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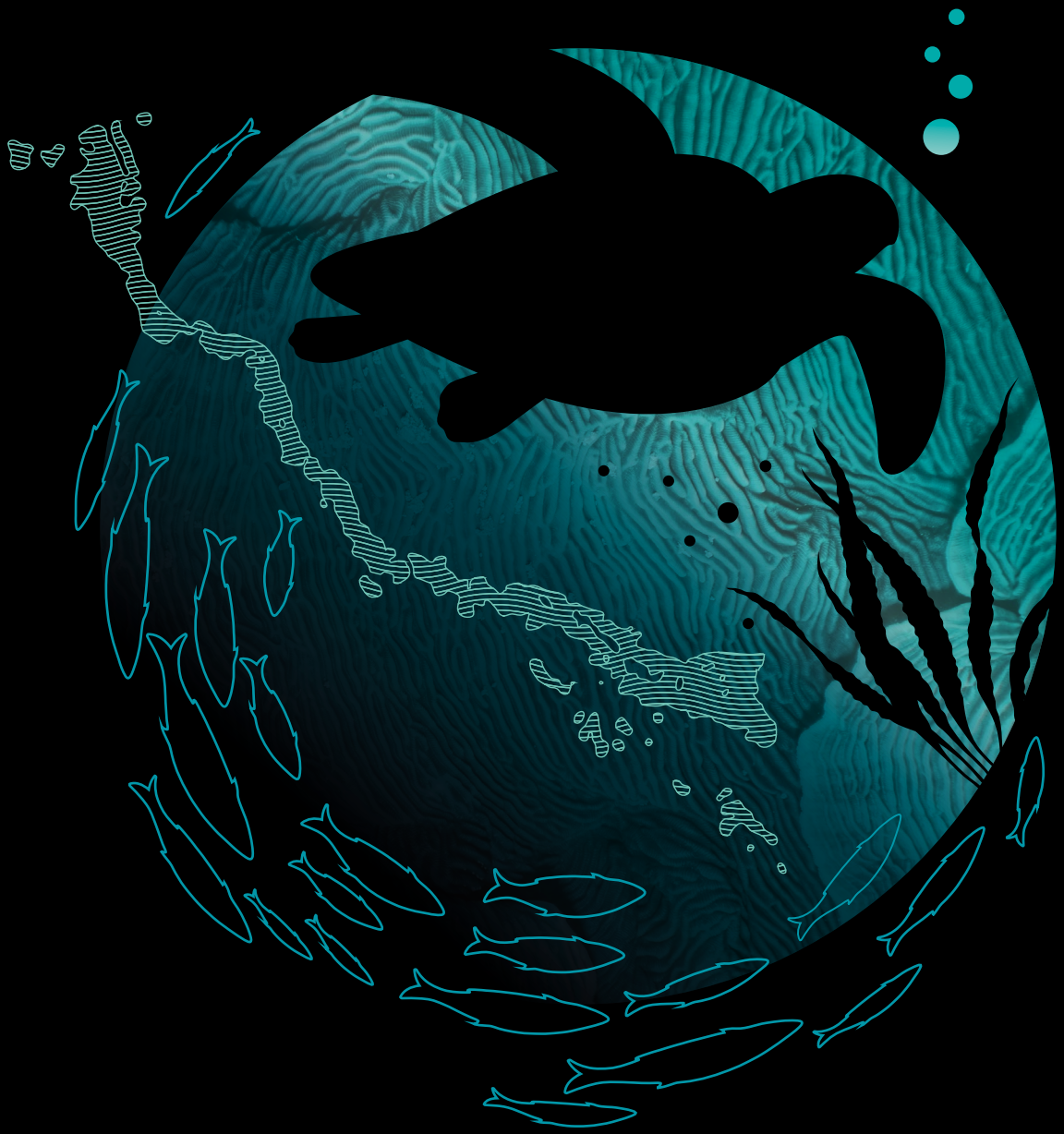


At what cost?

Safeguarding the Great Barrier Reef's role in Australia's economy

Great Barrier Reef Foundation
October 2025

Deloitte
Access Economics

Insights summary

Today, the Great Barrier Reef supports **77,000 jobs** and contributes **$9 billion** to the Australian economy. It remains a critical natural and economic asset. Climate action and investment in reef resilience creates a **$124 billion economic opportunity** over the next 50 years.

Australia's economic story – its potential – has always been grounded in its natural assets. Be it mining, agriculture or tourism, Australia's economy has been contingent on what we offer the world. Core to this narrative and to Australia's brand is the Great Barrier Reef.

Deloitte Access Economics captured this value back in 2017 and estimated the total economic, social and icon value of the Reef to be $56 billion. Capturing this value was necessary to elevate the Reef's status in economic decision making as it faced threats to its ongoing health. Jobs, businesses and livelihoods relied on the Great Barrier Reef. It's economic, cultural and natural importance made it too big to fail. Today, this value is estimated to be $95 billion.

As the world continues to warm, climate change continues to be the greatest threat to the Reef's vitality. Other stressors such as poor water quality from sediment runoff and crown-of-thorns starfish outbreaks further exacerbate the challenges to this natural wonder.

With threats remaining, and increasing, this puts the Reef's value at risk, making all efforts to sustain its health and increase its resilience even more critical. There is a lot to lose. The Great Barrier Reef cannot be taken for granted in Australia's economic outlook.

The Great Barrier Reef is one of Australia's top employers and a high-performing asset.

The Great Barrier Reef contributed $9 billion in value added to the Australian economy in 2023–24 and supported around 77,000 full-time equivalent jobs. If the Reef was a business, the scale of direct annual employment it supports would make it the 5th largest employer in the country.

The industries which create this economic contribution are diverse, spanning tourism, commercial fishing and aquaculture, and scientific research, conservation and environmental management. Unsurprisingly, tourism remains the Reef's largest contributor to economic activity, with around $7.9 billion in value added to the Australian economy due to the Reef. For Queensland alone, over 30% of all leisure tourism spending in the state comes from the Great Barrier Reef region. Its economic significance has not diminished.

Despite these substantial economic contributions, increasing threats and environmental challenges have led to stagnation in tourism growth. Environmental degradation deters visitor interest and hampers investment in the 'Reef economy'. This creates the ongoing risk of a negative feedback loop of lower tourism numbers leading to less investment which, in turn, slows growth in tourism.

This makes ongoing investments in reef restoration and adaptation critical to not only the natural environment, but the Reef's future contribution to Australia's economy.

Global climate action and ongoing investment in reef adaptation can create a $124 billion economic opportunity for the Great Barrier Reef region.

Australia has a contribution to make to global climate action that limits warming to below 2°C. Every degree of warming matters to the economic future of the Great Barrier Reef region. **Of the $124 billion, playing our part in the global climate effort results in a $110 billion economic benefit to the Great Barrier Reef over the next 50 years. Climate action is critical to the long-term growth of the industries and jobs that rely on the Reef.**[i]

i. Of the total $124 billion, $110 billion represents the economic benefit to the Great Barrier Reef region from Australia and the rest of the world taking action to limit global average warming below 2°C over the next 50 years to 2075. This figure is a net present value.

Avoiding the worst economic costs of climate change offers the Great Barrier Reef region a path to economic security in the face of ongoing global uncertainty, industrial change and increased environmental risk. The region's economic future and the contribution this makes to the national economy cannot be understated. But the economic benefits of avoided climate change risk are only one part of the opportunity the Reef offers Australia's economy.

Economic costs of global climate action vary and are shared, but actions to restore, adapt and protect the Great Barrier Reef are Australia's cost to wear. And in wearing the cost, we get the benefit.

Investment in restoration, adaptation and protection represents a $14 billion economic opportunity for the Great Barrier Reef, out of the $124 billion.[ii] As the world continues its effort to reduce emissions, the pressure remains to restore, adapt and protect the Great Barrier Reef from locked in climate damages – the consequences of both historical emissions and their ongoing release.

Australia has led the world in initiatives such as assisted coral evolution, crown-of-thorns starfish control, reef restoration and adaptation research and development, and in-water deployment. This leadership has seen more gains in science over the last five years than in the previous 50.

These reef science developments have the potential to protect the Reef's future health, while offering accelerated economic growth and gains due to these activities. These investments, at scale, represent the areas of economic activity that Australia is looking for – they are productive, with a view to the future and in support of the national interest.

The Great Barrier Reef has been an environmental and public policy priority for decades. Now is not the time to slow down. Realising economic opportunity requires investment in adaptation at scale, and quickly.

The economic opportunity for the Great Barrier Reef region represents the difference that meaningful restoration, adaptation and protection measures can have to build resilience as the climate changes. Investing in these measures leverages the Reef's inherent ability to bounce back, leading to steady improvements in its health, even in a 2°C world.

A step up in support is needed to realise the economic opportunity of a resilient Great Barrier Reef.

Australia has lifted its 2035 target ambition on the path to net zero. As further interim emissions reduction targets are set, governments at all levels are taking increased action to reduce emissions and ensure Australia contributes to the global effort to mitigate climate change. This effort matters for the future of the Great Barrier Reef.

But this effort must sit alongside an equal focus and increased support for adaptation, restoration and protection of the Great Barrier Reef, including continued support for current research and in-water deployment activities. The climate will continue to change due to past events and actions, but the future of the Reef can be improved through choices and investments made today.

Regardless of the outlook for warming, a step up in the scale and pace of public and private funding is needed in the next 10 years to create a resilient Great Barrier Reef. The plans, strategies and science exist to know where to focus the effort. It is the scale and activation of funding that is required to unlock the economic opportunity outlined in this report.

Adaptation, restoration and protection of the Great Barrier Reef is already Plan B. Getting the policy settings and associated funding mix right is critical to the Great Barrier Reef, and the jobs, livelihoods and regions that rely on it.

The Reef is not beyond saving. But the window for decisive action is now if we are to safeguard the Reef's economic, social and cultural value for future generations.

ii. Of the total $124 billion, $14 billion represents the economic benefit to the Great Barrier Reef region from proactive and scaled investments in adaptation and resilience as the climate continues to change over the next 50 years to 2075. This figure is a net present value.

The Great Barrier Reef remains too big to fail

Equivalent to Australia's 5th largest employer, the GBR makes a significant contribution to Australia's national economy.

$9 BILLION

in value added to Australia's economy

from the GBR region in 2023–24

77,000

jobs supported in Australia's economy

due to the GBR region in 2023–24

TODAY

FUTURE

CLIMATE ACTION

$110 billion opportunity if Australia and the world takes action to limit warming below 2°C

REEF RESILIENCE

$14 billion opportunity from proactive and scaled investments in adaptation and resilience as the climate continues to change

$124 BILLION

total economic opportunity for the GBR region

over the next 50 years

Contents

Preserving Australia's Great Barrier Reef

1.1 The economic, social and icon value of the Great Barrier Reef

Australia's Great Barrier Reef (GBR) – the world's largest living organism – is a beloved national symbol and a precious world heritage area. Alongside its important environmental and ecological functions within Australia and the world, the Reef also offers substantial value in terms of the economic and jobs activity it generates and the experiences it supports across the tourism, recreation and scientific industries.

In 2017, Deloitte Access Economics was engaged by the Great Barrier Reef Foundation to measure the economic, social and icon value of the Great Barrier Reef. The resulting report acknowledged that the intrinsic nature of the Great Barrier Reef makes it priceless, but in highlighting both the quantifiable and unquantifiable value of the Reef and its multifaceted importance to Australians and the world can effectively be considered in decision making.

The 2017 report estimated the Great Barrier Reef's:

- Contribution to the Australian economy in 2015–16 through industry value added and employment
- Economic, social and icon value, using non-market value techniques
- Significance to Traditional Owners
- Brand value to Australia and the international community.

The Great Barrier Reef had an economic, social and icon asset value of $56 billion – a value that exceeds the current market capitalisation of some of Australia's key institutions, such as Telstra, Woolworths and Qantas.[i] It supported 64,000 jobs and contributed $6.4 billion to the Australian economy in 2015–16. The 2017 analysis has been updated in this report to reflect a contemporary view on the total economic, social and icon value of the GBR.

At the time of the 2017 report, the GBR had endured two consecutive years of severe coral bleaching, as well as poor water quality from sediment run-off and pollution, cyclones and crown-of-thorns starfish outbreaks.

Eight years on, the Reef continues to face critical threats that compromise its health and sustainability. The most significant of these threats is climate change.

1.2 The Great Barrier Reef in troubled waters

Current assessments reveal a complex interplay of natural and anthropogenic pressures impacting the GBR's vitality. Coral bleaching remains a primary concern, largely driven by rising sea temperatures linked to climate change. The 2022 summer season witnessed widespread bleaching on the Reef due to elevated sea surface temperatures, further stressing coral resilience.[1]

Climate change is the greatest threat facing the Reef and managing these risks at a local and global scale remains imperative for the Reef's long-term preservation.

Although the Great Barrier Reef faces substantial threats, targeted local action combined with global climate initiatives offer a viable path towards recovery and future resilience. But continued investment in scientific research, in-water treatments, monitoring and community engagement is essential to bolster these efforts and enhance the Reef's resilience to future warming.

"We are in reach of a whole new relationship with the ocean, a wiser, more sustainable relationship. The choice lies with us."

– Sir David Attenborough[2]

i. ASX market capitalisation as at 20 May 2025 for Telstra Corporation Limited ($52.13B), Woolworths Group Ltd ($38.93B) and Qantas Airways Ltd ($15.46B).

Box 1.1: Maintaining Outstanding Universal Value of Australia's World Heritage Properties

Australia's identity has developed over centuries of significant transformation. Its landscapes, values, traditions, events and experiences collectively tell the Australian story, encapsulated in its natural and cultural sites. Among these are 20 Australian sites on the UNESCO World Heritage List, celebrated for their Outstanding Universal Value. Notable examples include the Great Barrier Reef, Uluru-Kata Tjuta and Sydney Opera House, which form a powerful trilogy in Australia's brand narrative: 'the Reef, the Rock and the House'.

Preserving these sites is crucial for their longevity. Despite their global significance, it is Australia's responsibility to ensure that the authenticity and integrity of these sites are protected, maintained and restored so that they can be experienced and enjoyed by future generations.

In 2023, Deloitte Access Economics provided an update on the economic and social value of the Sydney Opera House in its 50th year, including the contribution of its $300 million capital works program – 'Decade of Renewal' – in safeguarding these values for future generations of artists, audiences and visitors. The study found that the social value of the Opera House – contributions to mental, physical and social wellbeing through experiences – increased 38% over the preceding decade to $11.4 billion (real increase in like-for-like terms).

Just as the Sydney Opera House requires conservation and restoration to retain its Outstanding Universal Value, so does the GBR. The escalating environmental pressures on the Reef have led to continued warnings that it could be added to the In Danger List.

Addressing emissions alone will not safeguard the Outstanding Universal Value of the GBR. To offer the Reef a viable future, technologies for large-scale restoration need to be implemented alongside current restoration efforts. These technologies include cultivating corals on key local reefs now and enhancing their heat tolerance to survive escalating temperatures.

Preservation is not a one-off event, but a dynamic process involving science, community engagement and sustained financial commitment for collaborative stewardship to protect Australia's World Heritage sites for future generations.

Note: UNESCO defines Outstanding Universal Value as "cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity. As such, the permanent protection of this heritage is of the highest importance to the international community as a whole".

1.3 Valuing the priceless

In light of growing threats to the GBR, it is timely to understand the impact of the Reef's health on the regions, industries and people that rely on it. It is in this context that Deloitte Access Economics has been engaged to explore the many ways in which the Reef contributes value to the economy and its surrounding region.

This analysis aims to build on the analysis undertaken in the previous report to dive deeper into the economic linkages of reef health and regional economic growth. This is analysed through a:

- **Historical analysis:** analyses the drivers of performance within the 'Reef Economy' – tourism, commercial fishing and aquaculture, and scientific research, conservation and reef management.
- **Point-in-time analysis:** revisits the economic channels in which the Reef adds value to the economy and measuring the economic contribution of the GBR in 2023–24.
- **Future analysis:** estimates the regional economic and workforce impacts of limiting global warming and enhancing reef restoration, adaptation and protection.

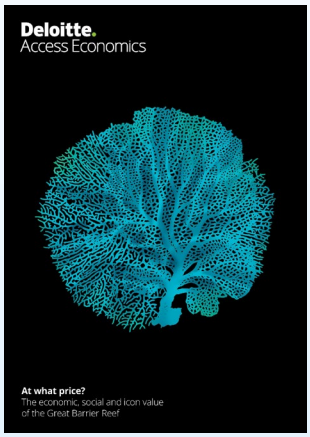
In this way, the analytical streams of this report complement, rather than replace, the non-market valuation analysis presented in the previous report.

A new look

How the analysis in this report compares

At what price? The economic, social and icon value of the Great Barrier Reef

2017 REPORT



At what price? captured the value of the Great Barrier Reef to Australia and the world. It established an asset value for the Reef, measured the GBR region's contribution to the economy and communicated its significant icon status as a symbol of Australia's national identity and 'brand' to the world. The report showed what was at risk beyond the GBR's natural significance.

At what cost? Safeguarding the Great Barrier Reef's role in Australia's economy

THIS REPORT

At what cost? analyses both the historical and future economic performance of the Great Barrier Reef. It updates the economic contribution measurement and estimates the GBR economy's future economic opportunity through economic scenario modelling. The analysis looks at new ways to understand the importance of preserving the GBR and the significance of its health to Australia's economy in the long term.

Cultural values and Traditional Owners

Aboriginal and Torres Strait Islander peoples are the Traditional Owners of the Great Barrier Reef area, with evidence of their connections to Country dating back over 60,000 years.

The report, *At what price? The economic, social and icon value of the Great Barrier Reef,* explored the value the GBR provides through cultural heritage, spiritual and religious, educational and knowledge services. These services partially capture the deep and enduring value the Reef provides First Nations peoples.

Several key publications explore the values and services of the Great Barrier Reef from the perspective of Traditional Owners, including the value of embedding Indigenous knowledge into reef management and value derived by First Nations peoples through traditional fishing and eco-tourism.

A forthcoming report in this series will focus on the value of the Reef that is embedded in Indigenous culture, spirituality, wisdom and stewardship. This report is expected to be released in 2026–27.

Total economic, social and icon value to Australia

Total non-use value to Australians is

$39B

Total direct use benefit to domestic tourists is

$40B

Total direct use benefit to recreational visitors is

$16B

1.4 Updating the total economic, social and icon value of the Great Barrier Reef

In 2017, Deloitte Access Economics estimated that the GBR's economic, social and icon value to Australia was $56 billion. This figure was based on measures of the value that all Australians place on the Reef regardless of their visitation to it (non-use value), and direct use value both to tourists and local recreational users.

Eight years on, this section provides an update to the valuation to provide a contemporary view of how Australians value the GBR. Valuation is based on the insights gathered in 2017, applied to updated price levels and increases in the Australian users of the Reef (both local and tourists) and the broader Australian population. Further details on methodology can be found in Appendix D.

Today, it is estimated that the Reef's economic, social and icon value to Australia is $95 billion. This estimate is in net present value terms at a 2% social discount rate to 2050, a key milestone for the global climate and the Reef's long-term sustainability.

Non-use value

Australians have consistently demonstrated a strong desire to preserve the GBR, even if they are not frequent visitors. This is for a range of reasons, including the option to visit the Reef in the future, and the value placed on having the Reef available for future generations to be able to visit and enjoy.

In 2017, Deloitte Access Economics estimated that 58% of Australians are willing to pay to preserve the GBR. In today's dollars, it is estimated that Australians would be willing to pay an average of $85.45 annually to ensure the GBR is protected into the future. Taken across the applicable Australian population, this amounts to **an annual willingness to pay, or non-use value, of $2 billion**.

This represents a **total non-use value to Australians of $39 billion** in net present value terms to 2050.

Direct use value

Tourism

In 2017, econometric modelling by Deloitte Access Economics found that consumers place a significant value on the ability to visit the Reef, over and above the price paid for trips to the GBR region. This consumer surplus is estimated at $837 per trip.

It is estimated that 2 million overnight holiday travellers visited the GBR from across Australia in FY2024, motivated by the Reef's natural values. Across these individuals, there is an estimated **$2 billion in annual consumer surplus**.

Total direct tourism value is estimated at $40 billion in net present value terms to 2050.

Recreation

Many residents of surrounding regions actively use the GBR for recreational activities such as snorkelling, diving, boating, and relaxing on its iconic beaches. It is estimated that in FY2024 residents of the GBR region visited the Reef and its surroundings an average of 12.4 times per person. **In total, this is equivalent to about 13 million recreational activities undertaken using the Reef**.

Locals highly value this access to the GBR, with the average consumer surplus per person estimated at $59 per visit. Across the applicable population, this results in an **annual direct benefit of $742 million from recreational trips to the Great Barrier Reef**.

Total direct recreational use value is $16 billion, in net present value terms to 2050.

Total economic, social and icon value

The updated total economic, social and icon **value of the Great Barrier Reef to Australians is estimated at $95 billion**. As a national icon and a natural wonder of the world, the Great Barrier Reef's value to Australians has always surpassed its market contribution. Its distinct natural beauty, biodiversity and recreational opportunities continue to make visiting the Reef a treasured experience that Australians want to preserve for future generations.

Table 1.1: Great Barrier Reef economic, social and icon value

	Net present value ($b)
Non-use value	$39
Direct tourism value	$40
Recreational use value	$16
Total	**$95**

Source: Deloitte Access Economics

Note: Net present value uses a 2% social discount rate to 2050 (see Appendix D). All values are rounded.

Still too big to fail

Economic contribution to the economy

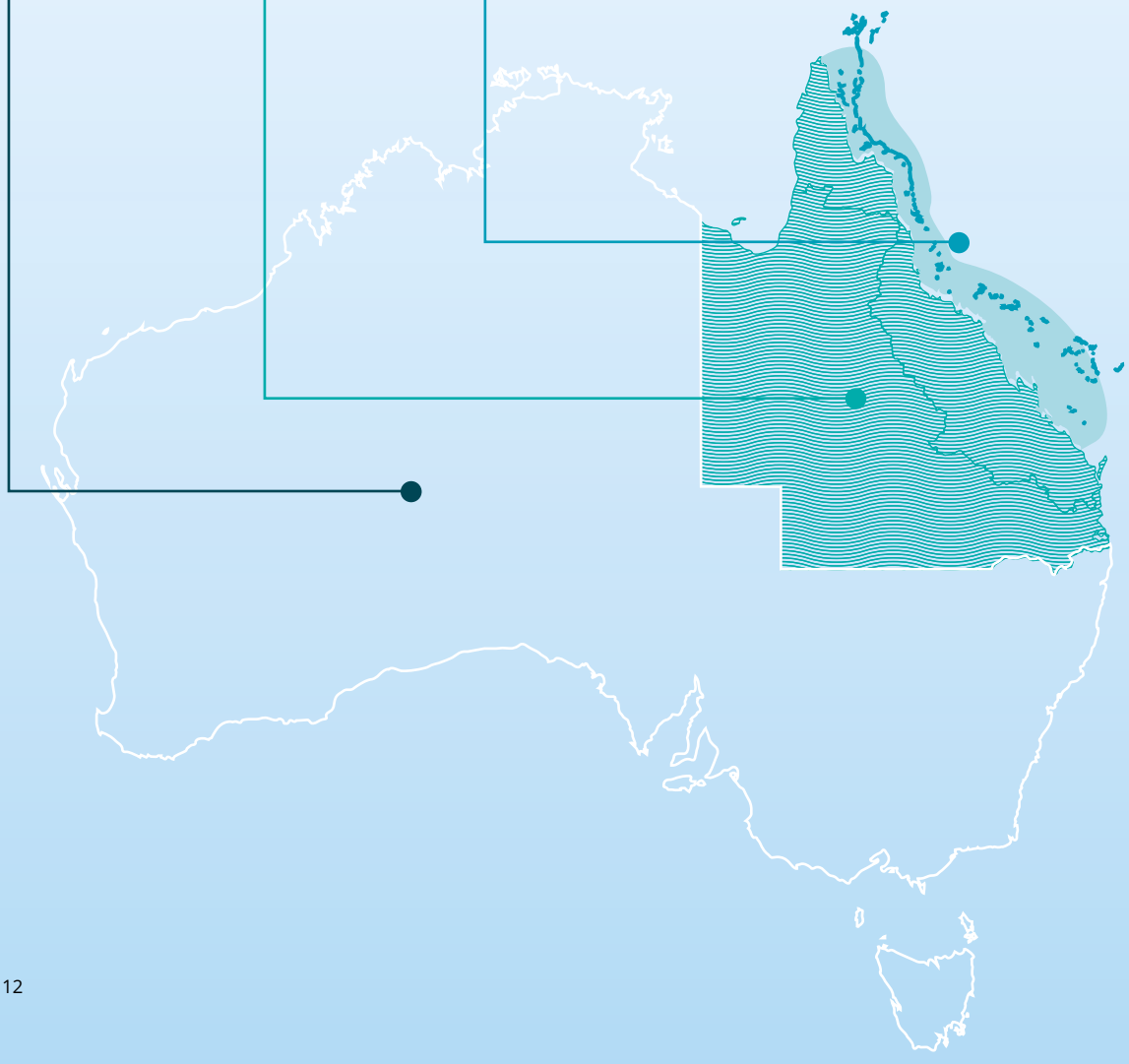
The Great Barrier Reef region's measured contribution of Australia's economy in 2023–2024

Total contribution to Australia

$9.0B and 77,000 jobs

$6.9B and 61,000 jobs
within Queensland

$6.1B and 56,000 jobs
within Great Barrier Reef regions



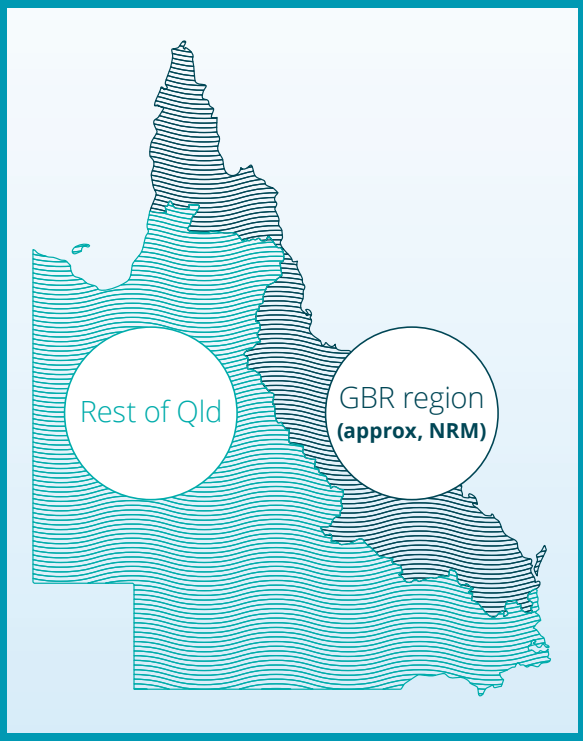
Economic contribution analysis

Defining the Great Barrier Reef region

How is the Great Barrier Reef region defined?

The Great Barrier Reef region (GBR region) is made up of six Natural Resource Management (NRM) regions that make up the Great Barrier Reef Marine Park:[ii]

- Cape York
- Wet Tropics
- Burdekin
- Mackay Whitsunday
- Fitzroy
- Burnett Mary.



In assessing the spatial dimension of the economic value supported by the Reef, this report refers to the above NRM regions as 'sub-regions' of the broader GBR region.

How does the Great Barrier Reef contribute value to the economy?

The GBR is a significant economic asset to local communities and businesses. Its famous corals, sea-life and waters facilitate not only a strong tourism sector in northern Queensland but also a productive fishing and aquaculture sector, recreational activity for locals and significant scientific research into marine life and environmental protection. In the following section, the economic performance of the GBR in terms of the economy is demonstrated through analysis of the following three sectors:

- **Supported tourism**, including the flow-on impacts of leisure spending from tourists in the GBR region
- **Commercial fishing and aquaculture**, including the output of both wild-caught and farmed fish and crustaceans on the Reef or in coastal areas directly reliant on waters from the Great Barrier Reef Marine Park
- **Scientific research, conservation and reef management**, including both scientific research activities reliant on the GBR in addition to management and conservation activity aimed at preserving the Reef for future generations to enjoy.

Importantly, while the economic performance of these sectors are dependent on the Great Barrier Reef, the Reef also contributes to the local economy through providing services for local communities. The reported economic contribution of the Reef in the following section of this report captures these values through consideration of the value of **recreational activities**, including boating, fishing, sailing, snorkelling, beach and island visits in the Great Barrier Reef Marine Park.

ii. For ease of comparison to the 2017 report, this report uses the former NRM region names.

The Great Barrier Reef contributed **$9 billion in value** added to the Australian economy in 2023–24, supporting around **77,000 full-time equivalent jobs**.

2.1 How the Great Barrier Reef generates economic value

The 'Reef Economy' describes the Reef's role in **supporting a tourism sector**, sustaining significant **commercial fishing and aquaculture** operations, and providing a platform for increasing **scientific research, conservation and reef management** activities and **recreational activity spending** by local residents who visit the Great Barrier Reef Marine Park.

These sectors reflect major avenues through which the GBR contributes to the Australian economy. However, it is noted that they reflect only the contribution that can be monetarily estimated. As such, the economic contribution does not include non-market benefits where monetary values cannot easily be estimated.

Two examples of these values are the value that residents place on the use and protection of the Reef (above and beyond that directly spent on recreation or tourism activities), and on the ecosystem services the GBR provides to local environments. While not a component of economic contribution studies, these benefits can be wide ranging and significant.

For example, in Deloitte Access Economics' previous study it was estimated that the GBR had a total economic, social and icon asset value of $56 billion, reflecting the value placed by Australians on the direct use of the Reef and on non-use facets such as the cultural importance of the Reef. One significant component of the non-use value is brand value, discussed further in Box 2.1. Further, page 33 of this report provides an experimental estimate of just one of the many ecosystem services the Reef provides – carbon sequestration, valued at around $217 million every year.

Box 2.1: The brand value of the Great Barrier Reef

In a public perception survey undertaken in Deloitte Access Economics' previous 2017 study, 65% of respondents, both domestic and international, listed the Great Barrier Reef as Australia's most iconic natural World Heritage site.[3] This placed the GBR ahead of other iconic attractions including Uluru-Kata Tjuta, Kakadu National Park, the Tasmanian Wilderness and the Blue Mountains. The integral place of the GBR as a centre-point of *Brand Australia* still holds today, with a more recent Tourism Australia study finding that the GBR was the 'icon' most positively associated with Australia.[4]

The Great Barrier Reef belongs to a small group of icons that are positively associated and synonymous with Australia, which Tourism Australia approved their use in marketing without requiring additional explanation.[5] As the most-visited and most-associated unique Australian icon, the GBR has cemented itself as a centre-point of Brand Australia. In this way, the health of the GBR is strongly linked to Australia's brand and international reputation.

2.2 Measuring the economic contribution of the Great Barrier Reef

A variety of primary and secondary data sources were used as a basis to measure economic contribution across the four streams of contribution, including:

- Australian Bureau of Statistics (ABS) Input–Output Tables, Consumer Price Index, Tourism Satellite Account and Labour Force statistics
- Tourism Research Australia's National Visitor Survey and International Visitor Survey
- Australian Charities and Not-for-profits Commission Government Charities Report data
- Annual reports for individual organisations
- The Queensland QFish fisheries database and Agriculture production summary for Queensland
- CSIRO Social and Economic Long-Term Monitoring Program (SELTMP) survey of GBR residents.

For each stream, direct and indirect economic contributions were calculated. This was completed using:

- the Deloitte Access Economics Regional Input–Output Model (DAE-RIOM) for tourism, commercial fishing and aquaculture, and scientific research, conservation and reef management.
- a Regional Tourism Satellite Account (RTSA) based contribution model for supported tourism.

These models are consistent with the ABS National Accounts and Tourism Satellite Accounting frameworks, respectively, reflecting internationally recognised best practice approaches to estimating economic contribution. These models are discussed further in Appendix A.

Direct contribution can be conceptualised as the value added and employment of organisations directly within or interacting with the Great Barrier Reef, while **indirect contribution** includes the value added of the various upstream suppliers of goods and services supporting these organisations. Together, direct and indirect values can be combined to estimate **total value added**.

Consider an example for a commercial fishing operator within the GBR region. The gross output of the operation is the monetary value of the fish caught. To catch these fish, the operator needs to pay others for supplies, such as bait, fuel and boat maintenance – these are called 'intermediate inputs'. Where these outputs are purchased locally from other Australian businesses, the fishing operation creates indirect value-add is created through the wages, business profit and taxes generated from this activity. The fishing operation also has its own direct value added, which is the amount of income it generates for staff (wages), government (taxes) and the remainder of the value of output that it retains for itself (business profits). Naturally, the value of gross output is equal to the sum of these values, representing the inputs to production in addition to business profits. See Figure 2.1.

Figure 2.1: Economic activity accounting framework – a commercial fishing operator

Source: Deloitte Access Economics

2.3 The total economic contribution of the Great Barrier Reef

Across the four economic contribution streams, the **GBR contributed $9 billion in value added** to the Australian economy in the 2023–24 financial year **and supported almost 77,000 full-time equivalent jobs**. This represents an 11% growth in the real economic contribution of the Reef to the Australian economy since the 2015–16 study, or an average growth of 1.4% per annum. While some changes have been made in approach (refer to Box 2.2), this low growth rate in economic contribution, below average Australian real GDP growth of 2.2% per annum over this period, primarily reflects challenges in maintaining the growth of visitors to the region alongside increasing environmental concerns. Table 2.1 provides a detailed breakdown of the GBR's economic contribution through value added and employment measures by stream and geography for the 2023–24 year.

Tourism is the largest measured economic contribution stream across all geographies, representing 89% of the overall contribution of the Reef to Australia.

Despite challenges in maintaining growth in the value of the region as a result of increasing environmental damages, the Great Barrier Reef remains an important asset to the Australian and regional economies. The GBR supports the employment of over 76,500 full-time equivalent (FTE) employees, of which 55,900 work within the GBR region. Further, with 53,700 FTEs working directly in businesses or organisations that facilitate the economy, if the Reef were a business, it would be the fifth largest employer in Australia.[iii]

iii. Based on employment of publicly trading Australian companies.

Table 2.1: Economic contribution of the Great Barrier Reef (2023–24, $ millions)

	Streams	GBR regions	Queensland	Australia
Value added ($m)	Tourism	$5,248	$5,985	$7,944
	Commercial fishing and aquaculture	$258	$259	$290
	Recreational activities	$388	$402	$443
	Scientific research, conservation and reef management	$256	$270	$314
Total value added ($m)		**$6,145**	**$6,916**	**$8,991**
Employment (FTE)	Tourism	48,300	52,900	68,000
	Commercial fishing and aquaculture	1,900	1,900	2,100
	Recreational activities	3,600	3,700	4,000
	Scientific research, conservation and reef management	2,100	2,200	2,400
Total employment (FTE)		**55,900**	**60,700**	**76,500**

Source: Deloitte Access Economics

Note: Value added by stream is not additive across region

Box 2.2: Comparison to the previous study

The total economic contribution of the Great Barrier Reef to Australia grew by 41% in nominal terms and 11% in real terms, mainly driven by increasing tourism spends per visitor in addition to a growing prawn aquaculture sector. Real contribution growth has been low, at 1.4% per year, reflecting the impacts of environmental and investment challenges for Reef economy tourism, as well as global shocks such as the COVID-19 pandemic (refer to Appendix C).

Notably, there has been a compositional change, in addition to overall real economic contribution growth since the previous study. For example, the contribution captured within GBR regions grew to more than 68% of the total Australian economic contribution, an increase of 23 percentage points since the 2015–16 study. Additionally, over 76% of the $9 billion in total value added to the Australian economy came from Queensland, up from 60% in the previous study. This primarily reflects an update of how tourism was attributed by region in line with the Regional Tourism Satellite Account framework, in addition to small updates in data sources used. Refer to Appendix A for method details.

2.4 Tourism contribution

The Great Barrier Reef is one of the seven wonders of the natural world, offering a multitude of tourism options for domestic and international travellers alike. In 2023–24, the GBR region hosted over 8.6 million overnight leisure visitors, of which 87% were domestic overnight travellers and 13% international travellers. On average, international visitors stayed 4.2 nights longer than domestic visitors; however, they spent less per night. Collectively, there were 33.8 million nights spent in the GBR region in 2023–24, with an average expenditure per night of $238. The GBR also hosted over 8,000 domestic daytrip visitors, with an average day spend of $164 (Table 2.2). In total, across domestic and international visitors, $9.4 billion of leisure visitor expenditure was spent within the GBR region in 2023–24.

Table 2.2: Estimated leisure visitors to the Great Barrier Reef region, 2023–24

Type of leisure visitor	Visitors ('000s)	Visitor nights and days ('000s)	Average nights/days per visitor	Expenditure per visitor night/day ($)
International	1,082	8,202	7.6	$144
Domestic overnight	7,548	25,612	3.4	$268
Total overnight	**8,630**	**33,814**	**3.9**	**$238**
Domestic daytrip	8,004	8,004	–	$164
Total	**16,634**	**41,818**	**2.5**	**$224**

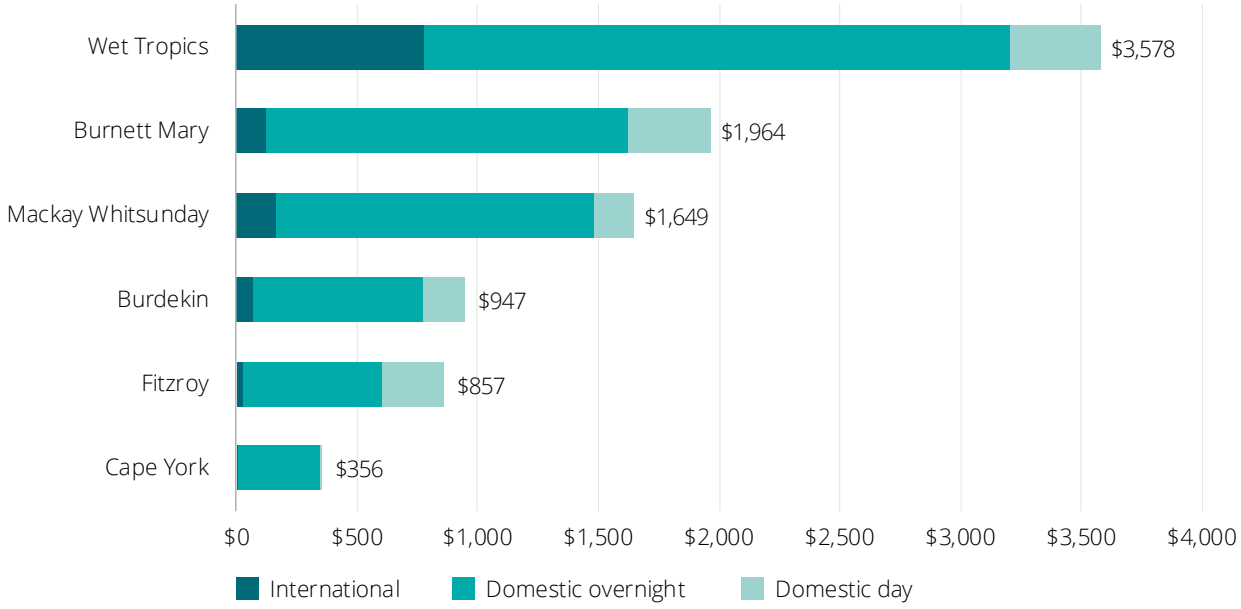
Source: Tourism Research Australia; Deloitte Access Economics

Approximately 38% of the Great Barrier Reef region expenditure was within the Wet Tropics, which includes Cairns, Innisfail, Atherton and Tully. This area serves as a major 'tourist gateway' to the Reef, particularly for international leisure visitors, leading to the most diverse expenditure split by leisure traveller type.

Approximately $0.8 billion (22%) of expenditure was spent by international visitors, $2.4 billion (68%) by domestic overnight visitors and $0.4 billion (10%) by daytrip visitors. Although the Wet Tropics NRM region had the highest expenditure compared to other NRM regions, its leisure visitation growth lags behind destinations with higher domestic leisure visitors.

Since the 2015–16 study, expenditure in the Wet Tropics grew by 13% in real terms, whereas the Mackay Whitsunday NRM region saw a 78% increase. This significant growth in the Mackay Whitsunday NRM region aligns with a rise in domestic overnight visitors, who make up 80% of tourism expenditure there, compared to 68% in the Wet Tropics NRM region.

Chart 2.1: Expenditure by leisure traveller type across the GBR NRM regions (2023–24, $ millions)



Source: Tourism Research Australia; Deloitte Access Economics

Note: Year ending June

The economic contribution of tourism activities within the GBR region is estimated to be $7.9 billion in value added to the Australian economy, supporting 68,000 FTE jobs. Approximately $2.9 billion of value added from tourism expenditure was directly attributable to tourism activities, with a further $2.4 billion of indirect value added indirectly supporting downstream industries that contribute to tourism activities, such as retail.

Despite the region lagging behind overall Queensland tourism industry growth since the mid-2000s (refer to next page), the GBR region remains a critical asset for the tourism industry. The GBR made a total tourism contribution to Queensland of $6.0 billion, equivalent to over one-fifth of Queensland's tourism value added,[iv] and supported an estimated 52,900 FTE roles in 2023–24.

Table 2.3: Great Barrier Reef tourism contribution, 2023–24

	Value added ($m)			Employment (FTE)		
	Direct	Indirect	Total	Direct	Indirect	Total
GBR region	$2,857	$2,392	**$5,248**	36,000	12,300	**48,300**
Queensland	$3,144	$2,841	**$5,985**	38,500	14,400	**52,900**
Australia	**$4,211**	**$3,733**	**$7,944**	**49,200**	**18,800**	**68,000**

Source: Deloitte Access Economics

iv. Based on the latest available State Tourism Satellite Account, which detailed 2022–23 total tourism gross value added (direct and indirect) of $28.6 billion.

Economic performance of the tourism sector

Long-term growth in tourism in the GBR region has been weak due to negative perceptions of the Reef's health and low investment.

The sheer value of tourism in the Great Barrier Reef demonstrates its significance to the Queensland economy. With an estimated $9.4 billion of leisure visitor expenditure[v] within the GBR region in 2023–24, this represented over one third of total Queensland leisure tourism expenditure.

Despite being a significant contributor to Queensland's tourism activities, the GBR region's revenue growth has not kept pace with the rest of Queensland. **Real tourism expenditure in the GBR region has grown at an average rate of 1.1% per year since 2007–08**, well below growth in the average annual Queensland tourism expenditure of 1.7% per year. Much of the growth in expenditure has been due to temporaneous growth in spending per visitor rather than in tourism volumes.

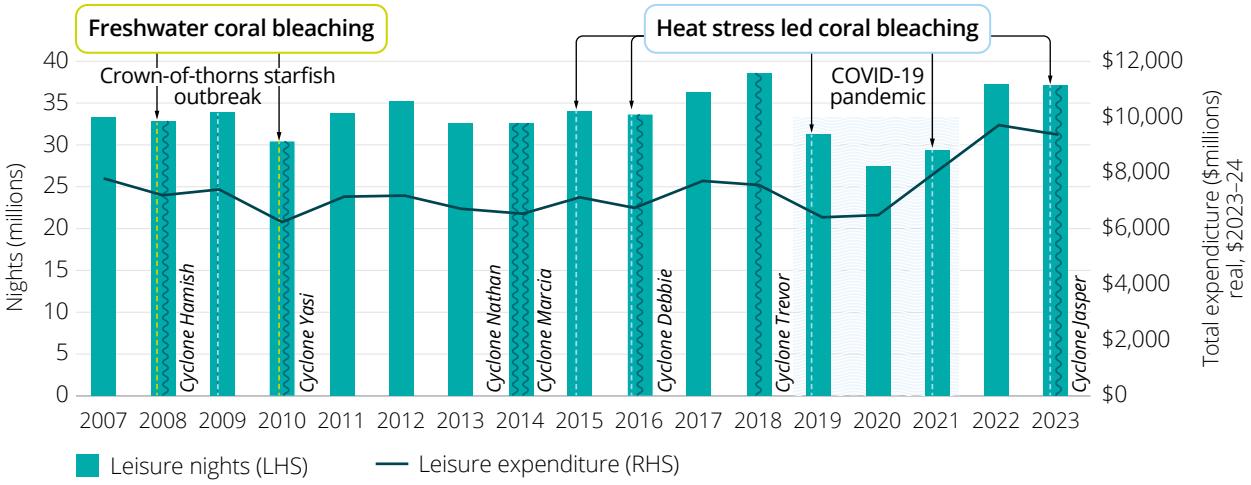
Growth in spending per visitor has been a result of shifts in the visitor profile since the COVID-19 pandemic, with the region being popular among high-spend domestic visitors in 2022–23 and 2023–24, in addition to rising prices for tourism products such as airfares, which have outpaced economy-wide inflation.[6]

Leisure visitor nights have only grown by an average of 0.7% per year to 2023–24.

Fluctuations in leisure tourist visitation to the GBR region have coincided with increasing environmental impacts to the Reef. These affect immediate tourism and, as reporting of coral bleaching compounds, deter long-term interest from travellers.

As depicted in Chart 2.2, the slowdown in GBR region tourism has coincided with significant pressures on the health of the Reef and its region. One significant pressure is cyclones, which cause extensive physical damage and associated flood plumes. The most recent of these, Cyclone Jasper (December 2023), was estimated by Tourism Tropical North Queensland to have resulted in $300 million in lost or cancelled tourism expenditure in 2023–24, equivalent to around 6% of annual tourism spend in the Tropical North Queensland region.[7] Repeated coral bleaching events linked to heat stress from a strong El Niño and rising ocean temperatures further compound these pressures. Outbreaks of crown-of-thorns starfish also occurred during this time, and poor water quality driven by nutrient run-off have further exacerbated a decline in the Reef's health.

Chart 2.2: Leisure visitation and expenditure in the GBR region, 2007–08 to 2023–24



Source: Deloitte Access Economics

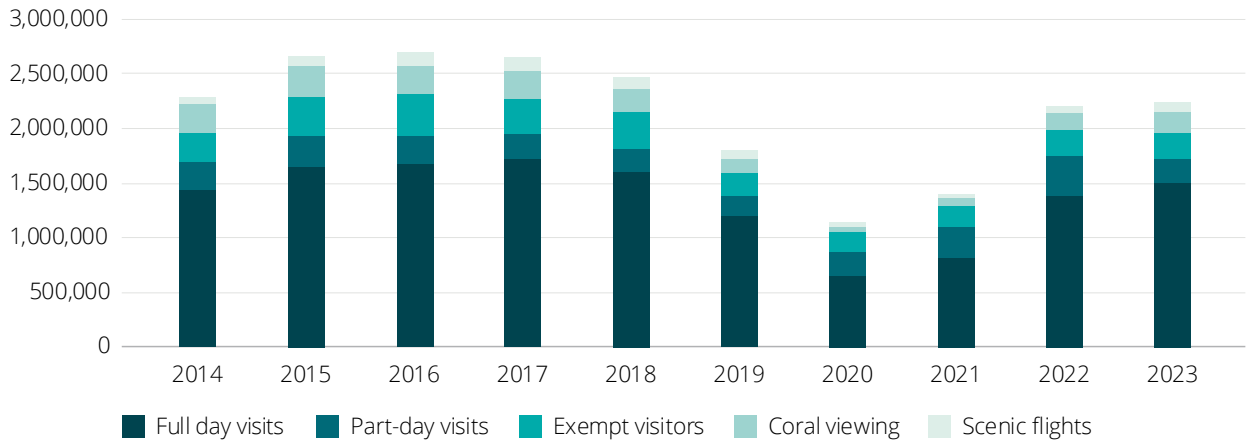
Note: Underlying data in financial years, but axis labels are simplified for readability (year ending June).

v. Leisure travellers include those who visit the region for holiday or visiting friends or family purposes. For more information on the quantification of tourism within this report, refer to Appendix A.

Difficulties in maintaining long-term tourism growth in the GBR region reflect the impacts of compounding environmental pressures, which have devalued the Reef as a tourism asset. While Chart 2.2 indicates the impact that these environmental issues have had on tourism in the region, these impacts are more acute for activities on the Reef itself, particularly in recent years.

Environmental Management Charge (EMC) data, collected on a per-person basis for commercial activities on the Reef, has revealed that **activities on the Reef in 2023–24 remains at only 84% of the 2016–17 peak**. The strongest decline has been in coral viewing, with a 19% decline between 2015–16 to 2018–19 accompanying mass bleaching events in 2016 and 2017.

Chart 2.3: Visitors undertaking activities on the GBR marine park, by EMC classification, 2015–16 to 2023–24

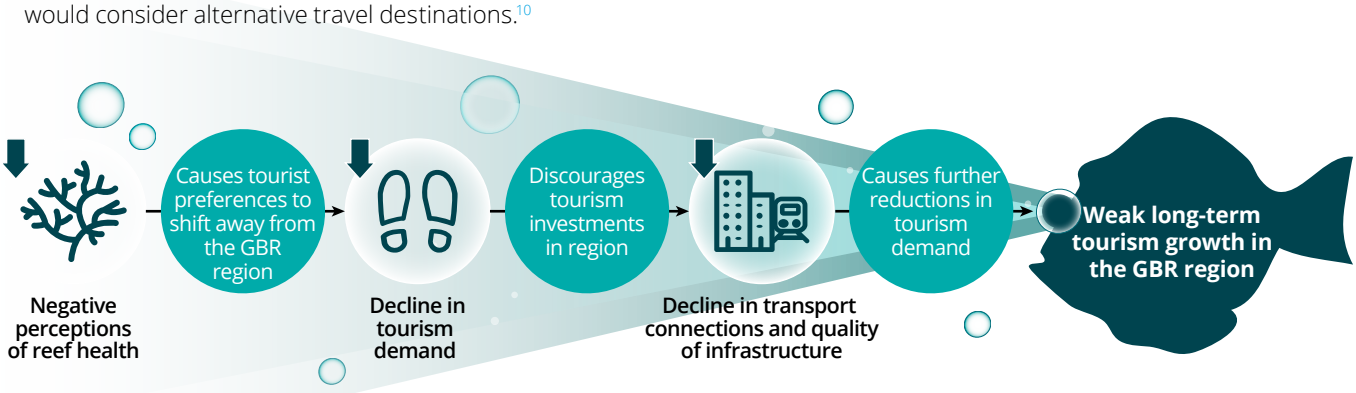


Source: Deloitte Access Economics (2025), Great Barrier Reef Marine Park Authority (2025).

Note: Underlying data is per financial year, but axis labels are simplified for readability (year ending June). Exempt visitors are passengers not required to pay the Environmental Management Charge (EMC), including children less than 4 years old, visitors from the tourism industry engaging in trade familiarisation, fourth and subsequent days for passengers on extended charters, and passengers for whom another operator has paid the EMC for that day.

While it is difficult to assess the scale of direct causality between the Reef's environmental quality and tourism, several survey studies have suggested a clear correlation between coral quality and tourism visitation. Researchers have found that tourists' sentiment shifted to 'last-chance tourism' and showed declining perceptions of aesthetic beauty, overall experience satisfaction, and quality ratings of Reef tourism activities.[8] Polling in the aftermath of the 2016 coral bleaching event also found that continued severe coral bleaching could risk the GBR region losing over 1 million visitors per year.[9] This finding has been corroborated by a recent 2021 study that confirmed that if the Reef continues to deteriorate, many visitors would consider alternative travel destinations.[10]

In turn, **prolonged weakness in visitation growth deters investment in tourism industries throughout the region**. A resulting lack of transport connections and ageing infrastructure further exacerbate the weakness in tourism (see Figure, below). This feedback loop is evident in hotel and aviation investment, both of which have trailed the Queensland average and compounded a weak outlook for future GBR region tourism growth. Investment trends in hotels and aviation, and their compounding implications on travel, particularly from international markets, is discussed in Appendix C.

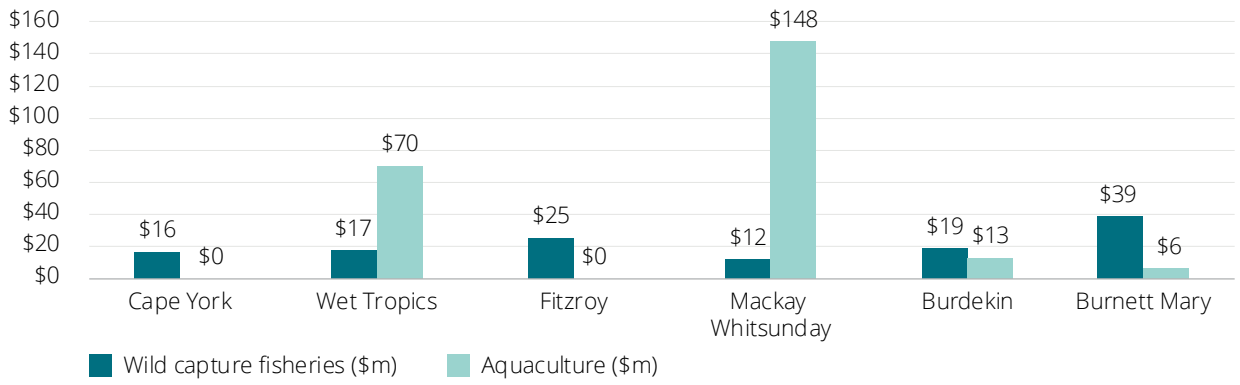


2.5 Commercial fishing and aquaculture contribution

The gross value of production across wild capture fisheries and aquaculture in the GBR region was estimated to total $364 million in 2023–24. Over two-thirds of this was associated with the aquaculture industry, which has grown on average by 10% per year in real terms since the 2015–16 study. Most of this growth occurred in the Mackay Whitsunday region, where gross value of production increased to $148 million in 2023–24 (see Chart 2.4) fuelled by prawn aquaculture (refer to page 25 for further details).

Wild capture fisheries' gross value of production totalled $128 million across the GBR region in 2023–24. These fisheries are concentrated in the southern section of the GBR region, with the Burnett Mary and Fitzroy regions accounting for 50% of the Reef's gross value of production. Overall, in like-for-like terms, the total gross value of production for wild capture fisheries has decreased by 0.2% per year since the 2015–16 study, with tighter wild caught fishing controls introduced by the Queensland Government in late 2022 to safeguard the Reef's delicate ecosystems.

Chart 2.4: Commercial fishing and aquaculture gross value of production across GBR regions (2023–24, $ millions)



Source: Deloitte Access Economics

Overall, commercial fishing and aquaculture in the Great Barrier Reef in 2023–24 supported an economic contribution of $290 million to Australia's total value added and job creation of 2,100 FTE roles. A large proportion of this contribution, or $160 million in value add, was contained within the GBR region and attributed to direct operator. The remaining $129 million is attributable to supporting industries that supply the commercial fishing and aquaculture industry across the Australian economy (Table 2.4).

Table 2.4: Great Barrier Reef commercial fishing and aquaculture contribution, 2023–24

	Value added ($m)			Employment (FTE)		
	Direct	Indirect	Total	Direct	Indirect	Total
GBR regions	160	92	**252**	1,200	700	**1,900**
Queensland	160	99	**259**	1,200	800	**1,900**
Australia	**160**	**129**	**290**	**1,200**	**900**	**2,100**

Source: Deloitte Access Economics

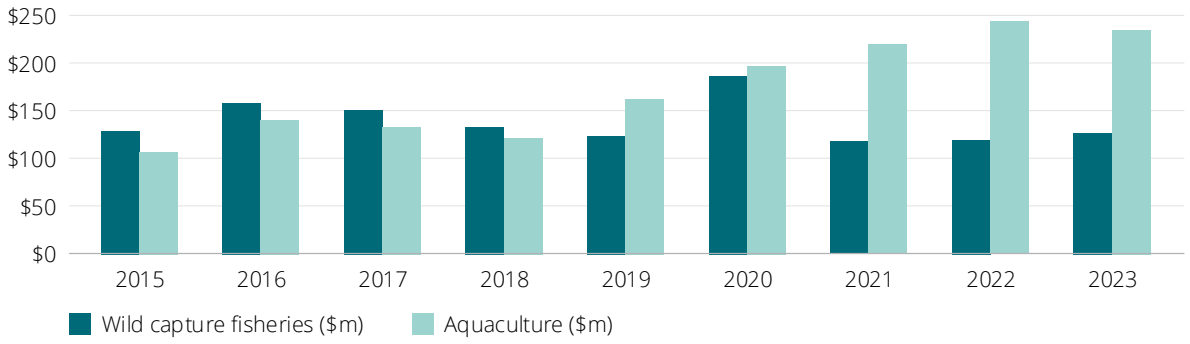
Note: totals may not add due to rounding

Economic performance of the commercial fishing and aquaculture sector

The Great Barrier Reef's commercial fishing outlook remains uncertain, as a booming aquaculture industry offsets a decline in wild capture fisheries production

Total aquaculture and commercial fishing production in the GBR region has **grown between 2015–16 and 2023–24 by an average of 5.8% per annum**. Growth in the sector is largely driven by aquaculture, which has doubled in real terms from 2015–16 to 2023–24. In contrast, wild capture fishing production has declined in real terms from the 2015–16 to 2023–24 financial year.

Chart 2.5: Commercial fishing and aquaculture industry gross value of production in the GBR region, real ($m 2023–24), 2015–16 to 2023–24 ($m)



Source: Deloitte Access Economics

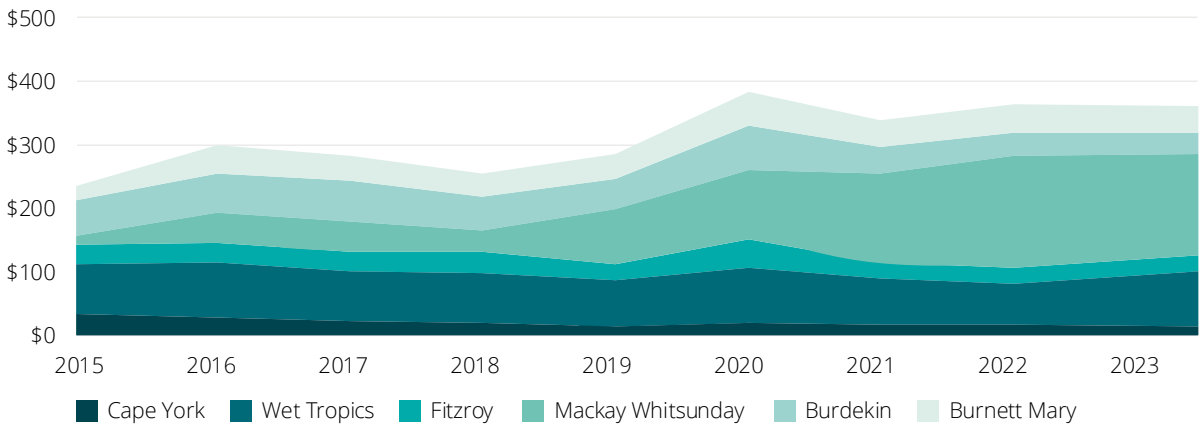
Note: Underlying data in financial years, but axis labels are simplified for readability (year ending June).

The prawn aquaculture boom has increased total industry revenue in the GBR region

The GBR region has benefited from strong investment in aquaculture, with total real aquaculture output growing by 10.9% per annum since 2016-17. Despite an initial slowdown in investment between 2016-17 and 2018-19, aquaculture production has bounced back, with aquaculture comprising over 50% of industry revenues in the GBR region since 2019-20. This has mainly been driven by the prawn aquaculture boom in the Mackay Whitsunday region, where aquaculture production has grown by 24% per annum in real value since 2016-17. This sector, located in coastal areas along the Reef region, is reliant on waters from the Great Barrier Reef Marine Park. Growth has been supported by an ideal, warm north Queensland climate and the proximity of farms to both high-quality water sources, facilitated by the GBR, and access to major towns, which allow for sufficient infrastructure to support expansion.[11]

This industry boom has also been supported by government programs, with the Queensland Government declaring more than 9,000 hectares of Aquaculture Development Areas across eight land parcels to support the aquaculture industry since 2019.[12] The Aquaculture Transformation Program (ATP) was also initiated in 2021–22 by the Department of Agriculture and Fisheries with $1.5 million in funding.[13]

Chart 2.6: Regional gross production value of wild capture fisheries and aquaculture production in the GBR region, by Natural Resource Management Region, real ($m 2023–24), 2015–16 to 2023–24



Source: Deloitte Access Economics

Note: Underlying data in financial years, but axis labels are simplified for readability (year ending June).

There has been decreasing investment in wild capture fisheries, driven by sustainability concerns

State and federal government regulations for commercial and wild fisheries have increased over the years as sustainability concerns have arisen in the Great Barrier Reef Marine Park. In 2015, the Queensland Government implemented net-free zones in Cairns, Mackay and Rockhampton. The ban on gillnets, while impacting local commercial fishing, has also led to an increase in the average size of king threadfin and barramundi caught, growing by over 20%.[14] While these zones were mainly implemented to support recreational fishing and the flow-on effects for local businesses and tourism, larger restrictions are currently being put in place, with the Australian and Queensland governments committing a combined $160 million to phase out gillnet fishing in the Great Barrier Reef World Heritage Area by mid-2027.[15]

Future challenges and opportunities for commercial fishing and aquaculture on the Great Barrier Reef

Environmental concerns are expected to continue to impact the growth of commercial fishing and aquaculture on the Reef, as operators, regulators and the community continue to balance environmental sustainability with economic development. Recent plans to phase out gillnet fishing in the Great Barrier Reef World Heritage Area are expected to target barramundi, grey mackerel and king threadfin, equivalent to around 5% of current total wild capture fishery production values.[16]

While environmental concerns have been raised about the booming prawn aquaculture industry's impacts on the Reef waters it relies on, the industry is generally seen as managing these environmental impacts effectively. It is argued that a combination of strict regulations and technological advancements has resulted in Australian prawn aquaculture's effluent discharge levels being among the 'world's best'.[17]

While gillnet fishing methods are at risk due to environmental concerns, there is potential for new growth in aquaculture, provided that environmental sustainability concerns continue to be adequately managed.

2.6 Scientific research, conservation and reef management contribution

Scientific research, conservation and reef management includes day-to-day management activities undertaken on the GBR in addition to the contribution of activities undertaken by institutions that support research and conservation activities on the Reef.

Environmental management, research and conservation activities are interlinked, with a focus in recent years being on the use of scientific data to enhance awareness of the threats to the Reef and empower evidence-based management and conservation activities. This focus has been apparent not only in the activities of longstanding members of the Reef community, including the Great Barrier Reef Marine Park Authority (GBRMPA), the Australian Institute of Marine Science, CSIRO and the Great Barrier Reef Foundation, but also in the increasing popularity of 'citizen science' organisations.

It is not possible within a market contribution study to capture all activity related to scientific research and conservation on the Reef, particularly given the increasing share of organisations and activity underpinned by the work of passionate volunteers.

Nonetheless, annual reporting and Australian Charities and Not-for-profits Commission data has been leveraged to estimate the contribution of the GBR-related activities of research, management and conservation organisations in 2023-24. This includes management entities ranging from the GBRMPA and NRM region management organisations, to Australian Research Council funding, and numerous citizen science and conservation organisations on the Reef. For further detail on organisations captured, see Appendix A.

Collectively, these organisations had estimated Reef-related revenues of $327 million in the 2023-24 financial year. As a sector made up of non-profit institutions, much of this revenue is used for the employment of local researchers and conservationists, in addition to local contractor expenses. Revenue from these institutions thus has a significant flow-on to the Australian economy. Overall, it is found that **the total economic contribution of Reef-related activities for these research, conservation and management organisations to the Australian economy is $314 million, with these activities also contributing to the employment of 2,400 FTEs**.

Table 2.5: Great Barrier Reef scientific research, conservation and reef management contribution, 2023-24

	Value added ($m)			Employment (FTE)		
	Direct	Indirect	Total	Direct	Indirect	Total
GBR regions	$94	$162	**$256**	600	1,400	**2,100**
Queensland	$94	$176	**$270**	600	1,500	**2,200**
Australia	**$94**	**$220**	**$314**	**600**	**1,800**	**2,400**

Source: Deloitte Access Economics

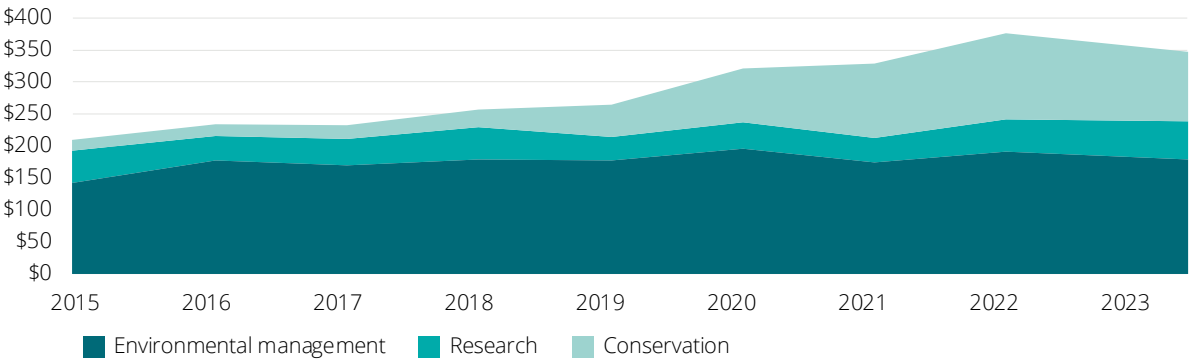
Economic performance of the scientific research, conservation and reef management sector

While research and conservation activity has been boosted by the Reef Trust Partnership, ongoing funding for science and conservation is uncertain.

From 2015-16 to 2023-24, GBR-related revenues for major research, conservation and reef management organisations grew by 66% to $348 million, largely due to increased revenues for conservation-related activities. Indeed, revenues for environmental management, comprising those of the Great Barrier Reef Marine Park Authority and organisations representing each of the six NRM regions, has remained quite stable from 2016-17 through to 2023-24.

Meanwhile, scientific research funding fluctuates through the time series but has shown general growth. For organisations that undertake research and conservation work on the Reef, however, revenues have grown considerably. This has been underpinned by the Great Barrier Reef Foundation, which has received government funding from the Reef Trust Partnership that it leveraged to expand its portfolio of programs with additional private investment. This has included supporting research and conservation projects through other entities that target water quality, crown-of-thorns starfish control, reef restoration and monitoring, and learnings from Traditional Owners and other community members.

Chart 2.7: Total research, conservation and reef management revenues, real ($m 2023–24), 2015–16 to 2023–24



Source: Deloitte Access Economics

Note: Underlying data in financial years, but axis labels are simplified for readability (year ending June).

While Reef Trust Partnership funding has driven revenue growth in conservation, raw revenue figures may still understate the impact of increasing volunteer activity in the sector. Indeed, organisations such as the Australian Conservation Council and the Reef Check Foundation rely on volunteers to drive activity. This non-market volunteering activity has risen in recent years, particularly as technology improvements have allowed volunteers to more easily contribute to reef monitoring, aiding conservation efforts.

Overall, increasing activity in the sector from non-profit organisations and volunteers alike reflects the increasing need for research and conservation efforts to accompany traditional environmental management, particularly as the Reef faces new and emerging environmental risks. This research and conservation activity also underpins sustained value in much larger commercial components of the Reef Economy, including tourism and commercial fishing.

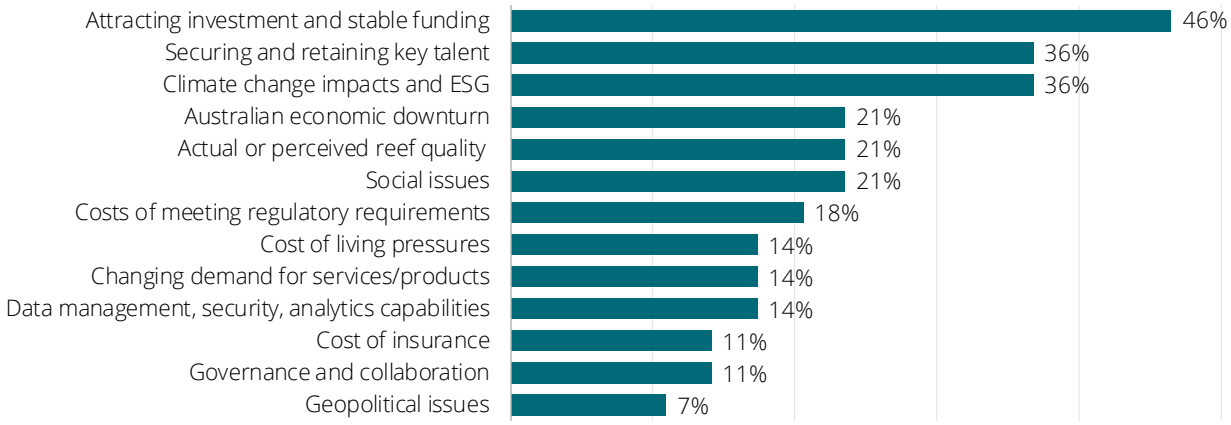
Challenges and opportunities for the Reef Economy – findings from the GBRF Partners Survey

As part of this study, a survey was distributed to Great Barrier Reef Foundation partners across the Reef Economy to gauge their level of optimism regarding the Reef and identify future risk areas. A total of 38 responses were collected, primarily (69%) in research and conservation, with the remaining in areas of government administration or tourism.

Generally, the survey found that while partners were overwhelmingly proud of the Reef (94% sentiment), optimism about the future of the Reef was mixed (52% sentiment). This is a concern given it was generally agreed that the economic viability of the region is dependent on the health of the Reef (86% sentiment).

In gauging the challenges facing the Reef, 46% of respondents noted that attracting stable investment and funding was a top concern (refer Chart 2.8 below). It was noted that investment in conservation and research was inconsistent. Ultimately, instability in funding impacts the ability of institutions to retain key talent and tackle the environmental challenges threatening the Reef, which were noted as other top challenges. As one respondent noted, "*[our largest challenge is] investment into long term projects rather than sporadic investment into small scale projects".*

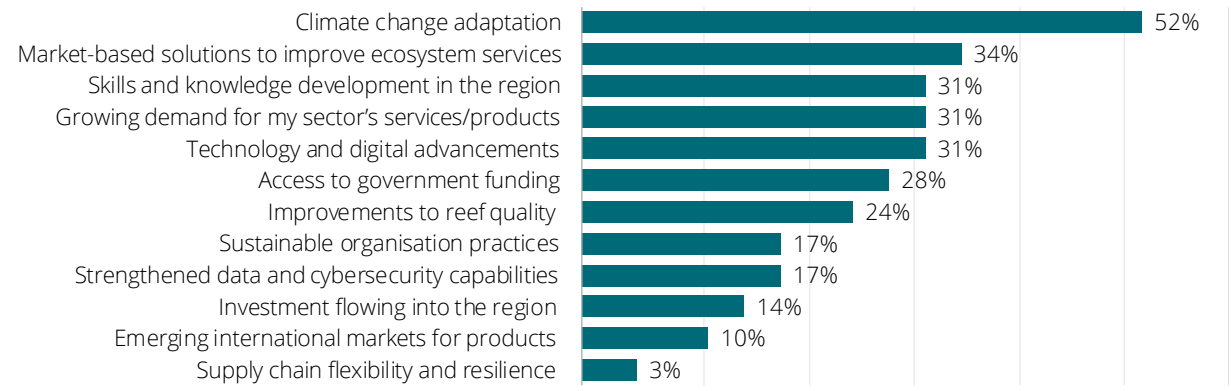
Chart 2.8: GBRF partner survey results, main challenges facing your sector in the Great Barrier Reef



Source: Deloitte Access Economics (2025), GBRF partner survey.
Question: "What are the main challenges facing your sector in the Great Barrier Reef region right now? Please rank the top 3 challenges for your sector."

The challenge of funding may also limit the ability of organisations to continue to target the plethora of opportunities available to tackle sustainability concerns. Beyond general climate change adaption, respondents also highlighted the potential sustainability improvements that could be derived from market-based ecosystem services solutions such as blue carbon trading and continued skills and technological developments.

Chart 2.9: GBRF partner survey results, main opportunities facing your sector in the Great Barrier Reef



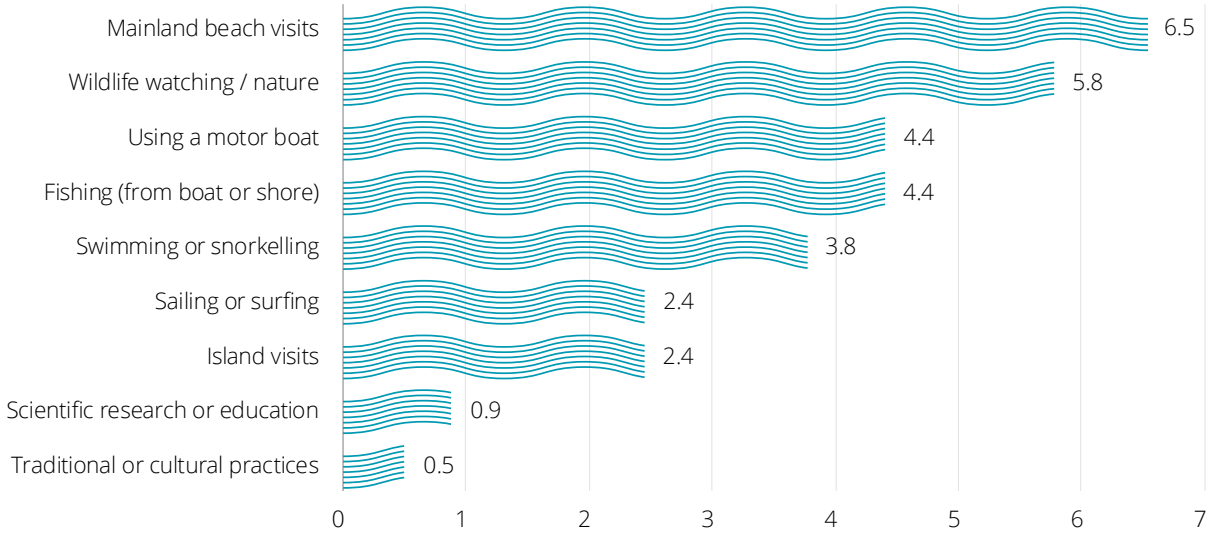
Source: Deloitte Access Economics (2025), GBRF partner survey.
Question: "What are the main opportunities facing your sector in the Great Barrier Reef region right now? Please rank the top 3 opportunities for your sector."

2.7 Recreational activities contribution

It is estimated that 1 million people live in the regions bordering the Great Barrier Reef Marine Estate as of 2023-24.[18] For these individuals, the Reef is not just a defining local landmark, but also a centre for activity, ranging from beach visits to sailing, snorkelling, education and cultural practices. On surveying those living in the region in 2023, the CSIRO found that 69% had visited the Great Barrier Reef in the past 12 months.[19] Further, many undertook multiple activities in the Reef region, with 19% going to the Reef fortnightly or more frequently.[20]

Deloitte analysis of visitation results finds that on a per-capita basis, Reef region residents undertake significant activities within the Reef region (see Chart 2.10). While beach visits are the most common, at 6.5 times per capita, many residents also undertook activities ranging from boating and fishing (each at 4.4 times per capita) to scientific research/education and cultural practices (at 0.9 and 0.5 times per capita, respectively).

Chart 2.10: Number of times per capita each of the following activities had been completed in the past 12 months in the Great Barrier Reef region, local residents



Source: Deloitte Access Economics, based on CSIRO 'Monitoring social and economic indicators among residents of the Great Barrier Reef region in 2023' (2024).

Considering the expenditure on recreational equipment and other personal expenses associated with undertaking the above activities, it is estimated that GBR region residents spent $534 million on Reef activities in the 2023-24 financial year. In general, fishing was associated with the greatest recreational expenditure at $253 million, reflecting the popularity of the hobby within the region (see Chart 2.10) in addition to the significant expenses associated with recreational fishing activities, such as for bait, equipment and boat hire. Island visit expenditure was also significant, given transportation needs and other expenses.

Table 2.6: Recreational expenditure by GBR region residents on Reef activities, by type of expenditure (2023-24, $ millions)

NRM region	Boating*	Fishing	Sailing, paddling, surfing	Island visits	Beach visit for other activity	Total
Burdekin	$10	$49	$5	$31	$8	**$103**
Wet Tropics	$12	$54	$5	$34	$8	**$114**
Cape York	$1	$4	$0	$3	$1	**$9**
Fitzroy	$10	$48	$5	$31	$8	**$102**
Burnett Mary	$15	$69	$7	$44	$11	**$145**
Mackay Whitsunday	$6	$29	$3	$19	$5	**$61**
Total	**$54**	**$253**	**$25**	**$162**	**$39**	**$534**

Source: Deloitte Access Economics

**Note: Boating does not include spend on boating activities that involve fishing. Boating activities that involve fishing are estimated within 'Fishing' expenditure*

Overall, the resulting contribution of recreational activities associated with the GBR was estimated to total $443 million, with 4,000 FTE employees supported in Australia. Importantly, much of the local recreational expenditure filters through local retailers, restaurants and tour providers. As a result, most of the value added attributed to recreational expenditure ($388 million) is within the GBR region itself.

Table 2.7: Great Barrier Reef recreational activities contribution, 2023-24

	Value added ($m)			Employment (FTE)		
	Direct	Indirect	Total	Direct	Indirect	Total
GBR regions	$257	$131	**$388**	2,800	900	**3,600**
Queensland	$257	$145	**$402**	2,800	1,000	**3,700**
Australia	**$257**	**$186**	**$443**	**2,800**	**1,200**	**4,000**

Source: Deloitte Access Economics

Future contributors to the Reef Economy

Blue carbon opportunities and the ecosystem services values of the Reef

While many have previously articulated the value of the Great Barrier Reef to human activities such as tourism and fishing, and indeed this has underpinned the concept of 'economic contribution' discussed in this chapter, the Reef and its catchments can also provide significant ecosystem services value. Ecosystem services refer to those that a natural ecosystem such as the GBR provide for humans and other interlinked systems. These are generally not directly captured in market values.[vi]

One specific ecosystem benefit of the Reef is that of its blue carbon services. 'Blue carbon' refers to the natural sequestration value of natural assets within the Reef catchment, or the capture of carbon dioxide (CO_2) from the atmosphere by its estuarine, coastal and marine vegetated ecosystems (including mangroves, seagrass and saltmarshes), stored under the seabed, in silt, soil or the living biomass. Crucially, blue carbon ecosystems store up to four times more carbon and sequester it up to 50 times faster than terrestrial ecosystems, per hectare,[21] due to higher burial rates of organic carbon.[22] In this way, ecosystems supported by the Reef have a critical role in reducing the effects of global warming by absorbing emissions that would otherwise increase the concentration of carbon in the atmosphere.

On recent measurement, it is estimated that mangroves, seagrass and tidal marshes within the GBR catchments hold 244 million tonnes of blue carbon stock (soil organic carbon).[23] Applying assumed sequestration rates, this is equivalent to 6.7 million tonnes of carbon dioxide equivalent (CO_2-e) sequestered per year. Applying the average Australian Carbon Credit Unit (ACCU) price of $32.49 per tonne of CO_2-e in 2023-24, it is estimated that the GBR ecosystem provided a value of **$217 million in carbon sequestration in 2023-24**. This value, like that of human activities, is also dependent on effective environmental management. Environmental management safeguards blue carbon ecosystems, preventing natural or human-induced degradation and ensures they continue to function as vital carbon sinks rather than becoming carbon sources, which is crucial for climate change mitigation. For example, modelling by the Blue Carbon Lab **found that erosion could lead to a decrease of 30–47% in the total net carbon sequestration** of these Reef assets.

Markets and ecosystems align – opportunities for markets to support increased sequestration

While the carbon sequestration value of the GBR is currently driven by the Reef's existing environment, the emergence of carbon markets and implied prices on carbon have increased recognition of the economic value of additional carbon sequestration. Indeed, along the Reef itself there is an emerging opportunity for the funding of blue carbon initiatives which, through improving mangrove, seagrass and salt marsh stocks along the Reef, boost its carbon sequestration capability.

Blue carbon projects along the Reef are still in their infancy, being funded primarily by government initiatives such as Blue Carbon Ecosystem Restoration Grants.[24] However, with the Clean Energy Regulator recently approving methods to claim ACCUs by reintroducing tidal flow to coastal wetlands,[25] incentives are quickly rising for private organisations to undertake market projects that enhance the Reef's sequestration values. A survey of GBRF partners undertaken during this study, largely of research and conservation agencies, found that while only 43% have engaged in market-based solutions (either through reducing sediment run-off or increasing sequestration capabilities), 82% have an interest in engaging with these solutions in the future.

vi. 'Market values' include the value added or related values estimated in the economic contribution, for example.


3

Opportunities from resilience

Threats to the future performance of the Reef Economy

The Great Barrier Reef faces several environmental pressures. These include climate change, land-based run-off, coastal development, and commercial and recreational fishing. These threats interact in complex ways. This analysis highlights the economic value at stake from unchecked climate change, as the most significant of these threats. Here we establish the economic value of limiting warming and the contributions that restoration, adaptation and protection can make in reducing the impacts of locked-in damages to the GBR and the economies it supports.

As such, this analysis articulates the opportunity Australia now faces – with actions that can make a substantive impact on reef restoration, while also delivering broader economic benefits through avoided climate damages.

Marine heatwaves

Marine heatwaves are prolonged periods of unusually high ocean temperatures, often exacerbated by climate change and regional climate patterns. These events cause significant thermal stress on coral reefs, leading to coral bleaching. Marine heatwaves on the GBR are increasing in frequency, intensity and geographical extent, with six heat-induced coral bleaching events since 2016.[26]

Crown-of-thorns starfish outbreaks

Crown-of-thorns starfish outbreaks are a significant environmental threat to the GBR and the leading cause of coral cover decline alongside marine heatwaves and tropical cyclones. Where outbreaks are left unchecked, coral cover across regions can decline by up to 37%. In contrast, when coral is protected from outbreaks, coral cover can increase by up to 44% and promote reef recovery and resilience.[27]

Natural disasters

Climate change is increasing the intensity of natural disasters including tropical cyclones, monsoonal troughs, intense thunderstorms and complex weather patterns – causing extensive physical damage to coral reefs, mangroves and land infrastructure – with associated substantial rain events and flood plumes affecting the Reef. Extreme cyclonic events and their associated negative ecological threats (reduced hard coral cover and fish species richness and abundance) on the Reef are anticipated to increase markedly through to 2100.[28] This has flow-on effects for tourism; recreational, commercial and subsistence fishing; and coastal defence.[29]

Water chemistry changes

Interacting effects of natural disasters and flood plumes along with land-based nutrient, pesticide and sediment run-off, freshwater salinity changes, ocean acidification, and nutrient changes associated with continental shelf upwelling all reduce water quality, which affects the ecological health and resiliency of the Reef. With regard to ocean acidification, carbon dioxide levels in seawater are now 28% higher than 60 years ago in the GBR, which weakens coral skeletons, and makes them more vulnerable to physical damage from cyclones[30] and biological threats like crown-of-thorns starfish outbreaks.

Fishing

Fishing and related pressures such as biomass extraction, incidental catch of threatened species, discarded catch and bycatch, and illegal fishing remain environmental threats to the GBR.[31] These activities disrupt the balance of fish populations and damage reef habitats, impacting about two-thirds of the Reef. Extracted and discarded predator fish make up approximately 40% of commercial fishing,[32] which threatens ecosystem balance. Queensland's biggest fisheries reform, the *Queensland Sustainable Fisheries Strategy 2017–2027*, is aimed at improving the sustainability of fisheries through fish stock management, rebuilding depleted stocks, and promoting better practice.[33]

Disease

Coral disease outbreaks such as white syndrome and brown band and black band disease threaten the Reef's coral health. AIMS research estimates that the prevalence of coral disease accounts for 6% of coral mortality in the GBR.[34]

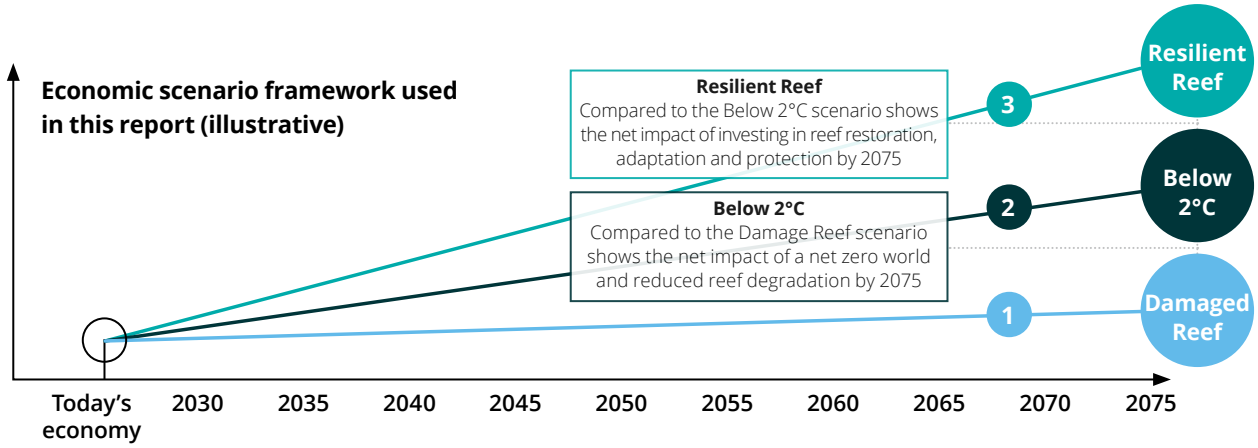
Modelling the impact of threats to the GBR regional economy

What model is used to analyse the impacts of climate change?

D.Climate is a climate-economy model developed by Deloitte Access Economics, reviewed by academic experts, and extensively applied across Australian governments and industry. The model shows how climate change, emissions from economic activity and the energy system interact, and the macroeconomic impacts of this. Appendix B provides a technical summary of the model and method used in this report.

How are the scenarios defined for modelling?

The results presented in the report reflect the **Below 2°C** and **Resilient Reef** scenarios, compared to the **Damaged Reef** scenario. In these scenarios, there is a defined view of the Queensland, Australian and global economies in relation to climate change impacts, emissions, technological change and the associated damaged to the Great Barrier Reef. Refer to Appendix B for detailed scenario definitions and assumptions.



Damaged Reef
Establishes the economic impacts to Queensland and the Reef from no further action to decarbonise from today as Australia and the world accelerate emissions reductions. Under this scenario, Global warming increases every year to 2.7°C by 2100 (IPCC pathway: SSP2-4.5 Middle of the Road). Against this, the economic and climate change impacts of a below 2°C world and a resilient Reef can be assessed.

Below 2°C
This scenario reflects a world where global warming is stabilised below 2°C, aligned to IPCC pathway SSP2-2.6 (~1.8°C by 2100). This scenario has a defined view of the Great Barrier Reef region and Queensland and will measure the economic gains of limiting global warming to below 2°C, and the associated reduced reef degradation.

Resilient Reef
The results presented in the report reflect the Resilient Reef scenario, compared to the Below 2°C scenario. The Resilient Reef scenario reflects a world where there has been active restoration, adaptation and protection measures implemented for the Reef. This scenario considers the additional value that can be gained from protecting the Reef, above and beyond climate change mitigation.

1 ◄---------- 2 ----------► 3

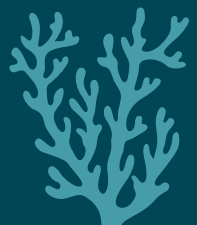
Difference reflects the net benefit of avoiding the worst costs from climate change due to global action

Difference reflects the net benefit of Reef adaptation and resilience as the climate continues to change

Climate action and Reef resilience measures create a

$124 BILLION

economic opportunity for the Great Barrier Reef region



$124 billion

economic opportunity over the next 50 years has two distinct drivers:

$110 billion

represents the economic benefit to the Great Barrier Reef region from Australia and the world taking action to limit warming to below 2°C over the next 50 years to 2075

BASED ON

- Avoided economic consequences of climate change
- A healthy Reef and Reef-reliant economy

$14 billion

represents the economic benefit to the Great Barrier Reef region from proactive and scaled investments in adaptation and resilience as the climate continues to change over the next 50 years to 2075

BASED ON

- Crown-of-thorns starfish control
- Assisted coral evolution
- R&D investment

Source: All results on this page are presented as net present value of the deviations, 2025 to 2075 at 2% social discount rate throughout

Limiting warming by around 2°C could deliver a **$110 billion economic dividend** for the GBR region over the next 50 years. Investing in restoration, adaptation and protection measures improves Reef resilience to the impact of locked-in damages – representing an additional **$14 billion economic opportunity** for the region.

3.1 Unchecked climate change threatens the health of the Great Barrier Reef and the performance of the Reef Economy

The GBR is a fragile asset facing intensified environmental threats exacerbated by climate change. With rising temperatures comes more bleaching events, more natural disasters, and physical climate damages that are felt across the economy. If climate change damages are not effectively mitigated over the next 50 years, the health of the GBR, and the sustainability of the economy that relies on it, will decline as the effect of climate impacts outpace the capacity of the Reef to recover.[35]

If the world was to reach 2.7°C of warming, continued temperature rises would result in repeated and severe mass coral bleaching events and could reduce coral cover on the Reef to around 5% by the end of the century.[36]

But the Reef is not beyond saving. Actions are being taken today to protect, restore and adapt the Reef through climate change mitigation and reef adaptation strategies. Expanding and building upon these existing actions represents Australia's opportunity, working alongside the rest of the world, to ensure that this environmental and economic asset can withstand the locked-in consequences of rising temperatures and continue to contribute significantly to the regional economy.

These comprehensive strategies reflect an understanding that the Reef's ecological health is intrinsically linked to its economic value, necessitating collaborative and multifaceted approaches to its protection.

While these actions have mitigated some threats, challenges persist, particularly with coral bleaching driven by rising sea temperatures. Efforts to improve water quality show promise, however, evidenced by reduced sediment and nutrient loads entering the Reef.

The pace of climate change necessitates more robust global action to secure the GBR's future sustainability.

Australian action will play an integral role in this global effort; however, the costs of such action will be shared across the globe. Alternatively, actions to improve Reef restoration, adaptation and protection weighs solely on Australia – to both bear the cost of action, but also to reap the benefits generated.

Box 3.1 The Reef Trust Partnership

The Reef Trust Partnership is a $443 million partnership between the Australian Government's Reef Trust and the Great Barrier Reef Foundation. The partnership has supported the delivery of 462 projects to achieve the pace and scale required to safeguard the Reef against rising threats. The Great Barrier Reef Foundation leveraged the government investment, and as of 30 June 2024, raised an additional $456 million from corporate partners, philanthropic donors and other partners and community members.

The Reef Trust Partnership has funded several key programs aimed at enhancing the health of the Reef, focusing on water quality, coral restoration and biodiversity. One major program targets water quality improvement by reducing agricultural run-off through land management changes and the implementation of best practice frameworks for farmers, resulting in measurable reductions in sediment and nutrient loads entering Reef waters. Coral restoration projects, such as the development of coral aquaculture technologies, aim to rehabilitate damaged areas by cultivating resilient coral species, which are then reintroduced to degraded sites to promote natural recovery.

Biodiversity enhancement efforts include the protection of critical habitats and species monitoring, facilitating a better understanding of ecosystem dynamics and enabling targeted conservation actions. These projects have shown positive outcomes, such as improved water clarity and increased coral cover in targeted areas. Collaboration is a cornerstone of these programs. They involve partnerships with local communities and Traditional Owners, who undertake on-the-ground implementation, and scientific organisations that contribute research expertise and monitoring capabilities.

Collectively, these efforts have not only fostered improvements in reef health but have also built a collaborative framework crucial for ongoing and future conservation success.

3.2 Limiting warming and reducing reef degradation remains integral to the economic development of the Great Barrier Reef region

The threats to the Reef, such as coral bleaching, natural disasters and outbreaks of natural predators including crown-of-thorns starfish, are highly complex and damaging, but all are more harmful to reef health when combined with warming waters. As temperatures rise, these threats compound in severity and increase in frequency – limiting the GBR's capacity to adapt and recover.

Limiting rising temperatures to less than 2°C is the most economically significant action that can be taken to protect the health of the Reef and the performance of the Reef Economy.

With the region's economic activity strongly tied to the natural capital provided by the Reef, the GBR region is particularly exposed to the economic consequences of a warming climate. **As such, limiting warming and avoiding the damages associated with unchecked climate change, including reducing reef degradation, can generate significant economic opportunities for the GBR region**.

Over the next 50 years, the region could gain an additional $110 billion[vii] from global climate action that limits warming to below 2°C.

The scale of this economic dividend is significant for the businesses, workers and communities that make up the GBR region.[37] Limiting warming means a larger economy, higher incomes and more jobs.

It is expected that avoiding reef degradation and broader climate impacts associated with an almost 3°C world and limiting warming to below 2°C will enable the GBR region to support over 20,000 additional jobs in 2075. The additional jobs supported increases every year and is at its highest in 2075. Additional economic activity will support industry expansion, which will inherently require more jobs to sustain. The potential additional jobs supported in the GBR region in 2075 alone under this scenario is **equivalent to over 50% of the direct employment in tourism in the GBR region in 2023-24**.[viii]

Climate action sees the GBR region capture significant levels of investment.

A more productive and less climate-damaged Reef Economy attracts investment to the region – almost $24 billion in investment is expected to be captured by the GBR region over the next 50 years to drive regional growth and development, relative to a scenario with higher climate damages.

Ultimately, limiting warming catalyses economic transformation in the region, which delivers new economic opportunities, new employment and investment, while reducing the negative consequences of climate change to the Reef and safeguarding the economic stimulus it generates.

The benefits of reducing climate-induced damages and avoiding reef degradation are substantial, equivalent to 40% of Australia's GDP today.[38]

vii. Results presented as net present value of the deviations, 2025 to 2075 at 2% social discount rate throughout.

viii. 36,000 direct employment in the tourism industry in the GBR region in 2023–24 (Table 2.3).

Limiting warming to below 2°C results in industry-wide benefits for the Great Barrier Reef region.

Climate change affects all sectors of the economy. Warmer temperatures and more frequent and severe natural disasters reduce agricultural output, labour efficiency and capital productivity, while sea level rise damages coastal infrastructure. Avoiding some of the worst of these damages by limiting warming to 2°C creates positive impacts for all sectors.

The services sector, including recreational and other private and government services, alongside labour-intensive industries, such as construction and manufacturing, are particularly exposed to heat stress and benefit the most from avoiding damages from unchecked climate change.

Industries reliant on and connected to the GBR face additional risks. As temperatures rise and the Reef degrades, industries suffer further economic consequences. However, limiting climate change to protect the Reef against degradation will unlock broader economic gains across industries in the GBR region.

The GBR region's entire tourism industry is at stake, but climate action and reef restoration can safeguard the economic drivers of the region.

While tourism is not reported as a standalone industry in the D.Climate model, tourist activity drives spending across sectors such as accommodation and food services, transport, retail and recreational services. Avoiding tourism-related losses through climate change mitigation activities directly benefits these industries, contributing $13 billion, or 12% of the potential economic benefits, to the GBR region's economy over the next 50 years.[ix]

The Reef is more than a tourist asset; it is a vital driver of economic growth.

While the Reef is undoubtedly an asset for the regional tourism industry, it has broader economic implications, as multiple industries throughout the region benefit from its sustained health and quality. As such, the benefits of avoided climate damages will be acutely felt by Reef-reliant industries that extend beyond the tourism sector.

From the construction of hotels and research centres to the maintenance of existing infrastructure, a significant proportion of activity in the region's **construction industry** relies on the Reef. Additionally, as warming is limited, economic activity generated elsewhere in the region drives greater investment in new developments, boosting the construction industry. As such, the construction industry could gain $12 billion under a scenario with limited warming and reduced Reef damage.[x]

Further, the **services sector**, which includes professional and scientific industries that may specialise in marine or reef-specific research and activities, will be able to sustain their economic activity if warming is limited. These industries contribute $40 billion of the overall benefit of limiting warming.[xi] A continued research presence in the GBR region will provide invaluable insights in marine ecology and coral reef systems, while contributing positively to the region's economy.

Education services, such as vocational, technical or tertiary pathways, can also benefit from reduced reef degradation. Multiple vocational and tertiary institutions have marine science or biology programs that are specifically provided in this region due to their access to the GBR. These institutions have gained global recognition for their research and student programs, and have supported over 400 PhD candidates and postgraduate students in marine sciences.[39,40]

Sustaining the GBR is vital for fish ecosystems and the ongoing activity of the **commercial fishing industry**. Degradation and declined coral reef coverage have a significant impact on fish stocks for two main reasons: species that do not wholly depend on coral reefs for their survival will migrate elsewhere, while those that are reliant on the Reef to survive will experience dwindling population numbers.[41] These will each lead to a reduction in overall commercial fishing yields, with flow-on impacts for other ecosystems.

ix. NPV discounted at a 2% social discount rate, 2025–2075

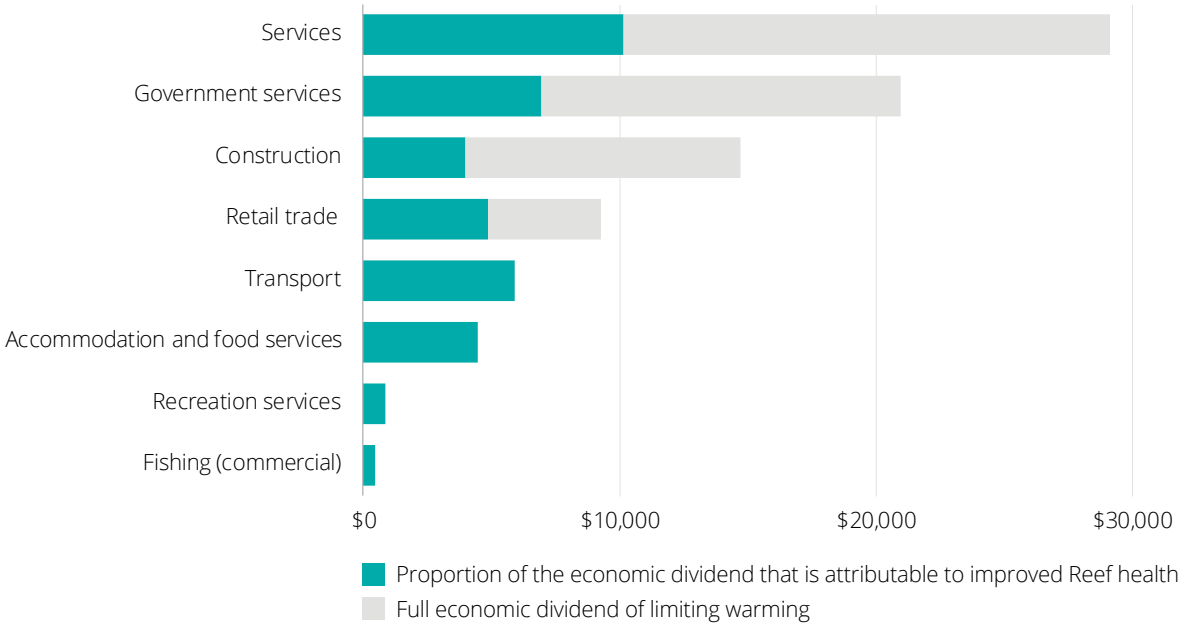
x. NPV discounted at a 2% social discount rate, 2025–2075

xi. NPV discounted at a 2% social discount rate, 2025–2075

Recent research has indicated that if live coral cover decreased from 10% to 5% it could lead to a drop in the yield of some fish species of up to 56% in the GBR.[42] Minimising the damage to Reef coverage, and the broader costs of climate change, could see the commercial fishing industry realise a $400 million benefit.[xii]

Overall, the proportion of these Reef-reliant industries that are directly impacted by the Reef could see a combined $33.5 billion gain in economic activity.

Figure 3.1: Queensland and GBR regional results, deviations of climate action scenario compared to the baseline with higher climate damages ($ millions)



Source: Deloitte Access Economics

Note: Output expressed as a NPV discounted at a 2% social discount rate, 2025–2075.

xii. NPV discounted at a 2% social discount rate, 2025–2075

3.3 Investment in restoration, adaptation and protection is essential to maintaining the economic, social and cultural value of the Great Barrier Reef

While climate change mitigation remains the most meaningful action Australia and the world can take to protect reefs around the world, global warming of over 1.5°C is still expected to cause substantial environmental damage.

Meaningful restoration, adaptation and protection measures are required to build resilience and avoid irreversible damage to the GBR. This holistic approach to reef conservation recognises the essential role of restoration and adaptation investment, alongside mitigation, in giving this critical ecological and economic asset the best chance of sustained health.

Australia has already conducted, and continues to develop, world-leading research, as well as in-water deployments. in coral reef restoration, adaptation and protection. This research has historically focused on two key streams: supporting the Reef species to adapt to a changing environment and accelerating the natural restoration of damaged reefs. Studies into such strategies have found that successful implementation can have a substantive impact on reef recovery.[43]

Additionally, where these strategies are implemented together, the benefits combine to better sustain the condition of the coral reef under climate change and protect critical reef functions.[44]

There are actions that can be taken now to safeguard the future of the GBR. Much of the current restoration, adaptation and protection strategies focus on reducing the flow-on threats of warming temperatures and increasing the heat resistance of these populations. These include the following.

Assisted coral evolution is a restoration and adaptation technique that involves the cultivation of corals in a controlled environment to accelerate evolutionary processes and enhance certain attributes, such as temperature tolerance. Cultivated corals are then deployed into vulnerable coral populations to supplement population stocks and support the natural improvement in heat tolerance.

Such strategies may be able to support coral conditions, and may play an important role in helping the Reef survive warming temperatures in the long term.

Crown-of-thorns starfish are a significant risk to the GBR, as they prey on coral and outbreaks can lead to mass destruction of reef ecosystems.

The impacts of outbreaks are currently managed on a large scale across the Reef, through targeted surveillance and culling. This active protection measure has demonstrated its value in boosting coral cover and is an important component of a long-term strategy for building Reef resilience, alongside other restoration and adaptation measures. This is a science-based approach and ongoing research is needed to improve its efficacy and capacity to boost Reef resilience as climate change impacts become more prevalent.

The above strategies are already in implementation; however, there is much to be gained from additional, and continued, **investment in research and development (R&D) across intervention strategies, and particularly in protection, restoration, adaptation and in-water deployment**. Research conducted thus far has had a significant impact on making adaptation and restoration practices both cheaper to deploy and more efficient in achieving outcomes. Further investment in R&D, in addition to the existing in-water activities, creates opportunities to conduct strategic and targeted deployment of adapted corals, in order to preserve reef function and better protect the Reef against warming waters. As such, a holistic approach to Reef conservation should strive to deploy restoration and adaptation strategies at the scale required to achieve outcomes, and continue research and innovation to improve deployment.

Successful reef restoration and adaptation not only safeguard the Great Barrier Reef but also the region's economic future.

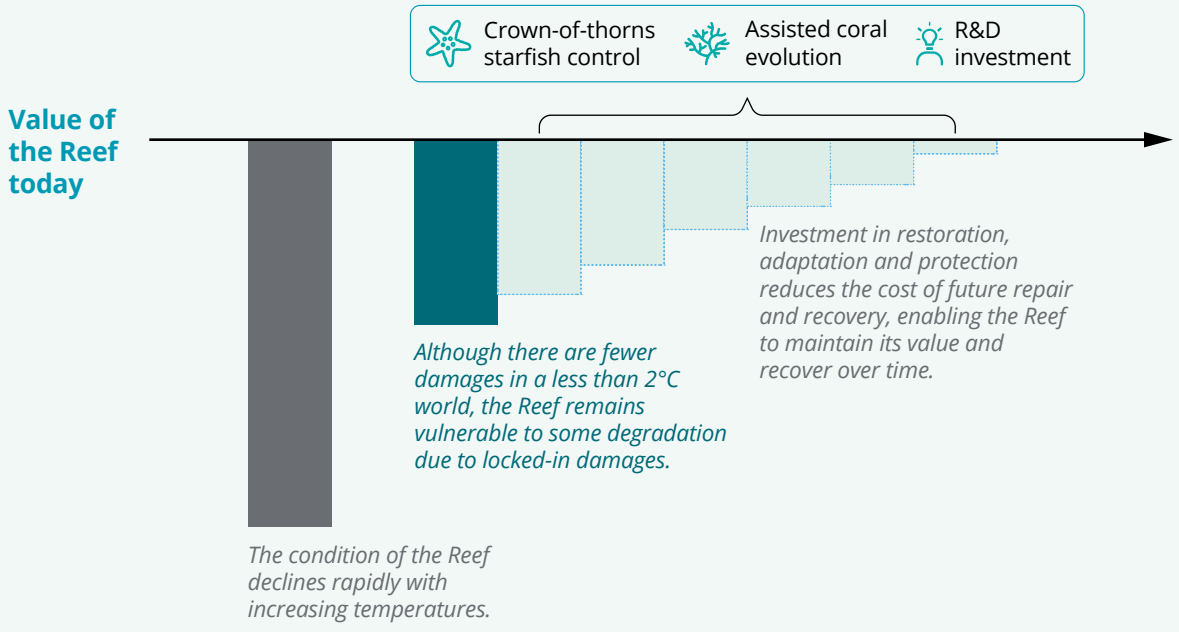
Local actions to support reef restoration, adaptation and protection carry substantial local economic gains. With the successful implementation of these strategies, the GBR can experience incremental, and continued improvement in its condition well into the future, exceeding what could be achieved by merely limiting temperature rise.

Investing in restoration, adaptation and protection measures improves Reef resilience to the impact of locked-in damages – representing an additional $14 billion economic opportunity for the region.

The benefits are twofold. Firstly, improved Reef condition increases tourist visitation, which in turn supports economy-wide activity. Secondly, continued investment in restoration and adaptation not only facilitates progress in effective approaches to reef protection but also makes these approaches more cost effective, enabling investment to be spent more efficiently.

Box 3.2 Approach to modelling restoration, adaptation and protection investments

Restoration, adaptation and protection strategies not only stave off the damage of rising temperatures but provide a meaningful opportunity to improve the condition of the GBR. It is these strategies and actions that will support the Reef to retain its non-use and indirect values and provide the possibility for the Reef to transition from an asset at risk to one that is restoring. This, however, can only be achieved through continuous and incremental action from today, leaning on the expertise and research conducted in the region to deploy successful restoration, adaptation and protection strategies.



Technical appendices

Appendix A: Economic contribution methodology

A.1 Economic contribution studies

Economic contribution studies are intended to quantify measures such as value added, exports, imports and employment associated with a given industry or firm, in an historical reference year. The economic contribution is a measure of the value of production by a firm or industry.

Value added

Value added is the most appropriate measure of an industry's/company's economic contribution to gross domestic product (GDP) at the national level, or gross state product (GSP) at the state level. The value added of each industry in the value chain can be added without the risk of double counting across industries caused by including the value added by other industries earlier in the production chain. Other measures, such as total revenue or total exports, may be easier to estimate than value added but they 'double count'. That is, they overstate the contribution of a company to economic activity because they include, for example, the value added by external firms supplying inputs or the value added by other industries.

Measuring the economic contribution

There are several commonly used measures of economic activity, each of which describe a different aspect of an industry's economic contribution.

- **Value added** measures the value of output (i.e. goods and services) generated by the entity's factors of production (i.e. labour and capital) as measured in the income to those factors of production. The sum of value added across all entities in the economy equals GDP. Given the relationship to GDP, the value added measure can be thought of as the increased contribution to welfare.

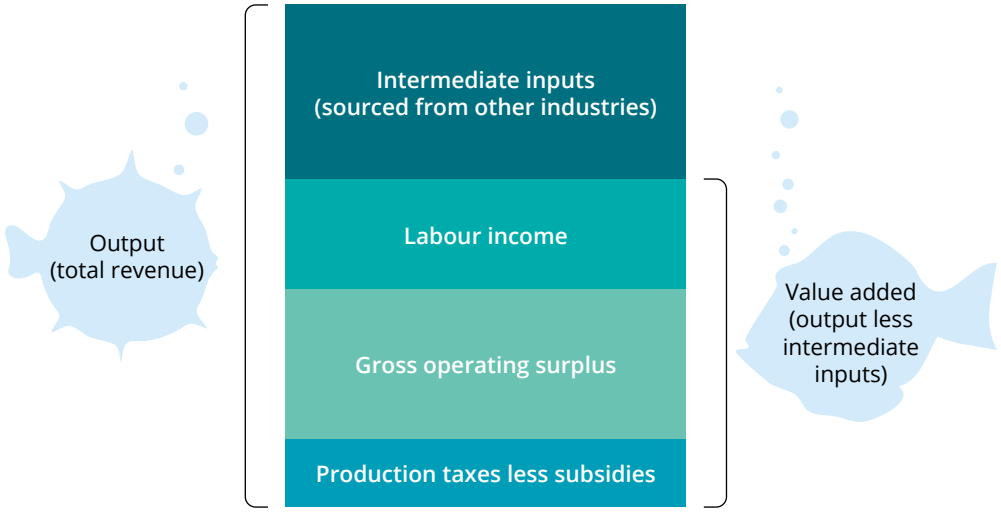
Value added is the sum of:

- **Gross operating surplus (GOS)** – the value of income generated by the entity's direct capital inputs, generally measured as the earnings before interest, tax, depreciation and amortisation (EBITDA)
- **Tax on production less subsidy provided for production** – this generally includes company taxes and taxes on employment
  Note: Given that returns to capital before tax (EBITDA) are calculated in the GOS measurement above, company tax is not included or this would double-count that tax.
- **Labour income** – the value of output generated by the entity's direct labour inputs, as measured by the income to labour.

Separately, economic contribution can include:

- **Gross output** – the total value of the goods and services supplied by the entity. This is a broader measure than value added, as in addition to value added by an entity it also includes the value of intermediate inputs used by the entity that flow from value added generated by other entities
- **Employment** – a fundamentally different measure of activity from those above. It measures the number of workers employed by the entity, rather than the value of the workers' output.

Figure A.1: Accounting framework used to evaluate economic activity



Note: Figure A1 shows the accounting framework used to evaluate economic activity, along with the components that make up gross output. Gross output is the sum of value added and the value of intermediate inputs. Value added can be calculated directly by adding the payments to the primary factors of production, labour (i.e. salaries) and capital (i.e. GOS or profit), as well as production taxes less subsidies. The value of intermediate inputs can also be calculated directly by adding up expenses related to non-primary factor inputs.

Limitations of economic contribution studies

While describing the geographic origin of production inputs may guide a firm's linkages with the local economy, it is important to recognise that these are normal industry linkages that characterise all economic activities.

Unless there is significant unused capacity in the economy (such as unemployed labour), there is only a weak relationship between a firm's economic contribution as measured by value added (or other static aggregates) and the welfare or living standard of the community. Indeed, the use of labour and capital by demand created from the industry comes at an opportunity cost as it may reduce the amount of resources available to spend on other economic activities.

This is not to say that the economic contribution, including employment, is not important. As stated by the Productivity Commission in the context of Australia's gambling industries:[45]

"Value added, trade and job creation arguments need to be considered in the context of the economy as a whole ... income from trade uses real resources, which could have been employed to generate benefits elsewhere. These arguments do not mean that jobs, trade and activity are unimportant in an economy. To the contrary they are critical to people's well-being. However, any particular industry's contribution to these benefits is much smaller than might at first be thought, because substitute industries could produce similar, though not equal that, gains."

In a fundamental sense, economic contribution studies are simply historical accounting exercises. No 'what-if', or counterfactual inferences – such as 'what would happen to living standards if the firm disappeared?' – should be drawn from them. The analysis – as discussed in this report – relies on a national input–output table modelling framework and there are some limitations in this modelling framework. The analysis assumes that goods and services provided to the sector are produced by factors of production that are located completely within the state or region defined and that income flows do not leak to other states or territories.

The input–output framework and the derivation of the multipliers also assume that the relevant economic activity takes place within an unconstrained environment. That is, an increase in economic activity in one area of the economy does not increase prices and subsequently crowd out economic activity in another area of the economy. As a result, the modelled total and indirect contribution can be regarded as an upper-bound estimate of the contribution made

by the supply of intermediate inputs. Similarly, the IO framework does not account for further flow-on benefits as captured in a more dynamic modelling environment like a computable general equilibrium (CGE) model such as D.Climate (refer to Appendix B).

Input–output analysis

Input-output tables are required to account for the intermediate flows between sectors. These tables measure the direct economic activity of every sector in the economy at the national level. Importantly, these tables allow intermediate inputs to be further broken down by source. These detailed intermediate flows can be used to derive the total change in economic activity associated with a given direct change in activity for a given sector.

A widely used measure of the spill-over of activity from one sector to another is captured by the ratio of the total to direct change in economic activity. The resulting estimate is typically referred to as 'the multiplier'. A multiplier greater than 1 implies some indirect activity, with higher multipliers indicating relatively larger indirect and total activity flowing from a given level of direct activity.

The input–output matrix used for Australia is derived from the Australian Bureau of Statistics (ABS) Input–Output Tables. The industry classification used for input–output tables is based on ANZSIC, with 115 input–output industry groups in the modelling framework.

A.2 Analysing the economic contribution of the Great Barrier Reef

Tourism

This analysis uses the Tourism Satellite Accounting (TSA) framework to measure the economic contribution of local tourism activity attributed to the GBR. The TSA framework is conceptually similar to the input–output approach which draws on the ABS input–output tables to generate results. It is based on an international approach to defining the tourism sector and different tourism products and related industries depending on the extent to which they interact with visitors either directly or indirectly. While conventional input–output modelling can be applied to any sector of the economy (including tourism by using an appropriate sector-specific definition of the tourism sector), the TSA approach is Deloitte Access Economics' preferred approach to measuring the economic contribution of the tourism sector as it ensures that the analysis is consistent with international guidelines for measuring and reporting on the economic activity of the tourism sector.

Direct tourism contribution

A direct contribution occurs where there is a direct relationship, both physical and economic, between the visitor and the producer of the good or service. Direct tourism output is essentially the amount of tourism consumption less net product taxes, wholesale and transport margins and imports.

In the case of retail goods purchased by visitors, only the retail margin contributes to direct tourism output, value added and gross regional product. This is because it is deemed that only the retailer has a direct relationship with the visitor and is therefore part of the tourism industry. Output and value added attributed to industries other than retail are excluded from the value of direct tourism output. Direct tourism output is therefore equal to internal visitor consumption at basic prices less the cost to retailers of domestic goods sold directly to visitors.

Direct tourism gross value added shows only the 'value' that a producer adds to the raw material goods and services it purchases in the process of producing its own output. Direct tourism gross value added is measured as the value of the output of tourism products by industries in a direct relationship with visitors less the value of the inputs used in producing these tourism products.

Indirect tourism contribution

The indirect effect of visitor consumption is a broad notion that covers upstream and supplier effects of visitor demand. Intermediate inputs represent those goods and services that support the supply of the tourism product – for example, the cleaning services that are inputted to the hotel sector, the fuel that is inputted to the aviation industry, the fruit and vegetables that are inputted to the restaurant industry. Together with any upstream impacts, it is these flow-on effects that determine the tourism industry's indirect contribution. The definition of direct and indirect are slightly different in the TSA approach, as direct is defined as activity involving a direct interaction with visitors. Accordingly, the ratio of direct and indirect activity differs from results using a standard input–output approach. However, estimates of total value added and employment should be similar across the two approaches.

The tourism contribution of the Great Barrier Reef

Data used to quantify the economic contribution of the GBR are drawn from Tourism Research Australia's National Visitor Survey (NVS), International Visitor Survey (IVS) and Regional Expenditure (REX) database.

The base for total expenditure used for the tourism contribution is leisure (such as for holidays and visiting family and friends) expenditure by visitors within the GBR region. Total expenditure is then disaggregated to individual tourism product categories according to holiday visitor expenditure profiles based on the type of visitor (international, interstate or intrastate, overnight, daytrip).

The economic value added that corresponds to this expenditure is then estimated using the TSA framework to determine induced tourism contribution at the regional, state and national levels.

Commercial fishing and aquaculture

Estimating the commercial fishing and aquaculture contribution involved a calculation of gross value of product of wild-capture fishing and aquaculture operations on the Reef or in waters feeding into it, which was then inputted into the input–output approach as discussed earlier.

Gross value of product was based on:

- **Commercial fishing (wild-caught):** QFish data for zones within the GBR region was used to determine production volumes by fish type,[46] which were then multiplied by latest current market prices, uprated by consumer price index (CPI), sourced from the Australian fisheries and aquaculture outlook 2024.[47]
- **Aquaculture:** Values were calculated based on by-region contribution from the Ross Lobegeiger 2023-24 Aquaculture production summary report.[48]

Employment was taken directly from the by-region estimates for aquaculture. However, for wild-caught fishing employment, as well as all measures of value added and supplier expenses, the value of product was split according to ABS input–output table averages for the relevant industries.

Recreational activities

Primarily, the contribution of recreational activities was based on a survey of GBR region residents by the CSIRO in 2023.[49] Averages in this survey were used to derive the 'number of times per capita per year' relevant recreational activities were undertaken in the GBR region.

Expenditure per activity was then derived using a variety of sources:

- **For activities involving fishing**, average values per fishing day specifically for 'fishing' expenditure were sourced from the National Recreational Fishing Survey.[50]
- **For activities involving the use of a boat**, average per-trip expenditures were derived from a 2018 NSW recreational boating survey.[51]
- **For activities involving surfing, kitesurfing or sailing**, average cost per trip from a 2024 national recreational surfing survey was used.[52]
- **For island visits**, in the absence of more recent data, estimates were based on a study on GBR local recreation conducted by Rolfe et al. (2011), as per the source used in the 2017 Great Barrier Reef economic contribution study.[53]
- **For all activities involving general beach visits**, a 2014 study on Gold Coast beaches was used to determine the market costs per visit to a local beach (while the original also estimated travel-time costs, in line with economic contribution best-practice only monetary transport costs and on-site expenditure were used for the current purposes).[54]

Expenses per activity data was uprated to the 2023-24 year using the ABS CPI. Expenses per activity were combined with activity frequency data, as described above, in addition to regional population estimates from the ABS[55] to estimate total relevant expenditure. This relevant expenditure was then attributed to industries, primarily retail and transport, according to the expenditures undertaken.

Scientific research, conservation and reef management

The GBR's continued management and protection has been carried out by numerous government and not-for-profit organisations, focused on research, conservation and the management of the Reef and waterways that feed into it. Thus, in measuring the contribution of scientific research, conservation and reef management, the contributions of **18 charitable organisations** and Australian Research Council funding related to the GBR were measured for 2023-24. The total contribution comprises components attributable to:

- Great Barrier Reef Marine Park Authority (GBRMPA)
- Great Barrier Reef Foundation (GBRF)
- Australian Institute of Marine Science (AIMS)
  Note: total expenditure for AIMS was portioned to only capture that related to the Reef.
- Lizard Reef Research Foundation
- Australian Marine Conservation Society
- Reef and Rainforest Research Centre
- Citizens of the Great Barrier Reef Foundation
- Coral Sea Foundation
- Great Barrier Reef Legacy
- Reef Check Foundation
- Reef Restoration Foundation
- Whitsunday Conservation Council
- Natural Resource Management (NRM) within the GBR region: Reef Catchments, Terrain, Fitzroy Basin, North Queensland Dry Tropics, Burnett Mary and Cape York
- Various universities and other research institutions (captured through GBR-related Australian Research Council (ARC) funding).

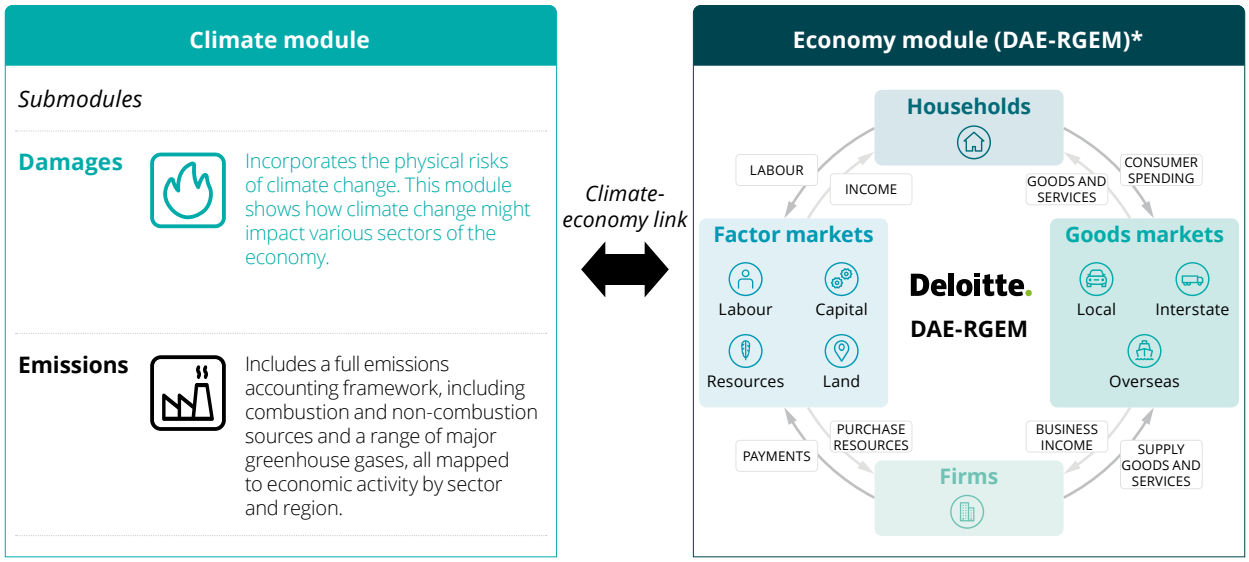
Primary resources for this contribution include annual reports, used for the GBRMPA, NRM organisations, AIMS and the GBRF, and ARC funding data. For smaller conservation and research organisations, expense and employment data was sourced from publicly available Australian Charities and Not-for-profits Commission (ACNC) data and, where necessary, updated to the 2023-24 year using the CPI. Where only aggregated expenditure information was available, this was disaggregated further to contribution components using averages from similar organisations where expenditure splits were available.

Appendix B: D.Climate modelling detail

B.1 D.Climate model

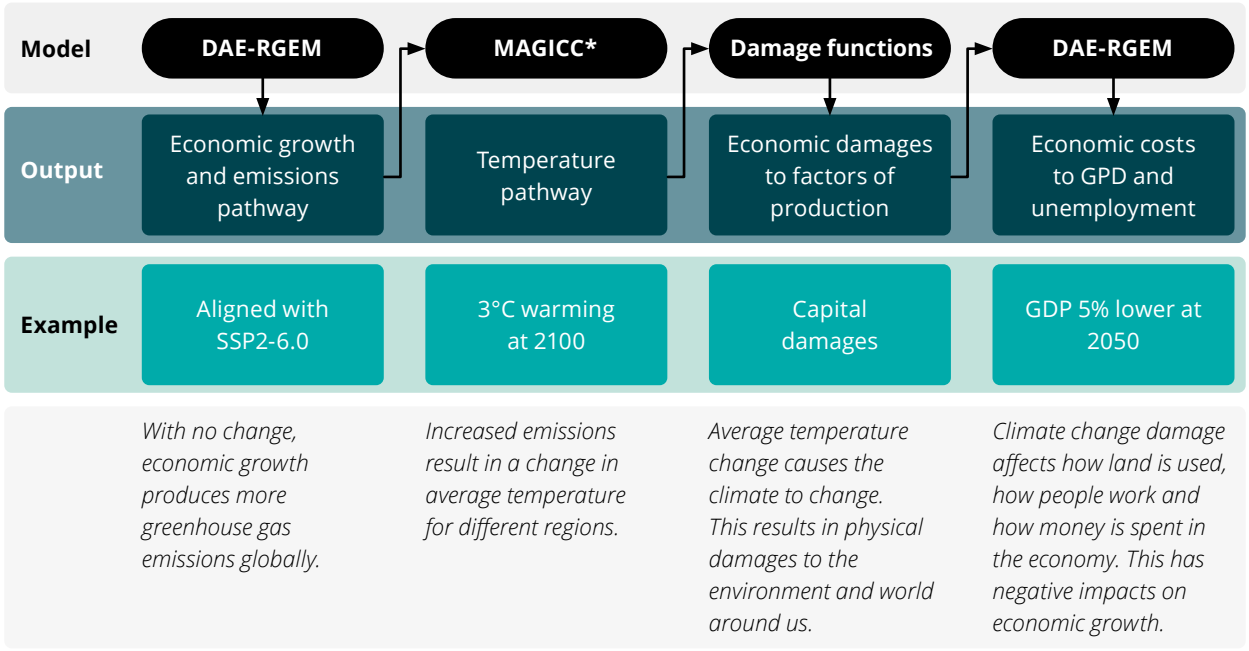
D.Climate, is Deloitte Access Economics' in-house climate-integrated computable general equilibrium (CGE) and integrated assessment model (IAM). It combines emissions, abatement and climate damages with an economic model to represent the implications of the latest climate science and climate policy for economic activity (see figures B.1 and B.2). In doing so, this model can capture the subnational, national and global picture of climate change policy, accounting for global trends in emissions reduction, technological development and changes in public policy to reflect the physical and transitional costs associated with different abatement pathways.

Figure B.1: D.Climate modelling framework



Deloitte Access Economics – Regional General Equilibrium Model

Figure B.2: D.Climate climate-economy link



**Model for the Assessment of Greenhouse Gas Induced Climate Change*

Results from D.Climate provide a 'top down' order-of-magnitude estimate of the impact of climate change on economic outcomes such as GDP, employment, industry value added (at the industry and regional levels), investment and trade. These outputs can be used to provide insights into which industries, jobs and economic activities have the most to lose – or gain – from different decarbonisation trajectories. Further insights involve which local economies are impacted the most by the choices being made, the costs and benefits of different options for decarbonisation, and by how much any degree of climate change will impact the economy and organisations. To this end, the core function of D.Climate is to provide an economic analysis tool that can be used to answer a variety of questions relating to the economic impacts of a changing climate and evolving policy landscape.

Importantly, results from D.Climate should not be interpreted as forecasts or 'most likely' estimates of climate change or net zero policy impacts. The scenario analysis and modelling framework instead provides a consistent lens through which to view the economic difference between possible future worlds, enabling conclusions to be drawn about trade-offs, and the direction of change in industries, and regional economic outcomes.

Regional and industry definitions

D.Climate is a global model and can be tailored to a specified regional concordance in line with the GTAP database. Three Queensland subregions (South East, Central and North Queensland) have been modelled (Table B1), in addition to other Australian states and territories, the Asia Pacific and the rest of the world.

Table B.1: Regional definitions

Modelled subregion	SA4 Breakdown
Great Barrier Reef region	Made up of six NRM regions that make up the GBRMP: Cape York, Wet Tropics, Burdekin, Mackay Whitsundays, Fitzroy and Burnett Mary.
Rest of Queensland	Rest of Queensland
Rest of Australia	All other states and territories
Rest of world	All other economies

The industries reported on in this report are defined in Table B2. These industry aggregations are based on specified sectoral concordance in line with the GTAP database.

Table B.2: Industry definitions

Industry	Definition
Agricultural and forestry products	Agriculture, forestry and land-use sector
Commercial fishing	Commercial fishing sector
Extractive industries, mining and manufacturing	Oil and gas extraction, mining (fossil fuels, metals and minerals) and manufacturing (petroleum refinery and gas manufacture, heavy manufacturing, chemical manufacturing, food and light materials manufacturing)
Energy and utility services	Electricity generation (fossil-fuel based and zero-emissions), transmissions and distribution and utility services
Construction	Construction
Hospitality, tourism and food services	Accommodation, food and service activities
Services	Public (e.g. defence, health, education) services, private services and wholesale and retail trade
Logistics and transportation services	Air, freight and logistics transport
Retail	Trade

Scenario descriptions

Several key variables and assumptions describe the scenarios analysed in this study. The global climate scenario, its impact on regional weather and climate, and the status of reef restoration, adaptation and protection is central to interpreting the results.

Table B.3: Scenario descriptions

Scenario	Climate damaged baseline	Below 2°C scenario	Resilient Reef scenario
Narrative	This scenario reflects the outlook for warming based on policies currently in place, which are insufficient to stabilise global warming to below 2°C before the end of the century. Increasing temperatures result in physical climate change damages for the world, including the GBR ecosystem and economy.	This scenario assumes all nationally determined contributions (NDCs) and long-term pledges to the United Nations Framework Convention on Climate Change are met in full and on time, and as a result global warming stabilises to below 2°C by the end of the century. This pathway includes a view to physical climate change damages and costs based on warming stabilising below 2°C. Although some damages are locked in, this scenario demonstrates the economic benefits from avoiding the physical damages associated with unchecked climate change.	In addition to limiting warming to below 2°C, this scenario demonstrates the economic opportunity of investing in Reef-related restoration, adaptation and protection to 'avoid' tourism losses and maintain a more resilient cost–benefit.
Global climate scenario	Global warming increases every year to 2.7°C by 2100, aligned to IPCC pathway SSP2-4.5. This 'middle-of-the-road' scenario features CO_2 emissions hovering near current levels before declining mid-century without reaching net zero by 2100. Socioeconomic factors follow historical trends with gradual progress towards sustainability and uneven development.	Global warming is stabilised below 2°C, aligned to IPCC pathway SSP2-2.6 (~1.8°C by 2100). In this scenario, global CO_2 emissions decline every year, eventually reaching net zero emissions.	

Sensitivity to discount rates

Although the Australian and Queensland governments recommend a central discount rate of 7% for cost benefit and policy analysis, the guidance outlines that a different discount rate can be used 'where there is a research-related reason.'

Deloitte Access Economics utilises a 2% social discount rate for economic analysis pertaining to the impacts of climate change. A lower discount rate recognises the long-term impacts of climate change and the role of action (or inaction) today and its impact on the wellbeing of future generations.

This rate also reflects a consistent view on social discounting in climate change economic analysis, based on the results of a survey of economists in the *American Economic Journal: Economic Policy* (the sample contains over 200 academics who are defined as experts on social discounting by virtue of their publications), which indicates that most favour a low discount rate, with more than three-quarters arguing for a median discount rate of 2%. More recently, Bauer and Rudebusch (2023) analysed trends in bond market interest rates, positing that the lower interest rates since the 1990s provide a rationale to use a lower social discount rate in climate policy analysis. Their analysis suggests real discount rates should range between 0.5% and 2%.

Nevertheless, the sensitivity of headline results to a range of discount rates is presented in Table B.4.

Table B.4: Sensitivities to discount rates (Resilient Reef scenario relative to a climate damaged baseline)

	Discount rate		
Great Barrier Reef GRP ($ billions)	**2%**	**4%**	**7%**
2025–2075	$123	$60	$22
2025–2035	$0.4	$0.3	$0.2
2035–2055	$30	$19	$9
2055–2075	$97	$43	$13

Source: Deloitte Access Economics estimates

Economic impacts compared to recent studies

There are wide-ranging estimates of the relationship between climate change and economic outcomes. Consensus has formed, however, around a negative relationship between global GDP and more than 2°C of warming.[56] This negative relationship also holds for most regions in the world, while some regions (e.g., Asia Pacific and Africa) are likely to be more negatively affected than others (e.g., Europe).[57]

At a global scale, the overall effect of the impacts of climate change and emissions reduction modelled by D.Climate can be situated within a literature of similar estimates for a sense of 'reasonableness' (Table B5).[58] There is a range of damage function specifications and impact channels adopted within the literature as well as other scenarios (emissions, temperature and time horizon) and methodological differences,[59] so the figures in Table B.5 are not necessarily like-for-like comparisons.

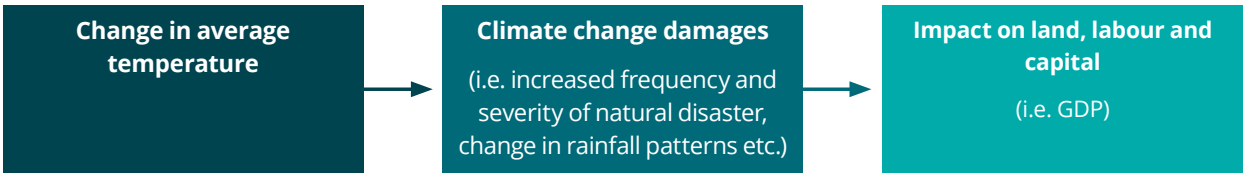
Table B.5: Select damage estimates from comparable studies (global)

Source	GDP deviation from baseline	Global average warming (°C)	Year	Comments
Deloitte (2022)	**–2.4%**	**1.9**	**2050**	
Kompas et al (2018)	–3%	3	2100	Global estimates not published for 2050
McKibbin (2021)	–0.7% to 3.7%	RCP6.0	2051–2060	Regional variation
SwisseRE (2021)	–1.3% to -11%	2	2050	'Unknown unknowns' estimates are featured in report.
Network for Greening the Financial System (2021)	–2.5%	1.8	2050	NGFS based on REMIND model, not NiGEM
Network Greening for the Financial System Phase 5 (2024)	–10.8%	1.8	2050	Delayed transition scenario, NGFS based on REMIND model, not NiGEM
IMF (Kahn et al) (2019)	–2.5%	RCP8.5	2070	GDP per capita
Burke et al 2018	–30%	4	2100	GDP per capita, damages accelerate over longer term

Damages module

The damages component of the D.Climate model links emissions and a changing climate to economic outcomes.[60] The fundamental 'driver' of economic damages is rising global temperatures, which induce climate change and extreme weather events. Economic output (as measured by GDP) is impacted through the physical damages that affect productivity and/or the stock of productive factors (see Figure B.3).

Figure B.3: 'Two-stage' economic damages relationship



Source: Deloitte Access Economics

Linking emissions to physical damages

Global temperature increases are the main driver of climate impacts and are regionalised via the damage functions. To accurately reflect the relationship between emissions and projected temperature changes in D.Climate, outputs from regional complexity models are used to parameterise global temperature and emissions trajectories aligned to a specified SSP-RCP scenario. Specifically, global mean surface air temperature (GSAT) changes relative to the pre-industrial (1750) baseline and global greenhouse gas emissions are sourced from the MAGICC as described in Meinshausen et al. (2011) and Meinshausen et al. (2020), and configured by Nicholls et al. (2021).[61]

Since the MAGICC does not provide regional temperature output or regional climate impacts, D.Climate uses regional average temperature, precipitation and relative humidity variables (Wet Bulb Globe Temperature (WBGT)) to quantify the physical damages associated with a changing climate. The data for each variable is the multi-model mean of 17 global climate models (GCMs) for the modelled SSP-RCP future pathways that are available from CMIP6.[62] The GCMs output was downloaded from the Earth System Grid Federation portal and then processed into monthly periods per geography/region across the modelled regions from the present day to 2100.[xiii]

Twenty-year averages of the GCM projections are used here to assess the key signals for future climate change across short- to long-term horizons. Each 20-year averaged period represents the climate of the midyear. For example, the average temperature projection for the period 2011 to 2030 is assumed to represent the climate in the 2020 horizon.

As economies reduce emissions, the impacts of damage also reduce. In this sense, abatement drives avoided damage benefits within the damage module. The combined effect of warming driven by historical emissions already in the atmosphere and the amount that will be emitted under the emissions path described in chapter 3, means that some amount of climate damage is unavoidable.

Damage functions

The relevant global and regional temperature pathways are used to quantify the physical damages across six regionalised damage functions, which include:

1. Heat stress damages to labour productivity
2. Human health damages to labour productivity
3. Sea level rise damages to land and capital stock
4. Damages to capital stock from climate disasters
5. Agricultural damages from changes in crop yields
6. Tourism damages to net inflow of foreign currency.

xiii. Only models that permit an appropriate licence for commercial application are used in the modelling process. Neil Cameron Swart et al. (2019), *CCCma CanESM5 model output prepared for CMIP6 ScenarioMIP*, Version 20190429. Earth System Grid Federation.

The damages module closely follows the approach developed by Roson and Sortori (2016).[63] The structure of these damage functions has been assessed by Professor Tom Kompas. The remainder of this section describes each damage function in more detail.

Heat stress damages on labour productivity

Rising average global temperatures lead to shifts in the distribution of daily peak temperatures and relative humidity. Heatwaves are likely to become more frequent and increasingly extreme for many countries.

A working environment that is sufficiently hot can negatively affect the health and safety of workers, as well as restrict their ability to perform tasks and limit their productive capacity.[64] To continue functioning at elevated body temperatures, workers may instinctively reduce work intensity (whether it occurs through self-instinct or occupational health management interventions), resulting in reduced 'work capacity' and lower labour productivity.[65]

This analysis estimates the effect of rising temperatures and changing relative humidity levels on labour productivity using WBGT as a measure of heat stress. The methodology follows an approach proposed by Kjellstrom et al. (2017), which uses a series of functions describing the relationship between WBGT and labour productivity across three different work intensities based on a review of epidemiological datasets. It is assumed that changes in labour productivity (an economic concept) are equal to changes in estimated work capacity (a physiological concept).

Consistent with the approach proposed by Kjellstrom et al. (2017), it is assumed that a geography or region's WBGT varies over three 4-hour intervals comprising approximately 12 hours in a working day. These three variants of WBGT (mean, max and half) have been projected at monthly intervals using the simplified WBGT index – sWBGT – based on surface temperature and water vapor pressure[xiv] (developed by the Australian Bureau of Meteorology).[66] Labour productivity is then estimated for each geography/region at monthly intervals, across each of the three 4-hour intervals assumed to comprise the working day. Monthly labour productivity estimates are then averaged to give an aggregate measure of labour productivity.

Human health damages to labour productivity

Climate change poses diverse and complex risks to human health, which have been a prominent feature of estimates of future climate change impacts. Many estimates of economic damages rely on direct costs methodologies (i.e. price times quantity). With regard to human health, the price is typically equal to the value of a statistical life, based on estimates of willingness to pay to reduce the risk of death or diseases, or the willingness to accept compensation for increased risk.[67] However, these methods ignore the human health impacts on labour productivity and the demand for health services.

This analysis estimates the higher-order economic effects (or indirect costs) of impacts to human health and variations in labour productivity based on the work undertaken by Roson and Sartori (2016), which in turn is based on Bosello et al. (2006).[xv] Bosello et al. conducted a meta-analysis of the epidemiological, medical and interdisciplinary literature[xvi] to estimate the number of extra cases of mortality and morbidity associated with a given increase in average temperature, for an increase in some vector-borne diseases (malaria, dengue, schistosomiasis), heat- and cold-related diseases, and diarrhea.[68] The information obtained in this research has been combined with data on the structure of the working population to infer the number of lost working days. The changes in morbidity and mortality are interpreted as changes in labour productivity. Roson and Sartori updated the work of Bosello et al. to account for recent literature on health impacts and studies mentioned in Intergovernmental Panel on Climate Change (2014), scaling up or down the variations in labour productivity.

The results of these studies are expressed as changes in average labour productivity for a 1°C increase in temperature (implicitly assuming that the relationship is approximately linear). For the purposes of this analysis, and to understand the relationship between impacts on human health, an increase in average temperature and time, we regressed the variables to find an equation with a satisfactory fit for the relationship.

Sea level rise

As average global temperatures continue to rise, glaciers and polar ice are melting, and water bodies are experiencing thermal expansion. Together, these

xiv. Water vapour pressure was derived using estimates of relative humidity and the corresponding surface temperature.

xv. This methodology excludes induced demand for health care.

xvi. This analysis does not include all diseases and health-related impacts mentioned in the IPCC Fifth Assessment Report.

factors cause sea level rise. Changing temperatures also affect local weather and climate, increasing the likelihood and intensity of storm surges in coastal regions.

Sea level rise can impact a geography/region's total stock of capital through a combination of erosion, inundation and salt intrusion along the coastline. As the global stock of land declines due to sea level rise, productive capital on that land is either fully depreciated and needs to be relocated or needs to be replaced more frequently due to gradual deterioration from erosion and salt-water intrusion. The extent of capital lost to sea level rise will depend on several geography-specific characteristics, including (i) the composition of the shoreline (cliffs and rocky coasts being less subject to erosion than sandy coasts and wetlands), (ii) the total length of the coastline, (iii) the share of the coast that is suitable for productive purposes and (iv) the vertical land movement (e.g. coastal subsidence or uplift).[69]

In this analysis, the impact of sea level rise and coastal inundation has been quantified as a reduction in capital productivity in coastal regions using outputs from Depsky (2023).[70] This open-source version of Diaz (2016) Coastal Impact and Adaptation Model (CIAM) quantifies global coastal damages for 12,000 coastal regions for a range of future adaptation (protection and/or retreat), emissions and socioeconomic trajectories. Coastal damages include both market impacts, such as capital costs from inundation and flooding, and non-market impacts, such as reduction in ecosystem services from wetland loss and mortality from extreme storm surges. These estimates can be flexibly aggregated at the city, country, regional and global level, and are widely used by government bodies and for cost–benefit analysis, including the US Environmental Protection Agency's calculation of the social cost of carbon.[xvii,71]

Since economic models such as D.Climate are designed to analyse market impact, the damage estimates utilised in this analysis have been scaled to reflect only the capital costs of sea level rise and coastal inundation modelled in Depsky (2023) and Diaz (2016).

Capital damages

Capital damages are 'measured as a reduction in capital productivity across sectors', reflecting the fact that a changing climate requires firms to spend more on capital to achieve the same amount of output in every period.

In this analysis, the relationship between temperature increase and estimated rising insurance premiums from the Cross Dependency Initiative (XDI) report is used as a proxy for the annual change in capital productivity in the D.Climate model, by state and territories in Australia.[72] The XDI data provides future estimates for increasing total technical insurance premiums at the local government area level akin to a monetised capital damage by local government area.[xviii] The estimated damages produced by this methodology can be interpreted as a percentage of annual capital investment that is diverted to repair and replace damaged assets due to an associated rise in average temperature in a region. This effectively smooths a stochastic process of natural disaster impacts over time into an average annual damage estimate captured by a reduction in capital productivity.

Although the damage estimate does not measure the direct impact of any particular temperature increase to a particular location at a particular time in future modelled periods, the implied relationship between temperature change and capital damage in XDI indirectly and implicitly reflects the fact that as global temperatures continue to increase above pre-industrial levels, the frequency and intensity of natural hazards will rise in aggregate and the productivity of capital will fall on average.

Agricultural damages from variations in total factor productivity

Climate change will see rising temperatures, higher concentrations of CO_2 in the atmosphere and different regional patterns of precipitation, which affect agricultural production.

In this report, the impact of climate change on the agriculture sector is studied through changes in total factor productivity (TFP) of agriculture using an empirical relationship between TFP, temperature and precipitation identified in Oritz-Bobea et al. (2021).[xix] By focusing on TFP, Oritz-Bobea et al. offer a broader reflection of the effects of climate change on the agricultural sector than previous studies that have focused mainly on crop yields. The relationship between agricultural productivity and temperature and precipitation is

xvii. In previous studies, D.Climate has estimated land loss due to sea level rise using an approach based on Roson and Sartori (2016), which links global mean temperature changes to sea level rise while accounting for vertical land movement. Agricultural and urban land losses are calculated using World Bank data on low-elevation coastal zones (LECZ), assuming the proportion of LECZ used matches the overall share of agricultural or urban land in a region.

xviii. The specific natural hazards captured in this study include riverine flooding, coastal inundation, forest fires, subsidence and wind gusts (excluding cyclones).

also defined by modelling a counter-factual trend, with greater methodological transparency and specification tests that empirically justify the baseline model utilised in Oritz-Bobea et al. (2021).

Consistent with the approach of Oritz-Bobea et al. agricultural productivity in this analysis is a function of temperature and precipitation. Surface temperature and precipitation are projected at annual intervals for each scenario. Agricultural productivity is then estimated for each geography/region annually.

Tourism damages

Climate-induced economic tourism damages are driven by changes in net visitor flows and expenditure. In D.Climate, changes to net visitor flows and expenditure are fundamentally driven by the exposure of each region to climate change. However, the impacts can be varied. Countries with lower current temperatures can experience a beneficial net inflow of foreign currency as temperatures rise and tourism increases in the region. Conversely, for countries with high current temperatures, further temperature rises mean the economy could experience a net outflow of foreign currency as tourism spending is reallocated to other regions.

To estimate tourism damages in D.Climate, functions that relate visitor arrivals and departures to average temperature are employed. These functions are consistent with those employed by Roson and Sartori (2016) and are derived from econometric models expressed in terms of land area, average temperature, length of coastline, per capita income and the number of countries with shared land borders.[73] Projected average temperatures are used as inputs to these functions to determine a resulting net flow of foreign currency. The magnitude and persistence of tourism damages are also functions of the economic structure of each region's economy. Regions with more diverse economic structures are less likely to experience persistent economic damages as industries are less reliant on tourism and more malleable and adaptable.

For the GBR region, the relationship between net visitor flows and expenditure has been scaled to account for the loss in tourism associated with the expected change in Reef condition as per the *Great Barrier Reef Coral Futures Report*. In the Resilient Reef scenario, tourism damages are adjusted to reflect avoided tourism losses due to the positive impact of crown-of-thorns starfish control and assisted coral evolution, reef restoration and adaptation R&D, and in-water deployment.

Approach to estimating the value of reef restoration, adaptation and protection investment

To estimate the economic benefits delivered by reef restoration, adaptation and protection strategies, Deloitte Access Economics considered the impact of three interventions for increased Reef quality and cover.

1. **Crown-of-thorns starfish control:** Crown-of-thorns starfish outbreaks are linked to human activities, including nutrient run-off and removal of natural predators. Targeted culling has demonstrated that it can effectively protect and increase coral cover at regional scales. It may also enhance natural adaptation processes by protecting the adult breeding corals that survive through marine heatwaves. Further R&D is needed to increase efficiency and effectiveness as the climate changes. However, this strategy is particularly relevant in the short to medium term.

2. **Investment in restoration and adaptation R&D and in-water deployment:** Current restoration and adaptation strategies require ongoing investment in R&D to enhance efficiency and cost-effectiveness. A comprehensive approach to reef conservation must simultaneously scale up restoration and adaptation measures alongside continued research and innovation to improve deployment.

3. **Assisted coral evolution:** This technique accelerates coral restoration and adaptation by cultivating corals in controlled settings to enhance traits like thermal tolerance. These enhanced corals are then introduced into vulnerable populations to bolster resilience against ocean warming. Assisted coral evolution is critical for the long-term survival of reefs amid rising temperatures.

There are two modelled 'drivers' of restoration, adaptation and protection benefits. Firstly, the avoided cost of restoration and adaptation was modelled as investment 'savings' accrued from R&D breakthroughs which both increase coral heat-tolerance and develop production systems that lower the per-unit cost of deployment. Current R&D investment in assisted coral evolution has made substantial progress in increasing

xix. In previous versions of D. Climate, the approach used to estimate the impact of climate change on the agricultural sector was based on Mendelsohn and Schlesinger (1999) and Cline (2007), where the variation in output of cereal crops per hectare was expressed as a function of temperature, precipitation and CO_2 concentration.

the heat resistance of corals and reduced the cost of such corals. However, if assisted coral evolution were to be deployed at the current level of research, it would come with a substantial cost. This modelling considers a scenario where investment in R&D continues, allowing progress to be made regarding the effectiveness and cost-efficiency of the technique. As such, this scenario looks at the incremental cost savings between these two scenarios. The second modelled driver focused on sustaining tourism flows to the GBR region by reducing the decline in reef cover and quality. Maintaining reef coverage and quality prevents a decline in tourism, thereby enhancing economic activity on the Reef.

A breakdown of the assumptions used under the Below 2°C and Resilient Reef scenarios is detailed in Table B6.

Table B.6: Underlying scenario assumptions across the restoration, adaptation and protection interventions considered as part of the Below 2°C and Resilient Reef scenarios

Scenario	Restoration, adaptation and protection intervention assumptions		
	Assisted coral evolution	**COTS control**	**Investment in R&D**
Below 2°C	This scenario assumes no Reef restoration, adaptation or protection strategies are deployed. As a result, there are no improvements to coral heat tolerance in corals beyond natural adaptation. Forecast Reef coverage and quality is based solely on the temperature pathway. In this scenario, deployment of restoration, adaptation and protection strategies would come at a high cost, acting as a barrier to effective deployment in order to reduce coral degradation.		
Resilient Reef	All interventions assume that the deployed restoration, adaptation and protection techniques are successful in reducing coral degradation at intervention locations by achieving an improvement in thermal tolerance of 10 Degree Heating Weeks (DHW) equivalency. A measure of +10 DHW indicates that R&D investment improves the ability of coral to survive up to 10 weeks under heat stress conditions that, without R&D investment, would otherwise cause significant coral mortality.		
	The scenario assumes that the deployment of reef restoration, adaptation and protection strategies generates economic impacts through avoided tourism loss. Following are the core assumptions driving this scenario. • The impacts of assisted coral evolution and crown-of-thorns starfish control on reef cover is additive and have no other interactive impacts. • Tourism demand is reactive to changes in reef quality; that is, tourism to the GBR region will improve following a relative improvement in reef quality.		This scenario assumes that protection, adaptation and restoration strategy deployment cost savings can be achieved through additional R&D investment. It is expected that additional R&D investment can result in an improvement in DHW of adapted coral and the associated cost per coral. This scenario assumes continued R&D can improve the effectiveness of the assisted coral evolution strategy (i.e. through improved heat resistance), and it can improve cost-efficiency by reducing expenditure per unit of coral to $2. In the absence of continued R&D, it is assumed that there is no further improvement in the heat resistance of adapted coral or the cost of strategy deployment. As such, this shock captures the cost savings of cheaper deployment, freeing up capital for use elsewhere in the economy.

Source: Materials provided by the GBRF.

Limitations and notes on interpretation

The particular scenario definitions and focus of this analysis mean that results may not be directly comparable to previous studies highlighted above.

- **Decarbonisation in Queensland and rest of Australia is kept constant across all scenarios.** This means the model does not show the economic benefits to Queensland and the rest of Australia from an orderly transition to net zero that capitalises on economic opportunities from the global transition. This modelling is based on changes in the physical damages experienced by Queensland and the rest of Australia only. It does not incorporate an explicit global, national or regional emissions reduction constraints that would facilitate emissions reduction and structural economic changes to reflect the benefits of investing in new low-emissions industries. As such, this analysis is not comparable with previous Deloitte Access Economics analyses.[74] Given its emissions-intensive industrial structure, Queensland, in particular, benefits from investing in export-oriented low-emissions technologies and industries in a timely and orderly manner, as demonstrated in Deloitte Access Economics' analysis of Queensland's interim emissions reduction targets for Queensland Government.
- **Restoration, adaptation and protection is only partially accounted for in this analysis.** The Resilient Reef scenario model avoided tourism losses through reef restoration, adaptation and protection but does not capture the full benefits of adaptation to all physical damages from climate change. While the D.Climate model includes some adaptation within its damage functions and economic components, it does not fully reflect comprehensive adaptation efforts. For example, the damage functions are based on empirical relationships that inherently account for long-term, ongoing adaptation processes embedded in historical data. Additionally, the economic component of the model (the DAE-RGEM) captures decision making by firms and households, that adjust their consumption and input choices based on relative prices and productivity shifts. This flexible response mimics certain aspects of adaptation but does not equate to a fully modelled restoration, adaptation and protection strategy.
- **Estimated benefits may be higher if modelling were extended beyond 2075**, as the avoided physical impacts of climate change will also continue to benefit Queensland long after the next 50 years. Transition costs – not modelled in this analysis – also peak and decline, meaning new green industries formed as part of the transition will continue to mature post-2075 in a net zero economy.
- **There are wider socioeconomic impacts and distributional impacts.** Stabilisation of global temperatures driven by emissions reduction may drive several wider socioeconomic impacts, such as improving environmental (e.g. air pollution), health and social outcomes. Economic models, such as D.Climate, are designed to analyse production, trade and employment outcomes that take place in markets. Such models do not necessarily capture broader impacts on welfare.

Appendix C: Additional analysis of the historic economic performance of the Reef Economy

Additional analysis of the historic performance of the tourism sector

Hotel investment in the Great Barrier Reef region remains below the Queensland trend

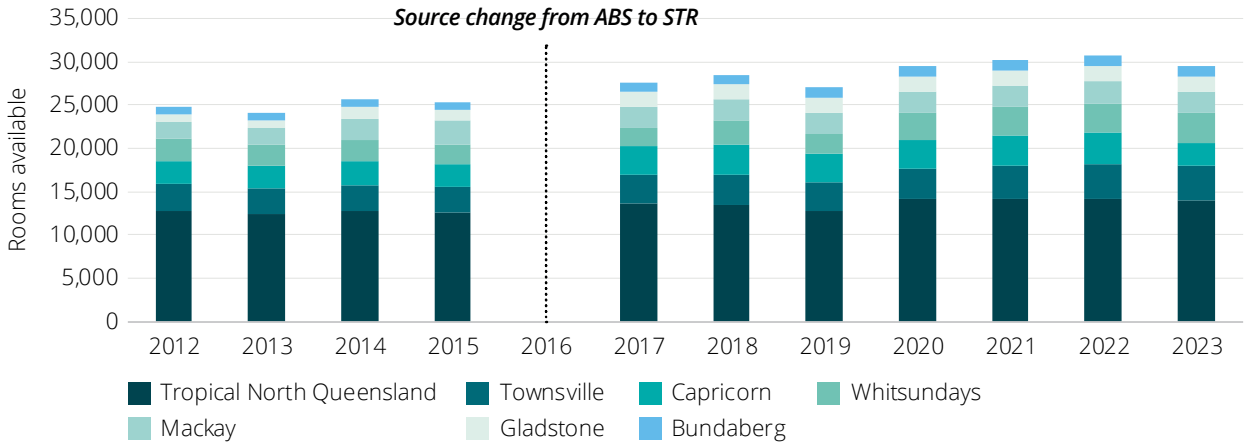
Coinciding with low growth in leisure tourism, particularly for international visitors, growth in commercial accommodation in the GBR region has been visibly lower than the Queensland average. Since region-level accommodation data has been available, from 2012–13, **commercial rooms offered in the GBR region have grown by an average rate of 0.7% per year, significantly trailing Queensland average growth of 1.5% per year**.[xxi] This indicates weak hotel investment in the GBR region, relative to the Queensland average.

In part, investment growth in the GBR region has been deterred by low occupancy rates for existing rooms, which have remained consistently below the Queensland average and reflect the region's long-term stagnation in visitor volumes. Nonetheless, lower investment as a result of a decline in visitation becomes self-perpetuating when tourists are deterred from the region in part by ageing tourism infrastructure. Indeed, reports have found that quality infrastructure is key to attracting regional tourism from growing visitor markets such as China.[75]

While investment in commercial accommodation across the GBR region lags behind the rest of Queensland's growth, certain areas within the GBR region show strong continued investment. Since 2017, island resort developments in the Whitsundays have boosted visitor demand and spurred investment in room offerings.[76] Similarly, strong tourism initiatives across sporting and other events have driven demand and investment in Townsville.[77]

xxi. While this data does not capture self-contained and hosted accommodation (such as Airbnb), which has been replacing traditional forms of accommodation, this trend has occurred nationally.

Chart C.1: Rooms available (hotels, motels, resorts and serviced apartments) by GBR tourism region, 2012-13 to 2023-24 (excluding 2016-17)



Source: Deloitte Access Economics

Note: Underlying data in financial years, but axis labels are simplified for readability (year ending June). Analysis cannot be made between 2015-16 and 2017-18 due to a data source change from the Australian Bureau of Statistics to STR, resulting in missing regional data for 2016-17. As a result of incomplete data and potential methodology changes, reported growths are an average of 2012-13 to 2015-16 and 2017-18 to 2023-24 values.

While Tropical North Queensland accounts for about 48% of all rooms supplied in the GBR region, the number of rooms offered in this subregion remains flat. Indeed, in 2024 CoStar reported that **no new hotels had opened since November 2020 in Cairns and there were no proposed projects for the city**.[78] Feasibility concerns have deterred new investment, particularly as construction costs increase. In the face of increasing costs, investors require certainty in visitor growth in the region. This, in turn, requires co-investment across the Reef Economy to ensure ongoing Reef protection and sufficient transport access, both of which have been ongoing concerns for the region.

Box C.1: The outlook for accommodation investment

The accommodation investment pipeline in the GBR region is continuing to look uncertain as **several large projects have struggled to take off or gain approval**. The North Queensland Ella Bay development, valued at $1.4 billion and offering 860 rooms, is currently in planning and up for sale by McGees Property, despite being in the pipeline since 2019-20. Elsewhere, the Aquis Great Barrier Reef mega-resort has been struggling to gain traction since the first stage of plans was greenlit in 2013.[79] Other developments, including a 120-room resort development in Palm Cove and a $300 million luxury Fairmont Resort in Port Douglas, have been rejected at the approval stage.[80] This sluggish investment pipeline has stemmed in part from planning difficulties, with concerns over environmental and social impacts being at the forefront of many rejected plans. However, overshadowing these problems is an underlying difficulty in securing financing and attracting investment. Indeed, it is difficult to guarantee the success of projects along the Reef when the health of the Reef itself is uncertain.

While investment is expected to be slow, there are some green shoots. Queensland Government funding and grant initiatives have supported some growth in accommodation investment, particularly for smaller footprint developments that minimise negative environmental and social impacts. The Growing Future Tourism program has provided financial support to Queensland tourism operators, including the development of Hook Island Eco Lodge and Stage 1 redevelopment of Lindeman Island Resort in the Whitsundays in 2023 and 2024.[81] High construction costs are expected to continue to drive slower growth in rooms offered.

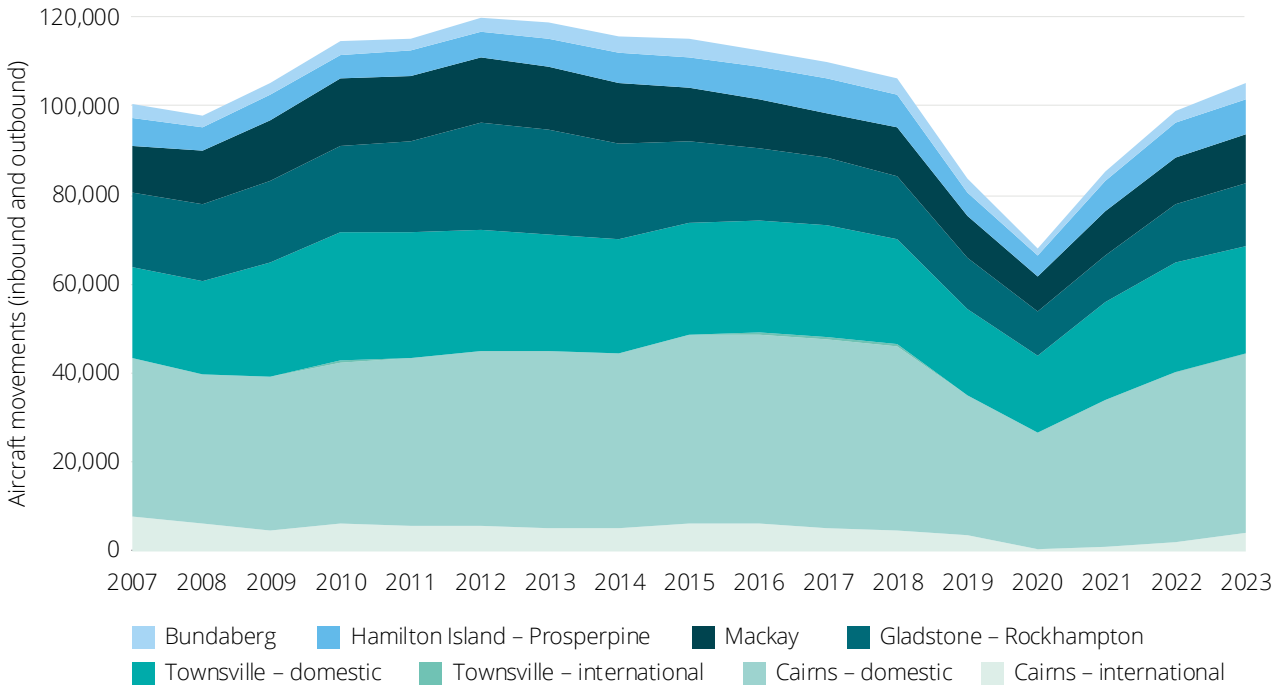
The aviation sector has seen a continued decline, deterring tourism growth in the North

As with commercial accommodation, aviation investment in the GBR region has also remained below that of Queensland, with total aircraft movements **increasing by an average of 0.3% per annum since 2007-08 (compared to 1.8% per annum in Queensland).** This weakness in GBR region growth has been consistent throughout the 2007–08 to 2023–24 period, with total flights in the region declining significantly even prior to the COVID-19 pandemic (-2.7% per year growth from 2015-16 to 2018-19).

As in the hotel industry, small pockets of the GBR region have experienced aviation growth over recent years. Since 2008, there have been significant aviation investments and a corresponding increase in flights to the Hamilton Island and Proserpine airports, averaging 1.6% per annum. New flight routes and airlines in the Whitsundays has been supported by extensive domestic marketing campaigns and accompanying accommodation investments.[82]

In contrast, Cairns has seen a marked decline in international aircraft movements over the period of analysis, where international flights peaked in the 1990s. More recently, **low international and domestic investments from Cairns have significantly hindered growth in the overall GBR region between 2015-16 and 2018-19** (refer to Chart C.2). While direct international flights returned to Cairns in 2022 following COVID-19 disruptions, the recovery in international flights to 2023-24 has been slower in Cairns than other Queensland and Australian destinations. Overall, weakness in aviation can be a significant barrier to the growth of tourism in the GBR region, given transport access precedes all other considerations for the success of regional tourism economies which are far from Australian transport hubs.[83]

Chart C.2: Aircraft movements inbound and outbound from Great Barrier Reef region airports, 2007-08 to 2023-24



Source: Deloitte Access Economics

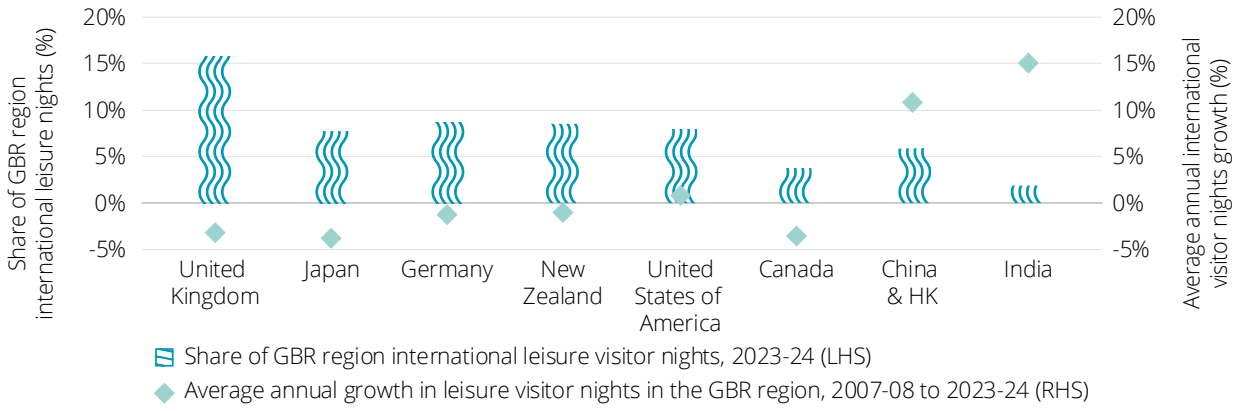
Note: Underlying data in financial years, but axis labels are simplified for readability (year ending June). Townsville – international operations were sporadic over the period, with operations in 2011 to 2012 and 2016 to 2019.

As Australia's international visitor profile changes, the Great Barrier Reef region needs further investment to ensure it adapts

The Great Barrier Reef region's international visitor market, measured in nights, contracted by 19% between 2007–08 and 2023–24. This decline has reflected a slow recovery from the pandemic, with international visitor nights being 76% of 2018-19 levels in 2023-24 (compared to an 85% recovery for Queensland), and challenges in maintaining long-term growth. There have been some periods of higher growth, including 7% growth in international visitor nights between 2016 to 2019, which exceeded the overall Australian growth of 6% in that period, but that followed a period of significant tourism marketing campaigns, Reef recovery efforts, traveller awareness of climate change impacts on the Reef, and the establishment of a direct aviation route from mainland China to Cairns in 2017.[84]

Analysis of the main international tourism markets of the region reveals that many have had low growth. For instance, while the United Kingdom, Japan and Germany continue to together comprise roughly one-third of all international visitors to the region, all three of these markets have seen a decline of over 1% per year in visitation to the region from 2007-08 to 2023-24 (refer to Chart C.3). Rather, it has been the United States as well as the smaller emerging markets of China and India that have grown in size over this period. Nonetheless, the GBR region continues to attract only a small share of visitors from China and India, accounting for only 1% of total in Australia-from-China visitors and 3% of nights in Australia-from-India visitors (compared to 11% and 14% of visitor nights from Japan and Germany, respectively).

Chart C.3: The Great Barrier Reef region's key source markets in 2023-24 and growth over time, 2007-08 to 2023-24



Source: Deloitte Access Economics

The GBR region's low market penetration of visitors from India and China reflects an overall weakness in the region's ability to adapt to Australia's changing international visitor markets as Germany and Japan become less prominent components of Australia's market mix. This is unlikely to be due to differences in consumer preferences for emerging markets; evidence has suggested that motivations for Chinese tourists in Australia include experiencing the natural environment and relaxing/escaping, thus playing to the Reef's advantage.[85] However, infrastructure to support these markets remains limited. As at the end of 2024, there are no direct international flights between India and the GBR region, while a seasonal service run by Cathay Pacific serves as the only route between China and Hong Kong and the GBR region.[86] Low direct connectivity, alongside other aforementioned supply side factors, including low growth in domestic aviation connections and ageing hotel infrastructure, thus limit the region's ability to target emerging international markets.

Looking forward – challenges and opportunities for tourism businesses in the Great Barrier Reef

The Great Barrier Reef remains one of Australia's largest tourism assets, however tourism in the region is struggling to keep pace with that in the rest of Queensland. While there have been pockets of growth, notably in the Whitsundays area, hotel and aviation investment in locations such as Tropical North Queensland have trailed that of the rest of

Queensland. In these locations, where tourism is often centred around direct visitation to the Reef itself, environmental concerns regarding coral bleaching have weighed heavily on visitors and investors alike.

While further investment in the tourism industry, including hotels and aviation, may be necessary to encourage domestic visitors and emerging international markets, there is a risk that these developments could exacerbate the very same environmental concerns that are currently limiting tourism investment. Indeed, almost one-quarter of respondents to the *GBRF partners* survey listed coastal development as one of the top three risks for the Reef.[87] Environmental concerns have also played a part in local opposition to certain hotel and resort developments within the region.

Ultimately, investment in tourism in the region must be coupled with the goal of sustainability. This may involve working to reduce the risks of tourism infrastructure developments on the environment, minimising the damages caused by tourists themselves, or offsetting Reef damages through increased conservation and rejuvenation efforts. The importance of the Reef's environmental quality to tourism highlights the incredible importance yet fragility of the Reef as a tourism asset, with conservation and effective environmental management being essential for sustaining and providing opportunities for economic value to grow. To date, initiatives such as creating artificial reefs have provided fishers and divers with alternatives to visiting more vulnerable ecosystems.[88] However, a vibrant reef that has developed naturally over millennia is impossible to replace.

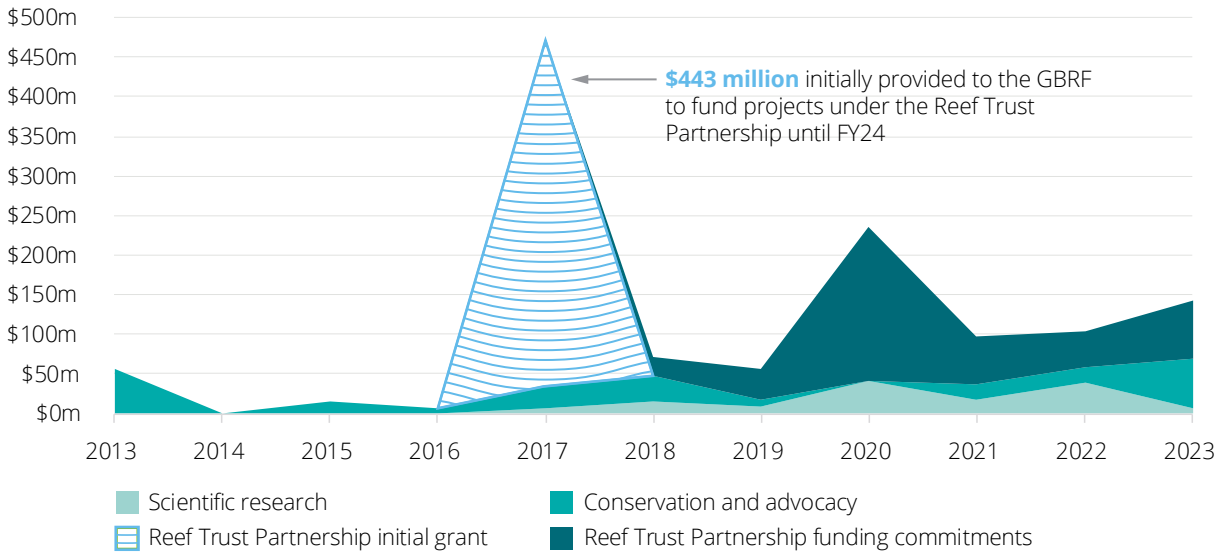
For many visitors, there is no substitute for visiting the Reef itself – thus there is an increasing need for new rejuvenation practices to sustainably maintain the Reef for future visitors to enjoy.

Additional analysis on the historic performance of the scientific research, conservation and reef management sector

The Reef Trust Partnership

While the Reef Trust Partnership has provided a considerable boost in funding for Reef conservation efforts in recent years, the program ended in the 2023-24 financial year. This marks a significant decline in funding available from 2024-25 onwards, given a majority of government grant funding in recent years has comprised funding commitments from the Reef Trust Partnership (refer to Chart C.4).

Chart C.4: Commonwealth and State grant funding for GBR conservation and scientific research activities ($m), 2016-17 to 2023-24



Source: Deloitte Access Economics

Note: Underlying data in financial years, but axis labels are simplified for readability (year ending June).

Looking forward – challenges and opportunities for research and conservation activities on the Reef

The Great Barrier Reef is an economic asset, albeit a fragile one, to its region. With the importance of Reef quality to the success of tourism and commercial fishing becoming increasingly clear as both of these sectors experience slowing growth, the importance of management, research and conservation work has been heightened. Indeed, while totalling $348 million in total revenues in 2023-24, the sector is responsible for supporting a much larger Reef Economy totalling over $10 billion.

Box C.2: Emerging roles for scientific research and conservation on the Reef

The scientific research and conservation sector has many potential avenues for achieving future growth that could amplify the value of the sector on the Reef. Beyond the increasing importance of its existing services, there are also opportunities to broaden the scope of the sector.

For scientific research organisations, there is a growing research role beyond aiding conservation and management, in areas such as health. As the Coral Reef Alliance notes, more than half of all new cancer drug research focuses on marine organisms.[89] While chemical compounds produced by reef organisms have been already used in treatments for diseases ranging from cardiovascular diseases to skin cancer, research in this field is still new, and there is potential for increased activity in this space – provided that reefs are adequately preserved.

Further, advancements in the recognition and valuation of the damages caused by carbon and sediment run-off can provide opportunities for conservation activities to grow on the GBR. These advancements have led to the creation of environmental markets such as the Reef Credit scheme, which allow businesses and government entities alike to invest in conservation activities that reduce nutrient and sediment run-off to the Reef.[90] Further, with the increasing recognition of the value of Reef assets such as mangroves and seagrass in carbon sequestration and the incorporation of coastal wetland establishment as a method of Australian Carbon Credit Unit generation, there is an opportunity for the further development of blue carbon opportunities. The Reef's current and potential blue carbon value is discussed further in Chapter 2.

Generally, while the role of non-governmental organisations in relation to the Reef has been growing, with technological advancements and skills development being led by an array of research and conservation organisations across the GBR region and nationally, there is a role for government to aid in the facilitation of 'cohesive adaptable governance' and promoting consistent and certain funding.

Appendix D: Economic, social and icon value update methodology

This report provides an update to Deloitte Access Economics' 2017 valuation of the GBR's economic, social and icon value, to offer a contemporary view of how Australians value the Reef.[91] This is estimated using an approach that applies updated price levels, rates of Australian Reef users (both local and tourists) and current Australian population estimates, to benefit-per-population values gathered during the 2017 study.

Calculating net present value

All estimates of the GBR's economic, social and icon value presented in this report are reported using net present value (NPV), a measure of determining the value of a series of future cash flows in today's dollar terms.

To discount the dollar value of the benefits received in future time periods into present value a social discount rate of 2% per annum is applied to all NPV estimates. Social discount rates, used to discount net benefits that are uncorrelated with market returns, are based on riskless rates of interest and time preferences.[92]

While the 2017 study applied a social discount rate of 3.74% per annum, this report applies an updated rate of 2% per annum. As discussed in Appendix B, a 2% social discount rate is consistent with consensus amongst experts on social discounting in environmental economic analysis.[93,94] Ultimately, this choice of social discount rate places no normative preference to the welfare of current generations over that of future generations, with the rate thus being determined by a low rate of interest consistent with a riskless interest rate. This is also consistent with the social discount rate applied to analysis from Deloitte Access Economics' D.Climate model.

NPV estimates are made over a 26-year time period, reflecting the time between the year of valuation (FY24) to 2050, or the remaining duration of the Australian Government's Reef 2050 Long-Term Sustainability Plan. The Reef 2050 Plan is Australia's response to the World Heritage Committee's recommendation that a long-term plan be developed for sustainable development to protect the Outstanding Universal Value of the Reef.[95]

Non-use value

Non-use value is a technique that measures the value people assign to goods or services even if they do not directly use or plan to use them. Effectively, it aims to capture the worth that individuals place on the existence or preservation of an asset.

In 2017, Deloitte Access Economics estimated that, on average, Australians had a weekly willingness to pay of $1.30 to ensure the GBR is protected into the future.[96] This figure was adjusted into 2024 dollar terms using the June 2024 ABS consumer price index (CPI), revealing an average weekly willingness to pay of $1.64, or $85.45 annually.[97] The willingness to pay figure was then extrapolated against the Australian population over the age of 18, approximately 21.4 million (at 30 June 2024).[98]

To estimate the total asset value, the annual figure was converted to a 26-year NPV discounted at 2% per annum. This approach values the GBR's total non-use benefit to Australians at $39 billion.

Direct use value

Tourism

Tourism value measures the consumer surplus that tourists gain from visiting the GBR, above the price they paid to visit. In 2017, Deloitte Access Economics estimated that the average consumer surplus per person, per trip to the GBR was $662.[99] When adjusted to today's dollar terms using the June 2024 ABS CPI, this is equivalent to approximately $837.[100]
To measure total consumer surplus, the annual figure was extrapolated across the annual number of applicable domestic visitors to the GBR region. Annual domestic visitor figures were sourced from Tourism Research Australia's overnight visitor datasets which indicated that in FY2024 the GBR region attracted 2.3 million adult overnight holiday visitors.[101] Overnight visitors from within the GBR regions were excluded from this estimate to prevent overlap with the estimate for recreational visitors (discussed in the next section).

To estimate the total tourism value, annual consumer surplus for tourists was converted to a 26-year NPV discounted at 2% per annum. This approach values the GBR's total tourism value to Australians at $40 billion.

Recreation

Recreational use value reflects the consumer surplus that local populations gain from accessing and using a recreational site or activity, in this case visiting the GBR.

To measure the consumer surplus that local populations derive from using the Reef, Deloitte Access Economics (2017) drew on estimates by Rolfe & Gregg (2012), who estimated the recreation values of residents from Bundaberg, Gladstone, Capricorn Coast (Rockhampton), Mackay, Townsville and Cairns placed on visiting the GBR. This valuation estimated an average consumer surplus of $43 per person per trip across all the neighbouring GBR regions.[102] When adjusted to June 2024 dollars, this is approximately $59 per person per visit.[103]

To estimate the total population-wide benefit, consumer surplus was multiplied by the relevant regional population and the average number of visits per person per year. The population of the relevant surrounding GBR regions was informed by ABS Regional Population estimates, for which a local population of approximately 1 million people was determined.[104] Average visits was estimated using survey results from CSIRO's 2024 report for the Social and Economic Long-Term Monitoring Program for the GBR.[105] This analysis indicates that residents of local regions visited the GBR an average of 12 times per year.

This approach results in an annual direct benefit of $742 million from recreational trips to the Great Barrier Reef. A NPV estimate was used to convert this annual figure to a total asset figure, finding that the **total direct use benefit to recreational visitors is $15.7 billion**.

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