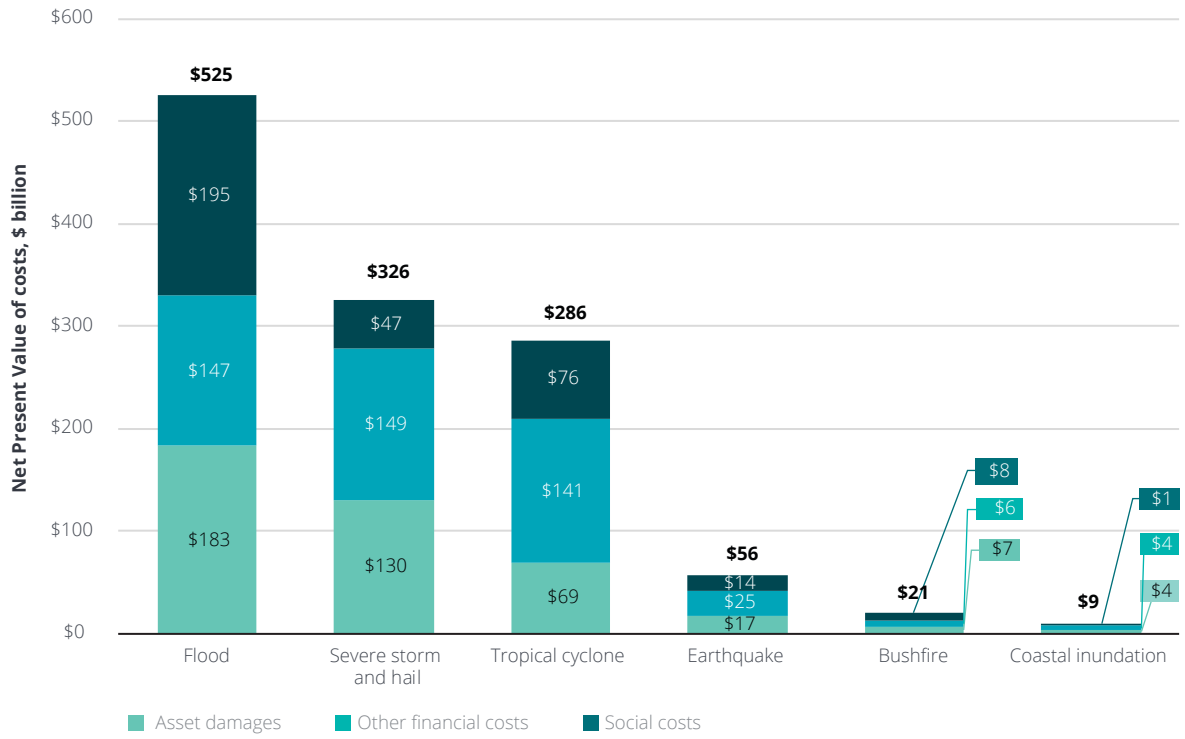
Table 3.1: Total economic costs under each emissions scenario, $billions

	Low emissions scenario	Medium emissions scenario	Higher emissions scenario
Present value (over 2020-2060)	$1,224	$1,272	$1,348
Average annual cost at 2060	$73.2	$81.8	$94.1

Source: Deloitte Access Economics 2021

Types of disasters differ in the main form of cost – asset damages, other financial 'flow on' costs and social costs. Under the low emissions scenario, the social costs account for 37% – or $195 billion – of the total costs of floods over the next forty years (see Chart 3.1). In comparison, other financial costs will be the primary driver of economic costs for tropical cyclones, and severe storm and hail events. For tropical cyclones, other financial costs account for 49% of all costs, equivalent to $141 billion over the next forty years under the low emissions scenario.

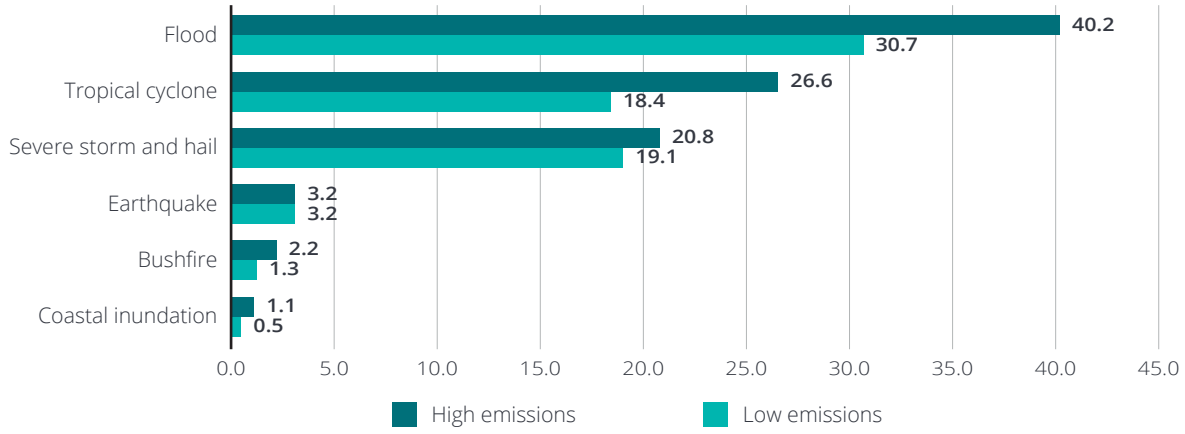
Chart 3.1: Present value of economic costs and the components of costs under low emissions scenario by type of natural disaster, $billion



Source: Deloitte Access Economics 2021

Comparing outcomes under the high and low emissions scenarios shows that the greatest increase in costs will be associated with floods and tropical cyclones. Annual costs from these types of disasters will be $9.5 billion and $8.2 billion larger in 2060 under the high emissions scenario (Chart 3.2). This difference reflects both the impact of climate change and the significant population growth predicted in areas such as South East Queensland, which are predicted to have much greater exposure to flood and tropical cyclone events under a high emissions scenario. In contrast, costs associated with earthquakes are the same under both scenarios, as the effects of climate change are not predicted to have an impact on earthquake risk.

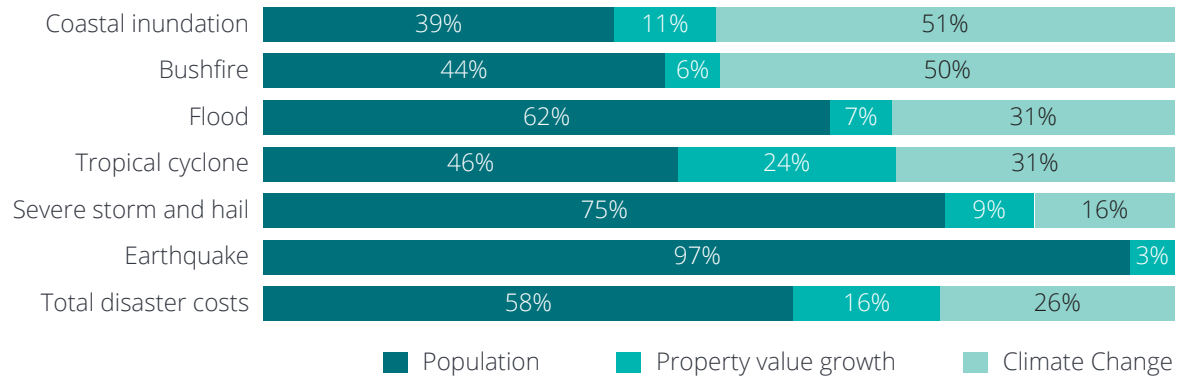
Chart 3.2: Annual economic costs in 2060 by disaster type under the high and low emissions scenarios, $billions



Source: Deloitte Access Economics 2021

This modelling takes into account the increased intensity and severity of weather-related hazards due to climate change, increases in the real value of property and forecast population growth to project future economic costs of natural disasters. All of these factors will contribute to rising costs from natural disasters as shown in Chart 3.3.

Chart 3.3: Share of increase in economic cost between 2020 and 2060 from natural disasters under a higher emissions scenario

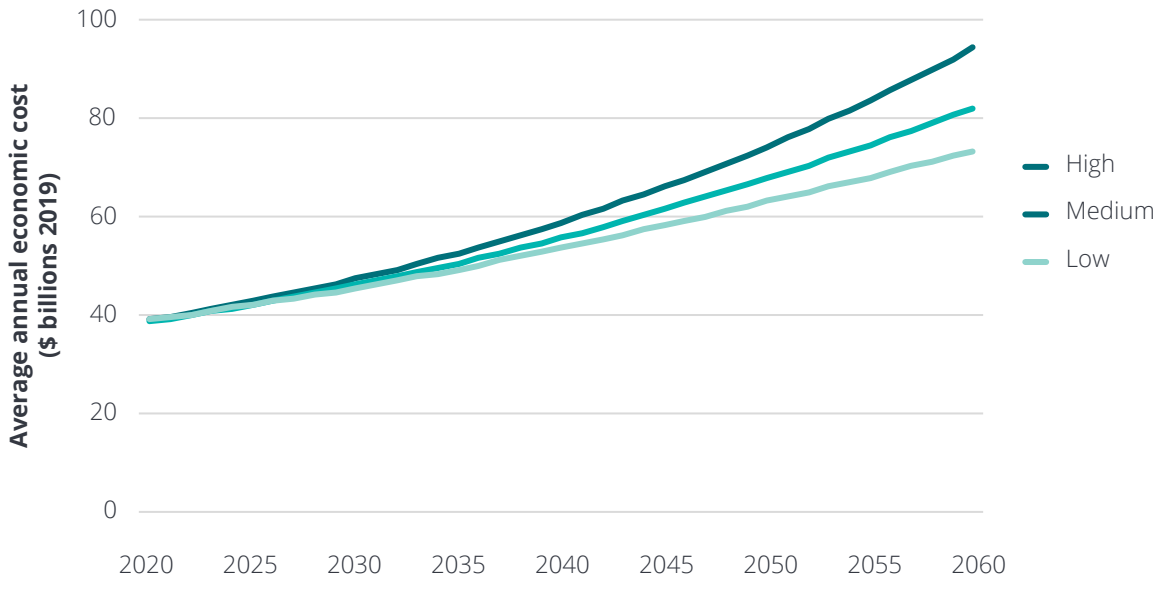


Source: Deloitte Access Economics 2021
Note: The costs associated with earthquakes are not expected to vary with climate change.

The impact of climate change on the total cost increase varies by disaster types. Under the higher emissions scenario, climate change will be the primary driver of growth in the cost of bushfires and coastal inundation events and will contribute to more than 30% of cost growth for flood and tropical cyclone events. Population growth accounts for more than half of the growth in cost for three out the six disaster types.

The impact of climate change also increases over time (see Chart 3.4). In 2020, total economic costs under the higher emissions scenario are only 0.02% more than under the low emissions scenario. In comparison, by 2060 annual costs under the higher emissions scenario are 29% more than the low emission scenario.

Chart 3.4: Time path of total economic costs, by emissions scenario



Source: Deloitte Access Economics 2021

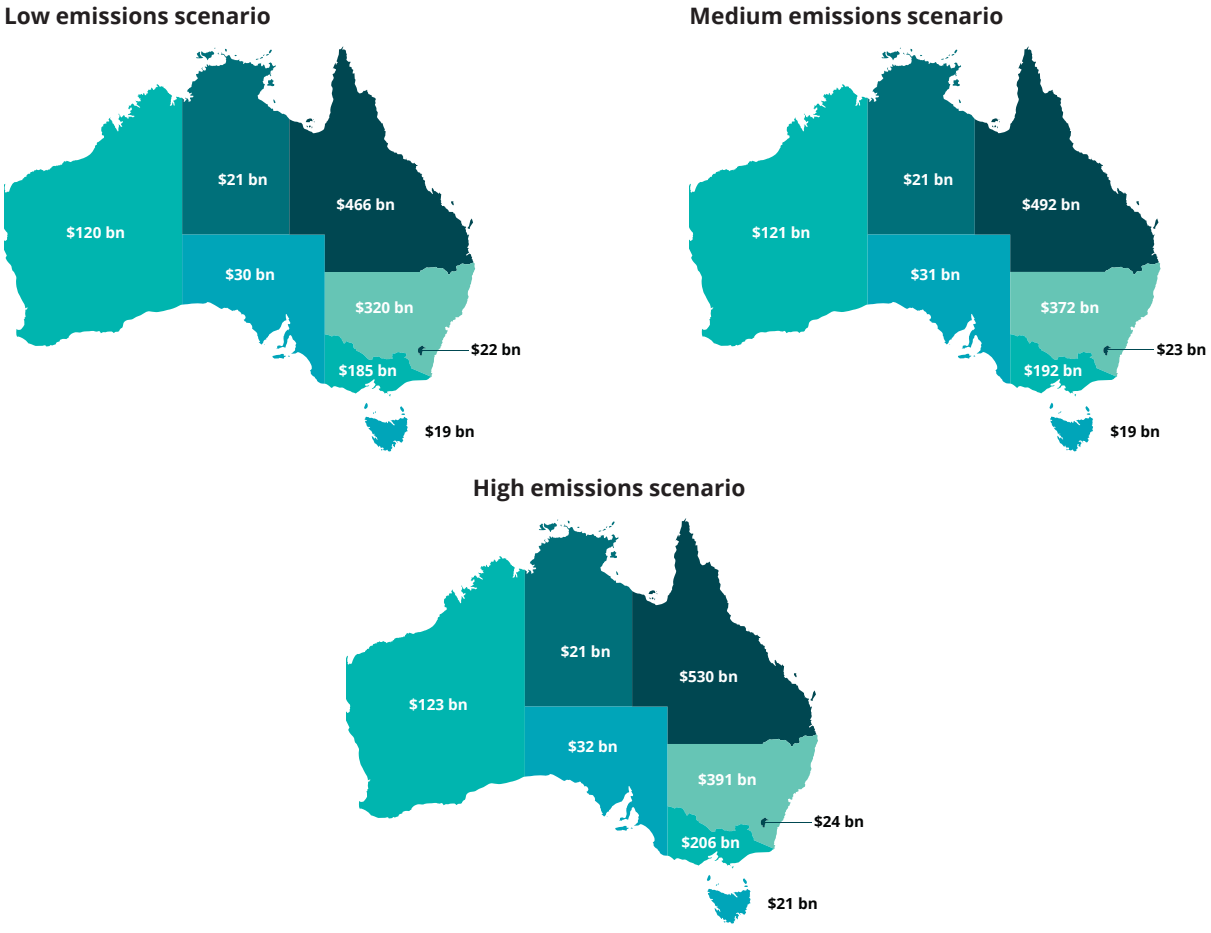
It is important to consider the compounding losses from natural disasters due to the interaction of these variables. For example, the effect of climate change will be larger due to population growth in high-risk areas or areas with high growth in asset value. As such, the impact of climate change in Chart 3.4 is a conservative estimate and requires recognition of its interaction with these other sources of increasing costs.

4.
States and regions most exposed to natural disasters

South East Queensland and North East New South Wales are expected to face the greatest increase in costs from natural disasters as the frequency and severity of some natural disaster events increases. These areas would benefit the most from greater action to address climate change and investments to improve natural disaster resilience.

Queensland is expected to incur the largest increase in costs related to natural disasters of any state, with an additional $64 billion in estimated costs in the high emissions scenario compared to the low emissions scenario over the next forty years (see Figure 4.1). In both scenarios, Queensland will account for nearly 40% of national costs. New South Wales follows, with an estimated increase of $31 billion in costs if the high emission scenario eventuates. Together, these states will contribute more than two-thirds of total national costs under all emissions scenarios.

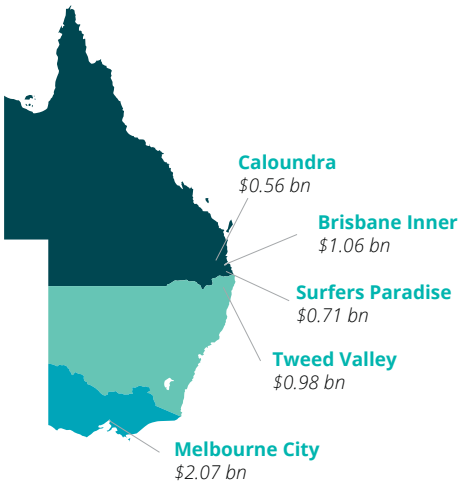
Figure 4.1: Total economic costs of natural disasters between 2020-2060 by state and territory



Source: Deloitte Access Economics 2021

Population centres in South East Queensland and North East New South Wales will see the greatest increase in natural disaster costs in a high emissions scenario relative to a low emissions scenario, as warmer oceans will enable tropical cyclones to move further south and increase exposure in these areas (Figure 4.2). Many of these regions will also see increased flood risk and rapid population growth.

Figure 4.2: Regions with the largest increase in costs for high emissions scenario (relative to low scenario), 2060



Source: Deloitte Access Economics 2021

The largest increases in the costs of natural disasters under a higher emissions future will occur in population centres located on major rivers, such as Melbourne City and Inner Brisbane. For Melbourne City, additional costs are largely attributable to forecast growth in costs from flood events. The growth in natural disaster costs in Brisbane City reflects both an increase in costs associated with tropical cyclone events ($1.4 billion per year under a higher emissions scenario compared to $0.73 billion per year under a low emissions scenario), and costs associated with flood events ($2.33 billion per year compared to $1.98 billion per year).

The areas facing the largest increases in costs related to a higher emissions scenario also face some of the largest increases in costs over time. Table 4.1 identifies the five regions with the largest increases in the costs of natural disasters between 2020 and 2060 under a higher emissions scenario. Melbourne City will have the highest costs per year by 2060 with $6.2 billion per year.

Table 4.1: Regions with the largest cost increases from 2020 to 2060 for the high emissions scenario

	2020	2060	Difference
Melbourne City	1.6	6.2	4.6
Brisbane Inner	1.0	4.3	3.3
Tweed Valley	0.9	2.4	1.6
Mackay	0.8	2.3	1.5
Surfers Paradise	0.3	1.7	1.4

Source: Deloitte Access Economics (2021)

Climate change will also lead to changes in the types of natural disaster threats regions face. In South Australia, the regions of Charles Sturt and Port Adelaide, which are located in and around the Port Adelaide harbour, will see a significant increase in costs associated with floods (see emerging disaster type in Table 4.1), which currently make up only a minor share of total disaster costs in these areas. Some coastal areas will also see a significant increase in costs associated with coastal inundation events. For instance, the region of Cronulla in Sydney's South will see annual costs associated with coastal inundation events increase six-fold between 2020 and 2060, from under $2 million to over $12 million.

Some country areas in Victoria and Western Australia will also face a growing threat from bushfires, which will make up an increasingly large share of total costs. For instance, the town of Bendigo in country Victoria and the region of Kalamunda located to Perth's East, will see the costs associated with bushfires almost double as a share of total disaster costs, from under 10% in 2020 to close to 20% in 2060. Finally, in a high emissions future, regions in South East Queensland and North East New South Wales will face a new threat from severe tropical cyclones, as oceans warm and move them further from the equator.

Table 4.2: Regions most at risk from new disaster threats in a high emission scenario

Region	Emerging disaster type	Cost profile in 2020		Cost profile in 2060	
		Total costs ($ million)	Contribution of emerging disaster type	Total costs ($ million)	Contribution of emerging disaster type
Charles Sturt (SA)	Flood	$59	6.3%	$191	56.5%
Ipswich Inner (Qld)	Tropical cyclone	$249	9.2%	$1,217	19.3%
Mid-West (WA)	Coastal inundation	$113	9.4%	$165	18.3%
Ipswich Hinterland (Qld)	Tropical cyclone	$122	8.5%	$516	18.3%
Bendigo (Vic)	Bushfire	$66	9.9%	$154	17.5%
Port Adelaide – East (SA)	Flood	$24	5.5%	$41	17.3%
Darwin City (NT)	Flood	$275	8.1%	$443	15.7%
Kalamunda (WA)	Bushfire	$34	8.8%	$61	16.0%
Clarence Valley (Qld)	Tropical cyclone	$432	4.4%	$624	13.2%
Cronulla - Miranda – Caringbah (NSW)	Coastal inundation	$62	3.2%	$102	12.2%

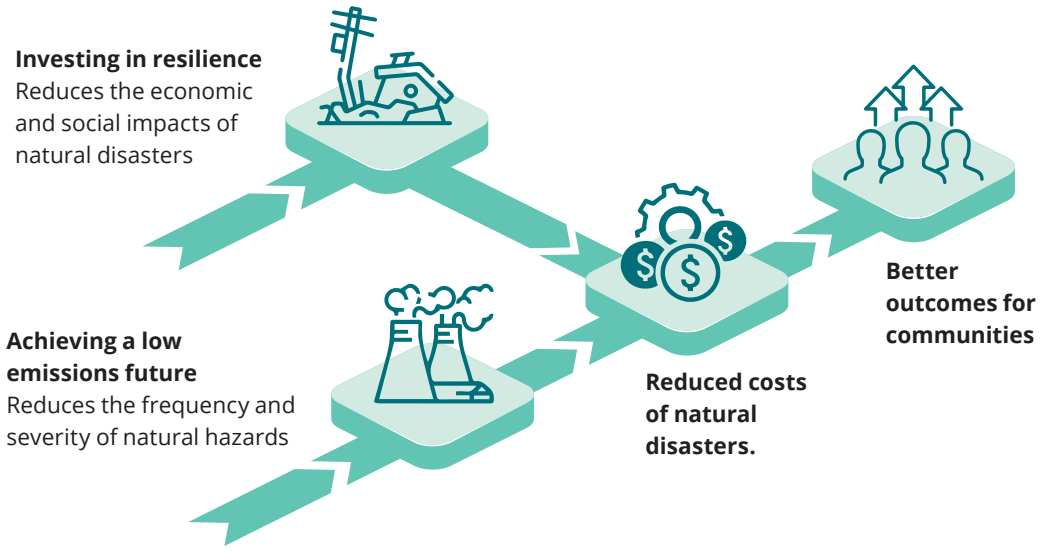
Source: Deloitte Access Economics (2021)
Note: Total costs presented are the expected value of annual costs of natural disasters in 2020 and in 2060. The emerging disaster type reflects the disaster type with the largest increase for that region.

5.
Implications for investment in resilience

Achieving a low emissions future coupled with increasing investment in resilience to natural disasters will deliver better outcomes for communities.

The Australian economy is facing $1.2 trillion in cumulative costs of natural disasters over the next 40 years even under a low emissions scenario. **This shows there is the potential for large economic gains from investments to improve Australia's resilience to natural disasters.** Targeted investments in both physical (such as infrastructure) and community (such as preparedness programs) resilience measures are predicted to significantly reduce the increasing costs of natural disasters. Investments in disaster resilience can be effective in lowering these costs, particularly if investments are maintained over a number of years.[18]

FIgure 5.1: Potential impacts from investments in resilience



Source: Deloitte Access Economics (2021)

Areas such as Melbourne, Brisbane, South East Queensland, and Northern NSW will face some of the highest escalating costs from natural disasters. These are significant population centres, integral to Australia's future economic prosperity. A deeper understanding of the potential costs and risks posed by different disaster types contained in this report should be used to **improve coordination and targeting of investments to avoid the impacts on some of the most vulnerable areas in Australia.**

Having identified the regions at significant risk, **all levels of government need to rise to the challenge and integrate natural disaster resilience into the future planning for Australia's cities and regions.** By working closely with affected communities to assess risks and vulnerabilities to natural hazards, better planning can ensure that appropriate natural disaster resilience measures are incorporated into managing both current communities, as well as future developments.

To promote this understanding and inform investment decision making, the Queensland Reconstruction Agency (QRA) has developed the Repeat Event and Dollars Index (REDI) to provide local governments with a heat map of historical damage and reconstruction spending. Currently, the REDI has mapped almost $5.5 billion worth of reconstruction costs over 10 years.[19] These types of decision-making tools could be useful if combined with forward looking indicators, such as the predicted temperature increases contained in this modelling.

Investment in disaster resilience give rise to additional co-benefits beyond avoided impacts. For infrastructure investments, co-benefits may include employment opportunities, improved service reliability, greater business confidence and incentives for innovation. Such co-benefits support economic growth and the deepening of social capital in Australian communities. Together, the avoided impacts of natural disasters and broader co-benefits from investing in disaster resilience provide a double dividend for impacted communities.

Yet, we know that a low emissions scenario is increasingly unlikely to be realised based on the IPCC's AR6. A high emissions scenario introduces an additional $125 billion in costs. It is imperative that **all levels of government, the business community, and broader society work together to realise a low emissions future to reduce the impacts of climate change on the frequency and severity of natural disaster events.** Delaying action will ultimately mean paying more later as the costs from natural disasters increase.

Now is the time to act as international momentum grows on the need to recognise and respond to the impact of climate change. Clear communication about the current impact of emissions on natural disasters is required to motivate more business leaders to take action now. One example is the international Task Force on Climate-related Financial Disclosures (TCFD), which was set up in 2015 to improve and increase reporting of climate-related financial information for use by businesses. These disclosures are allowing companies to incorporate climate-related risks into their strategic planning processes and ultimately empower financial markets to channel investments into sustainable and resilient business models.[20]

On a national level, there is increasing action being taken by the business community in Australia. The Net Zero Momentum Tracker records action taken by large companies and found that all 22 of Australia's largest emitters within the resource sector were taking steps to decarbonise their operations, with half committed to reducing their operational emissions in line with net zero goal by 2050.[21] More broadly, nearly three quarters of Australian Chief Financial Officers (CFOs) see environmental, social and governance considerations (including climate change) as an important consideration for their business and investor relationships.[22]

Efforts at securing a low emissions future must work hand-in-hand with broader investments in resilience to natural disasters to reduce the quickly growing costs from natural disasters in Australia.

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