



Economic reality check
Adapting Australia
for climate-resilient growth
January 2022

Deloitte
Access **Economics**



We need to break the cycle of our current, reactive approach to climate induced natural disasters and shift to forward thinking, planning and investment. We are working with community leaders, business leaders and government at all levels, to create highways to immediate and sustained action. This research is the first step in that journey. ”

Andrew Forrest
Chairman and Co-founder
of The Minderoo Foundation

AUSTRALIA-WEATHER-FIRES

Children play at the showgrounds in the southern New South Wales town of Bega where they are camping after being evacuated from nearby sites affected by bushfires on December 31, 2019. – Thousands of holidaymakers and locals were forced to flee to beaches in fire-ravaged southeast Australia on December 31, as blazes ripped through popular tourist areas leaving no escape by land. (Photo by SEAN DAVEY/AFP) (Photo by SEAN DAVEY/AFP via Getty Images)

Minderoo Foundation Executive Insight



As well as their devastating social impact, climate-induced extreme weather events including drought, fires, and floods have cost Australian communities an estimated \$120 billion over the past 50 years. That is expected to increase to \$150 billion over the next decade, rising to a staggering \$1 trillion by 2050 if we continue with business as usual.

At present, 97 per cent of all disaster spending in Australia¹ occurs after the event. New research commissioned by Minderoo Foundation from Deloitte Access Economics shows an immediate shift to climate adaptation (proactive investment to pursue climate resilience) combined with mitigation (proactively reducing greenhouse gas emissions), can save \$380 billion in GDP over the next 30 years. We call this the resilience dividend. As well as savings it will deliver positive economic benefits, including more than 73,000 additional jobs in the economy in sectors such as construction, transport, and manufacturing.

Much of the gain from adaptation in particular can be realised early – within the next decade – if investment is made now.

This is why we believe that climate change mitigation is only one side of the coin. Adaptation and mitigation are intrinsically linked and both are essential to how we approach climate change and its impacts. From investing in early warning systems and infrastructure resilience to community preparedness and improved building codes, climate change adaptation must now be considered a critical part of our approach.

Our research shows adapting to physical hazards caused by climate change builds resilience into the economy and into communities, and yields a triple dividend. Adaptation can avoid substantial losses from natural disasters; generate economic benefits by reducing risk, increasing productivity, and stimulating innovation; and deliver social and environmental benefits. Investing in adaptation strategies will help protect Australia by building resilience and reducing costs in the short term, allowing for the delivery of a better economic future.

The rapid increase in the cost of inaction means our window for positive change is closing. As the pace and scale of extreme weather accelerates and the burden on our systems grows, funding will continuously be redirected towards response and recovery efforts with limited ability to reduce sustained negative impact of extreme weather events.

The sooner Australia invests in adaptation, the sooner it will pay off. In fact, investment in adaptation by government and industry today are as significant as emissions reductions.

The time to act is now.

The Minderoo Foundation is already working with organisations in Australia and around the world who have created best-practice approaches to assess climate change risk and establish frameworks to invest in effective resilience. Doing nothing is not an option.

Globally, climate risk reporting using systems such as that of the Task Force on Climate-Related Financial Disclosure (TCFD)² is becoming mandatory for investors and companies. Australia cannot afford to be left behind. The interdependency challenge presented by climate risk requires a multi-disciplinary solution. A systems approach to adaptation brings together perspectives, knowledge, and skills from all parts of our economic, social, and environmental systems.

Recently, 27 per cent of 750 executives surveyed internationally in Deloitte's 2021 Climate Check report said that their companies are already feeling the operational impact of climate-related disasters and 26 per cent are facing scarcity of resources.³ Investing in resilience is now more important than ever.

Minderoo Foundation has developed and implemented a blueprint for change and is working with a comprehensive stakeholder network of over 50 government, business and philanthropic organisations. In the first 12 months of the program, a third of the roadmap has been activated so that Australian can become a climate resilience leader by 2025.

This report provides the basis for approaching climate risk analysis and the development of strategies to minimise negative impacts through adaptation before they happen. Case studies across the energy, services, health, agriculture, and construction sectors show practical examples of companies and organisations implementing resilience strategies.

For a climate-resilient Australia to become reality, we've identified five key steps all companies and organisations should take to understand climate risk and implement adaptation strategies:

- 1. Governance:** Establish a leader or team to be responsible for assessing risk and developing resilience
- 2. Shift focus:** Move from a post-disaster response approach to focus on preparation and investment in lifting resilience, proactively identifying and mitigating associated risks.

3. Build Partnerships: Develop a diverse network of multi-disciplinary experts from industry, government and your community to learn about and share best practice.

4. Strategy: Develop a blueprint for understanding and addressing climate risk including planning investment to minimise negative impacts.

5. Metrics and Targets: Set clear deliverables, timelines and measurements to track progress and communicate it to your stakeholders.

The Minderoo Foundation is leading the effort to build a national climate risk and resilience approach. We invite corporate, government and community leaders to engage with us and commit resources to this collective agenda.



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Report summary

Failure to act on climate change will increase costs nationally with more extreme weather events and damages in the next 10 years totalling a \$150 billion loss to the economy

Australia's window for action is narrowing. The latest Intergovernmental Panel on Climate Change (IPCC) assessment outlined a confronting climatic future in the absence of change. Even with the best mitigation strategies, warming of at least 1.5°C above pre-industrial times is now locked-in by historical greenhouse gas emissions.⁴

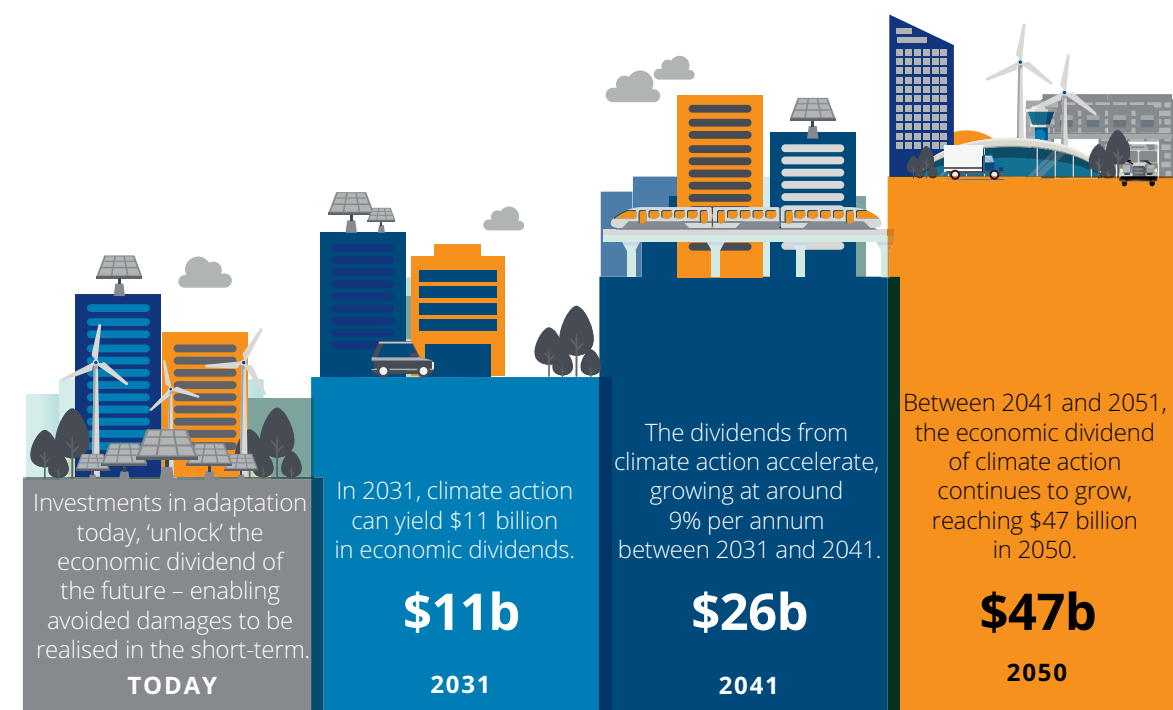
As the world warms, extreme weather events are expected to become more frequent and severe. This means the costs of extreme weather events to the Australian economy, communities and environment are expected to compound.⁵ Because the cost of extreme weather events in the future are not a linear extension of the past; they increase with the intensity and frequency of extreme weather events year-on-year due to climate change.⁶

Without rapid and significant climate action, over the next 10 years the loss to Australia's economy could reach \$150 billion (present value terms). This cost gets worse overtime with each year of inaction. Growing to a staggering \$1 trillion over the next 30 years to 2050 (present value terms). In its worst year in 2050, Australia loses 3.6 per cent of its GDP and 137,000 jobs due to inaction on climate.

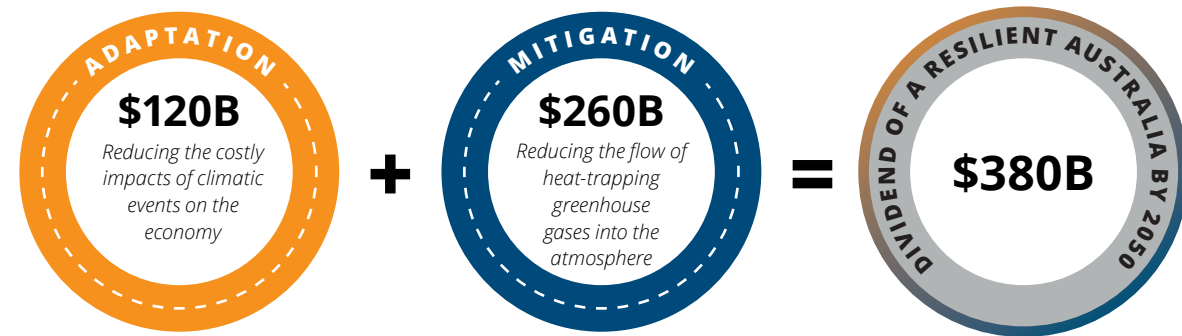
By investing in adapting now, Australia could avoid \$380 billion in worsening economic costs from climate change

Of the \$1 trillion economic cost of climate change over the next 30 years to 2050, **\$380 billion is avoidable through climate action that can be taken today. \$380 billion is the economic dividend from proactive action by industry, businesses, and governments to pursue climate resilience.** To put this in context, \$380 billion is greater than today's gross value added of the agriculture, mining and manufacturing industries.⁷ Actively pursuing climate adaptation strategies could save around 73,000 jobs in 2050.

The growing economic dividend of climate adaptation and mitigation



Total economic dividend of climate resilience by 2050



Source: Deloitte Access Economics

Adaptation underscores the economic dividend of \$380 billion, mitigation alone is not enough

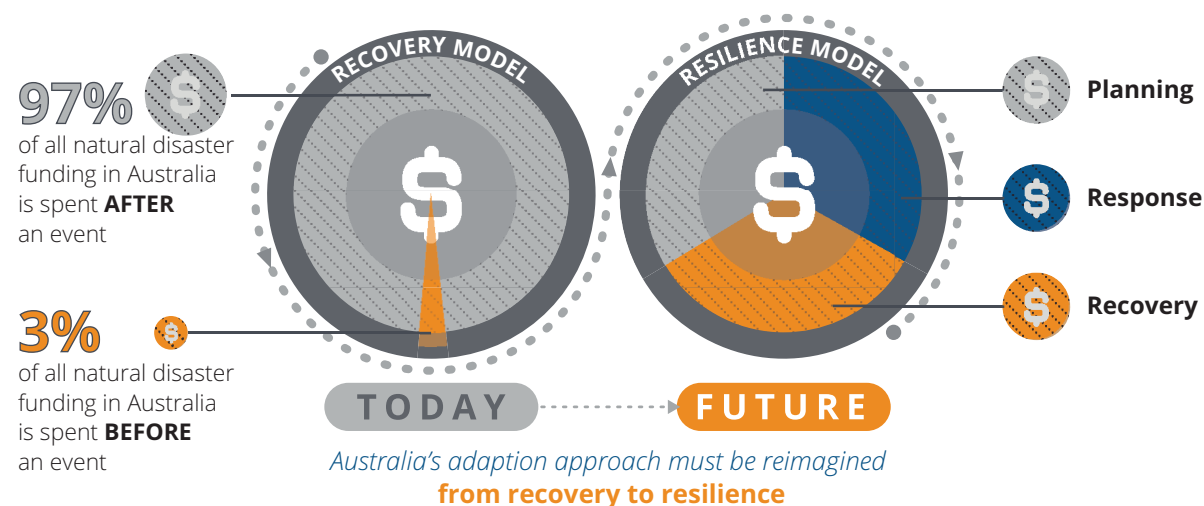
Mitigation involves reducing the flow of heat-trapping greenhouse gases into the atmosphere, either by reducing sources of these gases (e.g., the burning of fossil fuels for electricity) or enhancing the removal and storage these gases (e.g., ocean carbon sequestration).⁸ **Adaptation** involves adjusting to actual or expected future climate to reduce our vulnerability to the harmful effects of climate change.⁹

Mitigation and adaptation are linked to Australia's economic success. Mitigation is essential to reduce the magnitude of adaptation required in the future, while adaptation avoids locked-in impacts from historic emissions.

To realise the \$380 billion dividend of climate resilience, investment into both mitigation and adaptation is required.

A failure to do so could result in Australia missing the \$120 billion economic benefit from adapting Australia's economy to climate change and extreme events. And this adaptation is crucial for Australia today. The benefits of adaptation accrue from the time of investment, while the benefits of mitigation are realised overtime. Over the next decade, a significant proportion of the economic dividend from climate resilience is derived from investments in adaptation strategies.

Moving from recovery to resilience



Source: Deloitte Access Economics, Productivity Commission¹¹

Australia's adaptation approach must be reimagined from recovery to resilience

The impacts on our lives and livelihoods in the aftermath of natural disasters has meant that to date much of Australia's focus has, rightly, been on ensuring adequate support for affected communities to recover and rebuild in the aftermath of extreme weather events. The Productivity Commission estimated that 97 per cent of all natural disaster funding in Australia is spent after an event, with just 3 per cent invested prior to an event to prepare for the impact of future disasters.¹⁰

This focus – remaining reactive to managing natural disasters – with government acting as a lender of last resort is untenable in a world with locked-in climate change loss. Australia's capacity to provide recovery support, at an increased rate and scale will diminish as climate impacts increase.

Proactive adaptation is the only viable future option in building economic resilience. As the examples considered in this report show, this can take many forms, from choosing resilient building materials and improving building codes for greater durability, through to relocating critical assets to locations less likely to experience extreme weather. Building resilience through investments in adaptation enables economic, social and environmental structures to withstand extreme weather events and recover quicker, at lesser cost.

Reimagining Australia's approach to adaptation requires system wide coordination, everyone is responsible

Current underinvestment in planning, preparation, and resilience is often the result of a lack of information or understanding about how to assess possible adaptation investments. Across the adaptation landscape, there exist multiple decision makers across industries and regions. Each decision maker is responding to different needs from employees, shareholders, levels of governments, and diverse community views. This complexity prevents the costs of adaptation from being shared and undervalues the benefits of these investments. And this is all made more difficult by a lack of information on what works, and what to do today.

To overcome this and move from recovery to resilience, a system-level response is required. A systems approach brings together perspectives, knowledge, and skills from all parts of our economic, social, and

Data to enable climate risk decision making

The importance of **data for decision making** that builds resilience is widely recognised, but not applied well. Without access to consistent data, decision makers lack the evidence base to assess risk and make informed decisions about the best resilience options. **Getting data right is critical for resilience.** Data can be a precursor to adaptation planning and investment. The use of data cuts across all systems and phases involved in the disaster resilience cycle: before, during and after disaster strikes. Transgrid for instance, uses modelling to predict bushfire risk to minimise the exposure and vulnerability of its assets. With the findings forming the crux of Transgrid's' Asset Management Renewal and Maintenance Strategies (see Chapter 4 for detail). Where the window to invest in adaptation is narrow, this means the time to invest in data for building resilience is narrower. Australia's economy cannot afford to get this wrong.



environmental systems. And this approach requires better information to make decisions quickly to realise the economic dividend. Minderoo Foundation has implemented a mission model systems approach for building national disaster resilience to tackle hazard exposure, risk and vulnerability through its resilience Blueprint.¹²

Embedding adaptation into core operations will help to realise the economic dividend

Adapting to climate change presents a \$120 billion economic benefit. The evolving adaptation landscape provides opportunity for innovation and investment with co-benefits for Australia's economy, through job creation, spill over investment opportunities and renewed growth potential. Firms across all sectors who embed resilience in the way they work can create a legacy of growth and stability.

But for many boards and executive teams, this is a new, complex, and rapidly changing landscape to keep up with. The need to act is clear, but the path forward is not.

To increase stability and potential for growth, climate change adaptation needs to be core to business, it requires organisations to:

1. Turn identified risk and opportunity into strategies

- The first step for organisations is to invest in understanding their risks and risk channels through their operations, such as through the use of climate risk modelling specific to their organisations key risk variables. This understanding can then be used to develop a vision of resilience and strategy that will guide their decision making across all aspects of their operations.
- The type of understanding of risk will vary across sectors, from understanding organisations internal risk (e.g., the degree of risk across the organisation's asset base – known as financial risk) through to risk that may impact the ongoing operations in the event of extreme weather events (e.g., supply chain risk or impacts on labour productivity over time known as physical risk).

2. Implement and transform operations

- Informed by the first step, implementing the strategy across the organisation's workforce, operations and capital investments is at the core of embedding resilience. This is the activity of explicitly translating the understanding of risk into processes and decision-making, so it becomes business-as-usual. In this step, decisions on capital investments and selections of supply chain partners take into account natural disaster risks. Employees are trained to effectively identify and address risks in day-to-day decisions.

3. Measure and disclose

- Crucially, embedding resilience into core business requires the organisation to be able to continuously adapt and learn from shocks. This is where incorporating measurement and reporting against adaptation and resilience building activities – particularly in the aftermath of an extreme weather event is critical.

There is a need to understand what resilience looks like today. Case studies are featured in this report across the energy, services, health, agriculture, and construction sectors show practical examples of organisations that are currently implementing resilience strategies. These industries will be confronted by the most severe climate damages, but also have the greatest gain from building resilience and adaptation strategies early. By following the key steps our report outlines to approach climate risk management and develop an adaptation strategy, including working with organisations such as the Minderoo Foundation, companies and organisations can avoid the worst impacts and costs and benefit from early action.

Climate-led transformation framework



Resilience case studies in summary

The energy imperative

The energy sector is at the core of climate change adaptation and mitigation, being susceptible to both the physical risks as result of climate change, and transition risk as Australia's energy mix shifts away from fossil fuel and towards clean energy sources. Embedding resilience into core business will enable the energy sector to realise a \$1.0 billion annual dividend in present value terms by 2050. This report uses Ausnet and TransGrid as case studies to demonstrate how scenario modelling could be used to understand risks and manage assets in the context of adaptation.



The construction imperative

The construction sector, its workers and profits are exposed to the increased frequency and severity of extreme weather events. Embedding resilience into core business will enable the construction sector to realise a \$3.8 billion annual dividend by the year 2050. This report uses Dexus as a case study to demonstrate how an organisational model could be aligned to build resilience.



The service sector imperative

The service sector has the most to gain from climate adaptation and mitigation. Embedding resilience into core business will enable the service sector to realise a \$19.6 billion annual dividend by the year 2050. Banks, insurers and investment funds are exposed to increased credit risks, greater investment uncertainty, and changing policy environment. The health sector is at the forefront of the disaster response.

This report uses Suncorp and Insurance Australia Group (IAG) as case studies to demonstrate how climate risks could be assessed and accounted for in designing financial products. This report also uses Kaiser Permanente to demonstrate how operations could be configured to better provide support when climate disasters occur.



The agriculture imperative

Changing weather patterns and intensifying climate-related weather hazards such as drought and floods have the potential to reduce yields and expose the agriculture sector to significant economic losses. Embedding resilience into core business will enable the agriculture sector to realise a \$5.0 billion annual dividend by the year 2050. This report uses Elders as a case study to demonstrate the use of technology and data in improving the effectiveness of adaptation. This report also uses Queensland Government's Land Restoration Fund as a case study to demonstrate how government can encourage carbon farming while delivering environmental, social, economic and Indigenous co-benefits.



A disastrous outlook

For many Australians, decades have been marked by natural disasters. From the '74 and 2011 floods in Queensland, to the Black Saturday bushfires in Victoria and the Millennium drought – we know the devastating impact natural disasters can have on our lives and livelihoods.

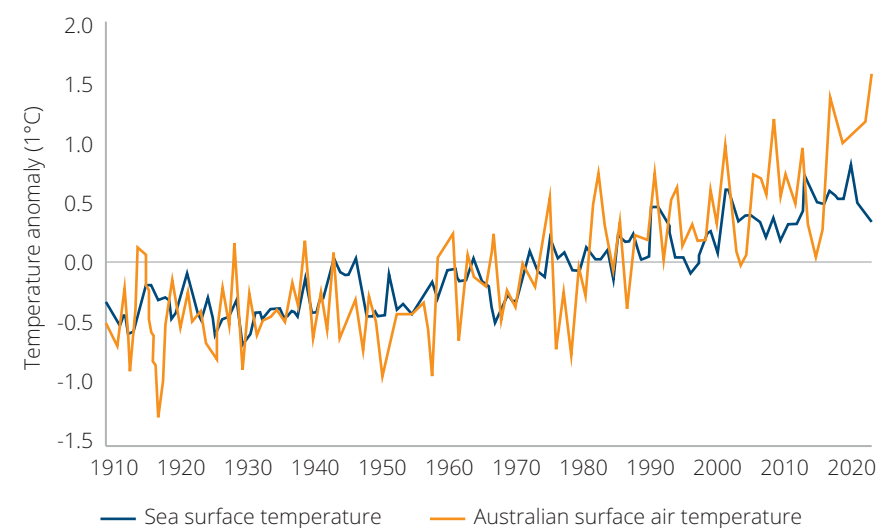
Even if Australia made every possible effort to reduce emissions, it could **take years for mitigating actions implemented today to have an impact** on the global temperature.

Natural disasters will cost Australia significantly.

A 2017 report commissioned by some of Australia's largest corporations and the Red Cross estimates by 2050 the total cost of natural disasters in Australia could be twice the cost of all natural disasters in the decade to 2016.¹⁵ The World Economic Forum identifies climate action failure and extreme weather events as the **most likely long-term risks we face over the next decade.**¹⁶ This not only underpins the seriousness of inaction, and the long-term costs associated with it, but also indicates the tremendous benefits that can be gained by minimising these long-term risks via adaptation in the short-term.

The recent release from the IPCC outlined a confronting climatic future in the absence of change. Even with the best mitigation strategies, **warming of 1.5°C above pre-industrial times is already locked-in** to the earth's atmospheric system through historic greenhouse gas emissions.¹³

This means, regardless of our actions to decarbonise today, **we have already locked-in damages.** We know there will be hotter days, fiercer fires and bigger storms and they will all be more frequent.¹⁴ Most concerning, the distribution of these events is changing, with communities and assets exposed that were not designed to cope with their impacts. Sea levels are also rising, posing existential threats to coastal communities, and amplifying the impacts of other extreme weather events.



Every year is now warmer than the range it would have been in a world without human influence, known as climate change 'emergence'.

2019 was Australia's hottest year on record, due to the combination of climate variability and long-term warming. This is expected to be an average year in a world where the global mean temperature is 1.5°C above the pre-industrial baseline period of 1850-1900

Source: Bureau of Meteorology, 2020, State of the Climate



An increase in frequency and intensity of extreme weather events makes one thing clear: there's a limit to how much Australia's economy and society can recover from extreme weather events.

With locked-in damages from climate change, mitigation alone is insufficient. Adaptation is key to protect Australia's economic future.

The economic benefit of a resilient Australia is \$380 billion. Of this total resilience dividend, over \$120 billion or approximately a third comes from initiatives specifically relating to adaptation.



1 The climate resilience dividend

1.1 The full climate response dividend

Shock after shock, Australians have responded generously to support those most affected in the aftermath of natural disasters. Over the last 50 years, the economic cost of climate induced natural disasters in Australia is estimated to AU\$120 billion, or 54 per cent of economic losses in the entire South-West Pacific.¹⁷ Over 350 lives have been lost, millions of hectares of bushland have burnt and there has been irreversible damage to communities, livelihoods and cultural lands.¹⁸ **In response to such devastating losses, Australia has spent billions to support affected communities in the aftermath.**¹⁹

Looking ahead, we face an increase in frequency and intensity of extreme weather events. This makes one thing clear: there's a limit to how much Australia's economy and society can recover from extreme weather events.

We do not have the ability to prevent natural disasters from happening, at least in the short term. What we do have is an opportunity to invest strategically in embedding resilience across our social, economic and environmental structures.

Resilience is the ability of an exposed system, community or society to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management.²⁰

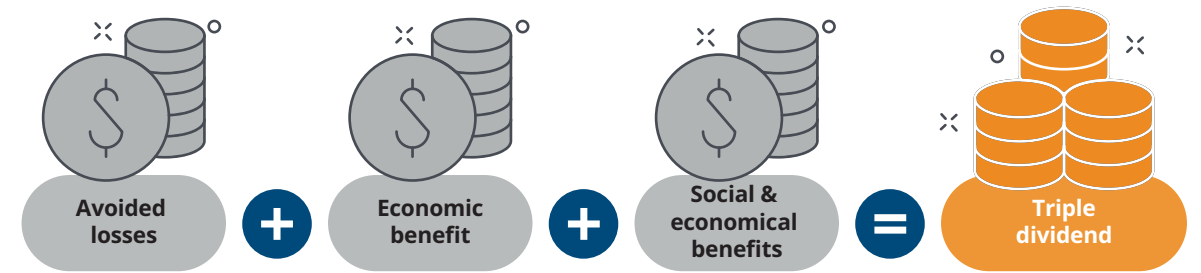
Adaptation is about building resilience. Without strategic investments in disaster resilience, defined below, Australians will not reap the benefits of a well-balanced response to the impacts of climate change that occur today and will continue into the future. Primarily, this is because economies, environments and communities that lack resilience create a drag on productivity.

The **benefits of adaptation, on the other hand, accrue on an ongoing basis from the time of investment.** As these benefits will be realised in the near-term, they can be considered "no regret" options.²¹

But adaptation alone is not sufficient. **Mitigation strategies are also critical** by reducing the flow of heat-trapping greenhouse gases into the atmosphere to constrain climate change, reducing the frequency and severity of extreme weather events.

Any climate change response, therefore, needs to involve both adaptation and mitigation. Adaptation is not an alternative to a redoubled effort to stop climate change, but an essential part of it.

Adapting to build resilience yields a triple dividend. It can avoid substantial losses from natural disasters; generate economic benefits by reducing risk, increasing productivity, and stimulating innovation; and deliver social and environmental benefits. Investing in adaptation strategies will help protect Australia by allowing us to build resilience and reduce costs in the short term, allowing for the delivery of a better economic future.



The public and private sector must reframe and use climate adaption as an opportunity to create economic value and embed it into everything we do. Adapting to climate change no longer constrains growth and increases costs but provides an opportunity to gain competitive advantage in a rapidly changing economic environment.

The evolving adaptation landscape provides opportunity for innovation and investment with co-benefits for Australia's economy, through job creation, spill over investment opportunities and renewed growth potential. By investing in data and technical capabilities to support adaptation, Australia can leverage its innovation potential and become a market leader in exporting innovative adaptation solutions.

In this new economic climate, businesses are not constrained by decarbonisation. Rather, they are catalysts of change. **So, what is the economic dividend of resilience in Australia?**

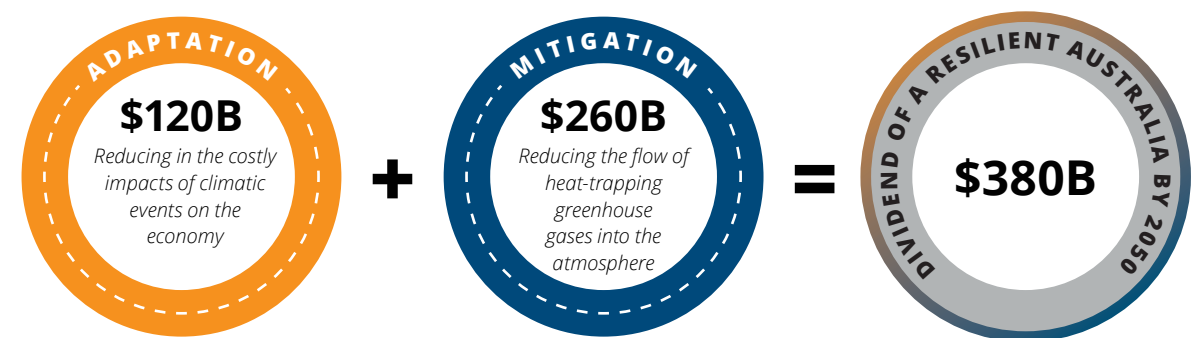
1.2 The economic dividend of a resilient Australia

When considered together, Australia's economy can avoid \$380 billion in economic costs compared to an economy that does not mitigate and adapt in response to climate change, in present value terms by 2050.²² That is, the Australia's economy stands to gain \$380 billion in GDP by mitigation and adaptation. This is the full economic gain from proactive action by industry and government to pursue adaptive strategies, resilience building initiatives and emission reductions.

Of the total resilience dividend, over \$120 billion or approximately a third of all relative gains to 2050 comes from initiatives specifically relating to adaptation.

Figure 1.1 The full climate change resilience dividend

Total economic dividend of climate resilience by 2050



Source: Deloitte Access Economics

There are two key factors that lead to the total economic dividend, each with distinct timing:

- **Adaptation and resilience:** Deliberate initiatives to further climate adaptation strategies and build resilience lead to reductions in the costly impacts of climatic events on the economy. These actions can take various forms and could range from relatively low-cost options such as early warning systems or community preparedness programs to more substantive undertakings such as changes to building codes and construction guidelines. Due to the breadth and timing of these opportunities, the positive impacts from adaptation and resilience initiatives can be experienced immediately and continue to accrue and grow over the period to 2050.²³
- **Mitigation:** Efforts to decarbonise and reduce emissions aim to limit global warming to as close to 1.5°C – or well below 2 °C – by the end of the century. Reflective of an RCP2.6 scenario (compared to around 3°C of global average temperature increase under an RCP6.0 scenario). This lower temperature trajectory leads to less severe and less frequent extreme weather events. However, it takes time for these impacts to be fully realised due to the nature of the global climate system.

This points to a simple conclusion: investments in adaptation and resilience are critical to avoiding the impact of climate change on the economy in the short and medium term, especially over the next decade.

1.2.2 The economic dividend by industry

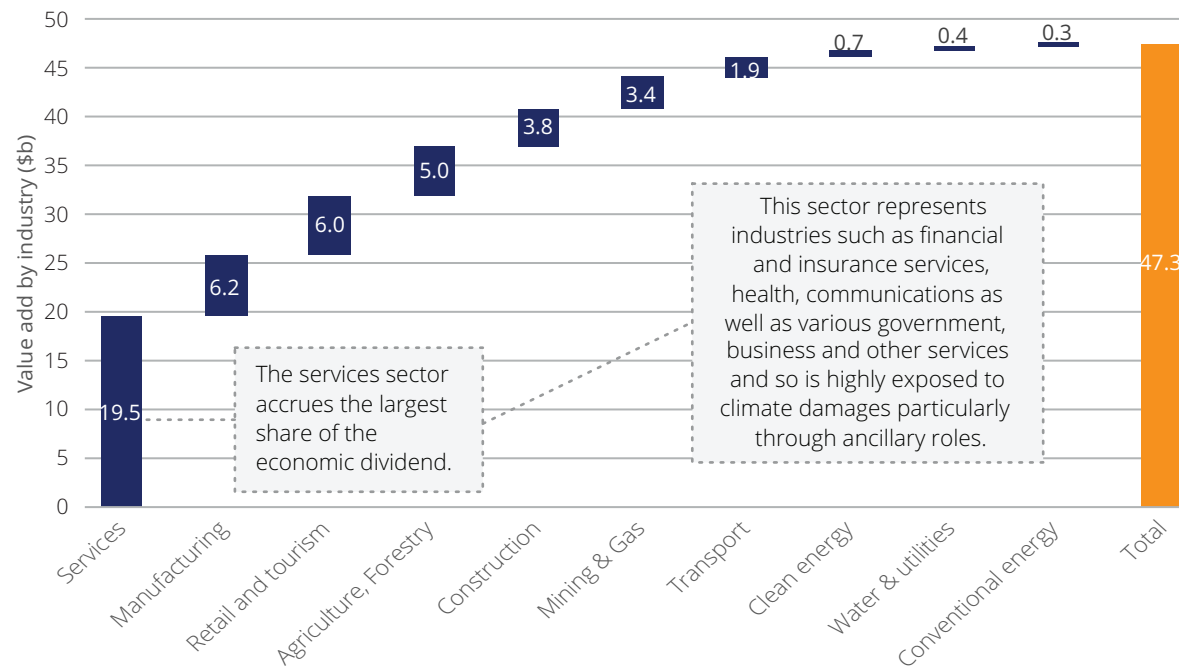
Underlying differences in the productive nature of industries (i.e., the significance of labour, capital, land, natural resources or intermediate inputs in the economic activity of an industry) results in an uneven distribution of these economic benefits across sectors (Chart 1.1).

As a diverse sector, and a key input to all other sectors of the economy, the services sector accrues the largest share of the economic dividend. Comprising of industries highly exposed to climate risk – such as insurance and other ancillary service-based industries – these industries stand to gain directly from avoided economic costs.

Primary and secondary producing industries (which include manufacturing, agriculture, forestry and mining and gas) also experience sizeable shares of the remaining economic dividend. As major employers and users of capital, these industries benefit directly from adaptation and mitigation improvements to worker productivity and reductions in capital damages.

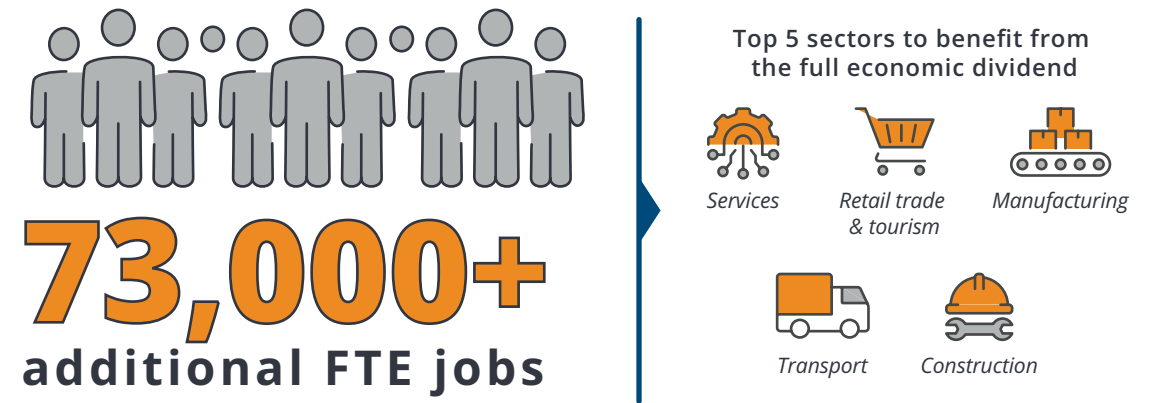
These benefits to industry support further employment opportunities for Australians across a range of sectors. The combined economic dividend yields employment impacts estimated to support more than 73,000 additional FTE jobs in the economy in 2050 (relative to the counterfactual). In general, these jobs accrue to those industries with the greatest share of the economic dividend (refer Chart 1.3).

Chart 1.1 Economic dividend of mitigation and adaption by sector, in 2050



Source: Deloitte Access Economics

Chart 1.3 Employment impacts associated with adaptation and mitigation, in 2050



Source: Deloitte Access Economics

Economic damages from natural disasters – a costly reality but an opportunity for adaptation

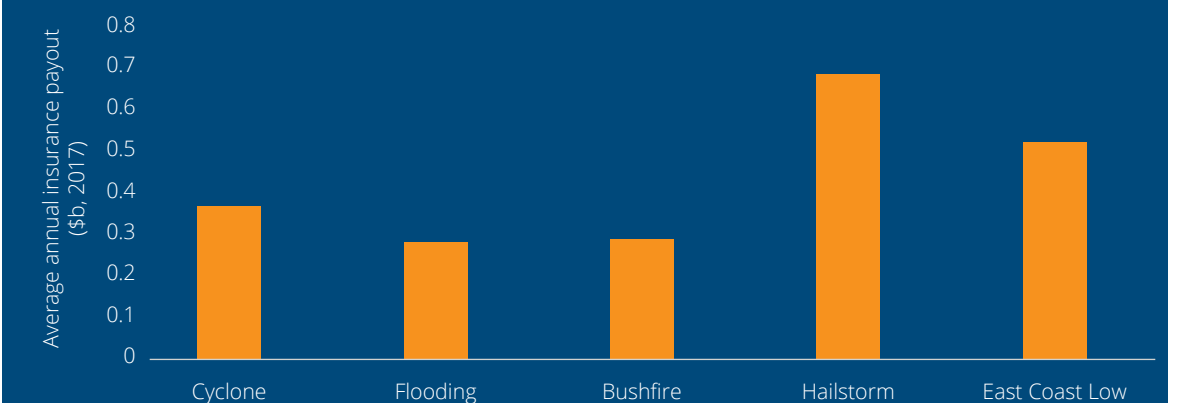
Insurance losses offer a tangible insight into a component of the physical risk of natural disasters and the impact of climate change. With climate change likely to lead to increased frequency/severity of these natural disasters, climate change is ‘front of mind’ for many major insurance companies.

Average insurance payouts for natural disasters in Australia cost insurance companies billions of dollars every year (Chart 1.2). Cumulatively, these insurance losses have topped \$98 billion since 1966.²⁴ Given that most public and many of the largest private assets are self-insured, and most individuals are under-insured, this is likely to be a significant under-estimate of actual losses sustained.

To meet the challenges of increased frequency and severity of natural disasters, insurers have developed an increasingly sophisticated ability to measure the risk faced by individual policyholders. This has enabled insurers to identify and avoid high-risks areas either through increasing premiums or declining to offer cover. For disaster prone Northern Australia since 2007, average home building insurance premiums have risen by more than 178 per cent for home insurance, and 122 per cent for combined home and contents insurance.²⁵ APRA has raised concerns that the impact of climate-related risks on insurance is the possibility that general insurance might become unaffordable or even unavailable in parts of Australia.²⁶

Adaptation and resilience represent an opportunity to reduce these impacts not just for the Australian insurance industry but for individual homeowners and other asset owners.

Chart 1.2 Average annual insurance payout by catastrophe type (\$b, 2017)



1.2.3 The narrowing window of adaptation opportunity

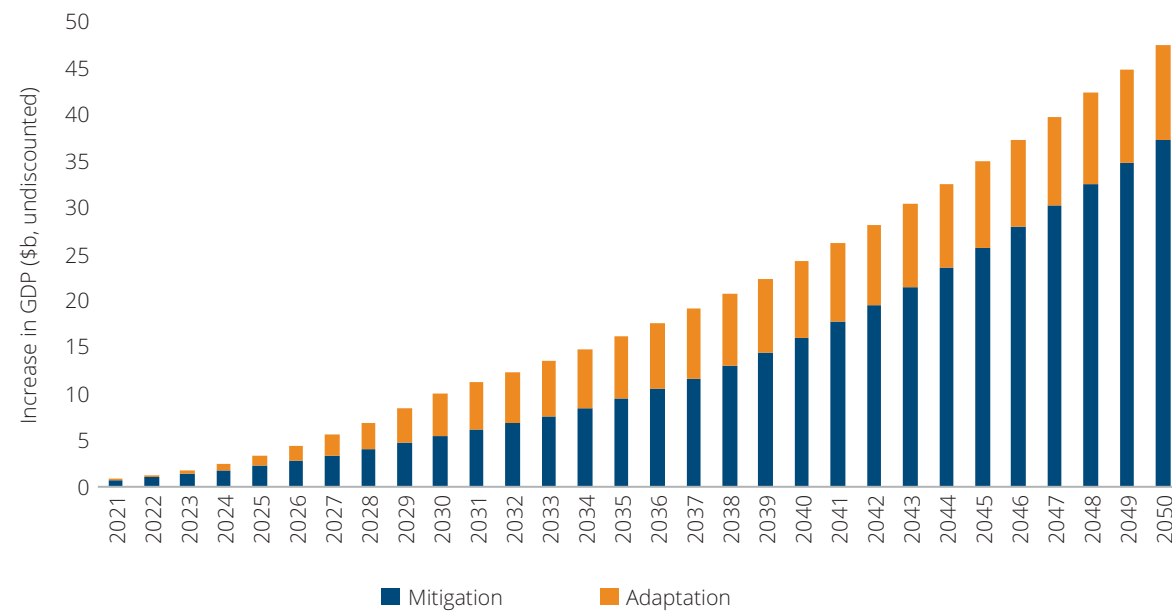
While actions to reduce emissions yield positive impacts – particularly over the long-term – adaptation leads to immediate economic benefits and plays a fundamental role in reducing the impacts of a warming world. In fact, **concerted actions on adaptation by government and industry today, are as significant as emissions reductions in achieving the economic dividend available in 2031.**

As the pace and scale of extreme weather events is set to accelerate due to climate change, the costs of extreme weather events will continue to rise and burden our systems. Funds will continuously be redirected towards response and recovery efforts that have limited ability to reduce the sustained impact of extreme weather events. This is especially true when recovery efforts only aim to replace damaged assets with similar ones, rather than aiming to improve the adaptive capacity of the communities.

Over the next decade (to 2031), the dividend from adaptation is more than \$19 billion in present value terms. However, the economic benefits of this quantum cannot be achieved unless we act today. Only through immediate actions that build resilience can the economic dividend available in future years be ‘unlocked’ and tangibly realised. **In fact, the sooner Australia acts, the sooner we can realise the economic dividend.** By putting off action, we only build up costs and delay the benefits.

Not only is adaptation essential to Australia’s climate response in the short-term, but the economy continues to benefit from the economic dividend in a compounding fashion to 2050. Even in 2050, where much of the benefit from emissions reductions under a deep decarbonisation, near net-zero pathway (limiting warming to well below 2°C) are realised, adaptation continues to yield increasing benefits in excess of \$10 billion per annum. This represents more than 20 per cent of the total economic dividend available in 2050.

Chart 1.4 The total economic dividend available through adaptation and mitigation



Source: Deloitte Access Economics

The conclusion is clear. The sooner Australia adapts, the sooner the economic dividend can be realised. Actions on climate **without** consideration for the role of adaptation **miss the mark.**

Photo by Xin Yen Goh/EyeEm EyeEm/Man on Field Against Sky via Getty Images



2 The cost of inaction

The damages of climate change bring both extreme economic costs and serious social burdens. Notably, these damages are not simply a result of inaction from today onward. The lack of action in the past has already locked-in some of these costs.

To lessen the impact on Australia's economy and its people, immediate and strategic investment in adaptation is essential. This can only be done by first understanding what Australia stands to lose as the impacts of climate change intensify.

2.1 The future we will have to face

As the world heats up, extreme weather events are expected to continue to occur more frequently. In Australia, floods, fires, heatwaves, and storms have occurred more frequently in many cities, at a great cost to the Australian people, communities, and economy.²⁷ Deloitte Access Economics' *Building Resilience to Natural Disasters* in our States and Territories report estimates the total economic cost of natural disasters is growing and will reach \$39 billion per year by 2050. These acute costs include significant, and often long-term, social impacts, including death and injury and impacts on infrastructure employment, education, community networks, health and wellbeing.

But the costs from extreme weather events are only part of Australia's climate change story – Deloitte Access Economics' analysis of the chronic economic impacts of climate change in a *New Choice: Australia's climate for growth* revealed there is a potential \$3.4 trillion present value loss to the economy by 2070 due to inaction on climate.

Further, the Carbon Disclosure Project estimates that assets worth US\$970 billion are at risk of damage due to climate change.²⁸ In fact, more than half of these losses are expected to occur over the next five years.²⁹

The acute and chronic costs of climate change will impact the economy through damages to capital, labour productivity, and business continuity. With a cross-sectoral impact, no industry will be immune to the impacts of climate change. Damage to capital in one industry means higher prices or delays to another.

By 2050, climate change induced costs to Australia's economy from chronic and acute impacts will total approximately \$973 billion in present value terms, compared to a world without climate change. In a matter of just 30 years, the devastating effects of climate change are already hitting Australia, causing widespread costs across the economy. Physical capital is damaged, labour productivity diminished, and business operations are disrupted.

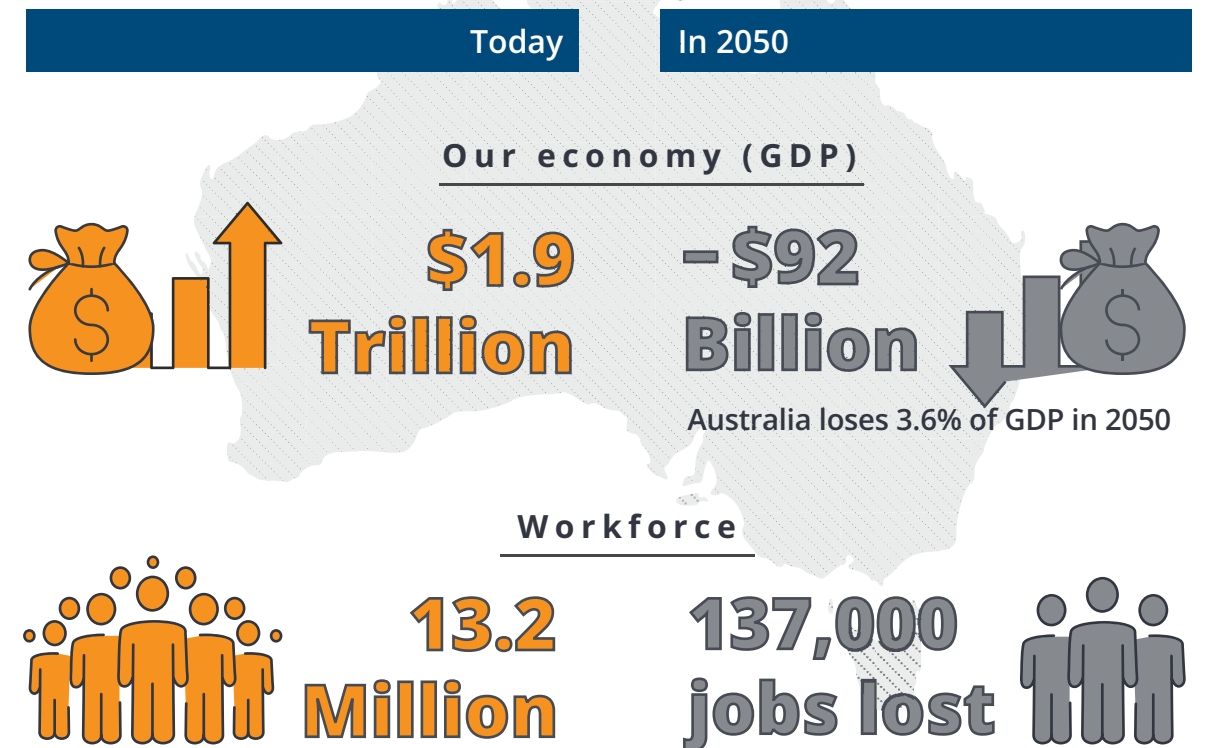
A loss on this scale by 2050 is equivalent to almost half of Australia's current GDP (as of 2021). To put this in perspective, the cumulative costs of climate change by 2050 are equivalent to losing the current size of Australia's entire mining, health care and social assistance, construction, financial and insurance services, and manufacturing industries.

In the modelled economic future, Australia loses 3.6 per cent of its GDP – \$92 billion – in 2050 alone. These costs have also meant that Australia's workforce will have 137,000 less jobs than it would be in the world without climate change in 2050.

It is important to note that these costs are not severe only in 2050. **The costs of climate change ramp up quickly, and the longer they are left to build up, the harder it is to recover from them.** In just ten years' time, the Australian economy is already suffering. By 2031, Australia's economy will have suffered costs totalling \$174 billion. In 2031 alone, Australia will lose 1.4 per cent of its GDP, or \$36 billion. In ten years' time, the costs to workforce have also already begun to take hold, with Australia's workforce expected to be 51,000 FTE jobs smaller than it otherwise would be without climate change.

Figure 2.1 The costs of unmitigated climate change to the Australian economy

The costs of unmitigated climate change and a lack of adaptation strategies are clear



Source: Deloitte Access Economics; ABS 2021

Compounding costs

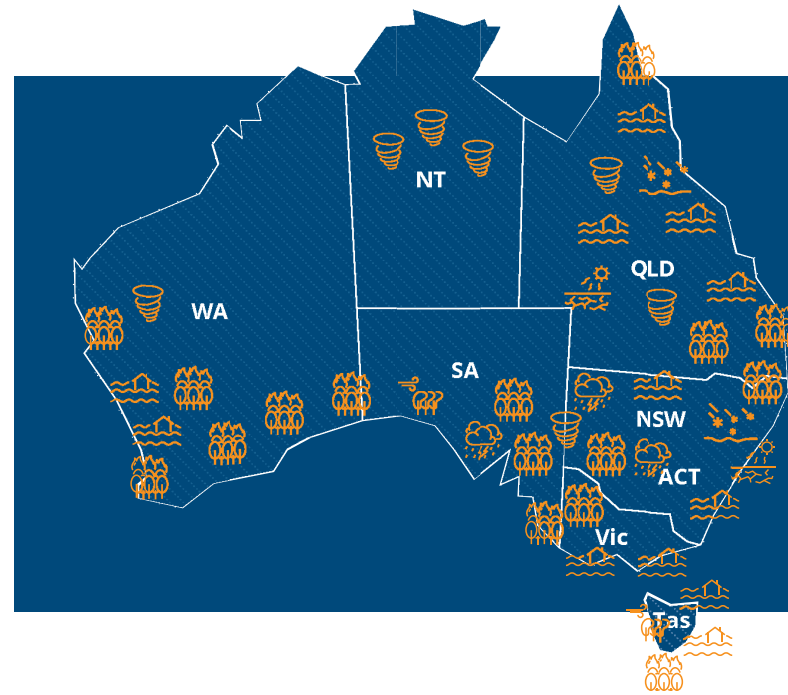
The real impact of inaction lies in the fact that climate change costs compound, damaging the economy and creating feedback loops, which continuously worsen the impacts over time. As such, the costs of climate change to the economy are non-linear, instead growing exponentially as the intensity and frequency of extreme weather events increase year-on-year.³⁰ Actions taken can impact these loops, lessening their effect through adaptation, or worsening them through inaction.

The costs caused by extreme weather events are already taking their toll on economies across the globe, but currently these events occur at intervals that allow local communities to gain ground on recovery before the next one hits. However, as temperatures rise and the effects of climate change intensify, these extreme weather events will only grow in both intensity and frequency. As this occurs, extreme events begin to compound on each other, causing a spiral of costs as extreme weather intensifies the effects of other extreme events.

This compounding nature of climate costs underpins the severity of this phenomenon and highlights why Australia's economy stands to lose so much in the face of climate change.

Accordingly, it's imperative that action is taken now. Systems of adaptation implemented now have the potential to save lives and the economy as extreme weather events increase in intensity and severity.

Australia's communities and cities are exposed to increasing frequency and intensity of floods, fire, heatwaves and storms

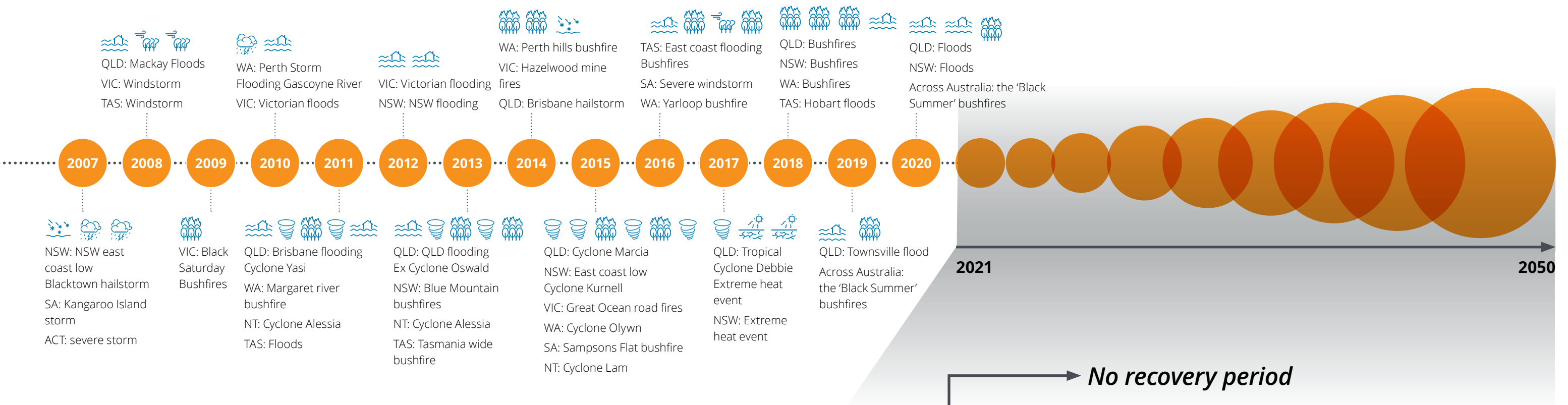


The window for action on adaptation is narrowing

Extreme weather events impact Australia's adaptation system through
People | Government | Economy

Without strategic investments in disaster resilience, Australia will continue to on the response and recovery cycle.

Soon, that strategy will no longer be feasible. By the time Australia is subjected to increased frequency and severity of extreme weather events, our economic, social and environmental systems will also be contending with the chronic impacts of temperature increases.



Continuing on the disaster response and recovery treadmill is not a long-term strategy.

The increasing frequency and intensity of extreme weather events will erode Australia's adaptive capacity.

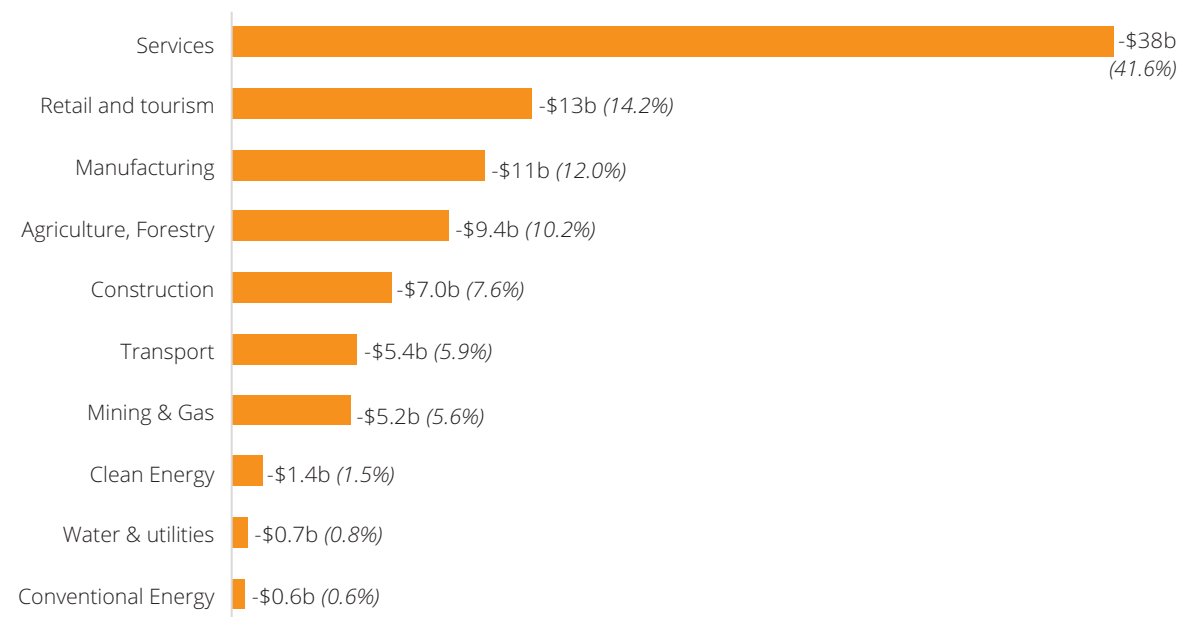


No recovery period

When extreme weather events begin to consistently overlap, there is insufficient time and resources for our economic, social and environmental systems to recover.

Each year, the acute costs of extreme weather events will grow in intensity and frequency, which creating a compounding effect and reduces our adaptive capacity.

Chart 2.1 Industry share of total damages (\$92 billion) in 2050



Source: Deloitte Access Economics

The impact of inaction in the face of extreme weather events is felt differently across industry sectors. The type of damages felt by different industries will also vary depending on what inputs they are most reliant on.

- **Construction** is highly dependent on labour, but this labour will also be especially exposed to the impacts of climate change, both acute and chronic. As such, it is integral that construction builds its adaptive capacity, both in a way to improve the sectors resilience as well as invest in more resilient building materials, improve building codes for greater durability and to gain economy-wide resilience through instruments such as energy efficient buildings. In a world where no resilience or adaptive capacity is built, over time the gradual changes in temperatures will slowly wear on the construction industry as there is little air conditioning or reprieve from the sun on building sites. This will directly impact the productive capacity of those labourers, the risk of accident, and could potentially affect the hours labourers can legally work as midday temperatures reach unsafe levels. Notably, these costs are further compounded by the increasing frequency and intensity of extreme weather events, which disrupt construction activities, creating delay and impacting profits.

- **Services**, retail and tourism are also exposed to the costs of climate change through their reliance on labour. The chronic costs of climate change can severely reduce labour productivity, contributing to overall lost economic productivity in some of Australia's largest industries. The presence of these chronic costs, as well as acute extreme weather events, can also impact retail and tourism through business disruption manifested by tourist perceptions. Tourism is reliant on natural assets, many of which are at risk of destruction or loss of beauty from climate change. As these natural assets deteriorate, this impacts the likelihood of tourists choosing Australia over other destinations. Adaptation and mitigation strategies to reduce impacts can also help reduce this cost. However, if industries do not act fast the severity of climate change cost will be harder to reduce.
- On the other hand, **manufacturing** relies on its asset base, and damages to its physical capital and supply chain due to extreme weather will be costly to repair and affect the ability to operate. Heavy manufacturing is especially reliant on its physical capital to facilitate large industrial processes so it's this manufacturing sector that sees the largest climate costs. There are a variety of adaptive instruments that can be utilised to reduce some of these damages, such as the use of 'green steel' to improve adaptability across sectors, or, at a business level, through adaptive strategies to protect critical capital from extreme weather.

The large costs threatening each Australian industry highlight why adaptation policies need immediate implementation, so that organisations can expand their current understanding of risks and work safety. This allows them to embed resilience and adaptation strategies in these industries that support them in a world with greater climate costs.

2.2 The costs we are unable to quantify

While some economic losses due to climate change can be directly quantified through financial outcomes such as GDP impacts and insurance claims, often the total cost to the economy, society and environment are far greater and not easily captured. Much like the economic costs of inaction, the social and environmental costs will only intensify over time, with the window for action that can alleviate these costs narrowing.

Of the costs that have not been quantified in this analysis due to data limitations, **the most comprehensively documented costs include effects on mental health, domestic violence, biodiversity loss; and water quality.**

In addition to these well-established social and environmental impacts, there is also a wide range of under-researched impacts which can be just as devastating both economically and societally. For example, there is emerging evidence to show increased community displacement, increased rates of crime, lower employee retention and a drop in school enrolment and completion rates due to the impacts of extreme weather events.³¹

Other environmental impacts include a rise in pest and disease outbreaks, direct damage to national parks, coastal erosion and beach damage, streambank damage, and coral bleaching events.³²

Even when triggered by acute episodes of extreme weather, the costs of resulting events are chronic.

The loss of life is permanent, so is the trauma an extreme weather event can create for people and communities living through it. As extreme weather events continue to grow in severity and frequency, the pressure on already strained systems is anticipated to grow, with compounding effects.

Further, the social and environmental impacts are critical. They're immediately significant to the health and wellbeing of the impacted population and environment and also often the precursor to a range of costly flow-on effects on the economy.

For example, there is a well-established link between mental health and labour productivity, which can partly explain the significant reduction in labour productivity following extreme weather events.³³ Biodiversity loss and water quality are crucial to a range of industries, such as fishing, aquaculture, and tourism.³⁴

Examples of the cost of extreme weather events and climate change on mental health, domestic violence, biodiversity loss, and water quality are provided in Table 2.1.



Photo by Chris Hyde/Severe Weather and Flash Flooding Hit via Getty Images

Table 2.1 Social and environmental impacts of extreme weather events

 Mental health	
<p>Description of impact</p> <p>The devastating impacts associated with the rise in mental health issues post extreme weather events is well documented. With steady increases in mental health service claims up to 12 months after an extreme event.³⁵</p> <p>Importantly, mental health issues are not limited to those directly affected by the extreme weather event, but also extend to those indirectly affected.</p>	<p>Size of impact</p> <p>A report published by Deloitte Access Economics assessing the economic impacts of the 2019 Far North Queensland Monsoon Trough estimated that health, social and community impacts accounted for \$2.3 billion in costs, of which \$1.7 billion could be directly attributed to mental health issues.</p>
 Domestic violence	
<p>Description of impact</p> <p>Climate change and natural disasters have been consistently shown to increase the prevalence of family and gender-based violence. Stress is often reported as a key driver in the heightening of existing problems following a disaster event.</p>	<p>Size of impact</p> <p>In 2016, the Department of Social Services estimated that the cost of violence against women and their children in Australia for 2015-16 was \$22 billion.</p> <p>In a study conducted by the Queensland University of Technology (QUT), it was found that more than 60 per cent of domestic violence service providers experienced an increase of clients during the pandemic.</p>
 Biodiversity loss	
<p>Description of impact</p> <p>As temperatures and extreme weather events increase, Australia and the world at large experience biodiversity loss at rates never seen before. In addition to the intrinsic value provided by nature and biodiversity, it is also critical to our fight against climate change and rising global emissions. Nature provides essential ecosystem services, it provides oxygen, regulates our weather patterns, pollinates our crops, produces our food, and helps clean our water.</p>	<p>Size of impact</p> <p>In the 2019-2020 Australian bushfires, ecosystems, which had received billions of dollars of investment in preservation efforts, were destroyed in under one month.</p> <p>It was estimated that more than 480 million native animals perished in the fires.³⁶ 800 native species experienced loss of critical habitats, and there was an increase in threatened species of 14 per cent.³⁷</p>
 Water quality	
<p>Description of impact</p> <p>A significant decline in water quality is often one of the most severe natural implications of extreme weather events. As events such as floods and bushfires become more severe and more common, the impact on water quality is expected to be exacerbated, creating contamination issues due to runoff. This can lead to issues with food production, soils, and water sources. This can also result in airborne pollution, necessitating expensive decontamination and clean-up efforts and creating potential liabilities for businesses responsible for the pollutants.</p> <p>Floodwaters can also promote other natural disasters, as they can store and transmit pathogens, which contribute to outbreaks of water-borne diseases like typhoid, cholera, leptospirosis, and hepatitis A. Flooding may also lead to increases in vector-borne disease such as dengue, malaria, and West Nile fever.³⁸</p>	<p>Size of impact</p> <p>The 2019-20 Australian bushfires posed significant risk to fire-affected towns, causing a necessity to boil water, or drink bottled water due to the growth of cyanobacteria (blue-green algae) in water sources, which was promoted by ash washed into the town water sources.³⁹</p>



The window for action is narrowing.

Our ability to withstand natural disasters economically, socially and environmentally will diminish as their frequency and severity increases.

To realise the full \$380 billion economic dividend Australia must get off the disaster response treadmill and strategically invest in resilience.

We need to break the cycle to realise the benefit.



3 How to break the cycle, and realise the benefit

Australians are looking at a future of more frequent and severe extreme weather events. Historically as a nation, we have focussed our emotional and financial attention on supporting communities, businesses and the environment to recover.

Our capacity to continue to provide support at an increased rate and scale will diminish. Building resilience through investments in adaptation that enable our economic, social and environmental structures to withstand extreme weather events today, will minimise our risk into the future.

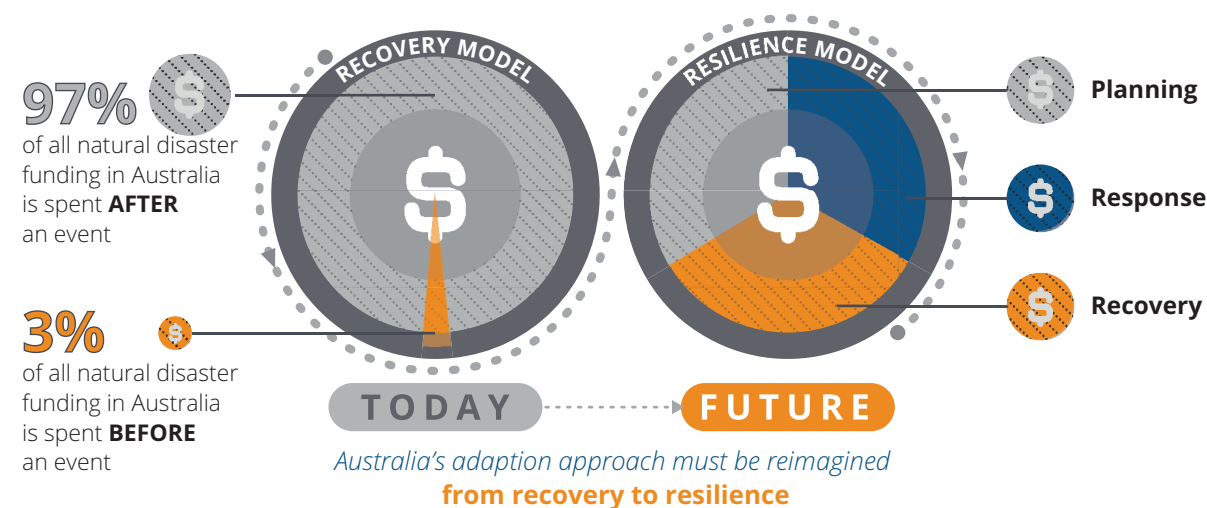
However, this window for action is narrowing. Failure to break the cycle of underinvestment today, will result in Australia missing the \$120 billion adaptation opportunity.

3.1 The underinvestment in adaptation planning, preparation, and resilience

Australia's disaster relief strategies are underpinned by a cycle of underinvestment in resilience and adaptation. It's been estimated by the Productivity Commission that 97 per cent of all-natural disaster funding in Australia is spent after an event, with just 3 per cent invested prior to an event to reduce the impact of future disasters.⁴⁰

This underinvestment cycle shown in Figure 3.1, reflects the three essential areas to invest in disaster relief: planning and preparedness, disaster response and the facilitation of recovery. However, current investment is largely funnelled into the disaster response and recovery areas, **leaving planning and preparation activities severely underinvested**. The shared benefits of disaster relief can best be realised through investment in resilience, creating cross-sectoral adaptive capacity across Australia.⁴¹

Figure 3.1 Disaster resilience cycle



Source: Deloitte Access Economics

Only focussing on recovery has consequences. Expensive ones. Our systems will endure recurring costs such as those of Cyclone Debbie in 2017 which caused wide-scale destruction across Queensland, with insurance losses totalling \$1.8 billion, and Natural Disaster Relief and Recovery Arrangements relief and recovery costs totalling over \$700 million.

The cycle of underinvestment that has plagued the Australian adaptation landscape has been perpetuated by its inherent complexity. Across the adaptation landscape, **there exist multiple decision makers across industries and geographies.** Each decision maker operates in their unique system, facing multi-faceted needs from employees, shareholders, governments, and communities. In all cases, adaptation requires numerous unique decision makers interacting, investing and adapting.

In this complex network of decision makers and their systems, **the benefit of adaptation can be non-exclusive.** That is, adaptation actions undertaken by one decision maker can benefit others. This is driven by the fact that extreme weather events are geophysical in nature and so they happen spatially and impact assets on a spatial scale. Co-located assets benefit from adaptation similarly, regardless of who owns the assets.

At the micro level of individual decision makers, whether to invest in adaptation and what to invest in are further complicated by the **vast array of adaptation options** and the reality that certain adaptation options can be costly for a single decision maker. These factors, in combination with the uncertainties associated with extreme weather events and the **lack of risk information** on where and when extreme weather events will occur, mean that it's hard, if not impossible, to gauge the level of investment required.

The complexity in adaptation has contributed to directing funding away from building resilience and towards response and recovery in the aftermath of catastrophic extreme weather events, where benefits and costs of recovery can be estimated with greater certainty and it is clear who should pay.

The lack of coordinated action to date has meant that adaptation costs incur only to a few. This leads to individual decision makers (across the public and private sectors alike) overestimating the cost of adaptation and underestimating the benefits.

As the pace and scale of extreme weather events is set to accelerate due to climate change, the costs of extreme weather events will continue to rise and burden our systems.

Funds will continuously be redirected towards response and recovery efforts that have limited ability to reduce the sustained impact of extreme weather events. This is especially true when recovery efforts only aim to replace damaged assets with similar ones, rather than aiming to improve the adaptive capacity of the communities.

The path forward requires systemic changes to overcome the complexities of the adaptation landscape and achieve balanced investments across all phases of the disaster resilience cycle.

3.2 A systems approach to overcome adaptation complexity

Given the complexity plaguing the current adaptation landscape; realising the full economic dividend will rest in our ability to coordinate and work collectively towards delivering investments in resilience that share the burden of costs and spread the benefits.

Extreme weather events are catastrophic and costly because they impact multiple systems at once. This has led to calls from the Royal Commission for further integration across all levels of government to efficiently respond to national disasters.⁴² The interdependency that exists across systems creates a complex task for decision makers looking to build resilience. **Applying a Mission model that identifies and articulates concrete problems that can galvanise production, distribution, and consumption patterns across various sectors is an approach that can inspire greater coordination between complex systems in society and the economy.**⁴³

Systems thinking provides a useful foundation for making sense of the complexity interconnected systems and their problems present decision makers.⁴⁴ Our world, systems, technologies and people have become increasingly interdependent, creating complex feedback loops across multiple areas of activity. In this context, a systems approach facilitates the coordination action that brings together perspectives, knowledge, and skills from all parts of our economic, social and environmental systems.

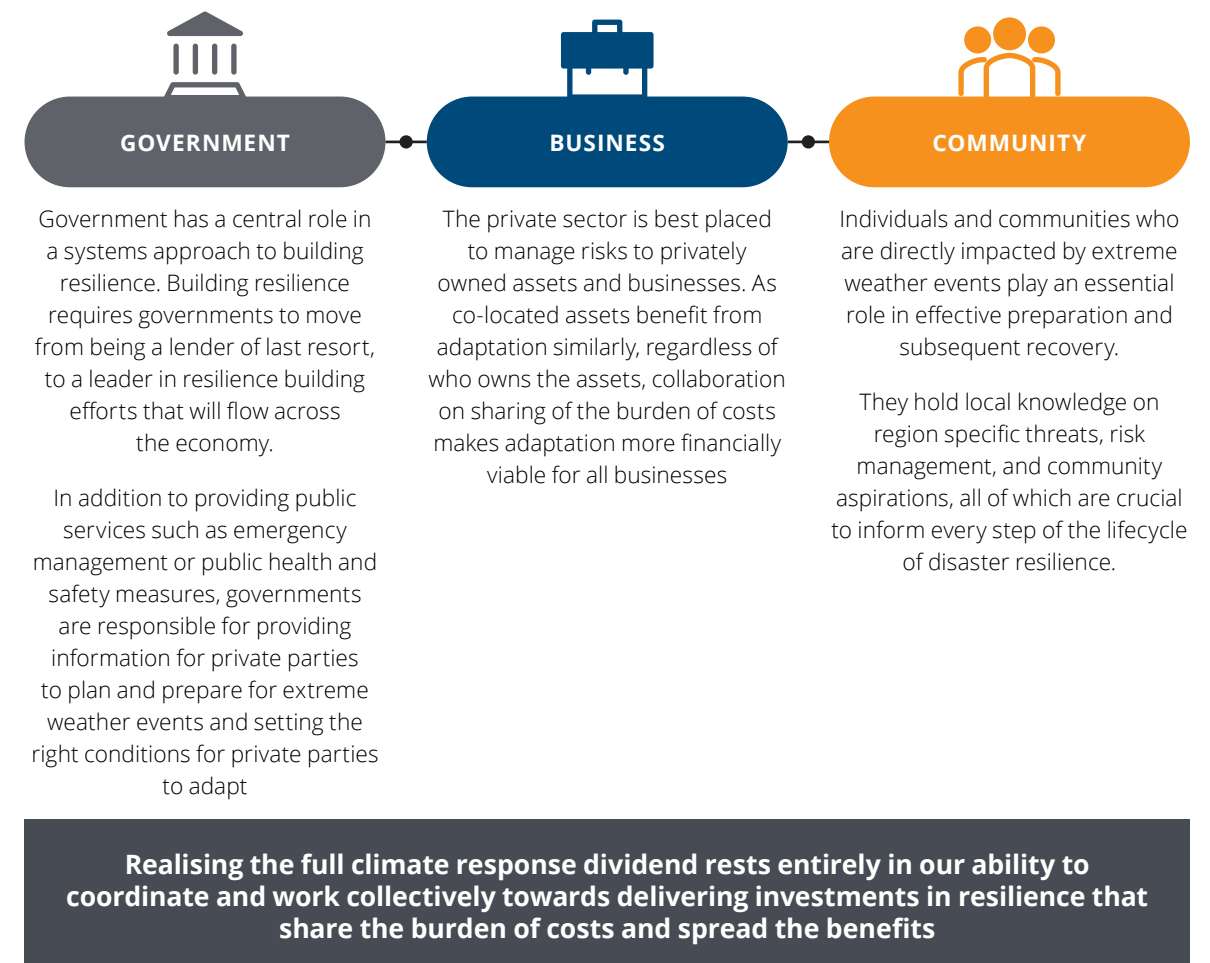
CSIRO's Climate and Disaster Resilience report found that a systems approach would bring efficiencies and agility through common tools, increased interoperability, education and training, sharing of resources, scenario planning approaches and data and decision platforms.⁴⁵

Systems thinking provides the framework in which opportunities for coordination may lie. These opportunities can be used to incentivise action and solve complex problems that cut across multiple systems. The idea that shared responsibility and national coordination is integral to the adaptation solution has been recognised by the Royal Commission. This call for a more coordinated response has also been echoed by the Productivity Commission, who argue that the greatest benefits from adaptation come from cross-sectoral initiatives. In fact, their key reform priorities are directed at both private and public sector, recognising the importance of action in both areas.⁴⁶

The need for a systems approach in building disaster resilience is also acknowledged by the Australian Government. In defining the roles and responsibilities for climate change adaptation in Australia, the Australian Government recognises that: **"Governments at all levels, businesses, households and the community each have important, complementary and differentiated roles in adapting to the impacts of climate change".**⁴⁷

However, acknowledging that more can be done is insufficient, and unhelpful. Particularly as government, businesses and communities face a narrowing window for action.

Figure 3.2 Adaptation roles and responsibilities across the system



Role of government in a systems approach

In situations of disaster, the government is often responsible for repairing major infrastructure and being the lender of last resort, providing emergency funding and assistance. This burden will become untenable for the government to pursue in the face of increased frequency and severity of disasters. The impact of the increased redirection of these funds will extend beyond the disaster response bill, leaving other sectors of the economy disadvantaged, whether over the short, medium or long term, as a result of relative underinvestment.

Without correcting for the underinvestment in resilience, the economic, social and environmental impacts will only increase as the frequency and severity of disasters continue to rise. Providing support to communities after a disaster has struck will only work for so long – without resilience embedded across multiple systems and actors these events will erode our adaptative capacity and ultimately become less effective when compared to the decreasing exposure and vulnerability to natural hazards and disasters at the outset.

The relationship of mismatch between strategic investments in resilience and reactionary funding for response and recovery needs to be re-imagined.

To overcome this challenge, the system-level response needs to be corrected – from recovery to resilience. For government, **in such a complex environment, clarity in roles and responsibilities is essential.** The role of the government needs to evolve and become a key facilitator and enabler that goes beyond disaster response. By collaborating across governments and private sectors, the government can provide all actors with the necessary data to provide greater clarity in decision making borne out of the identification of shared risk.

Acting as the facilitator and enabler in the resilience environment will overcome fundamental economic problems that have plagued the sector – i.e. market failures across mis-matched stakeholders that have resulted in underinvestment. Switching from a lender to an enabler places the government into a leading role to pull the focus of investment away from recovery and towards resilience. No longer limited to just one role and one response, the government can instead fully utilise policy levers to create adaptative capacity.

The transition from a reactionary government to one of resilience and preparedness is congruent with the transition from a lender of last resort to a facilitator of a broader system of resilience. This is a necessary transition in the face of rising disaster recovery costs, and one that will improve adaptative capacity across the economy.

Working with First Nations People is a critical part of a systems approach to adaptation.

Due to specific socio-economic vulnerabilities and the remoteness of Indigenous communities, Australia's First Nations people are disproportionately impacted by natural disasters.

During the 2019-20 bushfire season, 5.4 per cent of the total bushfire-affected population identified as Indigenous Australians. In comparison, Indigenous Australians in New South Wales and Victoria only make up 2.3 per cent of the total population.⁴⁸ Younger, Indigenous populations living in remote communities are more susceptible to losses from extreme weather events due to lack of adequate infrastructure, poor connectivity, higher unemployment rates and access to fewer financial resources.⁴⁹ These specific socio-economic circumstances render Indigenous Australians more vulnerable to natural disasters.

On top of this, damage from extreme weather events also disproportionately impacts the wellbeing of Indigenous Australians who experience a loss of cultural heritage due to the loss of land and environmental degradation of country. To build Australia's adaptive capacity, the specific needs of Indigenous Australians should be central to strategic investments into the future.

Working collectively with Indigenous Australians in adaptation is, therefore, crucial to ensure adaptation actions are culturally appropriate and are adequate to protect Indigenous assets and values.

Collaborations with Indigenous Australians also benefit the broader community, including non-Indigenous Australians. Indigenous Australians must not be construed through a narrow lens as passive, vulnerable members of adaptation efforts. Their knowledge and understanding of country provide their community with a degree of resilience.⁵⁰ Indigenous knowledge and practices in adaptation, if disseminated and applied, have the potential to immensely strengthen resilience in other parts of the society.

3.3 Data to enable decision making

The application of a systems approach to adaptation across all aspects of the cycle, will see greater collaboration across decision makers, both within and across the public and private sectors. Such coordinated action at a system level will not only provide benefits for just one actor, but also disperse benefits across the system and share the costs. The successful realisation of these benefits under a systems approach rests is interoperability.

In today's world, data is a key system enabler, underpinning interoperability and decision making. Across multiple systems high quality insights derived from data is the precursor to all other investment. Without access to data, decision makers lack the evidence base to make informed adaptation investment, resulting in underinvestment or investment dollar not being directed to areas of most need.

Given this, despite there being a vast array of areas that require greater collaboration and coordinated action, ensuring the effective and efficient supply and use of data is arguably among the most urgent.

This is especially poignant in the adaptation and resilience space. The importance of data in building resilience across economic systems is widely recognised; and has been echoed across government strategies and frameworks, scientific research papers as well as evident through our own experience.⁵¹

The use of data across every phase of the disaster resilience cycle during the most recent Black Summer fires in 2019-2020 is the case in point. Earth observation (EO) data was used to model the fire risk in the lead up to the fire, to understand and monitor fire behaviour during the emergency response and to assess the impact of ash and debris run off on natural vegetation and water ways in the post-fire phase.⁵²

The use of data cuts across all systems and phases involved in the disaster resilience cycle:

- **Before a disaster strikes**, EO data, for example, is fundamental in monitoring spatial and physical characteristics. The insights this data can provide are essential to disaster prediction, as well as supporting disaster management operations. Further, high quality data is essential in understanding how business assets, people and supply chains might be exposed to risk, particularly during an extreme weather event.
- **While disaster strikes**: The use of data and data analytics can prove crucial during the height of a natural disaster event. The effective use of real-time analytics can help governments, communities, first responders and rescue operations to identify impacted populations, get needed services to vulnerable or isolated populations and provide appropriate communications to at risk communities.
- **After a disaster strikes**, governments, businesses and communities must coordinate evacuations and disaster responses, which is often highly dependent on EO data to minimise risk to both the community and infrastructure.
- **During recovery**: Data is used in various ways across our social, economic and environmental systems. As communities begin to recover, data is again fundamental in identifying where recovery funds should be best directed. Finally, as local communities prepare to begin operating as usual, investment is needed to build resilience to future disasters. Data is also used to monitor the health of the environment, providing greater insights into how to best protect natural capital. Insights from monitoring and reporting activity is streamlined with the incorporation of data, with insights being transformed into action that builds resilience into economic systems.

Despite the importance of data, the lack of a systems approach across the supply and use of data has inhibited its usefulness to inform adaptation investment decisions. The current state of data supply and use is fundamentally deficient, creating problems for investment decisions. Not only is data collection fragmented, with methodology inconsistent amongst the different levels of government, it's not frequently shared across parties.⁵³ This reduces the usefulness of this data, as well as preventing the data from being transformed into tangible insights which can be provided to decision makers.

Getting data right is critical for resilience. With its crucial role in enabling good adaptation investments throughout the resilience cycle, it is the 'system break' that Australia need to transform the adaptation landscape.

The issues associated with the lack of co-ordinated approach to data supply and use can be mapped along the data value chain. Solving the problems in data supply and use requires systemic change across every step of the data value chain (see Figure 3.3). This will see collaborations across public and private sector in collecting and sharing of data, joint adaptation investments across businesses that create benefits for all parties, and continual application of new knowledge and insights into day-to-day business decisions.

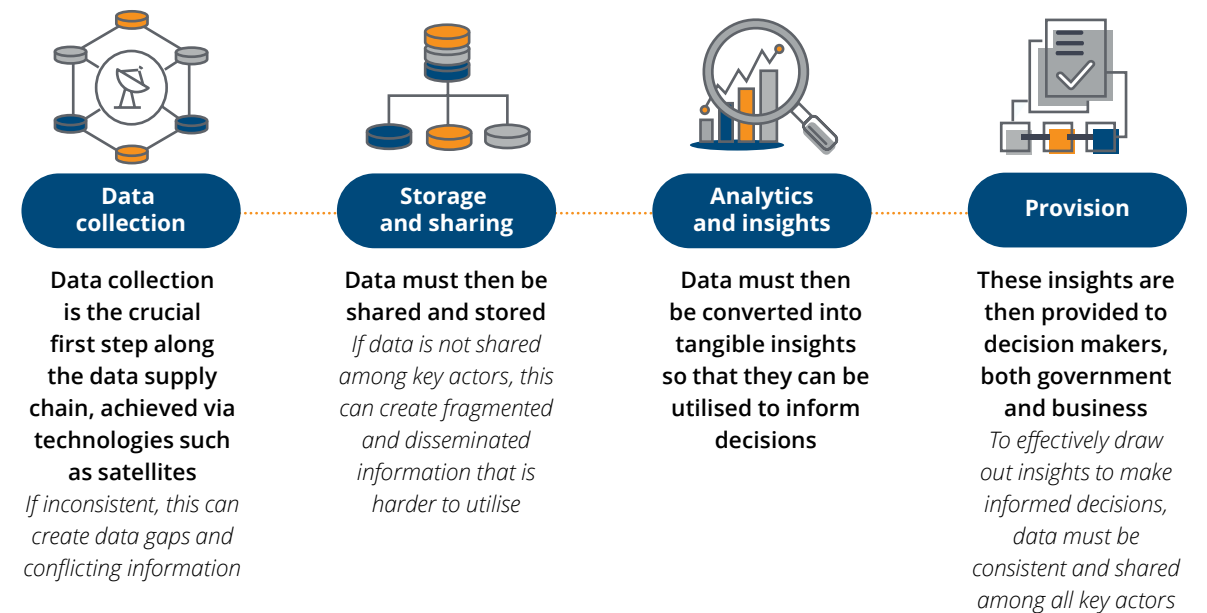
Successfully leveraging data and its insights to inform adaptation will benefit Australia as a whole, as well as all Australian businesses and communities.

Businesses able to leverage data in adaption actions have a competitive advantage in managing the risks of extreme weather events on their operations, which allows them to be well-positioned to create value added for their industry and community.

As a nation, investments in digital capabilities to collect, store, share, and analyse data will not only have the potential to transform Australia's adaptation capabilities but also create competitive advantage in the global digital economy. This should also prioritise factors that are currently difficult to quantify, such as mental health, domestic violence, biodiversity loss, and water quality.

The time to act is now. Data is a precursor to all adaptation investments. If the window to invest in adaptation is narrow, the time to invest in data to inform resilience building is narrower. Investment in technology capability to collect, share, and analyse data, and implement its insights will transform the Australian adaptation landscape so that Australians lives and livelihoods can be protected when facing natural disasters.

Figure 3.3 Data value chain



Source: Deloitte Access Economics

Using data to leverage Indigenous knowledge and capabilities:

Data and Indigenous land management techniques are helping transform the adaptation landscape in Northern Australia. Cultural burning is an Indigenous land management technique which is undertaken by traditional custodians to reduce the fuel load and minimise the potential of catastrophic economic and ecological losses from bushfires.

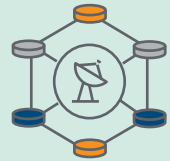
Today, more than 80 projects across northern Australia utilise cultural burning to reduce bushfire hazards in local community.⁵⁴ Remote sensing technologies such as GIS and GPS devices play a pivotal role in monitoring and managing cultural burns. Traditional custodians use satellite imagery to map fire scars to record, monitor and manage the scale of cultural burns.

Remote sensing technologies coupled with data collection and analysis tools have enabled land managers to track the benefits of cultural burning in minimising losses and reducing emissions. In 2016 cultural burning projects in Arnhem Land contributed to 800,000 tonnes of carbon abatement.⁵⁵ Leveraging Indigenous knowledge with new technologies enables communities to realise the economic opportunity from custodianship, caring for country and adaptation.

However, we must continue to consider new and innovative ways in integrating Indigenous knowledge to inform adaptations. Data has a pivotal role to play here too. Moreover, leveraging custodianship to collect data regarding a cross section of Indigenous land management techniques can provide the evidence needed to integrate cultural knowledge systems with mainstream decision making. Collecting information from bushfire-affected Indigenous communities can help governments and decision making authorities better understand how to support its First Nations people who have specific needs when it comes to building disaster resilience.

Data is the key enabler to a siloed management system. It provides the evidence base needed to support the adoption of new adaptation techniques.

The Minderoo Foundation has been critical in supporting climate change adaptation at every step along the data supply chain. Below steps out four case studies clarifying the Minderoo Foundation's role in this contribution and how they collaborate with other organisations to innovate within the data supply chain.



1 Data collection

DATA COLLECTION is the essential first step of the data supply chain. Earth observation (EO) data is integral in environmental monitoring, using remote sensing technologies to record spatial and physical characteristics.⁵⁶ This data, collected at various spatial scales and time intervals can be used to monitor, measure, and analyse changes in natural and human systems.⁵⁷

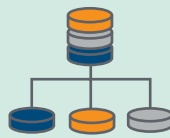
Early detection will be key to preventing natural weather events from becoming disasters. A resilient Australia will detect fires early and accurately, allowing for appropriate responses to be taken in a timely manner. **The Minderoo Foundation** is investing in three missions and a data collective alongside government, industry, non-profits, philanthropies and the research sector into a series of projects to improve Australia's earth observation data.

The aim of investment in EO data is to support detection of natural disasters in real time, at a high resolution through on ground, aerial and space assets. Examples of proposed solutions include: expanding ground sensors across high risk areas of Australia, activating sensor payloads on aerial assets by leveraging existing flight paths, using manned and unmanned aerial assets during bushfires and trialling a stratospheric high-altitude balloon solution.

The majority of natural capital investments in Australia focus on carbon capture and sequestration but very rarely focus on the loss of nature. Important aspects of nature such as the biodiversity of animal and plant/trees, vegetation cover, soil composition, salinity, carbon, erosion, water quality and fuel loads can be used as key environmental indicators.

To better inform adaptation investments the **Minderoo Foundation** is partnering with Accounting for Nature and the Burnett Mary Regional group to monitor and measure the change in natural capital assets over time. The pilot will cover 5.5 million hectares of natural land in Queensland and will deliver the first regional environmental account of the natural assets in the world.


This environmental account provides a balance sheet of the natural assets at regional scale across land uses. This account can be monetised for nature-positive investments into resilience building activities for this region. The account can also be part of a data-framework (data collective or commons), used to evaluate the level of risk to landscapes and prioritise interventions such as cultural land management, restoration, and conservation activities.



2 Storage and sharing

DATA SHARING across key stakeholders is essential for ensuring consistency and usefulness of data. For example, natural capital is inextricably linked to our economic success and longevity; however, inconsistent data among government levels can lead to inadequate decision making regarding these important assets.

The majority of natural capital investments in Australia focus on carbon capture and sequestration but very rarely focus on the loss of nature. Important aspects of nature such as the biodiversity of animal and plant/trees, vegetation cover, soil composition, salinity, carbon, erosion, water quality and fuel loads can be used as key environmental indicators.




3 Analytics and insights

DATA TRANSFORMATION AND ANALYSIS into useful insights that are easily communicated is integral to informing decisions.

There is a wealth of data and knowledge available collectively across the disaster response, emergency management, research and public and private sectors of the ecosystem, which is spread across multiple jurisdictions and private sector stakeholders. However, previous inquiries and Royal Commissions have highlighted how disaggregated data can lead to variations in how data is formatted and integrated.

It's imperative we transform data and knowledge into trusted information and insights we can collectively leverage and act on to address future hazards. This is why the Minderoo Foundation is working alongside the Australian Research Bushfire Data Commons (ARDC) to provide digital infrastructure solutions that improve bushfire risk management and advance operational planning and responses to bushfires.

Over two phases, this project seeks to develop a framework for modelling bushfire behaviour by collating data and increasing collaboration between various stakeholders, such as governments, research institutions and industry. Reliable access to transparent data about bushfires and their impacts is essential for effective planning and preparedness.



4 Provision

DATA PROVISION that is useful essentially stems from its ability to be provided to decision makers and utilised to make informed decisions. During disasters, it's essential that data is provided to all parties, so that collaborative action can be taken.

During fires and floods, volunteers are critical to recovery efforts. However, the *Royal Commission into Natural Disaster Arrangements*⁵⁸ found that without a coordinated approach to manage volunteers, bushfire affected communities struggle to respond to the spontaneous group of volunteers that become active at the time of disaster.

That's why the **Minderoo Foundation** is working alongside corporate partners to build the nation's largest volunteer network, the Australian Resilience Corps, to prepare and protect communities against the devastations of fire and floods. A coordinated volunteer approach will help minimise the future impacts of locked in climate change and pivot some of this support from the direct aftermath of an event to before it occurs. The Royal Commission found there needs to be greater support and better coordination of volunteers who are eager to help out in the event of future natural disasters.

Therefore, as part of its volunteerism project, Minderoo has developed a platform where volunteers can increase their awareness of disaster-based resilience and register to join the volunteer corps through a number of existing disaster resilience volunteer partners. The platform includes a suite of online resources and training modules and once the volunteer has completed online basic training, they will become 'Resilience Registered'. This training and registration process will enable them to take positive community action to build resilience. Actions include de-risking properties, reducing fuel loads in landscapes, and removing clutter from water ways. Minderoo is also supporting community-based projects in vulnerable and exposed communities across the country. These projects support communities to build resilience plans and access resources to support those action plans. Community actions such as these projects and increasing volunteerism will strengthen disaster resilience and help reduce the impacts of fires and floods in the future.

4 How to make adaptation core business

As this report shows, adapting to climate change is a \$120 billion opportunity. The evolving adaptation landscape provides opportunity for innovation and investment with co-benefits for Australia's economy, through job creation, spill over investment opportunities and renewed growth potential.

However, for many boards and executive teams, this is a new, complex, and rapidly changing landscape. The need to act is clear, but the path forward is not.

Strategic decision making in the face of the climate change challenge – increased extreme weather events coupled with rising temperatures – is fraught with uncertainty. To overcome this uncertainty and minimise the impact of extreme weather events, businesses that have explicitly embedded adaptation into the heart of their operations will thrive.

Explicitly embedding adaptation into core business fundamentally means organisations will become more resilient. When shocks occur, resilience enables business to not only withstand the impact of severe weather events, but to emerge stronger. This requires looking beyond standard measures of organisational health and short-term performance.

There is now an opportunity for firms across all sectors who embed resilience in the way they work to create a legacy of growth and stability, not just in the face of unpredictable threat of change, but in day to day operations as well.⁵⁹

Many businesses are already alert to this imperative to adapt and to build resilience. A Deloitte Global survey found that **nearly 30 per cent of executives say their organisations already feel the operational impacts of climate-related disasters and more than a quarter are facing a scarcity of resources due to climate change.⁶⁰**

The impacts of climate change are not a future problem, but one that is impacting organisations now. As previously observed, the need to act is clear, but the path forward is not. Despite this, there are examples of businesses who have already made an exemplary start to their climate-led transition journey.

The case studies featured in this section were selected based on alignment with the following three steps that make adaptation and climate change core business for organisations:

1. Turn the risk and opportunity into strategies
2. Implement and transform operations
3. Measure and disclose

These three steps organisations can take to make adaptation core business are shown overleaf. However, as this report has revealed, each sector will face different damages and challenges of climate change. As such, the steps taken to build resilience and adaptability will not be consistent across all sectors. Some aspects will be more important and some more urgent for different industries.

Businesses will need to understand what resilience looks like for each sector. Here, industry leaders taking steps to embed resilience into their core business have been featured. The five industries presented are some of the most heavily affected by climate change. Importantly, these industries will be confronted by the most severe damages, but also have the greatest to gain from building resilience and adaptation strategies early.

Below we've provided nine case studies across the energy, services, health, agriculture, and construction sectors showing practical examples of companies and organisations currently implementing climate change resilience strategies.

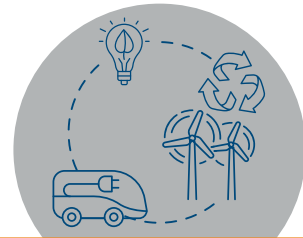


Risk and opportunity into strategy

Understand the risk: Building resilience into core business first requires organisations to have a robust understanding risk. This includes the type of risk, such as risks to assets, supply chains or workforce. As well as the risks by natural hazard type.

Have a vision for resilience: To facilitate future planning, the organisation should articulate the vision for the future. This includes specifically identifying what resilience looks like for the organisation across its inputs (assets, supply chains, people) and outputs (products and services, profits and revenue). Further, this vision should articulate the organisations concept of 'minimum acceptable loss'

Develop the strategy : Once a clear understanding of risk and the vision for the future has been established, organisations can bring these concepts together to inform the strategy. The strategy should not exist in isolation, rather, it should be considered a key aspect of existing enterprise strategies. The strategy should enable users to prioritise investment decisions, be accountable and be underpinned by shared values.



Implement and transformation

Capital planning and divestment: Implement resilience building strategies across assets as they are identified by the risk and strategy. This may include the divestment of assets if necessary. Proposed capital investments should be informed by the vision for resilience and supported by a framework for decision making that reflects the organisational strategy.

Workforce capability: Invest in educating the workforce on risk and resilience as two unique but interrelated concepts. This education should occur in the context of incorporating this understanding into everyday decision making.

Operations: Implement strategies to ensure supply chains (both internal to the organisation and external) are resilient to the short, medium and long-term impacts of natural hazards.



Measure and disclose

Regular risk assessments: In addition to regular monitoring and reporting requirements, building resilience requires organisations to regularly measure and assess risk. This enables plans and strategies to remain current. This should be data-driven, embedded within your existing monitoring and reporting systems, provide clear validation of the efficacy of climate related initiatives and enable real-time adjustment of settings to improve performance. Monitoring and reporting should be used to adjust the strategy to changing context and stakeholder preferences and requirements.

Feedback loops: Integral to ensuring that the organisation remains resilient into the future is continuously learning from the way in which the organisations investments in resilience have led to avoided costs or potential benefits (economic, social or environmental). This way, the cycle of continuous improvement reinforces investments in resilience that become core to business operations.

4.1 The energy imperative

Embedding resilience into core business will enable the energy sector to realise a \$1.0 billion annual dividend by the year 2050.

To realise this dividend, embedding resilience into our energy sector is critical. Recent events across Australia's east coast highlight the lack of system resilience with lengthy network recovery times, intermittent surges in wholesale power prices and thousands remaining without power weeks later.⁶¹ The AEMO has acknowledged the current weaknesses across the National Energy Market (NEM) and highlights how recent events have been a "wake up call for further investment".⁶²

The sector is susceptible to both the physical risks as result of climate change, and transition risk as Australia's energy mix shifts away from fossil fuel and towards clean energy sources such as wind, hydro, solar, hydrogen and bioenergy. While there has been significant investment to change the way we currently generate energy, there is still a lack of overall system resilience.⁶³

A recent project in the energy sector presents an example of the way in which multiple system actors can come together to deliver a system-wide solution that will enable operators to invest in resilience – the Electricity Sector Climate Information Project (ESCI). In the aftermath of the Independent Review into the Future Security of the National Electricity Market (also known as the Finkel Review) the ESCI project brought together the Australian Government Department of Industry, Science, Energy and Resources, the Bureau of Meteorology, CSIRO and the Australian Energy Market Operator (AEMO) to deliver tailored climate and extreme weather information for use by the electricity sector in assessing the risk climate change presents to sector investments, system reliability and system resilience.⁶⁴ The project identified key data gaps as reflected by the sector preventing the accurate assessment of climate risk to energy market assets. The project was able to provide energy market operators with tailored information on integrating climate risk into sector decision-making.



AusNet – Scenario modelling to understand risk

AusNet is a player in the energy sector, owning and operating the Victorian electricity transmission network, one of five electricity distribution networks, and one of three gas distribution networks in Victoria. AusNet's Task Force on Climate-related Financial Disclosures (TCFD) report discloses their **climate risk adaptation aspiration and approach** for their organisation. AusNet identified that to operate successfully, they need to deliver reliable energy to customers while creating lasting value for all stakeholders. Climate-related impacts pose a great threat in achieving this goal.

AusNet sought to understand their climate risk: To develop their strategy, AusNet conducted scenario analysis, applying the latest climate science by incorporating inputs from the IPCC and the International Energy Agency to base its climate risk assessment. AusNet also brought together various subject matter experts across their organisation to assist in climate risk identification. This shared ownership of the aspiration, and ensured risks were captured across the entire value chain. Ausnet has several governance processes in place, ensuring their strategy is successfully executed across the organisation.

AusNet identified opportunities to invest in resilience: AusNet identified extreme weather events such as bushfires as a major climate-risk. In response, one adaptation initiative AusNet undertook was the installation of Gippsland's first community battery in Mallacoota. The aim of this initiative was to 'keep the energy running' while crews try to fix any powerline issues as a result of bushfires. This project formed part of the Victorian Governments program to improve energy services in bushfire prone areas.

How this embeds resilience: By creating an adaptation aspiration and strategy AusNet have identified climate-risks and is reducing their customers exposure current and future extreme weather events. This will help future-proof society by increasing their resilience to extreme weather events and ensuring the future delivery of electricity in changing climatic conditions.

Transgrid – managing assets in the context of adaptation:

Transgrid is part of the National Energy Market. It builds, operates, and manages the high voltage electricity transmission network in New South Wales and the Australian Capital Territory. Comprising a network of high voltage infrastructure that spans more than 13,133 kilometres, Transgrid connects end users to energy generators and distributors.

Underpinning Australia's energy system, Transgrid's operations are essential to converting high voltage energy into low voltage energy, suitable for households. Since Transgrid's assets are critical to serving the energy needs of Australian communities, it has developed whole of life asset management system approach that minimises damage and consumer impacts from natural hazards which have the potential to cause significant disruption across the transmission network. At the same time, the asset management system also supports Transgrid in reducing and managing the risk of its network infrastructure causing bushfires.

Transgrid is investing in understanding their risk: To better understand the extent of the exposure of their assets Transgrid has invested in the tailored collection, collation and modelling of data on climatic conditions, wind patterns and ignition rates that have been instrumental in the development of a fire simulation model. Combined with economic indicators Transgrid utilises Bayesian modelling to predict bushfire risk based on causal relationships and associated uncertainties to minimise the exposure and vulnerability of its assets.

Transgrid incorporated data-driven insights into planning: These insights are incorporated across a number of strategic investment, management and maintenance plans.

- The findings from its modelling forms the crux of Transgrid's **Asset Management Renewal and Maintenance Strategies, and asset maintenance plan**. The maintenance plan is used to classify each of Transgrid's assets under different risk categories. Based on the exposure and vulnerability of each asset, preventative measures to minimise bushfire risk are prioritised for high-risk assets.
- Transgrid to develop a bushfire management plan that has been built into its asset valuation. In doing so, Transgrid's **bushfire management plan is not just stand alone, but integrated within its asset management plan**, enabling climate risks to be managed across its entire value chain.
- Transgrid has developed a **disaster risk management framework to build operational resilience** within its assets that provide critical infrastructure for Australian households.

Transgrid works collaboratively to build resilience: Transgrid also engages key stakeholders to develop adaptation strategies to minimise bushfire risk. Currently, it is working with First Nations communities to understand the role of tree species in contributing to fire risk and fire intensity. This can inform which tree species to plant near transmission networks to minimise bushfire damages. By collating information across a range of data sources, developing a fire simulation model and engaging with the local Indigenous community Transgrid is taking a holistic approach to adaptation. Its fire simulation model enables Transgrid to track the impact of adaptation measures such as changing foliage to understand the vulnerability of its assets to bushfires across a range of scenarios. By leveraging data to inform its risk management strategy, Transgrid has built in disaster resilience into its asset maintenance capabilities.

How this embeds resilience: The combined investments in infrastructure and platforms has a two-fold effect to build resilience. These investments work to both protect Transgrid's critical infrastructure, while also reducing the risk of the organisations' assets potentially being the cause of bushfires. This helps build resilience through two different avenues, creating adaptative capacity and reducing the risk of energy disruptions in the future.



4.2 The service sector imperative

Embedding resilience into core business will enable the services sector to realise a \$19.6 billion annual dividend by the year 2050.

4.2.1 Financial services

The financial services sector is integral to our economic, social and increasingly our environmental systems. Critically, the financial sector has and will continue to play a crucial role in supporting Australians through the impacts of extreme weather events and through the net zero transition period.

In April 2021 Australian Prudential Regulation Authority (APRA) has released for consultation draft guidance to banks, insurers and superannuation trustees on managing the financial risks of climate change. The draft Prudential Practice Guide CPG 229 Climate Change Financial Risks (CPG 229) is designed to assist entities in managing climate-related risks and opportunities as part of their existing risk management and governance frameworks.⁶⁵

Our research shows that to realise the benefit of the full economic dividend, a shift from risk to opportunity through developing new types of products and financial structures to help facilitate capital flows into adaptation projects must occur.⁶⁶

In the face of increasingly severe weather events, the financial services sector must simultaneously embed resilience into their operations to minimise risk and exposure, while also playing a role in breaking the chronic cycle of underinvestment that's prevailed. Doing both will ensure the sector is positioned to withstand the impacts of climate change and realise the opportunity.

Embedding resilience into business as usual

More frequent and severe extreme weather events mean insurers are facing larger payouts. Financial institutions face many challenges in this increasingly complex environment – insurers are exposed to increased credit risks across all sectors, greater investment uncertainty, and fund managers are now required to evaluate climate risks on investments in an uncertain policy environment.⁶⁷

Natural hazards impact large sections of the economy concurrently, during these periods, insurers are required to make large payouts during a relatively short period of time. This 'correlation of loss' or 'systemic risk' acts to concentrate risk both in time and place that ultimately leads to potentially unmanageable losses for insurers.⁶⁸

For organisations in this sector, understanding their exposure to climate risks, the impact on their value chain, and taking adaptation action to reduce these risks, will ensure profitability and financial security into the future. Due to the heightened level of uncertainty, taking steps to understand and reduce exposure and investing in opportunities for revenue now, will strengthen resilience to climate change.

The role of finance in climate adaptation and breaking the cycle of underinvestment

To date, the financial services industry (and the economy more broadly), has viewed the role of finance in adaptation as solely a risk mitigation lens that's applied to policy and decision making. This siloed approach to investment has resulted in the burden of financial responsibility resting largely on the individual, i.e. to purchase insurance to mitigate against risk, or on public institutions (to invest in adaptation solutions).

Insurance Australia Group (IAG)

IAG is the largest general insurer in Australia and New Zealand. Its businesses underwrite more than \$12 billion of premium per annum, selling insurance under many leading brands, including NRMA Insurance, CGU Insurance, SGIO and SGIC in Australia and NZI, State, AMI and Lumley in New Zealand.

Partnering to build resilience: IAG takes a proactive role in disaster and climate change risk reduction across Australia and New Zealand, while also being a key collaborator on a global level. As a founding member of both the Australian Business Roundtable for Disaster Resilience & Safer Communities and the New Zealand Leaders Coalition, IAG advocates for collective action to effect change in public policy and increase resilience among communities.

By supporting a coordinated national approach across government, industries, and businesses, IAG has been able to build resilience within communities by leveraging the knowledge and capabilities of different key actors. This has allowed IAG to collaborate in a more integrated way, from engaging with regulators and industry on climate policy, to contributing to research in order to address knowledge gaps on the physical risks of climate change, for example, the National Centre for Atmospheric Research and James Cook University's Cyclone Testing Station. This holistic approach to collaboration builds resilience across sectors, improving the ability of the community to understand and respond to climate risks.

IAG's climate strategy focuses on not only building resilience within its business, but also helping to prepare customers to increase their own resilience. This creates stronger, more resilient communities and, ultimately, can help to save the lives of those impacted by natural disasters. It also plays a role in lowering insurance claims costs which helps make IAG's business stronger and more sustainable. Consequently, IAG's resilience strategy has focused on supporting its customers to develop a greater understanding of climate risk.

IAG has approached this strategy with an understanding of the importance of collective action and collaboration. For example, IAG has partnered with the New South Wales State Emergency Service (NSW SES) for more than 10 years on a range of resilience programs and initiatives, including storm season awareness campaigns. They also have an ongoing partnership with the Australian Red Cross, with whom they created the 'Get Prepared' app. This app helps users create local networks and response mechanisms for natural disasters. These two initiatives alone have cumulatively reached 7.49 million people and have worked to improve community knowledge on climate change risk.⁶⁹ These projects, designed to practically contribute to community resilience, demonstrate how organisations can partner together to build Australia's adaptive capacity.

Beyond these collaborative examples, IAG continues to support property owners and their communities to improve their understanding of climate risk by developing their knowledge of, and ability to respond to, extreme weather events. On a quarterly basis, it releases the NRMA Insurance Wild Weather Tracker, using NRMA Insurance claims data to track the impact of extreme weather on NSW, QLD and the ACT, thereby building an understanding of the extent of preparedness of these communities.⁷⁰ Communities are then able to see the increasing frequency and severity of extreme weather events, improving their knowledge and understanding of future risk. This is further supported by IAG's severe weather fact sheets, which outline risk factors of extreme weather events to properties, and the ways in which homeowners can better prepare to reduce future damage and save lives.⁷¹

How this embeds resilience: As a key deficiency in community resilience, making information on climate risk readily available and digestible, as well as options for adaptation methods, yields a feedback loop that benefits both IAG and its customers. Improving customer knowledge of physical risk from extreme weather fosters resilience. This alleviates the financial, social and emotional impacts of natural disasters on communities,⁷² helps reduce the level of risk faced by IAG's customers, and therefore places downward pressure on insurance premiums. As extreme weather risks grow, improving customer information ultimately supports IAG's objective of robust and sustainable growth in the long run.

Suncorp – collaboration and innovation to build understanding

Suncorp is one of Australia's largest financial services providers offering general insurance and banking.

Identified risk: Suncorp identified that a significant proportion of Australian homeowners were not taking proactive steps to build resilience into their homes – with their research identifying eight in ten homeowners showed little interest in spending to make their home more resilient to natural disasters.⁷³ More than 100,000 homes in the North Queensland region are below minimum standard for cyclone safety,⁷⁴ and 90 per cent of homes in bushfire-prone areas across Australia aren't built to standard because their construction pre-dated modern regulations.⁷⁵ For Suncorp, this represents a portion of insured assets, and potential homes, that are exposed (i.e. likely to require payouts) in the event of a natural disaster. To overcome this barrier to invest in strengthening the resilience of homes, Suncorp worked collaboratively to develop new products and services that would educate, incentivise and in cases of significant claimable damage, provide additional resilient features to better protect Australian homeowners.

Developing innovative products to improve understanding: Suncorp partnered with James Cook University's Cyclone Testing Station, CSIRO and Room11 Architects to deliver the One House initiative – a project involving the design and testing of one of Australia's most natural disaster-resilient homes. The project contributes many benefits to the adaptation landscape – including acting as a conversation starter on the National Construction Code (and the ability of communities to remain up-to-date), providing information to consumers on ways in which they can practically upgrade their homes to become more resilient in the face of multiple natural disasters, including bushfire, flood, storm and cyclone.⁷⁶

By bringing together different knowledge, experiences and skillsets Suncorp was able to create a complete, innovative prototype built upon a shared understanding of the importance of resilience. Not only does the One House initiative help improve individual consumers' understandings of how they can build adaptive capacity, but Suncorp also incentivises building resilience via its Build it Back Better promise. This initiative provides up to an additional \$10,000 to help improve the resilience of a home for an approved home building insurance claim of at least \$50,000.⁷⁷

How this embeds resilience: Together, these two initiatives provide homeowners across Australia with the knowledge, capability and funds to build more resilience in their homes, improving their future adaptive capacity. The One House initiative endeavours to build adaptive capacity into economic and social structures by potentially reducing the number of displaced individuals after an extreme weather event. Combining education with incentives for customers intrinsically embeds resilience into homes, thereby lowering overall risk and helping keep insurance attainable and affordable for Australians.

4.2.2 The health services

The health sector is at the forefront of the disaster response. The Black Summer fires resulted in an 86 per cent increase in respiratory-related presentations to an emergency department, totalling \$2 billion in smoke-related health costs.⁷⁸

In addition to increased burden on health services, more frequent and severe climate-related weather events are likely to disrupt supply chains, prevent accessibility to health care facilities and result in significant losses to medical infrastructure. These costs are already being borne by the health care sector.

The increasing need for disaster response and possible disruption to health services operations and supply chains will have implications for clinical strategy and the future of health. By re-assessing their operational strategy, the health care sector has an opportunity to increase its adaptive capacity and build a resilient business model. Action on adaptation can protect communities and minimise injuries and loss of life, while also enabling the health sector to realise the dividend from climate adaptation.

Kaiser Permanente – implement and operationalise capability

Kaiser Permanente is a non-for-profit health care company, operating 39 hospitals and more than 700 medical offices in the US. It has experienced the first-hand impacts of climate-related weather events on health services during the 2017 Tubbs fires in California. Today, Kaiser Permanente is leading the health sector in investing in climate adaptation and disaster risk management. Their Disaster Risk Management policy not only communicates their accountability and intention to adapt to climate change, but also provides a clear operational strategy to achieve this aspiration.

The importance of building resilience in the health care sector, especially during a surge in demand, was made explicit during the 2017 Tubbs fire, where coordinated evacuation was hampered by the concurrent swell in bush-fire impacted clients. After a similar experience during the Kincade fire in 2019, the CEO of Kaiser Permanente noted that “health impacts of climate change are not abstract or far in the future- they’re here today, and they disproportionately impact the most vulnerable among us.”

Establish organisational intent and vision: In lieu of the Californian bushfires and its overwhelming impact on its ability to provide health services, Kaiser Permanente established the need to develop more resilient services to increase its adaptive capacity. The company recognised the value of incremental action and re-developed their organisational strategy build resilience and cope with a surge in demand for health services during emergencies without overwhelming current facilities.

Develop adaptation initiative: In response to the 2017 bushfires, Kaiser Permanente developed a turnkey command centre which provided visibility over the operational performance of each of their hospitals. During an emergency, this operational visibility enabled Kaiser to re-distribute resources, prepare emergency teams and provide the necessary resources and support in real-time. During the 2019 Kincade bushfire, Kaiser could ensure no one health care facility was overwhelmed. Rather changing its operational strategy to service whole of community needs across multiple locations and establishing a command centre before the threat became acute, it was able to promote a coordinated disaster response where emergency teams had the ability to communicate issues in real-time, develop planning scenarios and anticipated reactions, and set expectations and priorities across multiple locations.

How this creates resilience: Kaiser Permanente recognised the need to re-consider its organisational strategy and capabilities in order to adapt to climate change. It identified interdependencies within the system and activated resources as necessary to enable a coordinated response during and emergency. Better data, visibility and coordination enabled Kaiser to build more resilient health care facilities that can quickly adapt and share resources.

4.3 The construction imperative

Embedding resilience into core business will enable the construction sector to realise a \$3.8 billion annual dividend by the year 2050.

The construction sector, its workers and profits are exposed to the increased frequency and severity of extreme weather events, as well as the chronic damages associated with increased temperature.

Construction sites can also be impacted in varying degrees such as the workforce being unable to operate safely due to increased temperature.⁷⁹ Further, extreme weather events can also have severe impacts on the profits of the construction industry, primarily through weather-related delay. Significant extra time spent on projects can turn a profitable project into a loss, which is compounded by the fact the construction industry is already characterised by comparatively low profit margins. Given that adverse weather delays 45 per cent of construction projects worldwide, this is an issue already affecting the industry and it will only worsen over time.⁸⁰

Building resilience in the construction sector is critical. Resilience in the construction sector results in changes to internal information systems, organisational processes, and investment choices, as well as how buildings and precincts themselves are designed, built, and operated. This will not only protect the economic future of the construction sector and companies, but also strengthen resilience in other industries of the economy, as the infrastructure built by the construction sector is a critical factor of production of all sectors.

In other words, embedding resilience into core business will enable the construction sector to protect the economic future of themselves and their clients.



Dexus – aligning organisational model to build resilience

Dexus is one of Australia's leading fully integrated real estate groups, managing a high-quality Australian property portfolio. Dexus is a Top 50 entity by market capitalisation listed on the Australian Securities Exchange. Building resilience is considered an integral part of Dexus's business, and is integrated into the Dexus Environmental Management System, property operations, development and transaction activities.⁸¹

Dexus seeks to understand climate risk: Since 2011, Dexus has conducted scenario analysis to understand the exposure of its property portfolio to acute and chronic climate changes. This involves reviewing property-specific scenario data including flood maps, and likely frequency and intensity of bushfires and storms to assess each property and identify hotspots in each geographical market.

In 2021, Dexus extended its understanding of the financial impacts of climate-related issues by conducting an economic analysis of transition impacts relevant to Dexus's customer base. This analysis forecasted how customer sector outlooks may be economically impacted based on their exposure to physical and transitional climate impacts, and provided insights for Dexus to incorporate into its asset management and leasing strategies.⁸²

With the knowledge on climate risk, Dexus has identified opportunities to invest in resilience. This includes enhancements to building management systems and operational procedures, as well as targeted investment.⁸³

Dexus has expanded its site-specific environmental risk assessments to evaluate significant climate-related vulnerabilities and develop adaptation activities at high-risk properties.⁸⁴ This also filters through to its development pipeline, as the group creates plans for property enhancements to support business continuity which will be internalised and enacted by their construction partners.⁸⁵

How this creates resilience: Dexus's comprehensive approach allows it to follow through on their strategy. This approach has the potential to facilitate efficiency gains for the organisation over the long term as the adaptation capability becomes embedded in their operations. The effectiveness and efficiency of Dexus's adaptation plans are not only beneficial to them, but also filter through to their construction partners, improving resilience across supply chains.

4.4 The agriculture imperative

Embedding resilience into core business will enable the agriculture sector to realise a \$5.0 billion annual dividend by the year 2050

Although climate variability is not a new concept for Australian farmers and industry leaders, **climate change is likely to increase variability and exacerbate the stress on environmental and agricultural assets.** Changing weather patterns and intensifying climate-related weather hazards such as drought and floods due to climate change have the potential to reduce yields and expose this sector to significant economic losses.

It's estimated that profits fall by approximately \$105,000 in a dry year for typical Australian cropping farms driven by lower crop yields and large reductions in crop output.⁸⁶ During the severe drought condition in 2018-2019, farms in drought-affected NSW recorded declines in profit while farm profits in less drought-affected areas, such as Western Australia, increased.⁸⁷

Building resilience is critical for the agriculture sector to minimise the negative impact of climate change on yield quality and reliability of Australia's agricultural assets. It's important, particularly for the

agriculture sector, that climate adaptation actions are monitored and reported to provide clear validation of the efficacy and success of the initiative. Doing this provides financiers, investors and decision makers with the necessary information to support climate adaptation initiatives.

For example, this may mean investigating with current technology providers whether monitoring and reporting technology is available. New technologies are an investment, enabling real-time adjustments to optimise the effectiveness of adaptation practices.

By implementing new technologies and evolving best practices to adapt to climate change, land managers have the potential to improve their resilience and minimise losses. First movers in this space can not only realise a competitive advantage by investing in adaptation early, but also by monitoring and reporting on their outcomes, they can become market leaders providing evidence-based solutions to promote climate adaptation across the entire sector.



Elders – monitoring agricultural assets to improve the effectiveness of adaptation

Elders is an Australian Agri-business which provides agricultural goods and services to farmers and land managers. As an industry leader, it recognises the need to build a more resilient agricultural sector by ensuring profitable operations that are both sustainable and productive.

In its Sustainability Report in 2020, Elders noted the most important issue facing the Australian agriculture is climate change and its impact on water availability and severe weather events.⁸⁸

With this understanding, Elders is working with industry partners to monitor and report the impact of emerging technologies and adaptation solutions to help track water availability and soil health, schedule irrigation and improve farm efficiency.

How this creates resilience: By investing in emerging technologies and providing an evidence base for the impact of new technologies on yield, quality and value of agricultural assets, Elders is supporting the adoption of new strategies to promote climate adaptation in the agricultural sector.

Queensland Government, Land Restoration Fund

The Queensland Government's Land Restoration Fund (LRF) is expanding carbon farming opportunities in the state by supporting projects that deliver carbon credits plus environmental, social, economic and Indigenous co-benefits.

By valuing and paying a premium for carbon projects with co-benefits, the LRF enables land managers, including farmers and Indigenous peoples, to generate new, regular income streams while improving Queensland's environment and waterways, providing more habitat for threatened species, and creating regional jobs.

The LRF is underpinned by the LRF Co-benefits Standard (LRF 2021), which outlines how co-benefits from LRF projects are to be identified, measured, reported and verified. This standard ensures that co-benefits associated with carbon projects are evidence-based.

The Beef and Conservation for the Future project, delivered by key partners Goondicum Pastoral Company, GreenCollar and the Burnett Mary Regional Group, on Goondicum Station in Central Queensland, and funded through the LRF's 2020 Investment Round, demonstrates how the co-existence of grazing and regenerative agriculture can support a profitable grazing enterprise. Regenerative farming methods are producing rich soils and better-quality feed grasses. Thinning processes and 'cool fires' are also used on the property to maintain a balance of trees and pasture, creating an all-round healthier environment, with increased canopy cover reducing the cattle's exposure to temperature extremes.

Economic ideas in this report

Notes on the analysis

Since the Industrial Revolution, world economic growth has occurred in near lockstep with rising greenhouse gas emissions. As we burned fossil fuels and converted land to intensive agriculture, living standards and quality of life improved. While growth has not been constant or even – across countries or individuals – GDP growth per capita expanded at a rate of about 1.5 per cent per year from 1750 to present.^{89,90}

This growth model is now running up against an overwhelming scientific consensus – and increasingly our own lived experiences in Australia – which indicates the current system of economic production is rapidly generating untenable changes in the climate.⁹¹

In this report, Deloitte Access Economics presents scenario analysis from the D.CLIMATE framework that models the economic impacts of climate change if emissions go largely unchecked, and what could happen if Australia adapts to locked-in climate change and transforms to achieve net zero emissions by 2050.

This model is based on significant research on region-specific climate impacts – both acute and chronic – across Australia. This research is used as inputs for the D.CLIMATE model (refer to the Technical Appendix for more detail).

The results reveal the magnitude of the challenge in adaptation and mitigation, as well as the choices Australia can make to drive long-term economic resilience and prosperity. The modelling also identifies the moment when the benefits of early adaption and decarbonisation start to outweigh costs. This is what we call **Australia's resilience dividend**.

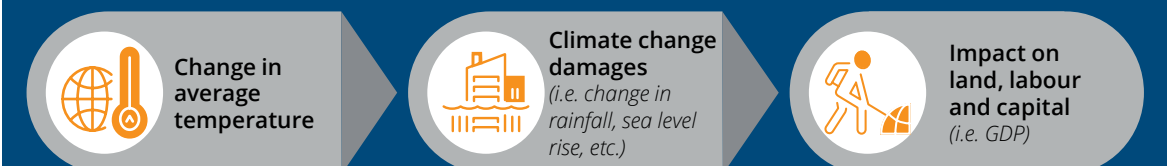
The resilience dividend depends on the economic structure that creates growth today, and how that's impacted by adaption and mitigation. It also depends on the exposure to 'locked-in' climate change impacts as best estimates indicate the world warms by at least 1.5°C to 2050.⁹²

Overview of D.CLIMATE modelling process

The D.CLIMATE model is based on significant research on acute and chronic changes in climate variables across Australia, the impacts of changing climate variables on factors of production, and the relationship between factors of production and economic outputs (GDP) and jobs. The D.CLIMATE modelling process can be summarised into three key steps:

1. Increased atmospheric greenhouse gases cause average global surface temperatures to rise further above pre-industrial levels.
2. Warming causes the climate to change and results in physical damages to the factors of production in the Australian economy.
3. These damages to the factors of production are distributed across the economy, impacting GDP.

Figure 4.1 The D.CLIMATE modelling process



Source: Deloitte Access Economics

Through this modelling process, any action that leads to changes in average temperature (i.e. decarbonisation) or changes in damages to factors of production (i.e. building resilience) will impact the whole economy. Climate actions (or inaction) have implications on the economy.

Estimating the economic dividend of a resilient Australia.

Throughout the report, we refer to scenarios modelled in D.CLIMATE that shape the findings. The following provides a shorthand description of these ideas to support the insights in this report:

- **The current system of economic production is rapidly generating untenable changes in the climate.**⁹³ Unless rapid and coordinated action is taken, a climate-damaged economy is the new normal. When evaluating the economics of adaptation, economic outlooks, decision making, and business planning needs to account for the consequences of climate change. Effective climate action for both mitigation and adaptation requires reorienting our thinking to consider economic systems and natural systems as inextricably linked.
- **Without action, global emissions and temperatures will continue to rise.** Without rapid, systemic change, the outcome is increasing global average warming toward the end of the century. In this world, insufficient action on climate change and adaptation would be the baseline path. This baseline would negatively impact economic growth, when compared to a world without climate change (refer to the Technical Appendix for discussion).
- **Rapid, coordinated adaptation and mitigation will not only limit the worst effects of climate change, but generate positive economic gains.** Transitioning to a net-zero and limiting warming as close to 1.5°C as possible requires an industrial transformation that would typically occur over a century to take place in just three decades. Adapting to the locked-in impacts of climate change as this transformation occurs is a climatic and economic imperative. Best practise adaptation and recovery strategies need to be developed and shared to improve outcomes nationally.

The following concepts and assumptions underpin the two scenarios:

- **Scenario 1: We do nothing further, and inaction on adaptation and mitigation increases the costs of more frequent and severe weather events while global emissions rise.** This economic path represents a future with a higher rate of GHG emissions, where current technologies and strategies reduce GHG emissions stabilise temperatures to around 3°C to the end of the century. This scenario reflects a widely adopted set of emissions, economic, and population assumptions, referred to as SSP2-6.0. This scenario is regionalised to Australia. The results of this scenario are presented in comparison – a deviation – to a world that does not have climate change impacts modelled.
- **Scenario 2: We act decisively to build resilience into our economic systems today and hit global net-zero by mid-century.** This economic path represents a sequencing of efforts by government, business, and citizens to transform to net-zero emissions by 2050 and limit warming to as close to 1.5°C, well below 2°C. This scenario is also regionalised to Australia. Proactive action by industry and government to pursue adaptive strategies, resilience building initiatives and emission reductions underpin this scenario. The results of this scenario are presented in comparison – a deviation – to the 3°C world.

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Established by Andrew and Nicola Forrest in 2001, Minderoo Foundation is a modern philanthropic organisation seeking to break down barriers, innovate and drive positive, lasting change. Minderoo Foundation is proudly Australian, with key initiatives spanning from ocean research and ending slavery, to collaboration in cancer and community projects.

In the aftermath of the devastating Black Summer bushfires across Australia in 2019-2020, Minderoo Foundation established the Fire and Flood Resilience Initiative and committed AU\$70 million to response, recovery and long-term resilience. Our vision is audacious. We want to reduce harm caused by fire and floods by harnessing the collective power of communities, industry, government, philanthropy and the research sector to lift Australia to be the global leader in disaster resilience by 2025.

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