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Access Economics



At what price?

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

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Foreword

There is no doubt that the Great Barrier Reef holds significant value for Australia, Australians and the global community.

Sir David Attenborough has declared our Great Barrier Reef to be “one of the greatest and most splendid natural treasures that the world possesses”. Beyond its unparalleled beauty and richness of biodiversity, the Reef delivers real economic value to the Australian economy.

Today, our Reef is under threat like never before. Two consecutive years of global coral bleaching are unprecedented, while increasingly frequent extreme weather events and water quality issues continue to affect Reef health. So there has never been a more critical time to understand precisely what the Reef contributes and, therefore, what we stand to lose without it.

The contents of this report should inform future policy settings and assist industry, government, the science community and the wider public to fully understand the contribution of the Great Barrier Reef to the economy and society, both in Australia and around the world.

The report’s findings emphasise the economic aspect of why the Foundation’s work over the coming decade is so important. We all must do more – much more – to protect the Reef. The Foundation is committed to enabling large-scale, ambitious projects that go to the heart of building the Reef’s resilience. We believe that mitigation and adaptation in the face of a changing climate are key. Fundamentally, our work is about finding ways to ease the environmental burden on the Reef – effectively buying the Reef time – as the world works to meet the terms of the Paris Agreement.

I would like to acknowledge and thank National Australia Bank and the Great Barrier Reef Marine Park Authority who have supported the Foundation to commission this report.

This report makes it clear that the Great Barrier Reef is a treasure that is too big to fail. It is a call to action for us all – individuals, businesses, foundations and governments – to respond in equal measure to ensure that we don’t fail our natural wonder.

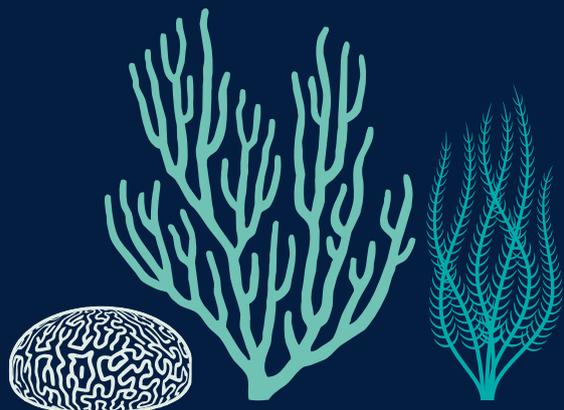
Undoubtedly there is a role for everyone to do more to protect the Great Barrier Reef. Please join us on the quest to ensure there is a *Great* Barrier Reef for future generations.



Dr John Schubert AO
Chair, Great Barrier Reef Foundation

“This timely report is a much needed, holistic view of the incredible economic value and opportunities provided by the Great Barrier Reef. Any failure to protect this indispensable natural resource would have profound impacts not only to Australia but around the world.”

Al Gore



Executive summary

The Great Barrier Reef has a economic, social and icon asset value of **\$56 billion**. It supports **64,000** jobs and contributes **\$6.4 billion** to the Australian economy.

The Great Barrier Reef is the largest living structure on Earth. It is as big in size as Japan, and bigger than the United Kingdom, Switzerland and the Netherlands put together. Spanning 2,300 kilometres, the Great Barrier Reef can even be seen from space. The hundreds of thousands of marine and coral species that make up its rich tapestry of biodiversity make it one of the most unique and complex ecosystems in the world.

But it is more than a coral reef.

The Great Barrier Reef is in Australia's cultural DNA. It is integral to the identity of Australia's Traditional Owners. What's more, its status as one the seven natural wonders of the world makes it an *international* asset. In many ways, it hardly seems necessary to quantify its value. The value of the Great Barrier Reef is priceless and we know that there is no replacement.

However, identifying, measuring and reporting on the economic and social value of the environment elevates its significance in decision making. Valuing nature in monetary terms can effectively inform policy settings and help industry, government, the scientific community and the wider public understand the contribution of the environment, or in this case the Great Barrier Reef, to the economy and society.

At a time when the global natural environment is under threat from the pressures of humankind, particularly climate change, it has never been more important to understand the economic and social value of the natural environment.

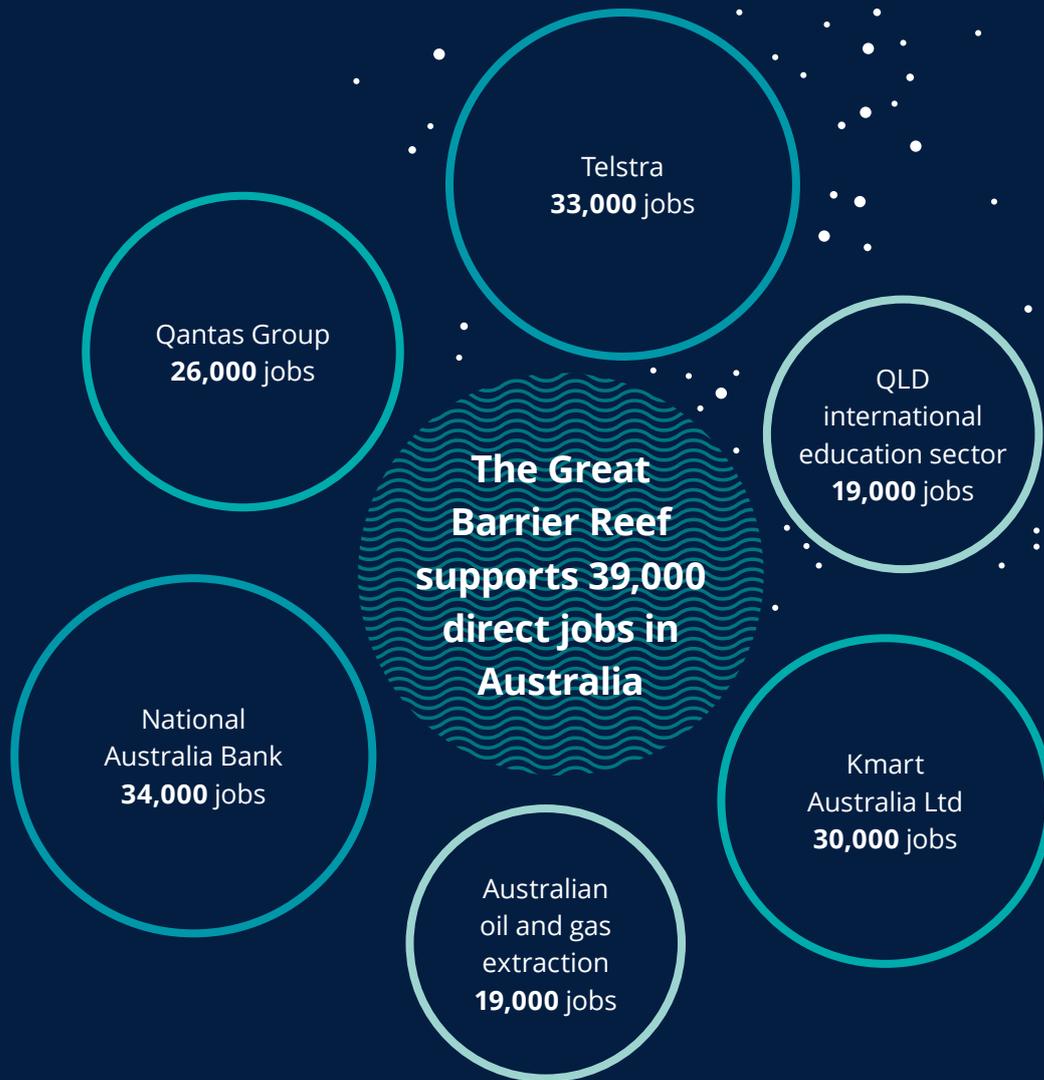
The Great Barrier Reef is incredibly rich, diverse – and under threat. The tight and unforgiving deadline the Great Barrier Reef is up against necessitates an understanding of its true value to know what kind of policy action is required in response.

This report assesses the economic, social, icon and brand value of the Great Barrier Reef. Its purpose is to gauge the Great Barrier Reef's value to Australians and understand how the international community values it. This research synthesises the results from a range of publicly available data sources, a new survey of over 1,500 Australians and residents from 10 countries world-wide, fresh insights from stakeholder consultations and the efforts of previous research. The sample was representative and the size statistically significant.

The report estimates the Great Barrier Reef's:

- Contribution to the Australian economy in 2015–16 through industry value added and employment,
- Economic, social and icon value,
- Significance to Aboriginal and Torres Strait Islander Traditional Owners, and brand value to Australia and the international community.

Let's put it in perspective



The first way of valuing the Reef is through its annual contribution to the Australian economy in terms of value added (Gross Domestic Product) and employment.

Our research has shown the Great Barrier Reef contributed \$6.4 billion in value added and over 64,000 jobs to the Australian economy in 2015–16 (direct and indirect). Most of these jobs came from tourism activities generated by the Great Barrier Reef, but there were also important economic contributions from fishing, recreational and scientific activities.

The annual employment supported by the Great Barrier Reef is more than most of Australia's major banks, and many corporates including the likes of Qantas and Deloitte Australia.

Considering this, the Reef is critical to supporting economic activity and jobs in Australia. The livelihoods and businesses it supports across Australia far exceeds the numbers supported by many industries we would consider too big to fail.

Another way of valuing the Reef is its economic, social and icon asset value. This figure captures the broader aspects of why we value the Reef, and cannot be added to the annual economic contribution figure.

More than the jobs it supports and the value it adds to the economy each year, **the Great Barrier Reef is valued at \$56 billion as an Australian economic, social and iconic asset.**

That's more than 12 Sydney Opera Houses, or the cost of building Australia's new submarines. It's even more than 4 times the length of the Great Wall of China in \$100 notes.

This is Australia's Reef. This is our natural asset. If we split the \$56 billion asset value down into its parts:

- Australians who have visited the Reef as tourists – on their honeymoon, on a family holiday, on a bucket-list trip – derive \$29 billion in value
- Australians that have not yet visited the Reef – but value knowing that it exists – derive \$24 billion in value
- And the lucky Australians that are recreational users of the Reef – going to the beach, taking the boat out, diving on the weekends – derive \$3 billion in value.

The above figures are estimates based on reasonable assumptions about the length of analysis and the 'discount rate' – how much we value the Reef in the future. Varying these produces a range of \$37 billion to \$77 billion. The estimates do not include quantified estimates of the value Traditional Owners place on the Reef. Another approach that analyses how the Reef is natural capital that provides ecosystem services is also explored qualitatively in this report.

So why do people value the Great Barrier Reef? What makes it worth \$56 billion? Australians and the international community value the Great Barrier Reef for a range of reasons. Some reasons are more concrete such as their belief in its importance for tourism, while some are more abstract such as their belief that Australia would just not be 'the same' without it.

Australians want their children and future generations to be able to visit the Great Barrier Reef and enjoy it. From a global perspective, the Great Barrier Reef's importance to the planet and to biodiversity is paramount. By every measure, the Great Barrier Reef is seen as the natural asset contributing most powerfully to Australia's global brand. In our research, the Great Barrier Reef left other Australian land-based natural assets far behind in terms of visitor preference, reputation and experience.

Why is this? Of the almost 1,000 respondents who named the Great Barrier Reef as Australia's most iconic natural asset, their justification includes: they consider it to be one of the most beautiful places in Australia; it's the most famous UNESCO natural site in Australia, and it is one of the seven natural wonders of the world.

Two-thirds of Australian and international respondents were prepared to pay to protect the Great Barrier Reef. Of these respondents:

- 61% alluded to its importance to the planet
- 59% felt future generations should be able to visit it
- 59% cited its importance to biodiversity
- 52% felt it was morally and ethically right to pay for its protection.

On one level, all of these figures seem enormous, but when you reflect on it, it's also clear how inadequate financial measures are for something as important to the planet as the Great Barrier Reef.

The Great Barrier Reef is an immense and unique ecosystem that holds a significant value to humans and other interlinked systems. In this sense, the Reef performs important environmental and ecological functions. These functions, if quantified, would show that the Great Barrier Reef is worth much more than the 64,000 jobs annually and \$56 billion asset value reported here.

This isn't the first report to consider the importance of the Great Barrier Reef – some of the significant examples include Costanza et al. (2014) analysis of Reefs globally, Windle and Rolfe's (2005a) application of choice modelling, Oxford Economics (2009), Stoeckl et al (2011) comprehensive account of literature and Deloitte Access Economics' various contribution analyses.

There have also been decades of effort to protect the Reef. The Commonwealth and Queensland Governments have implemented various policies to mitigate the impacts of local threats and build resilience against other pressures. The Great Barrier Reef 2050 Long-term Sustainability Plan was established in 2015 for greater coordination between stakeholders to protect the future health of the Reef. In addition, significant government funding is committed each year to the research effort of understanding – and protecting – the complex nature of the Reef.

While efforts to date have been substantial, the significance of the Great Barrier Reef's contribution to the Australian economy, to Australian jobs and its remarkable asset value strongly indicates the Reef should be given even greater priority by all citizens, businesses and levels of government.

There is an opportunity – and a need – now more than ever for action on a universal level.

But more than just getting the policy settings right and investing wisely, understanding the true value of the Great Barrier Reef shows us what is at stake. And when called on, it is this knowledge that allows us to make it clear that the Great Barrier Reef's protection is not only an Australian priority, or an international one – it is a human one.

1 Introduction

1.1 Overview

The Great Barrier Reef (GBR) is the largest living structure and continuous coral reef system on Earth. It is as large as Japan and bigger than the United Kingdom, Switzerland and the Netherlands put together. Spanning 2,300 kilometres, it can even be seen from space. The hundreds of thousands of marine and coral species that make up its rich tapestry of biodiversity makes it one of the most distinctive and complex ecosystems in the world.

But, it is more than a coral reef.

As the largest living structure on the planet, the GBR is incredibly rich, diverse – and under threat. The GBR is up against a tight and unforgiving deadline. To understand what kind of policy action is required in response, the value of the GBR must first be understood.

This report examines the economic complexities of the GBR and studies its value to the Australian economy and society. It expands on the 2013 report by Deloitte Access Economics that estimated the specific economic contribution of the Great Barrier Reef Marine Park area (GBRMP) in terms of its value added to the economy and contribution to employment across key sectors.

In addition to providing an updated economic contribution analysis, there are three other elements to this study.

The first is an analysis of the GBR's economic and social value as an Australian icon and natural wonder of the world, beyond what is captured by economic statistics.

The GBR provides additional benefit, or a surplus, to those who visit it through its natural beauty, biodiversity and the recreational experience it offers. For those who haven't had the pleasure of visiting, there is also a much broader social, cultural, heritage and iconic value attached to the GBR.

To capture these values, Deloitte Access Economics and Ipsos Public Affairs Australia conducted a research survey of over 1,500 Australian and international residents. This research across a statistically significant range of people covered simple topics like understanding the details of people's travel to the GBR, all the way to conceptually understanding how people think and feel about the GBR. It is important to note that this analysis is completed independent of the economic contribution analysis to avoid an overlap of the respective concepts.

Second, the **significance of the GBR from the perspective of Aboriginal and Torres Strait Islander Traditional Owners** is considered. The connection of Traditional Owners to the GBR spans over 60,000 years and its natural features of are deeply embedded in Indigenous culture, spirituality and wisdom. While this value is not quantified, its significance and qualitative value is demonstrated.

Third, the **value of the GBR's brand** to Australia and the international community is evaluated. Again, while not monetised, the power of the GBR and its significance to Brand Australia is assessed against four pillars – Differentiation, Relevance, Esteem and Knowledge.

3,000

coral reefs provide a year-round source of food and shelter



Critical to the survival of several endangered species

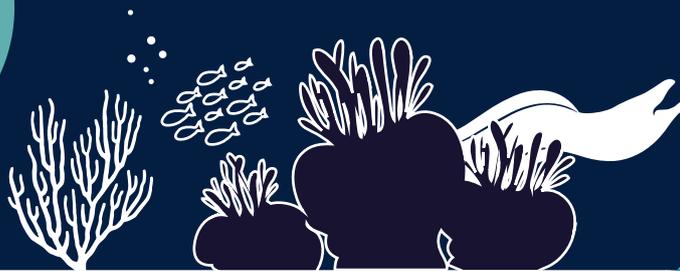
1,700

species of fish and other aquatic animals call the Great Barrier Reef home



14

coastal ecosystems are important to the functioning of the Reef



Home to animals since prehistoric times

1

Great Barrier Reef



Figure 1.1: Scope of the report

Economic Contribution	<ul style="list-style-type: none"> • Value added to the economy • Contribution to employment
Economic and Social Value	<ul style="list-style-type: none"> • Direct use value from tourism and recreation • Broad non-use value to society
Traditional Owner Value	<ul style="list-style-type: none"> • Cultural heritage • Spiritual and religious • Educational • Knowledge
Brand Value	<ul style="list-style-type: none"> • Differentiation • Relevance • Esteem • Knowledge

“What a fantastic endeavour, to try and place an economic value – however difficult it is – on something so central to all Australians' hearts. It could allow for some objective thinking about how to maximise this asset through indefinite time.”

Lord O’Neill of Gatley

1.2 Why value the Great Barrier Reef?

Intrinsically Australians appreciate nature and the wonders of the natural environment. The Australian psyche holds images of a sunburnt country, of sprawling arid bushland, vast mountain ranges, dense tropical rainforests and crystal clear oceans.

We know what it is like to see the sunrise over the ocean, to hear a rainforest’s natural choir, to take in the stillness of the bush and to take a deep breath atop a mountain.

Australians have *that* feeling, that instinctive understanding of what nature means and the power of it. Put simply, we value it. We value being able to eat, drink, swim, sleep, laugh and cry in it. We value its biodiversity, its wonder and its beauty.

We value it whether we are using it or not – because valuing nature is not only part of what it means to be Australian, it is part of being human.

This value often does not come with a price tag; it cannot be bought or sold. Nor should it, because to most of us nature is priceless. However, often nature’s significance is ignored due to its value not being fully captured commercially in the economy.

Economic benefits can conflict with the environment, leading to a trade-off. How policy makers approach such trade-offs is a matter of substantial debate. Some believe that environmental outcomes should take priority, while others argue that economic development must come first. Both of these views are limited in that the former effectively assigns an infinite value to the environment, and the latter assigns a very low value.

Public policy and the Great Barrier Reef

The GBR is a complex natural structure that supports a number of interlinked ecosystems. Currently, the health and functionality of these ecosystems are under severe pressure from threats such as climate change, land-based run-off, coastal development and illegal fishing.

The Commonwealth and Queensland governments have implemented various policies to mitigate the impacts of local threats and build resilience against pressures.

In 1975, the Commonwealth government enacted the Great Barrier Reef Marine Park Act 1975, the primary act used to create an exclusive protection zone and marine authority to prevent damaging activities. Currently, this legislation works in

conjunction with Queensland's Marine Parks Act 2004 and Coastal Protection and Management Act 1995 to enforce Commonwealth zoning and monitoring efforts.

Since 2009, the GBRMPA release an Outlook Report every five years to assess the effectiveness of their ongoing commitment to build GBR resilience through localised threat mitigation.

In 2015, the Commonwealth and Queensland government developed the Reef 2050 Long-term Sustainability Plan to establish greater coordination between stakeholders to ensure the long-term sustainability of the GBR.

Identifying, measuring and reporting on the total value of nature to an economy gives it a significance in decision making and provides a middle ground. Valuing nature in monetary terms can effectively inform policy settings and help industry, government, the scientific community and the wider public understand the contribution of the environment to the economy and society.

At a time when the global natural environment is under threat from the pressures of humankind, particularly climate change, it has never been more important to understand the value of nature.

When looking to our own Australian backyard, the case for putting an economic value on nature has never been stronger, especially when considering the GBR.

Capturing and quantifying the role the GBR plays economically, socially and culturally, is to capture and quantify the value of an Australian icon and one of the seven natural wonders of the world.

We know this value to be priceless and we know that there is only one GBR. But we also know the threats to the GBR demand that the total value Australians and the international community place on it be understood in the most appropriate way possible.

That is why Deloitte Access Economics, commissioned by the Great Barrier Reef Foundation, with the support of the National Australia Bank, Great Barrier Reef Marine Park Authority, and the community of people and organisations that work on and for the GBR, has estimated the total economic and social value of the GBR.

Not for sale

Valuing the GBR is useful for raising public awareness of its importance to our economy, society and environment. It can also assist in policy and planning discussions. In fact, we implicitly value the Reef and other environmental assets as we make a range of economic, business and policy decisions.

Valuing the GBR's benefits to society is not to imply it is commodified or should be privatised. Because it is a public good, it would not be better protected in a private market environment. Valuation is about the GBR's relative contribution to our wellbeing; like air or food, it is something upon which life depends.

Source: Deloitte Access Economics; Costanza et al (2014).

The economic and social value at the heart of this report is similar in objective, but different in methodology, to the emerging scientific discipline of ecosystem services. Where ecosystem services try to objectively measure coral reef services people may not even be aware of, such as storm protection, this report is based on direct uses of the GBR (such as recreation and tourism) and the non-use value, which is driven by a willingness to pay approach.

It's about perceptions of value and is bounded by income. Another important feature of our approach is that it is *Australian*, not global. It is a highly relevant estimate of how *we*, as Australians, value the GBR and, in a policy context, what we are willing to do about it.

1.3 Report structure

The report is structured as follows:

- **Chapter 2** presents the annual direct and indirect economic contribution of the GBR
- **Chapter 3** captures and quantifies the broad economic, social and icon value of the GBR to society
- **Chapter 4** considers the significant value of the GBR to Traditional Aboriginal and Torres Strait Islander Owners
- **Chapter 5** evaluates the brand value of the GBR to Australia
- **Chapter 6** brings it all together, highlighting the critical importance of the GBR to Australia.

In determining the total economic and social value of the Great Barrier Reef, the report is not an evaluation of any particular policy setting, a funding needs assessment, and it is not the basis of any project business case.

Economic contribution in 2015–2016

Total contribution to Australia

\$6.4B and **64,000 jobs**

\$3.9B and **33,000 jobs**
within Queensland

\$2.9B and **24,000 jobs**
within Great Barrier Reef regions



2 Economic contribution

The Great Barrier Reef contributed **\$6.4 billion in value added and over 64,000 jobs** to the Australian economy in 2015–16.

This chapter presents the contribution of the GBR to the regional, state and national economies in the 2015–16 financial year (FY). The analysis in this chapter focuses on the tangible and quantifiable contribution of the GBR to economic measures such as Gross Domestic Product (GDP) and employment.

2.1 Measuring the economic contribution

The GBR region is made up of six Natural Resource Management (NRM) regions that make up the GBRMP.¹ These include: Burdekin, Burnett Mary, Cape York, Fitzroy, Mackay Whitsunday and the Wet Tropics.

The GBR contributes significantly to the economy through a number of commercial channels, which ultimately contribute to the national accounts of Australia. The economic contribution of the GBR mainly comes from the economic activities that occur as part of:

- Tourism
- Commercial fishing and aquaculture production
- Recreational activity
- Scientific research and management.

As such, the economic contribution study focuses on value added to the economy, and the employment supported in these four sectors.

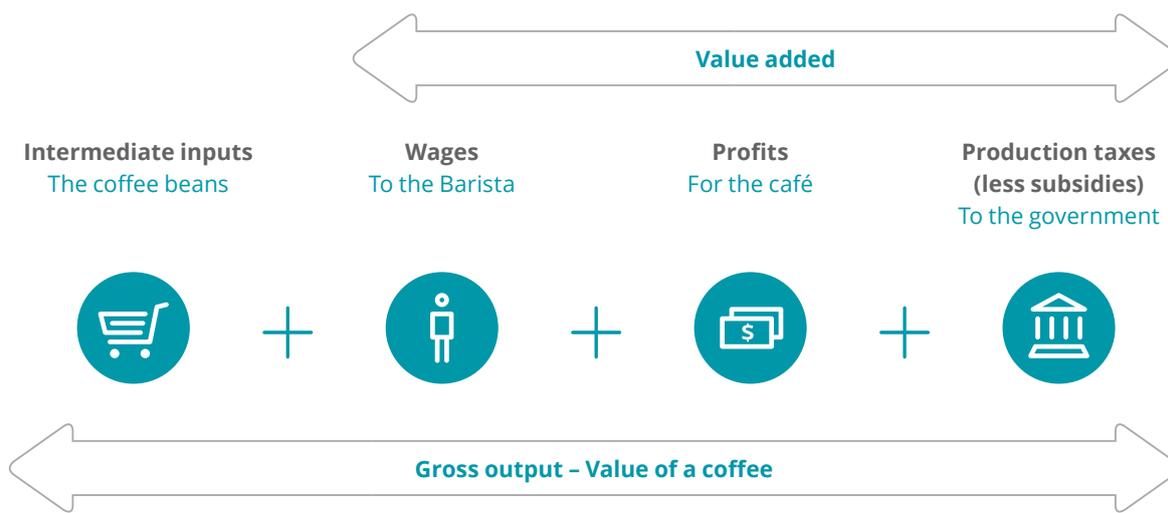
If we take a simple example of a coffee purchased on the Cairns Esplanade (see Figure 2.1) the direct value added to the economy is calculated by summing wages to the barista, profits to the coffee shop and production taxes (less subsidies) paid to the government. Gross output – or the amount paid for the coffee – is this value added, plus the intermediate inputs (coffee beans, milk). The indirect value added to the economy comes from these intermediate inputs.

To get the full contribution of the GBR to the Australian economy, we apply the same reasoning to all economic activities attributed to the GBR (e.g. a tourist hiring a boat to go snorkelling, a family on holidays having dinner on Heron Island, a marine research institution going about its daily business).

Further details on the framework behind economic contribution studies can be found in Appendix A.

1. Throughout this report, NRM region refers to geographical areas, not NRM management bodies.

Figure 2.1: Economic activity accounting framework - making a cup of coffee



Much like the example above, the GBR contributes to full time equivalent (FTE) employment directly and indirectly. Direct employment through activities such as tourism, which also contributes indirect employment to cafés through the increase in demand that tourism generates. The definitions used to describe the different contribution the GBR has to employment are detailed in Table 2.1.

Table 2.1: Types of employment contributions

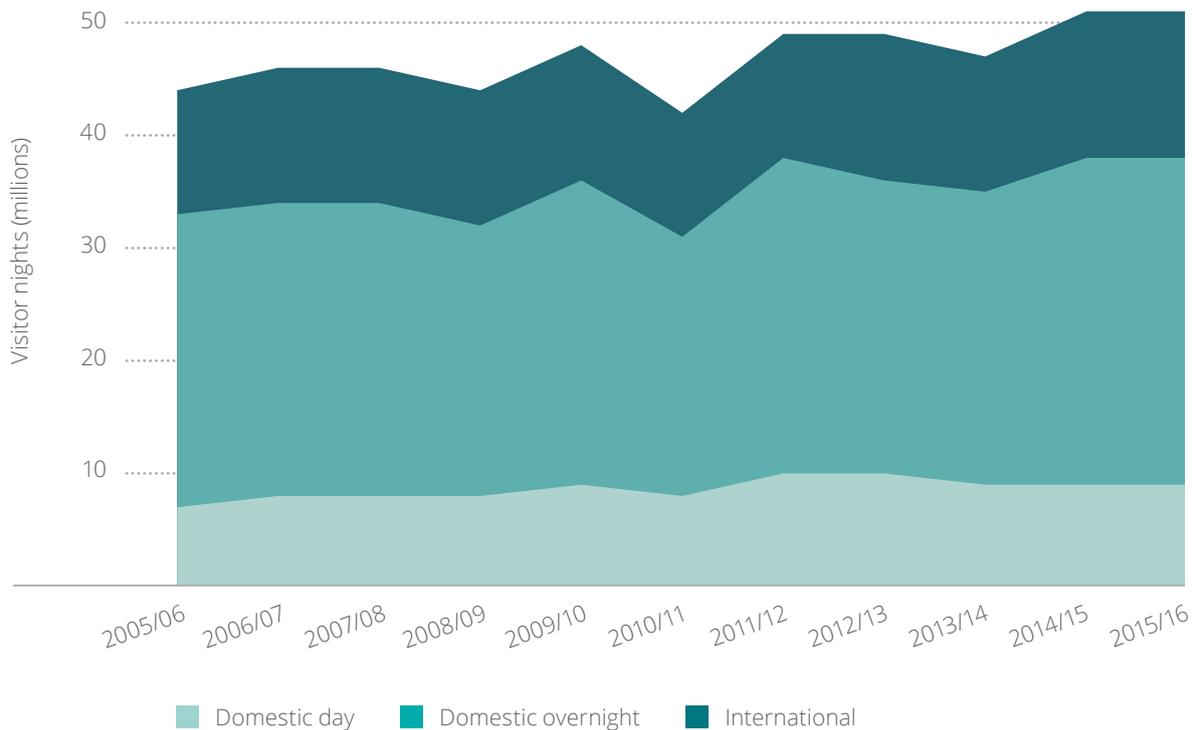
Job type	Definition
Full time equivalent (FTE)	Employment of approximately 40 hours per week
Direct FTE	Direct industry related FTEs
Indirect FTE	Flow on FTEs from direct FTEs
Total FTE	Direct and indirect

2.2 Tourism

The unique tourism offering of the GBR attracts millions of visitors each year. Tourism is a major industry along the GBR coastline, supporting thousands of jobs and boosting regional, state and national income. This section provides an overview of tourism trends between 2005–06 and 2015–16.

Chart 2.1 presents the trends in visitor nights in the GBR region. Overall, the total number of visitor days and nights in 2015–16 was 17% higher over the decade. This was partly driven by the annual increase of 1.8% in the average number of international visitor nights between 2005–06 and 2015–16.

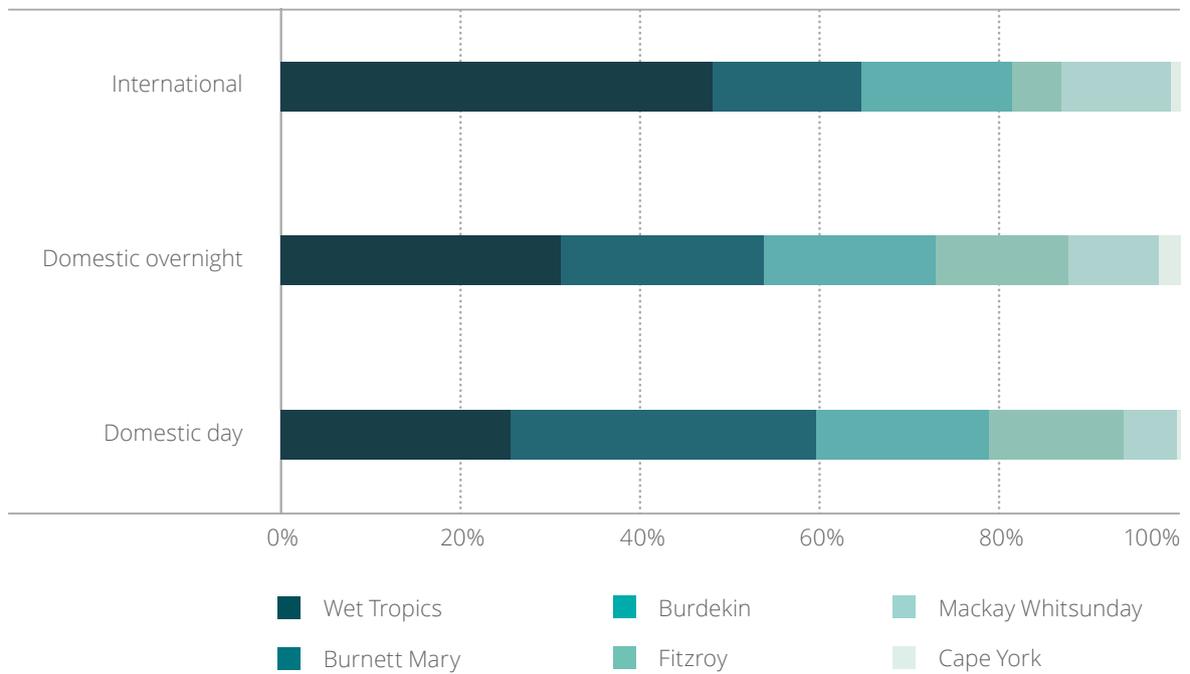
Chart 2.1: Visitor nights in the GBR region, 2015–16



Source: National Visitor Survey and International Visitor Survey, Tourism Research Australia

Across the NRM regions in the GBRMP, the Wet Tropics (including Cairns) and Burnett Mary (Bundaberg, Fraser Island and surrounds) are of particular importance to the regional tourism industry. These two regions alone captured more than half of the visitor nights spent in the GBR region. The geographical distribution of tourism activities in the GBR region is illustrated in Chart 2.2.

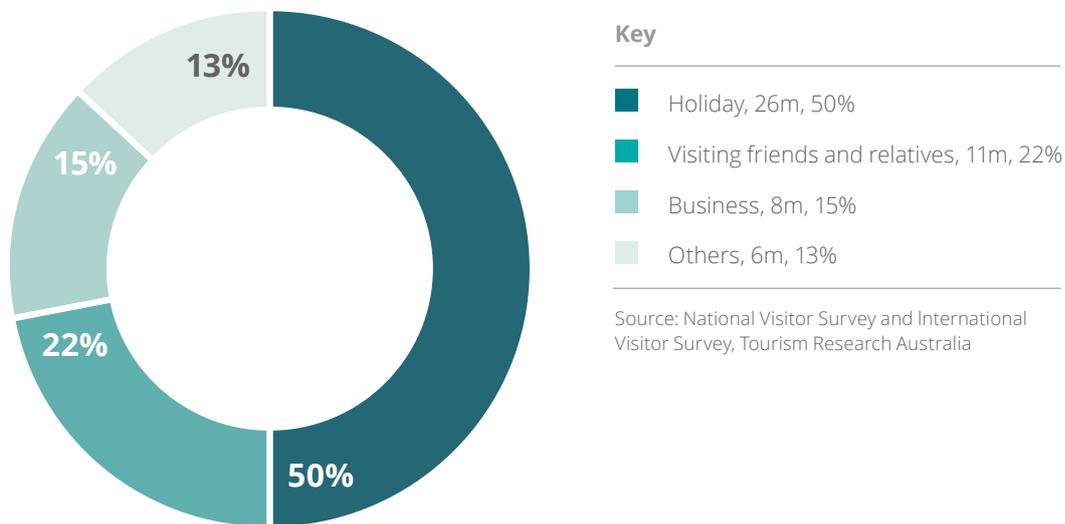
Chart 2.2: Regional composition of total visitor days (nights) in the GBRMP region, 2015-16



Source: National Visitor Survey and International Visitor Survey, Tourism Research Australia

As expected, holidaymakers are the largest visitor group to the GBR, with half of the nights (26 million) spent in the GBR region attributable to holidays (Chart 2.3). The remainder was made up of people travelling to visit friends and relatives (22%), business purposes (15%) and other (e.g. education) purposes (13%). The average expenditure per visitor day (or visitor night) differs by the type of visitor and destination.

Chart 2.3: Total visitor days and visitor nights by purpose of trips, 2015–16 (million)



Source: National Visitor Survey and International Visitor Survey, Tourism Research Australia

For a domestic day visitor, the Burdekin region has the biggest spenders, with an average daily spend of \$143, while Cape York tops the list for domestic overnight visitors with an average of \$225. Details on the average expenditure per night for each NRM region and type of visitor are provided in Table 2.2.

Table 2.2: Average expenditure per visitor day (or visitor night), 2015–16 (\$A)

	Domestic day	Domestic overnight	International
Burdekin	\$143	\$192	\$72
Cape York	\$131	\$225	\$152
Burnett Mary	\$105	\$135	\$54
Fitzroy	\$138	\$127	\$43
Mackay Whitsunday	\$113	\$210	\$118
Wet Tropics	\$133	\$225	\$152

Source: National Visitor Survey and International Visitor Survey, Tourism Research Australia

The total value of the significant tourist activity associated with the GBR in 2015–16 is estimated to contribute around \$5.7 billion to the Australian economy (Table 2.3).

Table 2.3: Tourism valued added to the economy

	GBR Regions	Queensland Total	Australia Total
Tourism (\$billion)	\$2.4	\$3.4	\$5.7

Source: Deloitte Access Economics estimates

2.3 Commercial fishing and aquaculture

Commercial fishing and aquaculture industries flourish at the hand of the rich biodiversity of the GBR. These industries are an important source of income for Queensland coastal communities and play a vital role in Australia’s seafood industry. Commercial fishing refers to the catching of fish that is not supported by human intervention to enhance production, while aquaculture refers to the catching of fish that have been farmed.

The total value of commercial fishing and aquaculture production in 2015–16 is estimated to be around \$199 million. As detailed in Chart 2.4, more than half of the total value comes from the Wet Tropics and Burdekin NRMs.

Chart 2.4: Regional contribution to the value of commercial fishing and aquaculture production in the GBR region, 2015–16

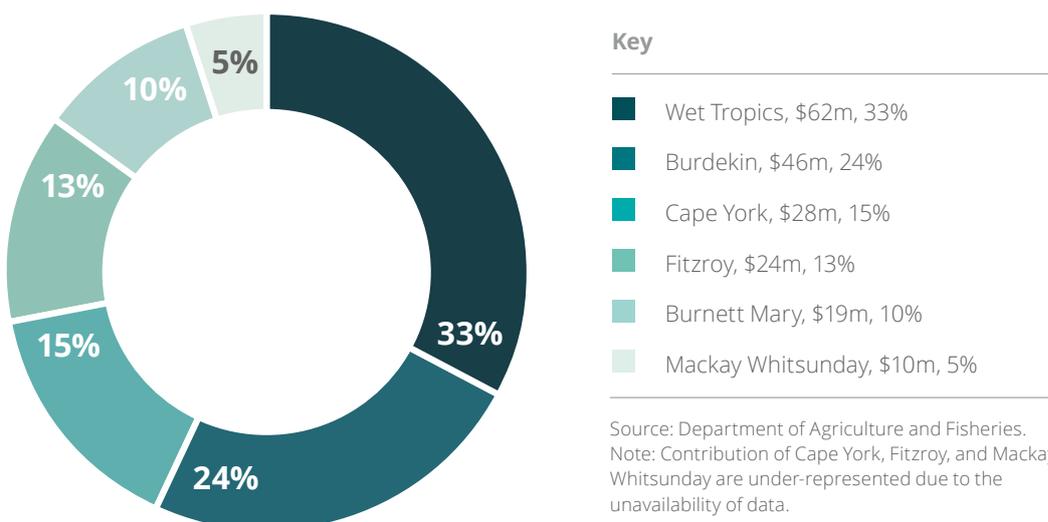


Table 2.4 demonstrates that line, net, pot, and trawl is most popular commercial fishing method in the GBR region. These fisheries, together with aquaculture, account for 95% of the total value of commercial fishing and aquaculture production in the GBR region.

Table 2.4: The value of commercial fishing and aquaculture production by NRM regions, 2015–16

(\$million)	Burdekin	Burnett Mary	Cape York	Fitzroy	Mackay Whitsunday	Wet Tropics	Total
Line, net, pot, and trawl	\$16	\$12	\$23	\$22	\$10	\$13	\$95
Harvest	\$0	\$0	\$5	\$2	\$0	\$0	\$9
Aquaculture	\$30	\$6	ND	ND	ND	\$49	\$95
Total	\$46	\$19	\$28	\$24	\$10	\$62	\$199

Source: Department of Agriculture and Fisheries

Note: The value of aquaculture production in Cape York, Fitzroy, and Mackay Whitsunday is not provided due to confidentiality reasons. Numbers may not add up due to rounding error.

The total value of commercial fishing and aquaculture associated with the GBR in 2015–16 is estimated to contribute around \$162 million to the Australian economy (Table 2.5).

Table 2.5: Commercial fishing and aquaculture valued added to the economy

	GBR Regions	Queensland Total	Australia Total
Fishing (\$million)	\$139	\$140	\$162

Source: Deloitte Access Economics estimates

2.4 Recreational activities

Many of the residents that live in the GBR region use the GBR for recreational activities such as visiting an island, snorkelling, diving, sailing, boating and fishing. The economic contribution of the GBR to recreation is captured by the expenditure on these types of recreational activities in the GBR region.

For each type of recreational activity, total expenditure is broken down into expenditure on recreational equipment and other personal expenses. Recreational equipment expenditure includes the purchase, registration, insurance, hire and repair of boats, fishing equipment, and water sports equipment. Recreational equipment amounts to over half of the total amount of recreation expenditure.

A detailed breakdown of the total recreational expenditure by NRM regions and types of expenditure is provided in Table 2.6. Of the four recreational activities, recreational fishing is the most popular with an estimated 3.8 million fishing trips taking place in 2015–16, the expenditure generated from recreational fishing activities amounts to \$70 million.

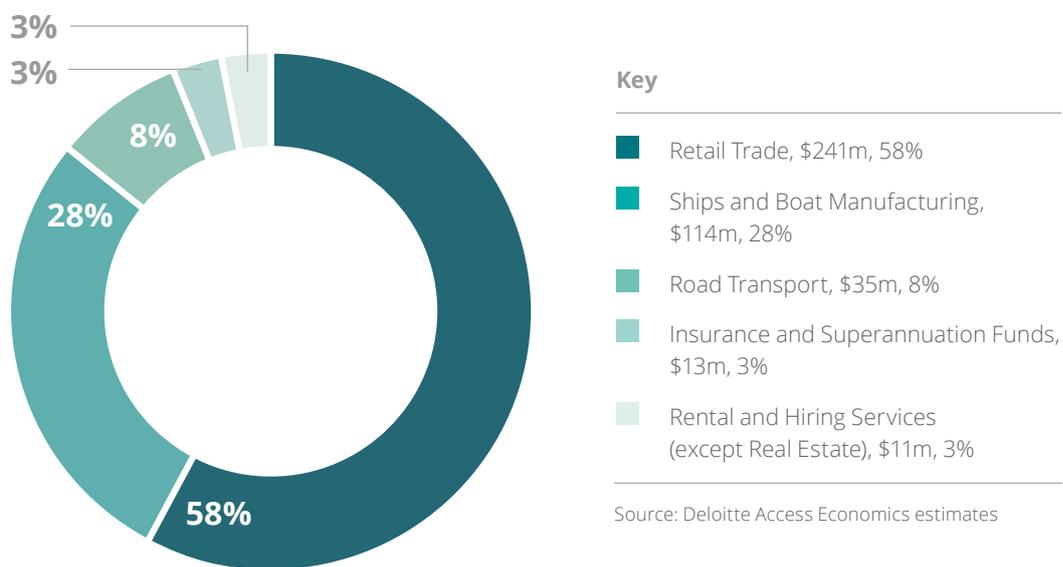
Table 2.6: Recreational expenditure on the GBR region by types of expenditure, 2015–16

By NRM (\$million)	Other personal expenses					Total
	Equipment	Fishing	Boating	Sailing	Visiting an island	
Burdekin	\$57	\$17	\$6	\$4	\$22	\$106
Burnett Mary	\$65	\$19	\$7	\$4	\$11	\$107
Cape York	\$2	\$1	\$0	\$0	\$1	\$4
Fitzroy	\$38	\$11	\$4	\$2	\$7	\$63
Mackay Whitsunday	\$26	\$7	\$3	\$2	\$5	\$42
Wet Tropics	\$53	\$15	\$6	\$3	\$17	\$94
Total	\$241	\$70	\$26	\$15	\$62	\$415

Source: Deloitte Access Economics estimates

Expenditure on recreational activities can be broken down into five industries. As shown in Chart 2.5, the majority of recreational expenditure is attributable to retail trade.

Chart 2.5: Recreation expenditure by industries, 2015–16 (\$m)



The total value of this recreational activity associated with the GBR in 2015–16 is estimated to contribute around \$346 million to the Australian economy (Table 2.7).

Table 2.7: Recreational activity valued added to the economy

	GBR Regions	Queensland Total	Australia Total
Recreation (\$million)	\$284	\$296	\$346

Source: Deloitte Access Economics estimates

2.5 Scientific research and reef management

As the largest living structure on the planet with one of the greatest diversity of species and habitats, the GBR has attracted a large number of researchers who work out of six research stations along the length of the Great Barrier Reef. In the eyes of many, it is the best-studied tropical marine ecosystem in the world. Despite the importance of the GBR to scientific research, information on the research conducted in the GBR region is often not available.

Given the limited data, five research and reef-related organisations that have carried out extensive research on the GBR have been selected, including:

- Great Barrier Reef Foundation
- Australian Institute of Marine Science (AIMS)
- Great Barrier Reef Marine Park Authority
- JCU ARC Centre of Excellence
- Lizard Island Reef Research Foundation.

These research institutions focus on the GBR’s complex ecosystem. A network of six island research stations at Lizard Island, Low Isles, Green Island, Orpheus Island, Heron Island and One Tree Island work with these five research organisations to understand the mysteries of the Reef and work to reduce the pressures that threaten it. This research is not only valuable to science, but to the economy.

In 2015–16, \$130 million of revenue was generated by these organisations through the conduct of scientific research, reef management, and related activities. They spent \$57 million and \$65 million on employment and intermediate inputs respectively.

The total value of the scientific research and reef management associated with the GBR in 2015–16 is estimated to contribute around \$182 million to the Australian economy (Table 2.8).

Table 2.8: Scientific research and reef management activity valued added to the economy

	GBR Regions	Queensland Total	Australia Total
Scientific research (\$million)	\$155	\$161	\$182

Source: Deloitte Access Economics estimates

Heron Island Research Station

Associate Professor Sophie Dove and Professor Ove Hoegh-Guldberg have led teams of researchers at Heron Island Research station (HIRS) on the southern Great Barrier Reef who have explored the question of how reefs are likely to change if we do or do not respond to climate change. To do this, they have devised a series of experimental facilities that expose coral communities to future ocean temperatures and carbon dioxide levels over long periods. These studies have been instrumental in understanding how the ecosystem services provided by coral reefs are likely to change under future ocean warming and acidification.

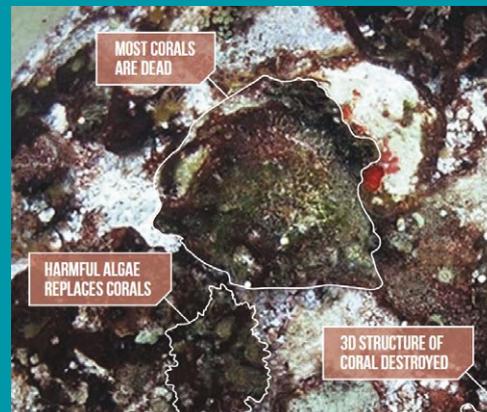
Most importantly, these experiments show taking action on climate change reduces the loss of coral reefs and has many benefits for the GBR and its dependent people and industries. These types of scientific experiment, in combination with field studies, have built a strong case for action on climate change.

Source: Dove et al., 2013; Attenborough's Reef 2015

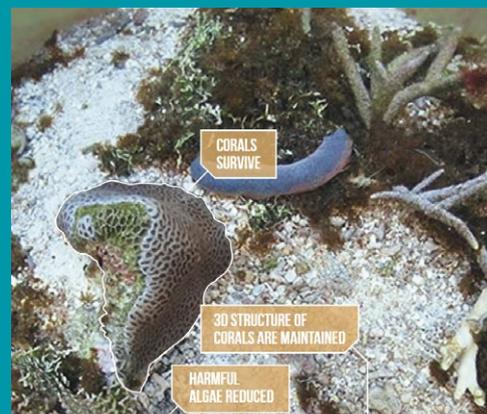
Current state



Change nothing scenario



Take action scenario



2.6 Economic contribution

Overall, the **GBR contributed \$6.4 billion in value added** to the Australian economy in 2015–16. Nearly 90% of this economic contribution (approximately \$5.7 billion) was from tourism activities alone. In terms of employment, the GBR supported more than **64,000 full-time jobs in Australia**.

Table 2.9 shows that more than 40% of the economic contribution of the GBR came from the regional areas in Queensland that make up the GBRMP. This is especially true for scientific research and fishing industries, in which more than 80% of the

economic contribution was from the GBRMP region. Of the \$6.4 billion in total value added to the Australian economy, over 60% of it came from Queensland, with the remainder coming from other states and territories.

Beyond the significant value added to the economy, the employment supported by the GBR is more than many of Australia's corporates including the likes of Qantas and Deloitte Australia. Considering this, the Reef is crucial to supporting economic activity and jobs in Australia – especially in Queensland with over half of the jobs coming from the GBR's home state.

Table 2.9: Economic contribution of the GBR 2015–16

		GBR Regions	Queensland Total	Australia Total
Value added	Tourism (\$billion)	\$2.4	\$3.4	\$5.7
	Fishing (\$million)	\$139	\$140	\$162
	Recreation (\$million)	\$284	\$296	\$346
	Scientific research (\$million)	\$155	\$161	\$182
Total value added (\$billion)		\$2.9	\$3.9	\$6.4
Employment (FTE)	Tourism	19,855	28,768	58,980
	Fishing	680	690	814
	Recreation	2,889	2,964	3,281
	Scientific research	895	914	970
Total employment (FTE)		24,319	33,336	64,044

Source: Deloitte Access Economics estimates

While the estimated value added is higher than the 2013 study, (\$5.7 billion for 2012), the number of jobs supported by the GBR has fallen from 69,000 FTE in 2012 to 64,000 FTE in 2016. This slightly reduced jobs figure is a result of updated Australian Bureau of Statistics (ABS) Input-Output tables in 2013–14 that are used to model the economic contribution of the GBR. The 2013–14 tables indicate a lower average industry estimate of employment per million dollars. As such, for every million dollar of value added in the economy, there are less jobs. As a result, estimates of the total employment supported by the GBR have fallen relative to the 2013 report. It is important to note that this change is not a reflection of significant job losses, rather it reflects a technical adjustment and underlying shifts in the overall structure of the Australian economy.

Further details regarding the economic contribution can be found in Appendix B.

Total economic, social and icon value to Australia



3 Economic, social and icon value

The Great Barrier Reef's economic, social and icon value to Australia is **\$56 billion**.

This chapter captures and quantifies the social and economic value of the GBR to Australians. For a range of reasons, the annual GDP contribution of the GBR presented in the previous chapter does not entirely reflect the GBR's total contribution to the welfare of society.

Consider the price paid for a holiday to the GBR. A visitor may have paid \$1,000 to fly to Hamilton Island, to relax on the beach and to go scuba diving. If the value and prices were higher, say \$1,500, they might still be willing to pay more to make sure they can enjoy Hamilton Island. That \$500 price difference the holidaymaker is willing to pay is a benefit to them because while they only paid \$1,000, it was really worth \$1,500.

When consumers' value is above the market price, an economic contribution study will underestimate the value because it is never paid. Or in this case, when the price of a holiday to the GBR is less than what a tourist might be willing to pay, the value of the GBR's offering is undervalued. This underestimated value is referred to as **consumer surplus** and comes from the GBR's **direct use** through tourism and recreation.

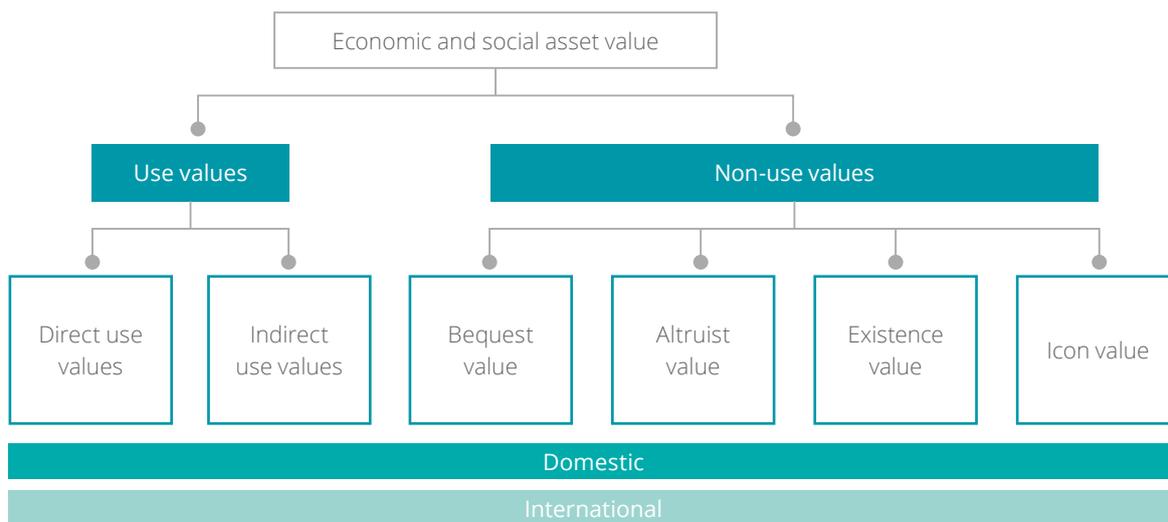
The GBR also provides value to those who have not, or may not ever visit it and directly use it. This **non-use value** can be described as social, cultural or even iconic. This value represents the place of the GBR in Australian and international culture in a way that no existing market price reflects. Leaving the GBR for future generations to enjoy is an example of a 'non-use' that has value to people. The price of accommodation in the Whitsundays is not going to reflect this kind of value, and nor should it.

To capture sentiment such as this, we estimate the non-use value of the GBR using contingent valuation. Contingent valuation is a way to place a value on something that does not have a market price. The relevant literature on how best to determine the non-use value of a natural asset like the GBR is summarised in Appendix C.

As direct and non-use values clearly differ to the economic contribution study in Chapter 2, the results in these two chapters cannot be added together. Furthermore, the total economic, social and icon value of the GBR is presented as an asset or stock value. As such, it is not an annual measurement that flows and changes, such as GDP or government budgets.

Importantly, the estimates in this chapter do not net out any costs to visitors, governments, industry, the environment or any other form of opportunity cost that may relate to the GBR. In this regard, the total economic, social and icon asset value is a gross benefit measure. While the values in this chapter are not calculated using market prices, and are therefore more abstract compared to the economic contribution results, they are no more or less real. However, like with all economic theory, the true power of figures is in their context.

Figure 3.1: Total economic and social value measurement framework



3.1 Valuation approach

The main technique to estimate the consumer surplus and non-use values that are not revealed by the market is to survey a sample of individuals who would have this value. In this case, a survey was fielded to a representative sample of Australians and international residents to understand how they value the GBR.

Deloitte Access Economics and Ipsos Public Affairs conducted a research survey of over 1,000 Australians² and 500 international residents. The research approach was designed to minimise any underlying respondent bias, and reduce inherent limitations to the valuation method outlined in Appendix C and Appendix E. This approach was strengthened further by survey design collaboration with Ipsos Public Affairs and by giving consideration to issues such as language and tone.

The international survey was delivered to people in Canada, China, France, Germany, India, Mexico, South Africa, Spain, United Kingdom and the United States. These countries were selected on the basis of their visitation rates to the GBR and broad representativeness of statistical geographic region (e.g. South East Asia), population size and main language spoken.

The survey was administered online and designed to reveal attitudes and preferences towards the GBR. The results of the survey provide a way to estimate the value of the GBR beyond its pure economic contribution to the Australian economy. The questions focused on three main areas:

1. General perceptions and attitudes towards the GBR as a natural asset to Australia and the world for all respondents
2. Australian and international respondents tourist activity and associated costs
3. Australian and international respondents' willingness to pay a levy to protect the future health of the GBR.

The survey results were analysed and then paired with established economic methods to estimate the total economic, social and icon values. The methods were developed based on the existing literature in Appendix C and applied as outlined in Appendix E. The full list of survey questions and results are presented in Appendix D.

2. The sample size for the Australian population was calculated using a confidence level of 95% and margin of error of 5%. The sample sizes achieved were all above the statistically significant level.

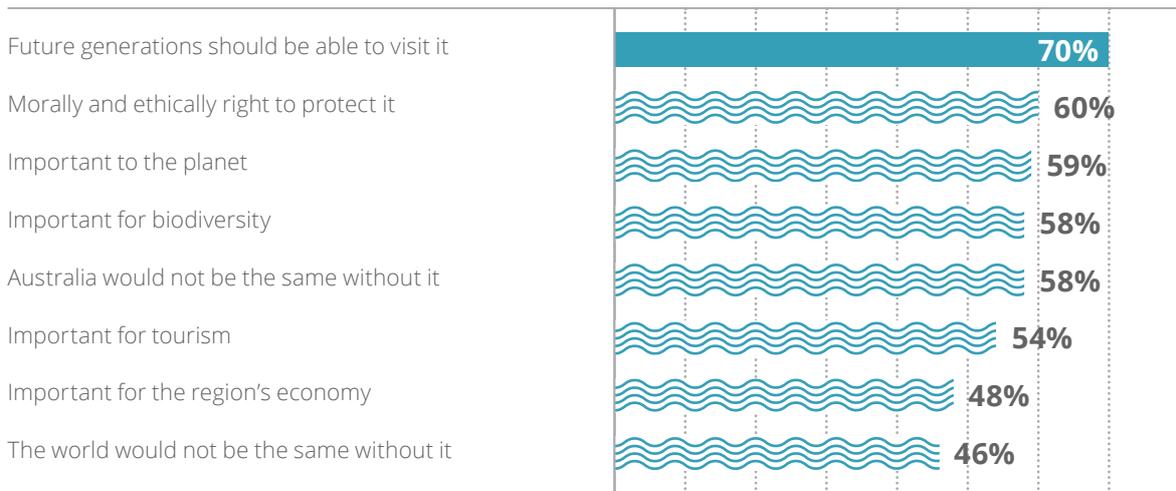
Why do people value the GBR?

Australians and the international community value the GBR for a range of reasons. Some reasons are more concrete such as their belief in its importance for tourism, while some are more abstract such as their belief that Australia would just not ‘the same’ without it. Needless to say, the values people attribute to the GBR are their own. They are shaped by life experiences and circumstances that will never be fully known. However, our surveying and research provides important insights into what people are considering when they value the GBR, and why they might, or might not value it.

Why are Australians willing to pay to protect the GBR?

Australians want their children and future generations to be able to visit the GBR and enjoy it. This desire is supported by a sense of the morality in guaranteeing the future health of the GBR and an acknowledgement of the GBR’s importance to the planet and biodiversity. All in all, there is a belief that Australia would just not be the same without the GBR and this sentiment supports the GBR’s total economic, social and icon value.

Chart 3.1: Why are Australians willing to pay to protect the GBR?

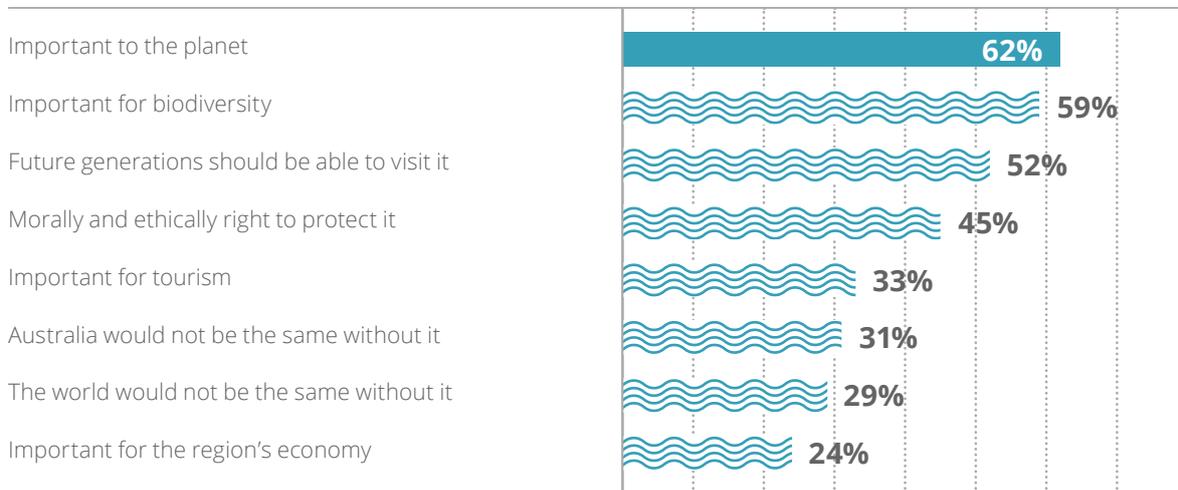


Source: Deloitte Access Economics survey conducted by Ipsos Public Affairs Australia
 Note: This is a 'Select all that apply' question.

Why is the international community willing to pay for the GBR’s future health?

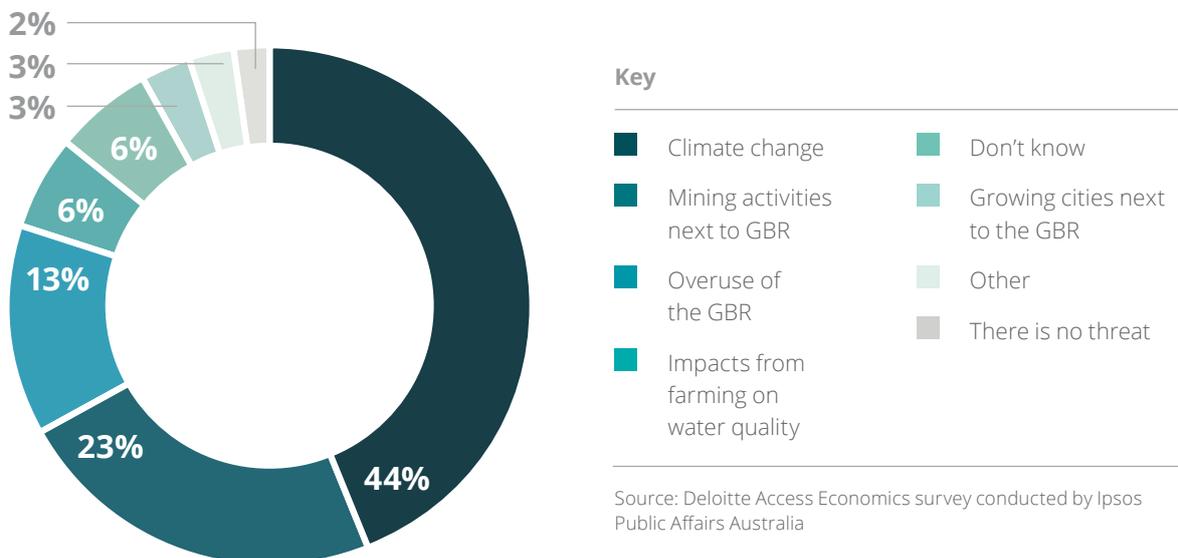
The international community values the GBR for a range of reasons. From a global perspective, the GBR’s importance to the planet and to biodiversity is paramount. Given the GBR’s status as one of the seven natural wonders of the world, this does not come as a surprise. The sentiment of its universal importance is supported by a desire for future generations to be able to visit the GBR.

Chart 3.2: Why is the international community willing to pay for the GBR’s future health?



Source: Deloitte Access Economics survey conducted by Ipsos Public Affairs Australia

Chart 3.3: Australian’s views’ on the biggest threats to the GBR

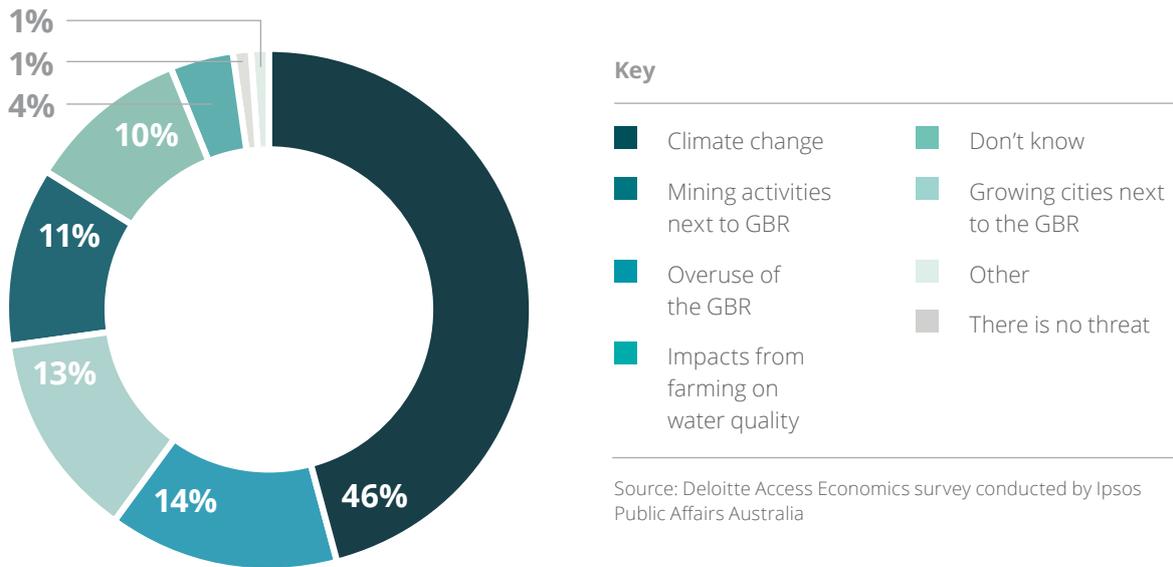


Key

- Climate change
- Mining activities next to GBR
- Overuse of the GBR
- Impacts from farming on water quality
- Don't know
- Growing cities next to the GBR
- Other
- There is no threat

Source: Deloitte Access Economics survey conducted by Ipsos Public Affairs Australia

Chart 3.4: International residents views' on the biggest threats to the GBR



Source: Deloitte Access Economics survey conducted by Ipsos Public Affairs Australia

Why are people not willing to pay?

The 46% of Australians, and 37% of international respondents, who were not willing pay to protect the GBR indicated they simply could not afford it. This reason was often accompanied by commentary around a desire to be able to pay for the GBR's protection, but practical budgetary constraints or other financial priorities prevented them. Other reasons, ranging between 10–25% of respondents, offered for why they were not willing to pay included:

- Belief that funding should come from another source
- Not enough information in their mind to decide on whether or not to pay

- Being prepared to pay for the GBR's protection, but not in the form of a levy or charge
- International respondents indicated they felt only Australians should only pay.

A very small proportion of respondents, ranging between 2–3%, indicated that:

- The GBR was not personally important to them
- The GBR was not under threat in their mind
- The GBR could not be protected regardless of any contribution.

Source: Deloitte Access Economics

3.2 Non-use value

Our research shows that Australians and the international community hold the GBR in high esteem.

- 73% of Australians surveyed, and 56% of international respondents, said the GBR is the most iconic UNESCO World Heritage natural site.
- 93% of Australians, and 83% of international respondents, either strongly agree or agree that the GBR is an iconic Australian landmark that contributes to Australia's national identity and international standing.

The way people value and perceive the GBR extends beyond consideration of its natural ecosystem. This value does not have a market price and understandably varies according to an individual's circumstances and experiences. The non-use value of the GBR to an individual has been measured using a contingent valuation survey that elicits the willingness of individuals to pay for the GBR's protection.

To ensure respondents had a realistic constraint in mind, the survey elicited what they would be willing to pay in a weekly 'Great Barrier Reef Future Health Charge' that all Australians would pay over the next 10 years. All respondents were made aware of what happens to the GBR if society '**changes nothing**' from how it works today, or '**takes action**' to limit the impacts of environmental pressures and threats to the GBR.

The 'change nothing' scenario stated the GBR is not protected and does not exist for future generations. The 'take action' scenario ensured protection and future existence. In each scenario the environmental pressures and threats were unspecified to prevent over complication. In this sense, a respondent's willingness to pay is contingent on a scenario and making a clear trade-off. Appendix E details the method applied to calculate the average willingness to pay figure for both Australian and international respondents from this trade-off.

Australia

58% of Australians surveyed were willing to pay for the preservation of the GBR. Australians have an average weekly willingness to pay of \$1.30, or \$67.60 annually, to ensure the GBR is protected into the future.

Taken across the applicable Australian population, that produces an **annual willingness to pay figure of \$1.2 billion**. This is an estimate of Australia's non-use value. To convert this from an annual figure to a total value asset figure, we take a 33 year net present value (NPV) – the time period from present day out to the end of the Australian Government Reef 2050 Long-Term Sustainability Plan – and apply a social discount rate of 3.7% per year (see Appendix F for discussion). The **total non-use value to Australians over this period is \$24 billion**.

Chart 3.5: Weekly willingness to pay by state and territory



Source: Deloitte Access Economics survey conducted by Ipsos Public Affairs Australia

International

Of the 10 countries surveyed, all valued the GBR and 73% were willing to pay to for its preservation. The research show that many different countries value the GBR. From Australia's regional neighbour in China, to across the world in Europe, and down in South Africa, developed or developing – all were willing to contribute to the GBR's protection.

The international willingness to pay figures are not reported or calculated as an economic, social and icon asset value for a range of reasons. To extrapolate the values, apply assumptions and present an 'international' or world non-use value would be unreliable. Underlying biases in the data, contextual cultural factors, language barriers and purchasing power differences all provide challenges to modelling.

However, if we were model the annual willingness to pay figure for the United States, the United Kingdom, France, Germany and Canada, it would be USD\$5 billion in 2016 purchasing power parities (PPP). This annual willingness to pay figure is derived from the proportion of each country's employed population over the age of 15 years in the middle income percentile, or 20%³. This is larger than the annual willingness to pay of Australians.

Ultimately though, the survey respondents while broadly representative, cannot speak for the world when considering the non-use value of one of its seven natural wonders. Despite the non-use asset value not being reported in equivalent terms to the Australian non-use value, the insights from the research are no less valuable and clearly show, as an international asset, the GBR would be worth several times the Australian value.

3. As per the United Nations World Population Prospect: The 2015 Revision.

Average weekly willingness to pay:

\$1.98

Canada

USA

*"I agree that the reef must be protected – however, that being said, that is the express job of the Australian government."
"World treasure. Save it."*

Mexico

*"It is necessary to preserve our planet"
"It is important to conserve corals as it is a very important national treasure for the ecological balance of the marine world."*

South Africa

"The amount I specify is not how much I would like to pay, but the amount I am able to pay (on a pension)... It would be tragic to watch the GBR die."

Reason for willingness to pay

Top 3 countries

Important to the planet

Spain, UK, USA

Morally and ethically right to protect it

France, Spain UK

Australia would not be the same without it

USA, India, China

The world would not be the same without it

Spain, USA, Canada

Future generations should be able to visit it

South Africa, UK, India

Important for tourism

India, China, Mexico

Important for the region's economy

UK, India, Canada

Important for biodiversity

Spain, Mexico, Germany

UK

"It made me feel guilty about the amount I said I would pay to protect the GBR, but being disabled and not working makes it very difficult to afford more, which I would definitely do if I was able to."

"The governments around the world need to do more."



Spain

France

"It would be nice for the world (the richest countries) to pay this tax."

Germany

"I find it frightening that this reef is just so destroyed."

China

"Human kind should start protecting the environment without any delay. Everybody should raise awareness and work towards a common goal."

India

*"I am overwhelmed by the loss to the reef."
"It is necessary that rich people not only contribute more for the protection of the reef, but take strong action to prevent its misuse. I wish I could pay more."
"The GBR is a fabulous asset to our earth."
"People all over the world should help to protect it."
"The GBR is one of nature's best gifts, should be protected at all cost."*

You can't value what you don't know

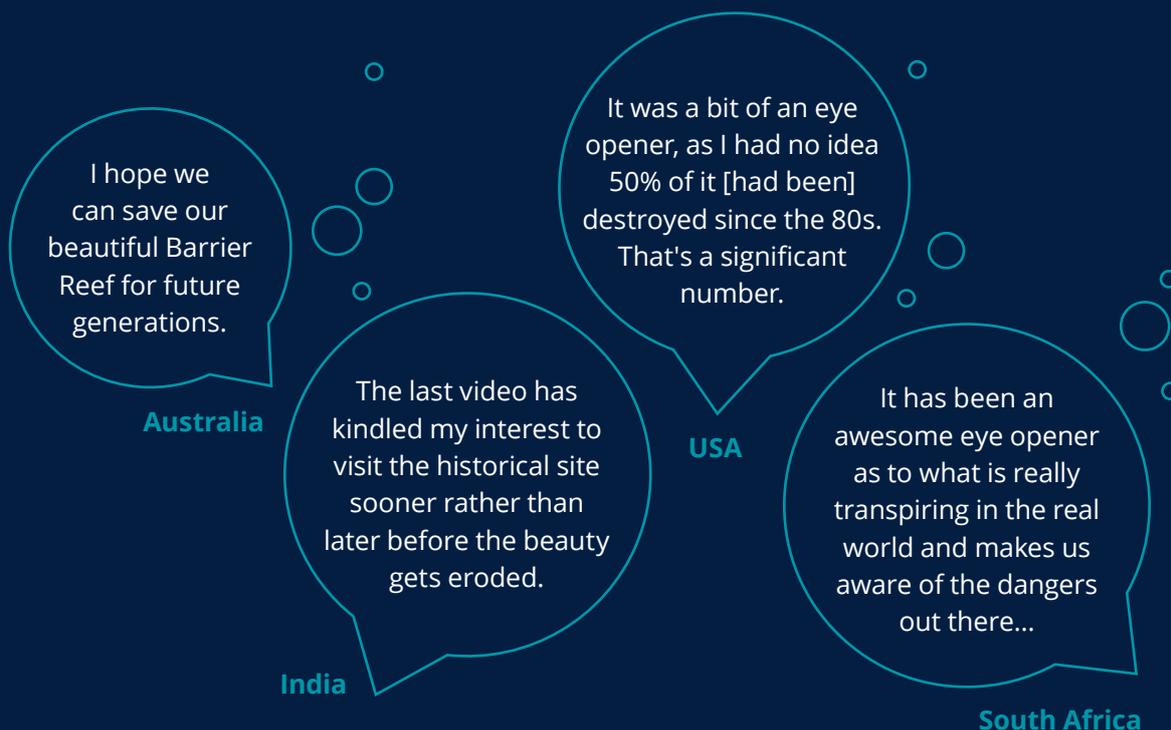
Just 0.01% of the world's population has dived on a coral reef. If the majority of people don't feel connected to the GBR's natural wonder, how can they be motivated to protect it?

Considering this, domestic and international respondents were asked for their willingness to pay to protect the GBR under the survey scenarios. While we had their attention, we wanted to test what the impact of more information on the threats the GBR is facing on their willingness to pay to protect it.

Respondents were asked to watch a short YouTube video titled The Great Barrier Reef is in Danger from David Attenborough's the Great Barrier Reef © Atlantic Productions 2015. Following this clip, their previous willingness to pay was restated and they were asked, after watching the video, if they were willing to pay more.

When given more information on the threats the GBR is facing, 35% of Australians and 51% of international respondents were willing to pay more. An increased level of understanding, and the sentiment respondents felt when confronted with the potential loss of the natural wonder, increased the value they felt for it.

What did respondents have to say?



3.3 Direct use value

Tourism

From the economic contribution we know that tourism in the GBR contributes \$5.7 billion to the Australian economy per year. This contribution relies on market transactions taking place. To understand the full benefit visitors to the GBR receive, an estimate of the consumer surplus is required.

Since there is no 'price' for the GBR, information from the GBR tourism industry can be used to reveal the value of these benefits to visitors. The travel cost method is what is routinely used to value consumer surplus by observing individuals' travel patterns and behaviour. In this way, the consumer surplus from tourists in the GBR comes from observing the amount visitors are willing to pay to get there and how often they are doing it.

Travel costs, including flights, accommodation, meals, equipment hire and organised touring were used as a proxy for the price of visiting the GBR. People who live a long distance from the GBR naturally pay more for their trip than those that live close by and consequently make less trips. As a result, the demand for trips is reliant on the costs to get there.

Research was conducted on tourists to the GBR to help understand their travel costs and number of trips taken. The survey returned 268 domestic responses that were representatively spread across states and territories, see survey in Appendix D. As travelling to the GBR is expensive and can be a 'once in a lifetime trip' for domestic tourists, especially interstate visitors, trip frequency to the GBR was asked over the past five years.

Through econometric modelling, detailed in Appendix E, the average consumer surplus per person, per trip is estimated at \$662. To find the total consumer surplus, the annual figure was extrapolated across the annual number of domestic visitors to the GBR. The number of annual domestic overnight visitors was sourced from TRA data (at the NRM level) and a total of 2.3 million overnight trips were made to the GBR in 2016 (see Appendix E for further discussion around visitor number assumptions). This amounts to **\$1.5 billion in annual direct benefits to domestic tourists from the GBR.**

To convert this from an annual figure to an asset figure, we used the social discount rate of 3.7% to derive the NPV over 33 years. This makes the **total direct use benefit to domestic tourists \$29 billion.**

Recreation

There are a number of studies that have undertaken the challenging task of valuing access to a recreational site such as the GBR⁴. Due to the quality of the benefit estimates derived in these studies, a transfer of the benefits estimated to the context of this study is appropriate.

A benefit transfer is only as good as the research on which it is based, therefore numerous studies were evaluated using the criteria detailed in Appendix E. The most notable and relevant to our study is the work undertaken by Rolfe and Gregg (2012), who estimated recreation values in Bundaberg, Gladstone, Capricorn Coast (Rockhampton), Mackay, Townsville and Cairns.

The consumer surplus estimates for Rolfe & Gregg (2012) were adjusted using the March 2017 ABS Consumer Price Index (CPI), and ranged from \$26 per person per trip in Cairns to \$63 per person per trip on the Capricorn Coast. Across all the GBR sites, the consumer surplus was estimated at \$43.

TRA data on intrastate day trips for the NRM regions that fall within the recreation boundary, specified in Chapter 2, were used to calculate the annual recreational visits to the GBR. 3.9 million trips were made by recreational visitors to the GBR in 2016 (see Appendix C for further discussion around visitor number assumptions).

Taking the consumer surplus figure across the annual recreational trips gives **\$170 million in annual direct benefits to recreational visitors to the GBR**. Using the same social discount rate of 3.7% to estimate the NPV asset value over 33 years, the **total direct use benefit to recreational visitors is \$3.2 billion**.

3.4 Indirect use value

Ecosystem services

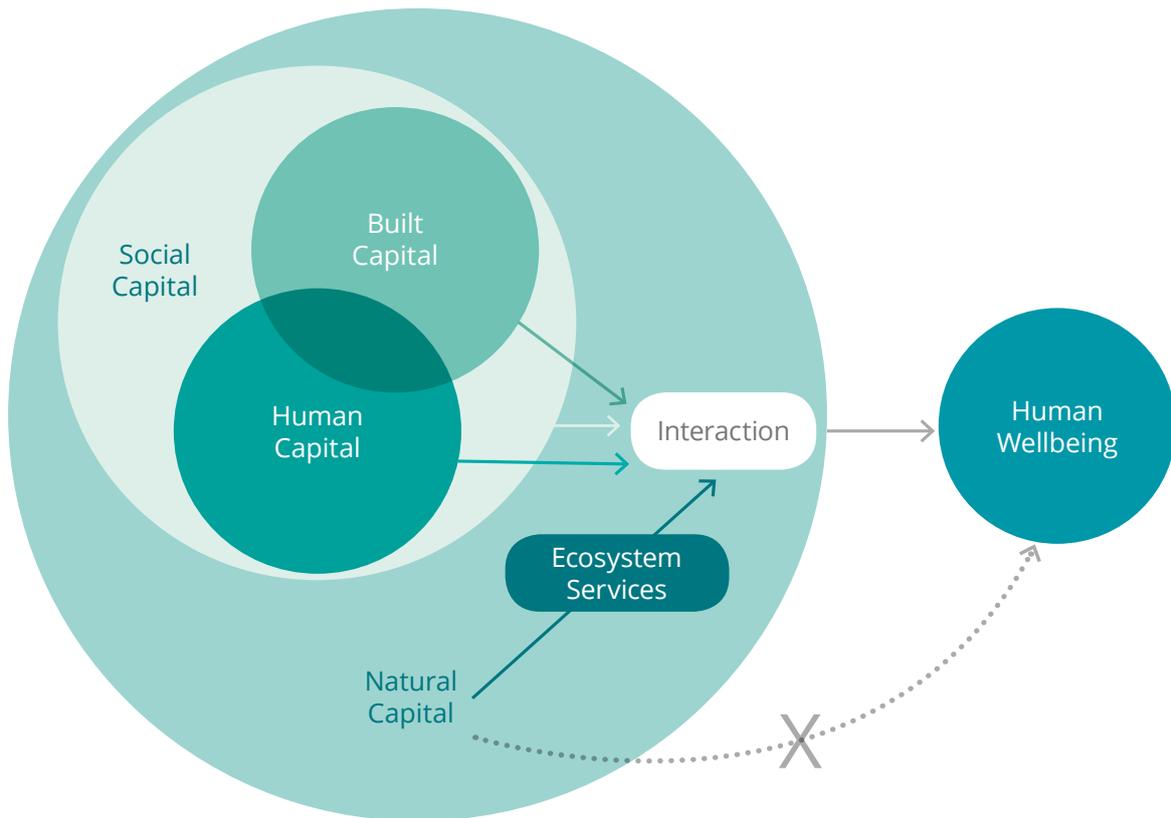
The GBR is an immense and unique ecosystem that holds a significant value to humans and other interlinked systems. In this sense, the GBR performs an important environmental and ecological function. These functions are known as ecosystem services and are important to societal wellbeing and are valuable inputs for production.

Figure 3.2 shows the interaction between the types of capital in an economy and human wellbeing used in ecosystem services analysis. Costanza et al. (2014) found that even with falling coral reef area, rising values (reaching US\$352,249/ha/year) meant that the world's coral reefs were worth trillions of dollars to human wellbeing. Ecosystem services are not bound by willingness to pay or GDP and can produce estimates significantly higher, because the intent is to capture the contribution to human wellbeing.

The ecosystem services of the GBR, for example, produce food, maintain water quality, and provide fisheries habitat. The GBR as a part of nature also provide important storm protection for the Queensland coast. These kinds of ecosystem services can be grouped as; cultural, provisioning, regulating, and supporting services (Figure 3.3).

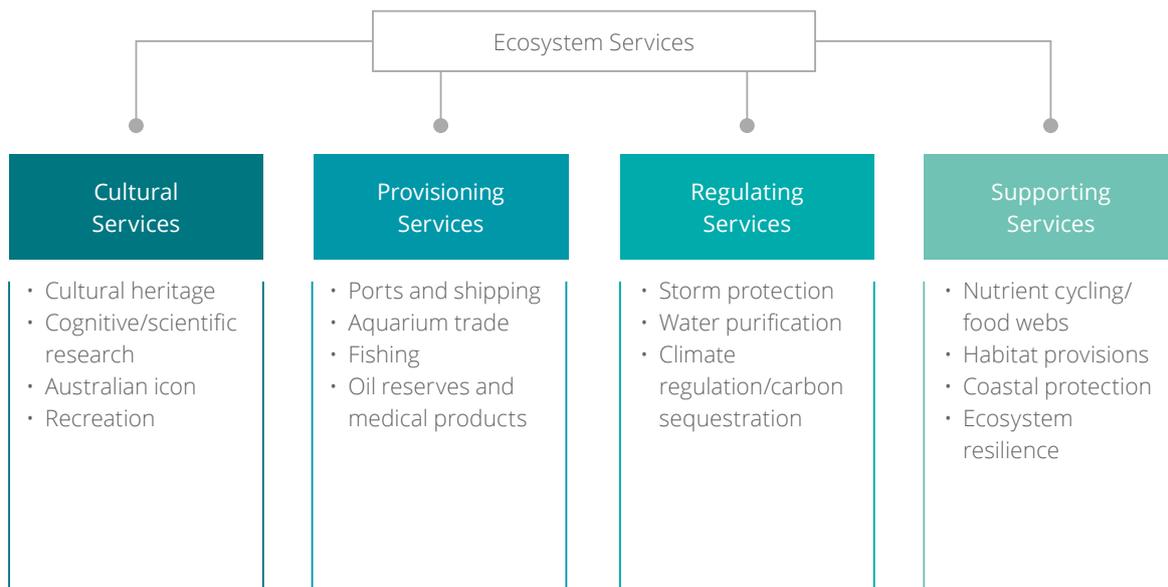
4. GBRMPA charges \$6.50 per person an Environmental Management Charge that applies to all persons over the age of four years of age to enter the GBR. However, this charge is included in the cost of tourist activities such as equipment hire, boat excursions and organised touring and not charged to users of the Reef that aren't involved in such activities.

Figure 3.2: Natural capital and human capital interactions



Source: Costanza et al. 2014

Figure 3.3: Ecosystem services



Source: Adapted from Stoeckl et al.,2011.

While this study covers aspects of cultural and provisioning services such as icon value, recreation and fishing, it doesn't cover all of the GBR's ecosystem services. Specifically, regulating and supporting services are not included in this study.

The ABS, however, has developed an Experimental Ecosystem Account for the Great Barrier Reef Region (2015), which measures various elements of these ecosystem services in the GBR catchment. The ecosystem accounting approach provides a quantitative assessment by directly linking the GBR's ecosystems to economic and other human activity.

These links are both the services provided by the GBR ecosystem, and also the impacts that economic and human activity can have on the GBR ecosystem. The output is reported as a net measure of these impacts on the GBR's natural capital. For example, the ABS estimates the ecosystem service value of nutrition and materials (biomass) in the GBRMP from agricultural industry production to be \$1.4 billion (FY2012–13).

This ecosystem account of the GBR highlights the important relationship of environmental condition to economic and other social benefits that are provided in the GBRMP.

Where some of the ecosystem service values are captured discreetly in the GBR economic contribution, to include them in this study would be to double count. More detail are described in Appendix E.

However, while ecosystem service values are not explicitly quantified in this report, their importance to the value of the GBR must still be considered.

The significance of the Great Barrier Reef as a natural capital asset, and the need for the protection of its ecosystem service offerings, are fundamental elements of its true value.

Great Barrier Reef's natural beauty

"[The Great Barrier Reef is an] outstanding example representing a significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals"

UNESCO Natural Heritage Criteria, 1996

The GBR is a tremendous natural asset of universal value. As the largest living structure on the planet, the GBR includes the world's largest coral reef ecosystem along with an extraordinary variety of marine habitats, flora and fauna. The GBR is particularly unique as its geographic position means a variety of marine habitats – from shallow estuarine areas to deep oceanic waters can thrive.

There are 14 coastal ecosystems that are important to the functioning of the GBR. The most iconic is the coral reef ecosystem. The GBR hosts over 3,000 coral reefs of remarkable colour and size. Although coral reefs only comprise about 7% of the GBRMP, coral reefs provide a year-round source of food and shelter for local marine life. Coral reefs alone are estimated to support up to 25% of all marine life worldwide.

The various marine habitats in the GBR are home to just under 1,700 species of fish and other aquatic animals. The GBR accommodates a large range of ecological communities, including those who only migrate during certain times of the year. Many animals migrate to the GBR in order to reproduce and find food during the colder months, with some coming from as far as Antarctica.

The GBR's unique ecosystem means that it continues to support one of the world's most diverse collections of biodiversity. The natural purity of the GBR means that some animals, including turtles and crocodiles, have been around since prehistoric times and have remained relatively unchanged over time. The GBR is also critical to the survival of several endangered species, providing a safe and controlled area for these animals to reside.

Source: Great Barrier Reef Marine Park Authority; Hughes et al. 2017; WWF 2017

3.5 Economic, social and icon value

Overall, the GBR has an estimated **total economic, social and icon value to Australia of \$56 billion**, representing a 33 year present value range of benefits out to the end of the Australian Government Reef 2050 Long-Term Sustainability Plan.

Over half of this value is attributed to those Australians who have visited the GBR and experienced its wonder. The connection these people feel to the GBR, and the benefit above what they actually pay to visit, is an important part of its total value.

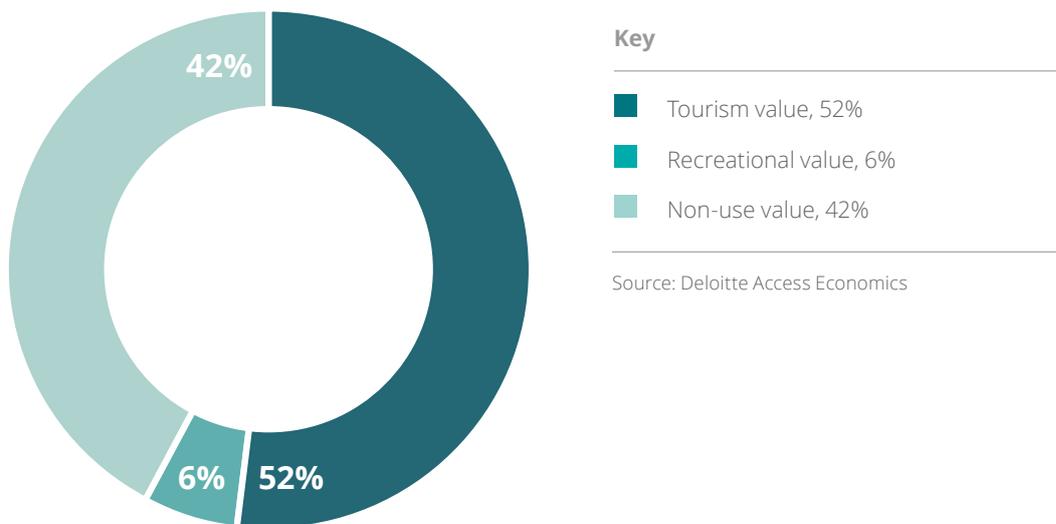
Beyond this benefit, a significant proportion of the GBR's total value arises from those who have never even visited it. This reflects the value Australians have in being able to leave the GBR to future generations, to know others enjoy its natural beauty and its importance as an Australian icon and natural wonder of the world. The total value also includes the additional value that recreational users of the GBR receive that they don't necessarily pay for.

If we split the \$56 billion asset value down into its parts:

- Australians who have visited the Reef as tourists – on their honeymoon, on a family holiday, on a bucket-list trip – derive **\$29 billion** in value
- Australians who have not yet visited the Reef – but value knowing that it exists – derive **\$24 billion** in value
- And the lucky Australians who are recreational users of the Reef – going to the beach, taking the boat out, diving on the weekends – derive **\$3 billion** in value.

By all measures this value is conservative and only represents an Australian perspective. Were it to consider the international community's value it is clear it would be much higher, if not priceless. Indeed, the conservative nature of this total value calculation does not include many elements that are considered priceless, such as Traditional Owner and brand value. Chapters 4 and 5 explore these core elements to the GBR's value, ones which do not have a dollar value, but are no less important to Australians and the international community alike.

Chart 3.6: Natural capital and human capital interactions



Source: Deloitte Access Economics

Source: Deloitte Access Economics survey conducted by Ipsos Public Affairs Australia

4 Traditional Owner value

The value of the Great Barrier Reef extends far beyond what can be measured.

Aboriginal and Torres Strait Islander peoples have a strong connection to the GBR as Traditional Owners of the GBR Region, with evidence of their connections to country dating back over 60,000 years.

The natural features of the Reef are embedded in Indigenous culture, spirituality and wisdom. There are more than 70 Aboriginal and Torres Strait Islander Traditional Owner clan groups in the GBR Region, with each group associating significant value to the Reef and its ecosystems. We respectfully acknowledge the Traditional Owners of the Great Barrier Reef, and pay respect to the First Nations Peoples and their elders, past, present and future.

4.1 Cultural ecosystem services

Millennium Ecosystem Assessment defines cultural ecosystem services as:

“The non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experience, including knowledge systems, social relations and aesthetic values.”

The ABS Experimental Ecosystem Account for the Great Barrier Reef Region 2015 categorises the cultural ecosystem service values that Traditional Owners obtain from the GBR under four groupings: cultural heritage, spiritual and religious, educational, and knowledge services.

Cultural heritage services

Cultural heritage services reflect the custodial responsibilities of Aboriginal people and Torres Strait Islanders to other generations of their societies. In the total economic valuation framework, these values reflect aesthetic and bequest values. Aesthetic values are not only consequential but also include duties such as ‘educational’ and ‘symbolic’ services. Bequest values reflect the cultural services custodians pass on to younger generations through knowledge and skills in areas that reflect their cultural identity such as cultural practices, totems, observances, customs and lore.

Spiritual and religious services

Spiritual and religious services reflect the sacred connection between people and earth. This is particularly true for sacred sites, sites of particular significance, and places important for cultural tradition.⁵ The strong connection to country is core to spirituality and this relationship, the spirit of country, is of central importance to Indigenous people today.

“We cultivated our land, but in a way different from the white man. We endeavoured to live with the land; they seemed to live off it. I was taught to preserve, never to destroy.”

Tom Dystra
Aboriginal Elder

5. Australian Government, Australian Indigenous cultural heritage, <http://www.australia.gov.au/about-australia/australian-story/austn-indigenous-cultural-heritage>

Educational services

The educational cultural services include educational, entertainment and aesthetic values, which are expressed through stories, song lines, outfits, dances, arts and languages that connect them to a place and/or time. Australia's Traditional Owners have been educating generations on the history of the Reef long before the rest of the world knew it existed. In particular, Australian Aboriginal stories have been determined to represent genuine and distinctive observations of increases in sea level after the ice age 10,000 years ago and of the origins of the GBR itself.⁶ The case has been made that Indigenous stories are sources for accurate knowledge across time and are far more valuable than ever previously imagined.

Knowledge services

Knowledge services refer to the archaeology of the GBR that reflects the history of human existence over thousands of years. These include Indigenous structures, technology, tools and archaeological sites. The ABS has categorised these archaeological sites as:

- Occupation sites – stone tools, food remains, ochre, charcoal, cooking stones, shells
- Middens – deposits of food refuse
- Grinding grooves – evidence of tool making or food processing
- Rock art – Dreamtime stories, pictorial evidence of past rituals central to lives of Indigenous people
- Scar trees – result of bark being removed for food or to make canoes, water containers, shields, huts.

The value of these knowledge services is not only significant to archaeology, but to our Traditional Owner heritage and history.

4.2 Traditional Owner economic value

Associate Professor, Henrietta Marrie, CQUniversity

Despite Aboriginal, Torres Strait Islander and Traditional Owner representation within the committee structures responsible for managing the policy environment surrounding the GBR, including the Tourism Reef Advisory Committee, Aboriginal participation in the local GBR tourism industry is almost non-existent – despite abundant opportunities to do so. This is in distinct contrast to, for example, Aboriginal involvement in tourism in the adjacent Wet Tropics World Heritage Area.⁷ Further, there appears to be little or no Aboriginal interest in the industry itself other than to ensure that protocols regarding cultural heritage sites, and hunting and fishing rights and practices are respected and regulated.

Lacking the necessary reef transport infrastructure and equipment to conduct, for example, fishing and diving tours of local reefs, Aboriginal participation in coral reef tourism is very low, as measured, for example, by advertisements in local tourism trade literature. Major reef tourism operators rarely include representatives of local Traditional Owners as guides and cultural interpreters. Aboriginal participation in the industry is largely restricted to on-shore cultural activities (for example, cultural performances that celebrate stories of important reef-associated species, such as turtle, dugong, sharks, and crocodiles as part of welcome to country ceremonies for conference participants, visiting dignitaries and overseas tourists), sale of Indigenous reef-related art works and other merchandise, and participation in local festivals, such as the annual Gimuy Fish Festival in Cairns and the Cairns Indigenous Art Fair. Employment for local Aboriginal people in the tourism industry is therefore largely confined to the hospitality sector.

6. Reid, Nunn and Sharpe (2014)

7. See, for example, Marrie HL and Marrie APH, 2014. Rainforest Aboriginal Peoples and the Wet Tropics of Queensland World Heritage Area: The Role of Indigenous Activism in Achieving Effective Involvement in Management and Recognition of Cultural Values. In Disko S and Tugenhardt H (eds) (2014). World Heritage Sites and Indigenous Peoples' Rights. IWGIA, Copenhagen, 340–375.

However, the whole area of Indigenous coral reef tourism remains largely un-researched and CQUniversity's Centre for Tourism and Research Opportunities and Office of Indigenous Engagement are in the process of addressing this research deficit from both local and global perspectives.

While the direct economic contribution of Traditional Owners is undervalued, the GBR, nevertheless, remains economically important to its traditional inhabitants who regularly carry on fishing, hunting and gathering practices for domestic consumption and artefact production. Gathering includes shell-fish, crabs and seabird eggs. Many of these traditional activities are regulated under Traditional Use of Marine Resources Agreements (TUMRAs) and native title Indigenous Land Use Agreement (ILUAs). While it remains a controversial issue, turtle and dugong are hunted under a permit system, although such hunting is usually associated with catching animals for important family and ceremonial occasions.

The economic value of this Traditional Owner marine resource subsistence economy also appears to be un-researched. However, it is likely to be high. Based on the commercial per kilogram value of such iconic species as mud-crabs, crayfish, barramundi and coral trout, the annual economic value of this Traditional Owner subsistence economy across the length of the GBR could run would have a significant monetary value. The findings could surprise, for example, a report authored by Professor John Cordell in 1995 for the Cape York Peninsula Land Use Strategy found that the value of the Indigenous subsistence economy exceeded that of the cattle industry at the time.

4.3 Economic valuation

To our knowledge, no current studies present an economic valuation of the GBR as an Indigenous cultural asset. But there are several studies that have aimed to value Australian cultural heritage through commercial benefits (Janke, 1998; Zeppel, 2001) and through the replacement value of subsistence production (Altman, 1987; Asafu-Adjaye, 1996).

These studies all focus on use values, with Rolfe and Windle (2003) being the first published study to estimate the non-use values of Australian Indigenous culture. More recently, Zander & Stranton (2010) estimated the value Indigenous Australians put on river ecosystem services and Gillespie & Bennet (2012) valued the impact of open-cut mining on highly significant Aboriginal sites in the Hunter Valley. All of the non-use valuation studies used choice experiments to arrive at their values.

In valuing the GBR, sacred values are particularly sensitive and therefore resistant to price-based trade-offs due to a lack of substitutability. Traditional Owners often have a deep connection with natural resources that play a unique role in shaping their cultural identity, through traditions, stories, and ceremonies making them sacrosanct and irreplaceable (Venn & Quiggin 2007).

As non-market valuation is reliant on substitutability to obtain a value, this makes monetising access to cultural goods and services unsuitable. Fundamentally, in the context of our study Traditional Owners do not require a quantified value in order to understand significance of the Reef. However, as an area of research it requires further attention and investment.

The story of Jiigurru, Lizard Island

The shark and the stingray were living in the island's lagoon. They were talking one day and decided that, because the goannas shared the same beneficial oils, they would invite them to come to their island and live with them. This way the goannas could look after the land, whilst they would look after the lagoon. The stingray offered to go and fetch them, and use his broad back to bring them to the island. So off he went to Yuuru (now known as Cape Flattery) where the silica sands are, and there he found manuya, the sand goannas, and invited them to come to the island. He told them to get on his back so he could take them across the sea to the island.

So he took some of the goannas over to Jiigurru, then returned to the mainland to see if there were more. But when he got back to Yuuru he was spotted by the Dingaal hunters who started throwing spears at him. Badly wounded he went to shelter on the south side of Yuuru. You can still see the place where he died, marked by a big boulder lying just off the shore. And from the air you can see an imprint in the lagoon in the shape of a stingray. As for the goanna, they now live on the island as they had no way of leaving once the stingray had died.

Willie Gordon

Nugal-warra Elder and Guugu Yimithirr speaker



5 Brand value

No single Australian natural asset contributes as much in terms of brand and icon value to international perceptions of Brand Australia as the Great Barrier Reef. In our research, the Great Barrier Reef left other Australian land-based natural assets far behind in terms of visitor preference, reputation and experience.

Of the more than 1,500 people Deloitte Access Economics surveyed domestically and internationally, 65% felt the GBR is Australia's most iconic natural World Heritage site. Of these, Australians selected the GBR more than international respondents: 73% of Australians rated it as Australia's most iconic natural site, and 56% of international respondents. The second was Uluru, also rated an iconic natural asset by both international and domestic visitors. Other important natural assets include the Kakadu National Park, Australian Fossil Mammal Sites, the Tasmanian Wilderness and the Blue Mountains.

By every measure, the Great Barrier Reef is seen as the natural asset contributing most powerfully to Australia's global brand.

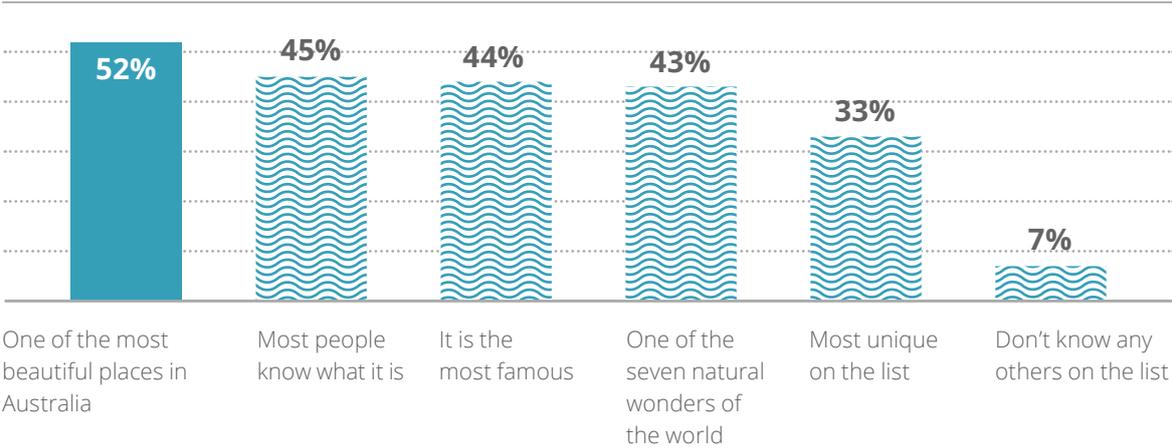
Why is this? Of the almost 1,000 respondents who named the GBR as Australia's most iconic natural asset, they consider:

- The GBR to be one of the most beautiful places in Australia
- Most people know what the GBR is
- The GBR is the most famous UNESCO World Heritage site
- It is the most famous on the list
- One of the seven natural wonders of the world.

Furthermore, a large majority of all those surveyed agreed or strongly agreed that the GBR:

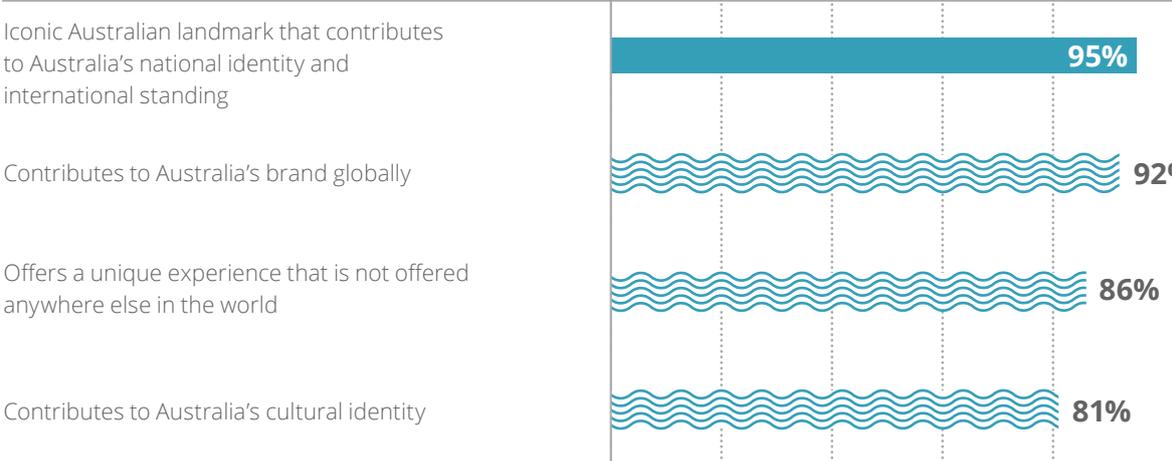
- Contributes to Australia's global brand
- Offers a unique experience that is not offered anywhere else in the world
- Contributes to Australia's cultural identity
- Is an iconic Australian landmark that contributes to Australia's national identity and international standing.

Chart 5.1: Why the GBR is the most iconic to Australians and international respondents



Source: Deloitte Access Economics

Chart 5.2: What Australians and the international community thinks about the GBR



Source: Deloitte Access Economics
 Note: Chart represents respondents who 'Strongly agreed' or 'Agreed'.

5.1 Australia's Brand Trinity

While the GBR is globally famous as the 'world's largest living organism' and a huge drawcard for tourists in its own right, it is not purely a standalone brand. It combines with other elements of Australia's reputation internationally – enhanced by the ambassadorial role Australians play when living and travelling abroad – to shape international perceptions of Brand Australia.

Australia's artists, film-makers, musicians and entertainers also play an important role. In 2016, Deloitte Access Economics published a report commissioned by Screen Australia that found that Australian film and television contributed to international tourism worth \$725 million to our economy in 2014–15. Australia's cuisine, sports culture, food and wine have also added texture to perceptions of Brand Australia. The Sydney Fish Markets, for example, welcomes 3 million tourists a year. A variety of Australian business activities combine to shape perceptions of Brand Australia for potential visitors.

However, when potential international visitors are asked why they might want to travel to Australia, three attractions form a powerful trilogy in Australia's brand narrative: 'the Rock, the Reef, and the House'. These unique icons of Australia – Uluru, the GBR, and the Sydney Opera House – are interchangeable when used as shorthand visual symbols for the country.

The Sydney Opera House, as Deloitte Access Economics showed in a previous report (How Do You Value an Icon? October 2013), represents an iconic and brand value to Australians and international visitors far in excess of its narrow financial contribution through ticket sales. The Opera House's cultural and iconic value to Australia is estimated at \$4.6 billion.

In the same way, the brand value of the GBR to Australia far exceeds the revenue it generates for the national and Queensland economy. While the GBR's economic contribution totals \$6.4 billion, the GBR's total value to Australia when one considers the consumer surplus, cultural value and enhancement it provides to the bigger brand of Australia as a destination, is \$56 billion.

With great brand value comes great responsibility. Whether the GBR is regarded as the property of its Traditional Owners, of humankind as a whole, or whether it is considered beyond 'ownership', Australia as a nation is legally considered its owner, and morally, its custodian. Accordingly, the way in which Australia responds to threats to the health of the GBR will influence Australia's brand. Just as Australia's reputation can be enhanced by its character on the battle field in Gallipoli or diminished by refugee policies perceived as mean-spirited, so too will its stance on environmental management and the actions it takes to safeguard global assets of which it is seen as guardian, continue to shape Australia's international brand. If the brand of the GBR is damaged or destroyed, so too will Australia's brand reputation suffer as a vibrant, healthy and invigorating destination, famed for its outdoor lifestyle and natural assets.

The power of this interrelationship cannot be overestimated. In our research, commentary by respondents ranged from the GBR's description as **“the most beautiful and wondrous place on Earth”** to its capacity to **“draw people from around the world, across continents, just so they can experience it; it is loved by millions and known by billions”**.

5.2 Valuing the Brand

All methodologies in use for measuring brand value are subject to debate and scrutiny. Because of the very nature of measuring brands – notoriously difficult given they are rationally constructed but emotionally measured assets – there will never be a truly watertight method for ascribing a dollar value to a brand.

For the entity of the GBR, opinions of its brand value vary widely due to the societal, political, industrial, or environmental lens through which it is viewed.

Nonetheless, applying different brand measurement frameworks can be instructive and revealing. Perhaps the world's oldest and best known brand valuation methodology is the Brand Asset Valuator (BAV) which measures the strength of thousands of brands in more than 50 countries by surveying tens of thousands of consumers. Developed originally in the 1970s by design consultancy Landor Associates in San Francisco as ImagePower and then relaunched in 1992 as BAV following Landor's acquisition by ad agency Young & Rubicam Associates, this pioneering survey measures a brand's momentum, future potential and resonance by assessing its Differentiation, Relevance, Esteem and Knowledge in the minds of its audiences.

While BAV has not traditionally been applied to natural assets like the GBR, this 'four pillars' approach can be used to generate a hypothetical assessment of the brand's current and future status. The first two pillars, Differentiation and Relevance, combine to represent Brand Vitality – a brand's future growth potential. In terms of Differentiation, the GBR exists within a crowded global category of coral reefs found across the world, and also competes alongside other globally renowned Australian natural assets. Yet the GBR's distinction as the world's largest living organism; its unique qualities of length, scale and biodiversity; the cultural and historical significance given it by Australia's Aboriginal and Torres Strait Islander peoples; and its powerfully visual associations with the image of contemporary Australia; these factors collectively put the GBR in a unique category and work to strengthen the Differentiation of the GBR's brand, a key driver of its future value and sustainability.

The GBR's Relevance pillar, meanwhile, is another key indicator of its brand value. While the GBR's relevance might be seen as strongest to those who have experienced it themselves, a broader significance can be extrapolated from what the GBR brand stands for in relation to Australia's national identity, its importance to the collective psyche, and the role it plays in generating positive feelings amongst the country's citizens, as well as international audiences.

A multi-country study published in March 2017 by the BBC Worldwide Global Insight Team and the University of Berkeley, California (Exploring the Emotional State of 'Real Happiness': A Study into the Effects of Watching Natural History Television Content) indicated that people are happier after they watch nature documentaries. Watching the BBC's Planet Earth series, for example, inspired significant increases in feelings of awe, contentedness, joy, amusement and curiosity, as well as reducing feelings of tiredness, anger and stress.

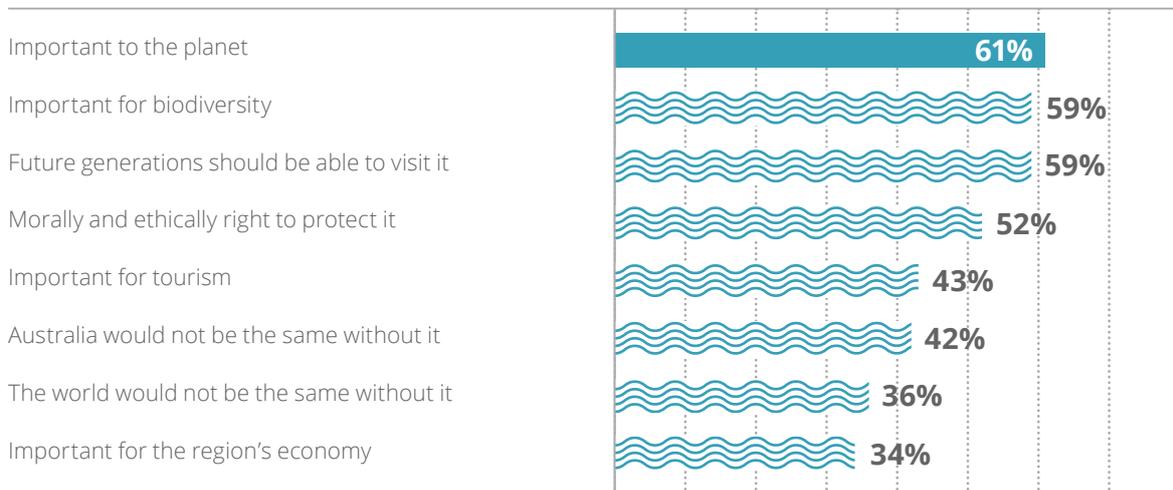
In this context, whether by televisual or direct experience, it is suggested that exposure to a unique natural phenomenon like the GBR has a positive impact on people's sense of wellbeing and personal motivation. While economists make obvious links between the GBR and the jobs and livelihoods affected by it, ascribing a value to the positive bond between Australians and the GBR, while difficult, is possible given the well documented connections between collective morale and national productivity.

Australian author Iain McCalman believes that Australia’s sense of self-esteem and its national identity are inextricably linked to the GBR – and that an adverse impact on its health would in turn damage our brand. If we fail in our task as global caretakers “one of the first things we lose is our own identity,” he told Radio National’s Breakfast in October 2013. “A massive part of what constitutes an Australian is what people think of, the phenomenon of the GBR... We’re a people who live on the coast, and this is our greatest stretch of coast. We lose an enormous amount of our identity and our history, but we also lose our honour as world citizens who have been given this privilege for our own benefit, but also for the benefit of the world.” By extension, were the GBR to die, a degree of Australian self-esteem, would die with it.

A combination of the two other BAV pillars of brand value, Esteem and Knowledge, represents the current power of a brand, or Brand Stature. On Esteem, our research indicates that both internationally and domestically, regard for the GBR as a brand is peerless, and the desire to preserve it is high. Of 66% of people in our survey who described themselves as ‘prepared to pay to protect’ the GBR:

- 61% alluded to its importance to the planet
- 59% felt future generations should be able to visit it
- 59% cited its importance to biodiversity
- 52% felt it was morally and ethically right.

Chart 5.3 Why are people willing to pay for the GBR's future health?



Source: Deloitte Access Economics
 Note: Domestic and international results combined.

Overall, **43% said that Australia would not be the same without it and 36% said that the world would not be the same without the Great Barrier Reef.** Esteem for the Great Barrier Reef reinforces international perceptions of Australia as an iconic national brand; conversely, the economic consequences of a “no action projection” on the Great Barrier Reef are mirrored by a negative impact on its brand value as a crowd-pulling icon.

What is at stake?

63% of domestic non-users surveyed said they were likely to visit the GBR in the future. However, when presented with imagery from the University of Queensland’s Heron Island Research Station that reflected the GBR under a business as usual (BAU) scenario, 38% said they no longer planned to visit.

To put this in perspective, if domestic tourism in the GBR was to decrease by 38% that would amount to a \$585 million annual reduction in tourism consumer surplus benefits and a \$2.1 billion cost to Australia’s GBR related tourism industry.

...\$2.1 billion loss for one year

Source: Deloitte Access Economics estimates

Overall, the number of respondents saying that they wouldn’t visit a damaged GBR more than tripled from 10% to 38%. It is clear that Esteem for the GBR, and by extension for Brand Australia, is tied closely to the health of this asset.

The final BAV pillar – that of Knowledge – can be gauged by estimating the depth of international awareness of the GBR as a global environmental asset and living organism of unequalled scale, and through its mythologising and description in film, culture and narrative as a place of unique beauty and interest. Movies like *Finding Nemo* have raised widespread awareness of the GBR’s unique qualities and its place in the ocean’s ecosystems. More broadly, as awareness of the planet’s environmental situation increases through widespread education, the perception of the GBR as a canary in a gold mine – an early warning system for a global ecology under threat – grows, along with desire for knowledge about the plight of the GBR.

On all four key brand measures of BAV therefore – Differentiation, Relevance, Esteem and Knowledge – the GBR has great strength and momentum. Were it to sustain degradation along with other natural assets under threat from a changing environment, it would initially lose Differentiation and Relevance – a clear indication of a declining brand – and subsequently, Esteem. With this, it must be anticipated, would come a correlative diminishing of perceptions of Brand Australia.

5.3 Brand Australia

The importance of a strong national brand in generating economic value cannot be underestimated. In a 2013 report *Progressing Australia*, with a survey sample drawn from over 30 countries, Young & Rubicam used BAV to frame its assessment of the influence of Australia's brand upon inbound foreign investment and exports, on the power of 'Made in Australia' endorsements, and on international tourism. The research was the most comprehensive ever of perceptions of Brand Australia by Australians and international audiences.

Unsurprisingly, Australians placed Australia at the apex of the BAV 'Power Grid'; they rated Australia as high in both Brand Vitality and Brand Stature, and as being ahead of nearest competitors the USA, UK, Japan, Germany, NZ, Canada, France and Singapore. Yet when audiences of other countries were interviewed about their perceptions of Australia, the shoe was frequently on the other foot. France, Holland and Japan placed Australia as high in Vitality but low in Stature; conversely India and China rated Australia's brand as strong in Stature, but rated its Vitality as low and losing momentum. While Germany scored Australia high in all categories, other countries like Mexico rated it as low in both Vitality and Stature.

The strategic task facing Australia, according to the study's conclusions, is to enhance the national brand's vitality through increased Differentiation and Relevance. Revealingly, many visitors to Australia – indeed, many of whom had visited the GBR – returned to their own countries with a higher opinion of Australia as a brand. Yet brand perceptions linger of Australia as a country that is 'Nicely differentiated – but without much to admire', according to the BAV study. The main challenge facing Australia in reshaping external brand perceptions, therefore, is that the country needs things of difference and relevance that others will admire.

In the case of the GBR, this is less about Australia's 'ownership' of the GBR and the GBR's mere existence and location as part of the Australian continent, and more about Australia's relationship with the GBR, and guardianship of its future. Our care for and nurturing of a healthy Reef under challenging circumstances could build admiration and esteem for Australia's brand. Were the GBR brand to be adversely impacted through a combination of global and localised environmental factors with Australia a complicit bystander, Australia's credentials as a responsible global citizen would suffer.

Two other international country brand studies appear to support these perspectives. The Country Brand Index 2014/15 by FutureBrand, another global brand consultancy, and the annual Best Countries Ranking created by US News, each draw clear associations between a country's sense of environmental and social citizenship and its global brand strength.

In the FutureBrand study, Australia ranked a strong 8th, influenced by such elements as its value system (including environmental standards) and experience (tourism, heritage and culture including natural beauty). In the US News Best Countries ranking, meanwhile, Australia also ranked number 8, just ahead of France and behind the United States with brand perceptions of Australia scoring especially high in quality of life and citizenship.

Within the US News study's Citizenship attribute, Australia ranked 8.5/10 in a measure of 'cares about the environment' and 8.1/10 for being a 'progressive country'. In the same study, Australia ranked 10th on the list of 'Best countries for Green Living', 11th on that of 'Forward-looking countries' and 10th in terms of 'Transparency'. It is evident that all these measures would be adversely affected by a serious decline in the health of the GBR.

The science of branding is traditionally one of competitive comparison; consumer brands, corporate brands, and country brands are ranked according to their relative strength in the minds of consumers, citizens, and global audiences. Considering a living organism like the GBR as a brand is therefore economically problematic. If price is largely driven by relativity – supply, demand, and quality – then by definition, the very uniqueness of the GBR renders it price-less. While the Sydney Opera House could conceivably be rebuilt should it be damaged or worse, a vibrant the GBR, having naturally developed over millennia, would be far more difficult to replace, even with scientific developments to accelerate reef regeneration.

Using this logic, the GBR's value is beyond measure. Nonetheless, insurance specialists are occasionally faced with a related problem of valuation. To compensate the loss of a limb resulting from an industrial accident or medical negligence, for example, the use of that limb must be ascribed a cost. A dollar equation is calculated for each arm or leg: items that are beyond value and intrinsic to the psyche, daily abilities, sense of self-identity and, inevitably, the earning power of an individual. While someone can never be fully compensated for the loss of a limb, they can and will accept a calculated compensation and will thereafter get on with their lives as best they can.

Johan Rockström, director of the Stockholm Resilience Centre and a professor of environmental science at Stockholm University, has spoken widely of the economic impact of environmental upheaval: 'Nature is beginning to send us her invoices,' he says of the growing cost of climate change-induced damage to infrastructures, supply chains, food chains and other dimensions of the modern connected economy. Rockström urges businesses to recognize the true cash value of natural systems, to manage risks beyond their own value chains, and to think transnationally while embracing the circular economy of recycling and reusing. Critically, he recommends that businesses factor in environmental costs when measuring their performance – doing so, he says, can strengthen business decisions by giving visibility on long term risks and opportunities.

If brand is accepted as one of the critical assets on a business balance sheet – then Brand Australia's value will increasingly be affected by environmental factors, both within and beyond its control or influence, and their impact upon the country's natural assets like the GBR.

The crucial implication for the Great Barrier Reef, is that if it is seen to be 'going backwards', its value will inevitably decline. On the other hand, if scientific initiatives are embraced and work successfully helps regeneration, it should induce future confidence, and indeed the Great Barrier Reef's value should rise.

6 Too big to fail

The GBR is unequivocally valuable in terms of its contribution to the Australian economy, and its broader economic, social and icon asset value. Australians and the international community alike value the GBR for its significance to our planet, and are willing to pay to support its continued existence and protection.

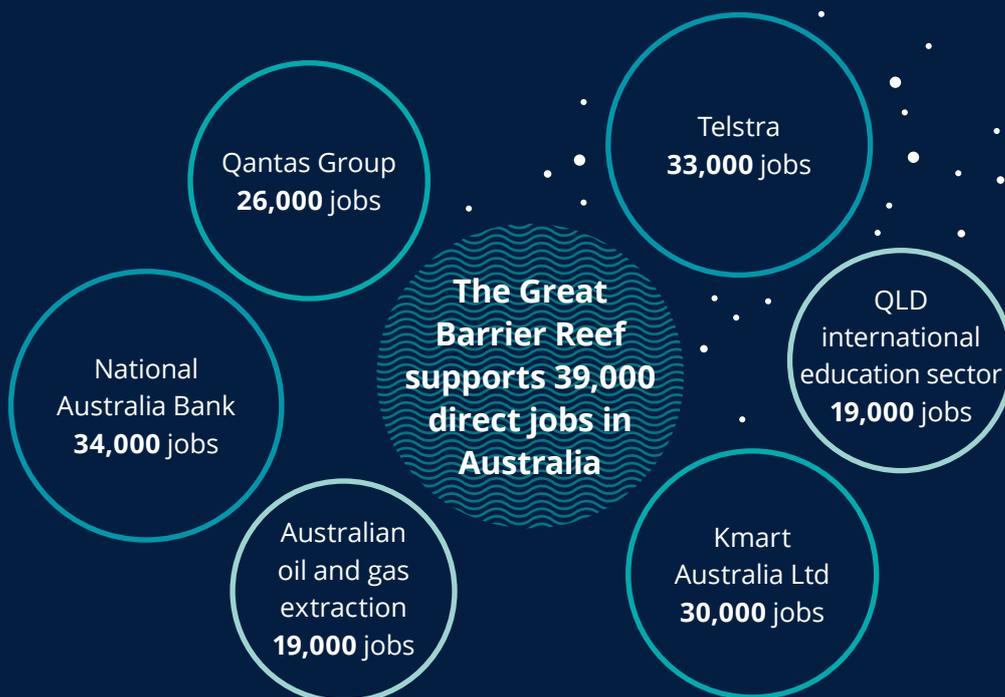
Annually, it supports employment for 64,000 Australians across industries, sectors and skills. That's more than many of Australia's corporates including the likes of Qantas and Deloitte Australia. When considered this way, the GBR is critical to supporting jobs in Australia. The livelihoods and businesses the Reef supports across the nation far exceeds the numbers supported by industries we would consider too big to fail.

The importance of the GBR to jobs clearly matters. But above all, it matters most to the tourism industry. Tourism was named as one of the fantastic five industries in the Australian economy in Deloitte Access Economics' report *BTLC #3 Positioning for Prosperity? Catching the next wave*. Collectively tourism, along with the other fantastic four, have the potential to keep Australia at the top of the world's national prosperity list.

Where demand for Australian tourism is driven by our beautiful natural assets and spectacular destinations like the GBR, the Reef's significance cannot be underestimated for Australia's economic prosperity.

Although significant, the GBR is much more than just the jobs it provides and its contribution to the Australian economy.

Let's put it in perspective



The economic, social and icon value of the Reef is \$56 billion. That's more than 12 Sydney Opera Houses, or the cost of building Australia's new submarines. It's even more than 4 times the length of the Great Wall of China in \$100 notes.

On one level, all of these figures seem enormous, but when you reflect on it, it's also clear how inadequate financial measures are for something as important to the planet as the GBR. The tremendous biodiversity and natural wonder value on a global scale is also not captured in this figure. If quantified, they would show it is worth much more than what is reported here.

The GBR is in Australians' cultural DNA and Traditional Owner identity. And its status as one of the seven natural wonders of the world makes it an international asset. Considering this, what matters most is not quantifying its value as an exercise to simply put it on an economic leader board. Fundamentally, we know that the value of the GBR is priceless and we know that there is no replacement.

"Brisbane Airport is a Queensland company and our growth is heavily influenced by increased visitation to Queensland for tourism, study and investment. A damaged reef will affect visitation and the Queensland tourism brand."

Julianne Alroe

CEO and Managing Director,
Brisbane Airport Corporation Pty Ltd

But we also know all of the jobs, all of its economic, social and icon value is under threat. Climate change, poor water quality from run-off, impacts from coastal development and illegal fishing are well documented threats to the GBR. Of these, climate change remains the most serious and our research has shown Australians and the international community agree.

We have already lost around 50% of the corals on the GBR in the last 30 years. Severe changes in the ocean will see a continued decline ahead of us. Further, we now know that researchers have found efforts to improve water quality does simply not reduce the severity of coral bleaching events on the GBR.

With the recognised threats to the GBR, and an understanding of the economic, social and icon value, comes the opportunity for us all to know what we do about it.

"We do not inherit the Great Barrier Reef from our ancestors, we borrow it from our children."

Dr Roger Beeden

Director Reef 2050 Integrated Monitoring,
Modelling and Reporting Program,
Great Barrier Reef Marine Park Authority

Certainly, the GBR has been an environmental and public policy priority for decades. But the significance of its contribution to the Australian economy, to jobs and its remarkable value to Australians and the world suggests the Reef should be given even greater priority by all citizens, businesses and levels of government.

There is opportunity now more than ever for action on a universal level. Local communities can do their bit – whether it is participating in citizen science initiatives at a grassroots level or simply playing a role to reduce their environmental footprint in the region.

Business and industry have a chance to invest in the ideas, technologies and outcomes that will drive the change needed to protect the GBR and its asset value.

Governments of all levels – local, state, national and international – can establish the policy settings and make the right investments that will ensure the GBR's value is there for future generations.

But more than just getting the policies right and investing wisely, understanding the total value of the Reef shows us what is at stake. And when called on, it is this knowledge that allows us to make it clear that the Great Barrier Reef's protection is not only an Australian priority, or an international one – it is a human one.

Acronyms

Acronym	Full name
ABS	Australian Bureau of Statistics
BAV	Brand asset valuator
DAE-RIO-M	Deloitte Access Economics' Regional Input-Output Model
GBRMP	Great Barrier Reef Marine Park
GDP	Gross domestic product
GOS	Gross operating surplus
GVA	Gross value added
GSP	Gross state product
LGA	Local government area
NRM	Natural Resource Management area
NPV	Net present value
WTP	Willingness to pay

Glossary

Term	Definition
Consumer Surplus	Additional benefit a consumer receives when the price they actually pay (market price) is lower than the price they are willing-to-pay
Direct use value	Value individuals attribute to the actual use of the Great Barrier Reef
Indirect use value	Value attributed to indirect use benefits of the Great Barrier Reef's ecosystem services
Market benefits	Measurable commercial and economic contribution of the Great Barrier Reef
Non-market benefits	Measurable social, cultural and economic benefits of the Great Barrier Reef that do not have an existing commercial market
Non-use value	Value that people assign the Great Barrier Reef even if they never have and possibly never will use and/or visit it
Recreational user	A local resident of the Great Barrier Reef Region where it takes them less than 1.5 hours to drive to the coastline
Total economic value	Combined value of direct, indirect and non-use values
Tourist	A visitor to the region, who stays overnight and lives more than 1.5 hour drive from the coastline

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Appendix A:

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.

A.1 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.

A.2 Measuring the economic contribution

There are several commonly used measures of economic activity, each of which describes 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 gross domestic product. 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) – GOS represents 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 the returns to capital before tax (EBITDA) are calculated, company tax is not included or this would double count that tax
- Labour income is a subcomponent of value added. It represents the value of output generated by the entity's direct labour inputs, as measured by the income to labour
- Gross output measures the total value of the goods and services supplied by the entity. This is a broader measure than value added because it is an addition to the value added generated by the entity. It also includes the value of intermediate inputs used by the entity that flow from value added generated by other entities
- Employment is 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: Economic activity accounting framework

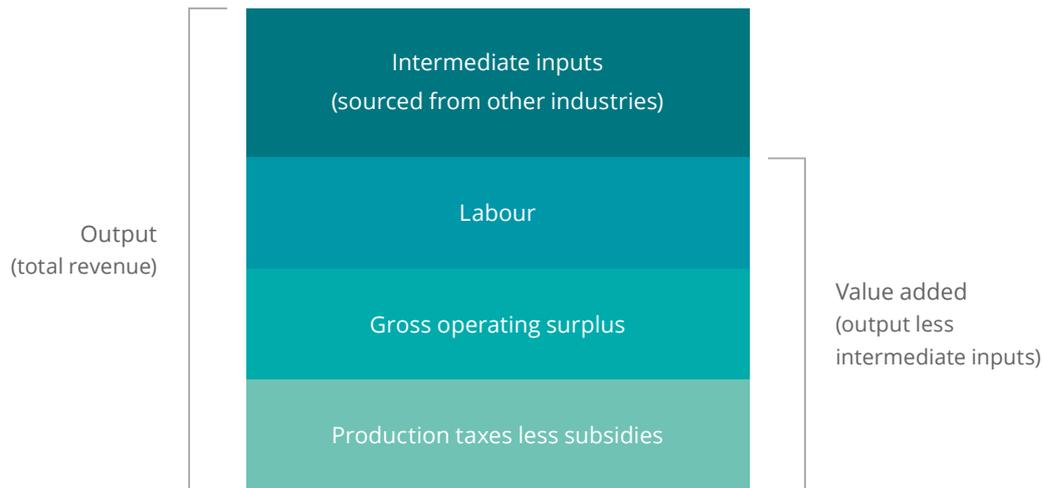


Figure A.1 shows the accounting framework used to evaluate economic activity, along with the components that make up gross output. Gross output is the sum of value added and the value of intermediate inputs. Value added can be calculated directly by adding the payments to the primary factors of production, labour (i.e. salaries) and capital (i.e. gross operating surplus (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.

A.3 Direct and indirect contributions

The **direct economic contribution** is a representation of the flow from labour and capital in the company.

The **indirect economic contribution** is a measure of the demand for goods and services produced in other sectors as a result of demand generated by the GBR. Estimation of the indirect economic contribution is undertaken in an input-output (IO) framework using Australian Bureau of Statistics input-output tables that report the inputs and outputs of specific sectors of the economy (ABS 2013–14).

The **total economic contribution** to the economy is the sum of the direct and indirect economic contributions.

A.4 Limitations of economic contribution studies

While describing the geographic origin of production inputs may be a guide to a firm's linkages with the local economy, it should be recognised that these are the type of 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 industries⁸:

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 wellbeing. 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 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 the report – relies on a national IO 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.

The IO 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 the CGE model.

A.5 Input-output analysis

IO 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 one implies some indirect activity, with higher multipliers indicating relatively larger indirect and total activity flowing from a given level of direct activity.

The IO matrix used for Australia is derived from the ABS IO Tables. The industry classification used for input-output tables is based on ANZSIC, with 111 sectors in the modelling framework.

8. Productivity Commission (1999), Australia's Gambling Industries, Report No. 10, AusInfo, Canberra (page 4.19).

Appendix B: Economic contribution

B.1 Data source

Table B.1 provides a summary data used to assess the economic contribution of the GBR.

Table B.1: Sources of data to measure the economic contribution

Economic activity	Data type	Data source
Tourism	Visitor nights and average expenditure per visitor night	National Visitors Survey (NVS) and the International Visitors Survey (IVS)
Commercial fishing and aquaculture	Gross value production	Queensland Department of Agriculture and Fisheries
Recreation	Expenditure on recreational equipment	Australian Bureau of Statistics Household Expenditure Survey 2009–10 (ABS cat. no. 6530.0)
	Recreational activities undertaken in the GBR	Valuing local recreation in the Great Barrier Reef, Australia, a survey conducted by John Rolfe et al. (2012)
Scientific research and Reef management	Australian Research Council (ARC) fund and the financial statements of selected research organisation, including: <ul style="list-style-type: none"> • Great Barrier Reef Foundation • Australian Institute of Marine Science • Great Barrier Reef Marine Park Authority • JCU ARC Centre of Excellence • Lizard Island Reef Research Foundation 	Website of the ARC and research organisations

Source: Deloitte Access Economics

B.2 Economic contribution of tourism activities

Overall, tourism in the GBRMP region adds \$5.7 billion in value added to the Australian economy and 58,980 full-time jobs. A major part (more than 60%) of the contribution is attributable to economic activities in Wet Tropics and Burdekin.

The economic contribution of the GBRMP to the Australian economy is presented in Table B.2.

Table B.2: Economic contribution of tourism in the GBRMP region by NRM region and types of visitor, 2015–16

		Burdekin	Cape York	Burnett Mary	Fitzroy	Mackay Whitsunday	Wet Tropics	Total
Expenditure (excl. imputed)		1,465	182	1,312	756	858	3,268	7,841
Value added (\$m)	Direct	503	65	437	252	303	1,165	2,725
	Indirect	546	73	474	279	331	1,256	2,959
Total value added (\$m)		1,050	138	911	532	633	2,420	5,684
Employment (FTE)	Direct	7,323	942	2,192	3,712	4,425	16,891	35,485
	Indirect	4,332	577	3,765	2,213	2,627	9,980	23,495
Total employment (FTE)		11,655	1,519	5,957	5,926	7,052	26,871	58,980

Source: Deloitte Access Economics estimates

B.3 Economic contribution of commercial fishing and aquaculture

The \$199 million generated through commercial fishing and aquaculture in the GBRMP region contributes to \$162 million to Australia's total value added and generates 814 full-time jobs. Table B.3 provides information on the contributions of six NRM regions to total value added and employment.

It should be noted that due to the unavailability of the aquaculture data in Cape York, Fitzroy and Mackay Whitsunday, the figures corresponding to these regions in Table B.3 are likely to underestimate their contributions to the economy.

Table B.3: Commercial fishing and aquaculture contribution to the Australian economy by NRM regions, 2015–16

		Burdekin	Cape York	Burnett Mary	Fitzroy	Mackay Whitsunday	Wet Tropics	Total
Expenditure (\$m)		46	19	28	24	10	62	119
Value added (\$m)	Direct	28	15	11	13	6	38	116
	Indirect	11	7	4	6	3	14	46
	Total	38	22	15	19	8	52	162
Employment (FTE)	Direct	115	77	49	66	28	151	507
	Indirect	69	46	29	40	17	91	306
	Total	184	123	78	106	46	242	814

Source: Deloitte Access Economics estimates

Notes: Due to the unavailability of data, the figures for Cape York, Fitzroy, and Mackay Whitsunday underestimate the contributions of these regions. The sum of NRM regions does not equal the total also because of this reason.

B.3.1 Economic contribution of recreational activities

The economic contribution of the GBR to recreation is presented in Table B.4. The total recreational contribution to the Australian economy is \$346 million in value added, which is equivalent to 3,281 full-time jobs. Burdekin, Burnett Mary, and Wet Tropics are the regions with the highest contributions to the Australian economy.

Table B.4: Recreation contribution to the Australian economy in terms of value added, 2015–16

		Burdekin	Burnett Mary	Cape York	Fitzroy	Mackay Whitsunday	Wet tropics	Total
Value added (\$m)	Direct	53	53	2	31	21	47	206
	Indirect	36	36	1	21	14	32	141
	Total	89	89	3	52	35	78	346
Employment (FTE)	Direct	605	601	22	354	236	534	2,352
	Indirect	237	238	9	140	94	210	929
	Total	843	839	30	494	330	745	3,281

Source: Deloitte Access Economics estimates

B.4 Economic contribution of scientific research and reef management

Overall, scientific research on the GBR and reef management activities contribute \$182 million to the Australian economy. This is equivalent to 970 full-time jobs. Details on economic contribution of scientific research and reef management activities on the Australian economy are presented on Table B.5.

Table B.5: Economic contribution of the GBR to scientific research and reef management, 2015–16

		Value added (\$m)	Employment (FTE)
Direct		62	514
Indirect	GBR	93	381
	QLD	98	400
	Australia	120	456
Total contribution to Australia		182	970

Source: Deloitte Access Economics estimates

B.5 Summary of employment contribution to Queensland

The GBR supports significant employment across Queensland. Details on the direct and indirect jobs supported by each major GBR industry is presented in Table B.6.

Table B.6: Summary of the economic contribution to Queensland

(FTE)		Tourism	Fishing	Recreation	Scientific research	Total
Employment	Direct	18,843	520	2,352	514	22,229
	Indirect	9,925	171	612	98	10,806
	Total	28,768	690	2,964	613	33,035

B.6 Summary of employment contribution to Australia

The GBR also supports significant employment across Australia. Details on the direct and indirect jobs supported by each major GBR industry is presented in Table B.7.

Table B.7: Summary of the economic contribution to Australia

(FTE)		Tourism	Fishing	Recreation	Scientific research	Total
Employment	Direct	35,485	507	2,352	514	38,859
	Indirect	23,495	306	929	456	25,186
	Total	58,980	814	3,281	970	64,044

Appendix C:

Literature review

C.1 Literature review framework

The literature framework was structured to build an understanding of the literature, theories and concepts that underpin the valuation of environmental assets, the total economic framework and non-market valuation techniques.

The literature review framework was limited to the specific scope of this study, which is the valuation of the GBR within a total economic valuation framework. Stoeckl et al. (2011) provided a detailed review of the numerous valuation studies focused on the GBR, which provided a broad direction for the literature review.

The literature search returned a substantial amount of domestic and international studies that assisted in the framing of the methodology for measuring the total economic value of the GBR. The following section provides a condensed overview of the key literature as it related to the GBR and outlines the relevance to conducting a total economic valuation of the GBR.

C.2 International studies

There have been various credible studies that have used the total economic value framework to value large environmental assets such as, forests in Mexico (Adger et al., 1995), wetlands in Sri Lanka (Wattage & Mardle, 2008), small-scale fisheries in Madagascar (Barnes-Mauthe, Oleson, & Zafindrasilivonona, 2013), mangroves in India (Badola & Hussain, 2005) and terrestrial and marine biodiversity (Turpie, Heydenrych & Lamberth, 2003).

The early literature surrounding the valuation of coral reefs only valued the cost of reef degradation, rather than the benefits that made up the total economic value. Moncur (1973) was the first with a Hundloe et al. (1987), Hodgson and Dixon (1988) and McAllister (1988) soon to follow. From then, large number of valuation studies of coral reef were released in the 90's, see Spurgeon, 1992, for a full account.

C.3 Australian studies

Stoeckl et al. (2011) released a comprehensive account of the literature surrounding the economic and social valuation of the GBR. Their account highlights numerous gaps in the literature, particularly in the valuation of regulating and support ecosystem services. This report attempts to build on existing literature by addressing a number of gaps highlighted in Stoeckl et al. (2011).

Hundloe et al. (1987) was the first study to value the use and non-use values of the GBR and set the standard for other practitioners to follow. From then on, a number of studies have aimed to value the financial benefits the GBR contributes to the Australian economy.

Driml (1999) was the first of these studies, reporting estimates of major direct uses of the GBR, such as tourism, through productivity change, a method mirrored by KPMG (2000) and Asafu-Adjaye et al. (2005). PDP Australia (2003) then followed, but used tourism expenditure to estimate the GBR's contribution to the Australian economy.

From then, Access Economics (2005, 2007 & 2008) valued the economic contribution of the GBR using a value-add approach with input-output tables. This method has continually been updated, and refined. Deloitte Access Economics (2013) is the most recent report assessing the economic contribution of the GBR, using the value-add approach. The majority of these studies valued the GBR's economic/financial contribution to industry (profitability) but failed to account for consumer benefits.

Following Hundloe et al. (1987), there has been a number of studies that have applied non-market valuation techniques to value a range of consumer benefits on the GBR. The most commonly applied revealed preference, non-market valuation technique is the travel cost method⁹ that has been used to value such activities as beach recreation (Rolfe et al., 2011), recreational fishing (Prayaga et al., 2010) and general recreation (Rolfe & Gregg, 2012).

Very few studies have aimed to estimate tourism, beyond a local, recreational scope, due to complexities in defining travel costs, multiple purpose trips and functional forms. Carr and Mendelsohn (2003) is the only study to our knowledge that has attempted to aggregate domestic and international tourism benefits of the GBR using the travel cost method.

Despite being the most commonly used stated preference technique internationally (Carson et al., 1994), Contingent valuation isn't as commonly applied in Australia. Farr et al. (2014) built upon the Hundloe et al. (1987) application of the contingent valuation method using the GBR as a case study. Farr et al. (2014) measured domestic and international tourist's WTP for marine animal sightings. More recently, Stoeckl et al., (2014) used a combination of various economic valuation techniques including, contingent behaviour and contingent valuation. They estimated the collective value of services on the GBR such as, tourism and other non-use values to be between \$15 and \$20 billion.

The literature search returned a number of choice modelling articles, with Windle & Rolfe (2005a) being the first to apply choice modelling to the GBR context, and the second study to value the non-use values of the GBR (after Hundloe et al., 1987). Since then the pair used choice modelling on the GBR to answer a number of other research questions (Windle & Rolfe, 2005b; Rolfe & Windle, 2010; Windle & Rolfe, 2011; Rolfe & Windle, 2012).

Kragt et al. (2009) was the first study to our knowledge to apply the contingent behaviour technique to a GBR case study. The study aimed to monetise the effects of GBR degradation on diver and snorkeler's demand for reef-trips.

To our knowledge Oxford Economics (2009) is the only study that has attempted to estimate the total economic value of the GBR. The aim of the Oxford Economics study was to value the consumer and producer benefits lost under a severe coral bleaching scenario, rather than valuing it as an iconic asset. It is worth noting that the majority of their social and economic values were realised through a benefit transfer from the previously mentioned academic sources.

Jacobs (2016) recently estimated the value of the GBR as a piece of economic infrastructure as part of their business case for investment in the GBR. Tourism expenditure and the findings found in Stoeckl (2014) were used to arrive at the conservative asset value of \$21 billion. These finding suggested that an appropriate level of annual funding (including operations, maintenance and depreciation) for the GBR would be \$830 million.

C.4 Review findings

The literature review provided direction to the development of the technical methodology for the social and economic values of the GBR, particularly for non-market valuation techniques.

Domestic and international literature helped conclude that the travel cost method is the most appropriate method to be used for valuing domestic tourism benefits to the GBR, with Carr and Mendelsohn (2003), Prayaga et al. (2010), Rolfe & Gregg (2012), Pascoe, et al, (2014), collectively providing valuable insight into suitable survey design, assumptions and econometric modelling.

Contingent valuation was chosen as the most robust method to value the domestic non-use values of the GBR. This was due to the large international presence in literature (Carson et al. 1994) and the “best practice” structure of its application through the National Oceanic and Atmospheric Administration (NOAA) guidelines. The NOAA guidelines (Arrow et al., 1993), Kotchen, Boyle & Leiserowitz, (2012) and the findings from Carson et al’s (1994) literature review were used the framing of the contingent valuation question and the assumptions used (see Appendix D and E).

Appendix D: Primary research and results

The following section presents the full results of the survey.

It is important to note results may not add to 100% due to rounding.

D.1 General

D.1.1 Are you an Australian resident?

Yes	54%
No	46%

D.1.1.1 Where do you normally live?

Australia	52%
France	2%
Germany	3%
Spain	1%
UK	2%
South Africa	2%
China	13%
India	14%
Canada	1%
Mexico	4%
USA	6%
Other	< 1%

D.1.2 How old are you?

Under 18	0%
18–34	31%
35–54	35%
55–74	27%
75 and over	8%

D.1.3 What gender do you identify as?

Male	50%
Female	49%
Other	< 1%

D.1.4 What is your *highest completed level of education*?

Primary school	1%
High school	22%
Certification or trade training	25%
Undergraduate	30%
Postgraduate	23%

D.1.5 In your opinion, which Australian UNESCO World Heritage *natural* site is the *most iconic*?

Great Barrier Reef	65%
Kakadu National Park	4%
Willandra Lakes Region	1%
Lord Howe Island group	1%
Tasmanian Wilderness	4%
Gondwana Rainforests of Australia	3%
Uluru-Kata Tjuta National Park	6%
Wet Tropics of Queensland (Daintree)	2%
Shark Bay Western Australia	2%
Fraser Island	2%
Australian Fossil Mammal Sites	4%
Heard and McDonald Islands	1%
Macquarie Island	1%
Greater Blue Mountains Area	3%
Purnululu National Park	2%
Ningaloo Coast	1%

D.1.5.1 Why did you pick the Great Barrier Reef?

(Select all that apply)

It is the most unique on the list	33%
It is one of the seven natural wonders of the world	43%
It is one of the most beautiful places in Australia	52%
Most people know what it is	45%
I don't know any others on the list	7%
It is the most famous on the list	44%
Other	3%

D.1.6 Do you agree/disagree with the following statements?

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The Great Barrier Reef is an iconic Australian landmark that contributes to Australia's national identity and international standing	63%	32%	4%	1%	< 1%
The Great Barrier Reef contributes to Australia's cultural identity	42%	39%	17%	2%	< 1%
The Great Barrier Reef offers a unique experience that is not offered anywhere else in the world	48%	38%	12%	2%	1%
The Great Barrier Reef contributes to Australia's brand globally	57%	35%	7%	1%	< 1%

D.1.7 Have you ever visited the Great Barrier Reef?

Yes	43%
No	57%

D.1.8 Have you visited the Great Barrier Reef in the past five years?

Yes	30%
No	70%

D.1.8.1 What was the *main reason* for your visit?

	Domestic	Inter-national
Business (you travelled for work)	< 1%	2%
Holiday (you went as a tourist)	27%	16%
Visiting family and friends	7%	3%
Recreational use (you live close by and a regular visitor to the Reef)	2%	< 1%
Did not visit	63%	79%

D.2 Tourist Respondents

D.2.1 In the past five years, how many times have you visited the Great Barrier Reef? This includes visiting the beaches, swimming, snorkelling and sightseeing around the Reef.

	Domestic	Inter-national
1	40%	59%
2	21%	27%
3	12%	8%
4	4%	2%
5	8%	4%
More than 5	15%	0%

D.2.2 How many persons (*excluding yourself*) were you financially responsible for on this trip?

	Domestic	Inter-national
I did not pay for this trip	7%	5%
I only paid for myself on this trip	28%	28%
1 other person	32%	26%
2 other people	12%	17%
3 other people	14%	16%
4 other people	5%	4%
5 other people	1%	2%
More than 5 others	1%	1%

D.2.3 How many nights were you away from home in total? Include any other travel not related to the Great Barrier Reef.

268 domestic and 128 international respondents

D.2.4 How many nights did you stay at the Great Barrier Reef specifically? This includes, for example, accommodation in Cairns or Townsville.

268 domestic and 128 international respondents

D.2.5 Please estimate the total cost of your trip for all persons.

Travel costs (e.g. flights, vehicle costs, cruise/ferry/bus tickets)	268 domestic and 128 international respondents
Accommodation (e.g. hotel, unit, Airbnb, campsite, caravan)	268 domestic and 128 international respondents
Meals and incidentals (e.g. lunch cost)	268 domestic and 128 international respondents
Organised touring (e.g. scuba diving, site seeing, boating)	268 domestic and 128 international respondents
Individual equipment hire (e.g. personal scuba diving gear, paddle boards, fishing equipment)	268 domestic and 128 international respondents
Other costs	268 domestic and 128 international respondents

D.2.6 What was the main reason you chose to visit Australia?

	International
Visiting the Great Barrier Reef	52%
Visiting other attractions in Australia	12%
Experiencing Australian culture	32%
Other	4%

D.3 Non-Users

D.3.1 What do you think is the biggest threat to the health of the Great Barrier Reef?

	Domestic	International
Climate change	44%	46%
Impacts from farming on water quality	6%	4%
Growing cities next to the Reef	3%	13%
Overuse of the Reef	13%	14%
Mining activities next to the Reef	23%	11%
There is no threat to the Great Barrier Reef	2%	1%
Other... Specify	3%	1%
Don't know	6%	10%

D.3.2 Do you think climate change is caused by human activity?

	Domestic	Inter-national
Yes	69%	87%
No	15%	8%
Don't Know	16%	6%

D.3.3 Will you likely visit the Great Barrier Reef in the future?

	Domestic	Inter-national
Yes	63%	60%
No	9%	11%
Don't know	28%	29%

D.3.4 How much are you willing to pay weekly to guarantee that the Great Barrier Reef is protected?¹⁰

	Domestic	Inter-national
\$0	42%	27%
\$0.44 per week	21%	25%
\$1.15 per week	19%	19%
\$2.33 per week	6%	8%
\$3.58 per week	3%	6%
\$4.75 per week	5%	4%
\$7.19 per week	1%	3%
\$8.40 per week	< 1%	1%
\$9.62 per week	< 1%	1%
\$10 per week	2%	2%
\$15 per week	1%	3%
More than \$15 per week	< 1%	1%

10. This question was asked after framing the contingent valuation scenario. The scenario included a Great Barrier Reef Future Health Charge that all Australians had to pay. The respondent was told that their payment would guarantee that the GBR was protected and would reflect that of the "take action" scenario, rather than the "change nothing" scenario presented in Chapter 2 (Heron Island Research Station).

D.3.4.1 What was the *main reason* you are not willing to pay the Great Barrier Reef Future Health Charge?

	Domestic	Inter-national
I cannot afford it	46%	37%
I don't believe it can be protected	3%	2%
I am prepared to pay, but not through a charge	4%	1%
The Great Barrier Reef is not important to me	2%	3%
I do not have enough information to decide	9%	13%
The Great Barrier Reef is not under threat	2%	-
I think the funding should come from elsewhere	23%	21%
I think only Australians should pay	-	16%
Other	10%	5%

D.3.4.2 Why do you think paying to protect the Great Barrier Reef is worth it? Select all that apply.

	Domestic	Inter-national
Future generations should be able to visit it	70%	52%
It is morally and ethically right to protect it	60%	45%
It is important to the planet	59%	62%
It is important for biodiversity	58%	59%
Australia would not be the same without it	58%	31%
It is important for tourism	54%	33%
It is important for the region's economy	48%	24%
The world would not be the same without it	46%	29%
Other (Specify)	1%	1%
Don't know	0%	1%

D.3.5 Would you still visit the Great Barrier Reef if it looked like the CHANGE NOTHING Scenario?

	Domestic	Inter-national
Yes	25%	36%
No	38%	32%
Don't know	37%	32%

D.3.6 You were willing to pay \$X in the Great Barrier Reef Future Health Charge. After watching the video, are you willing to pay more?

	Domestic	Inter-national
Yes	35%	51%
No	65%	49%

D.3.7 How much more would you be willing to pay weekly as part of the Great Barrier Reef Future Health Charge?

	Domestic	Inter-national
\$0.44 per week extra	37%	27%
\$1.15 per week extra	22%	16%
\$2.33 per week extra	13%	3%
\$3.58 per week extra	7%	5%
\$4.75 per week extra	9%	13%
\$7.19 per week extra	1%	13%
\$8.40 per week extra	2%	8%
\$9.62 per week extra	1%	7%
\$10 per week extra	6%	4%
\$15 per week extra	1%	1%
More than \$15 per week extra	1%	2%

Appendix E:

Economic, social and icon value

E.1 Non-use value

E.1.1 Assumptions

As contingent valuation is hypothetical in nature, it is subject to a range of biases. The magnitude of these biases can be reduced with careful survey design and testing a pilot survey.

E.1.1.1 Willingness to pay vs willingness to accept

One of the key assumptions that can lead to large differences in estimate is how the price trade-off is communicated in the survey. The contingent valuation question is usually framed in such a way that it directly asks a respondent how much they are WTP to prevent a decrease in reef quality or WTA as compensation if such a decrease was to occur.

In most cases WTA produces a higher estimate than WTP, with Hammack and Brown (2016) finding that WTA reported estimates four times larger than WTP. In order to remain conservative with our estimates, the contingent valuation question was framed to elicit an individual's WTP.

E.1.1.2 Pricing techniques

WTP can be elicited from three common techniques: payment card, dichotomous choice and open-ended questioning. Both dichotomous choice and payment card methods are superior to open-ended questions in that they account for uncertainty in respondents' preferences through allowing them to trade-off between WTP options. The payment card technique has the relative advantages over dichotomous choice of being effective for online surveys, more informative, and avoiding anchoring and 'yeah saying' (giving positive but possibly false responses) when a sole bid is presented.

The payment card technique is also subject to bias resulting from survey design of interval size and range of monetary options. To alleviate a lot of this bias we followed the payment options in Kotchen, Boyle & Leiserowitz, (2012).

A maximum amount of \$15+ and a no payment option of \$0 were established, then a middle amount of \$7.19 was set and subsequent middle amounts set above (\$8.40, \$9.62, 10 and 15) and below (\$4.75, \$3.58, \$2.33, \$1.15). Figures such as \$2.50 and \$4 are avoided as people are more likely to answer 'yes' to lower even amounts than odd numbers that are very close. Finally a lower figure of \$0.44 was added as most people are usually willing to pay a modest amount. This approach yields conservative results and is in line with NOAA Blue Ribbon Panel's guidelines for Contingent Valuation.

E.1.2 Average WTP

The average WTP figure were calculated per state and per country for domestic and international non-users using the survey data. The average WTP figures encapsulate respondents that were WTP zero so that the estimates were an honest reflection of the domestic and international non-user's WTP. This technique reflects the methodology used in DAE's 2013 *Sydney Opera House: economic, cultural and digital value* study and their 2016 study of the *Economic and social value of improved water quality at Sydney's coastal beaches*.

E.1.2.1 Domestic value

The average WTP figure for the Australian population was \$1.30 per week. All respondents that selected that they would be WTP more than \$15 per week (n=4), stated that they would be WTP \$20 per week in the open response. The average WTP figure was then extrapolated against the entire Australian population over the age of 18, 18,715,742 people.¹¹

11. As at June 2016 ABS 3101.0 – Australian Demographic Statistics, Sep 2016

E.1.2.2 International value

The major issue with extrapolating international WTP estimates is that it is difficult to accurately discern an applicable population for modelling from research results.

The results showed that respondents from developing countries were relatively wealthier than the average, and respondents from developed countries were relatively poorer than the average. This was likely due to wide discrepancy between emerging and developed countries in regards to access to the internet, and therefore presence in the online survey.

The extrapolation of these figures was therefore avoided due to a relatively small sample size representing the WTP of the international population. However, a weekly WTP figure can be produced from the survey sample.

The respondents that selected that they were WTP over \$15 per year was assumed to be WTP \$20, as this was the figure reported by the domestic responses. This was assumed to remain conservative and to ensure data is not skewed.

The weekly WTP was then averaged across the 555 international respondent sample size.

E.2 Indirect use value

E.2.1 Ecosystem services

The GBR's ecosystem services provides significant economic and social value, which needed to be considered as part of this valuation. The ABS released an Experimental Ecosystem Account for the Great Barrier Reef Region in 2015 that accounts for the stock of ecosystem services and condition in both monetary and physical terms.

To use the monetary terms from the ABS Ecosystem Account we would need to convert the stock figure (actual) to flow figures (marginal) and separate the ecosystem services provided by the terrestrial and river ecosystems from the marine ecosystem. An example of this is for the agriculture industry, where the ecosystem service value is made up of the services provided by multiple ecosystems (primarily terrestrial). As the proportion that is attributable to the GBR's marine ecosystem cannot be separated from other ecosystems, it would be inappropriate to include it in analysis.

The ecosystem service the GBR provides to the fishing and tourism industry can largely be attributable to the GBR's marine ecosystem. However, including this in the analysis could result in a double count, as it the economic contribution would have discreetly captured a proportion of this value.

An alternative to using the ABS Ecosystem accounts, is to evaluate an individual's willingness to pay (WTP) to conserve a specific ecosystem flow. This would have also resulted in a double count as a proportion of this value would likely be encapsulated in the non-use value.

E.3 Direct use value

E.3.1 Tourism

The zonal travel cost model is often used to estimate the direct use values of tourism sites visited infrequently by travellers from afar. This is due to individuals who have to travel a long distance to access the site in question having a low trip frequency. When there is a lot of individuals with a low trip frequency (e.g. 1 trip a year) in the sample, it is difficult to derive a relationship between travel cost and demand for visitation.

The questionnaire asked for the number of trips respondents make every five years, rather than annually. This provided us with more variation in the dependent variable (trip frequency). This allowed us to derive a demand curve using the individual travel cost model, which has more explanatory power than the zonal travel cost method.

The travel cost method involves making a number of assumptions appropriate to the site under investigation. Three key assumptions that often lead to differences in estimates are the treatment of time, multipurpose trips and international visitors.

E.3.1.1 Travel time

The value of time is based on the notion of opportunity cost. This is defined as the benefit that a person would have experienced by undertaking the next best activity with the time spent travelling to the recreation site (Parsons, 2003).

There is no commonly agreed upon method to measure this opportunity cost. However, it is often assumed to be a proportion of income. Beal (1995) contested the inclusion of travel time in travel cost models due to full-time workers having fixed working hours and paid leave for leisure. He also reasoned that opportunity cost isn't only related to income foregone, but also to other leisure activities, meaning that the value of time is variable between an individual's preferences.

A number of articles (Pascoe et al., 2014; Rolfe & Dyack, 2011 and Rolfe & Prayaga, 2007) applied a zero cost figure to travel time, which has been assumed in this report in order to align with the literature and to remain conservative in our estimates.

E.3.1.2 Multiple-site visits

Another major assumption of the travel cost method is that all of the accrued travel costs are incurred exclusively to access one site. Due to the high costs of travelling to a location that required flights and accommodation, such as the GBR, visitors often engage in other activities at the site or visit other sites during their trip. Failure to distinguish between multiple purpose visitors than those that solely visited the GBR, would result in bias (Parsons, 2003).

Despite multi-purpose trips receiving consideration in literature, there has been no single theoretical approach that has been agreed upon to address this issue (Ward & Loomis, 1986). Common approaches are, to either assume all trips are single purpose, adjust multiple purpose visitors travel costs to a portion of total cost or to drop all multi-purpose visitors from analysis altogether (Pascoe et al., 2014).

The most appropriate approach for this report was to ask respondents how many days in total they spent away from home and how many days were spent at the GBR, as detailed in Appendix D. The total travel cost of the trip was then allocated proportionately to the GBR.

E.3.1.3 Treatment of international visitors

The treatment of international visitors varies in GBR literature, see for example, Carr & Mendelsohn (2003) and Prayaga et al. (2006). Tourism benefits to international visitors are of interest to this report, however, it attract enough respondents to have a reliable sample proved challenging. IPSOS attracted 130 respondents. The individual and zonal travel cost method was attempted but due to an insufficient variation the dependent variable (number of trips between individuals/zones), a demand curve could not be derived. Therefore, international tourism was not included in the analysis.

E.3.1.4 Model specification

An individual's demand to visit the GBR is determined by their trip frequency, which the travel cost method assumes to be a function of their travel costs and socio-economic characteristics. The standard demand curve for an individual i can be written as:

$$x_i = f(z_i) + \epsilon$$

Where x_i is the number of trips to the GBR, and z_i is a vector of factors influencing demand which are travel cost, income, gender, age and education, and ϵ is a random error term.

Ordinary least squares regression methods are not commonly used to model to travel cost data due to the non-negative nature of the dependent variable (number of trips) in tourism data. Therefore, a count model was chosen over standard regression techniques as they estimate the probability of an individual choosing to visit the GBR. A Poisson regression is a popular count model to use, however, it assumes that the mean and variance of the data are equal and will return biased results if used on data that has overdispersion.

A likelihood ratio test performed on the Poisson regression confirmed that our data was characterised with overdispersion, therefore, a negative binomial regression was employed as it corrects for bias by adding in an additional parameter α into the probability function. The probability function of a negative binomial model is given by:

$$\Pr(x_i) = \frac{\Gamma(x_i + \alpha^{-1})}{\Gamma(x_i + 1)\Gamma(\alpha^{-1})} \left(\frac{\alpha^{-1}}{\alpha^{-1} + \lambda_i v}\right)^{\alpha^{-1}} \left(\frac{\lambda_i v}{\alpha^{-1} + \lambda_i v}\right)^{x_i}$$

Where $\Gamma(\cdot)$ is the gamma probability density function evaluated at (\cdot) , and $v > 0$ is an independently and identically distributed random variable with density $g(v|\alpha)$ (Martínez-Espiñeira & Amoako-Tuffour, 2008). This collapses to Poisson distribution when the overdispersion parameter, α is equal to zero (Pascoe et al., 2014).

Several functional forms were tested and the double log functional form was determined as best fit, in comparison to the linear and log-liner forms. Due to this functional form the consumer surplus had to be measured at multiple points. The model found that visitors place a high value on their first trip to the GBR, with this value depreciating as more trips are taken. \$662 is the weighted average that takes this variation into account and visitors that take multiple trips over five years.

E.3.1.5 Visitor numbers

TRA data on intrastate and interstate overnight trips within the GBR NRM regions, specified in Chapter 2, were used to calculate the annual visitor numbers to the GBR. As it is unlikely that 100% of “holiday” visitors to the NRM regions visited the GBR, visitor numbers were adjusted by applying a set of assumptions.

We conservatively assumed that only 50% of the visitors to Burdekin, Cape York, Burnett Mary and Fitzroy visited the GBR, with popular entry points to the GBR such as, Mackey Whitsunday and Wet tropics, getting a larger weighting of 90%. This adjustment resulted in the total number of domestic overnight visitors to the GBR being 2.3 million for 2016.¹²

E.3.2 Recreation

Benefits transfers can result in biased estimates if the transfer site and study site are immensely different. Fortunately, there are numerous recreation valuation studies that use the GBR as a case study. The appropriateness of the GBR studies were judged on the following criteria:

- Robustness of estimates
- Appropriateness of non-market valuation technique and application
- Ability to fit geographic scope

If the case studies failed on any of the above criteria, they would be deemed inappropriate and primary research would have been undertaken. This was unnecessary as the estimates in Rolfe & Gregg (2012) were robust and covered the full GBR scope covered in this report.¹³

E.3.2.1 Visitor numbers

TRA data on intrastate day trips within the GBR NRM regions, specified in Chapter 2, were used to calculate the annual recreation visitor numbers to the GBR. As it is unlikely that 100% of visitors to the region visited the GBR, therefore, we adjusted the TRA data in line with the domestic overnight visitor numbers, detailed in C.3.1.5. This adjustment resulted in the total intrastate day trips to the GBR becoming 3,989,898.

12. TRA categorises all visitors as either, “holiday”, “visiting friends and relatives”, “business” or “other” which reflects the visitor’s main purpose of trip.
 13. All of the regions in the Rolfe & Gregg (2012) study were included in the analysis, except for Bundaberg. It was determined that general recreational activities undertaken as a “day trip” in Bundaberg would not be attributable to the GBR. The Bundaberg estimate was therefore not included in order to remain conservative.

Appendix F: Valuing the future and the discount rate

F.1 Valuing the future and the discount rate

It is very difficult to 'discount' the future of the GBR. Some people find it impossible or simply wrong to 'discount' the future of something as important as the GBR. But it is important to recognise intergenerational benefits and welfare in determining the total social and economic asset value. This raises the question of how future generations are valued relative to the present when it comes to the GBR. How much value is attributed to those who are not even born yet? In comparing welfare, utility and benefits across generations, the discount rate needs to be determined.

F.1.1 Discount rate

The Ramsey equation is used to calculate the discount rate applied to determine the NPV social and economic asset value of the GBR. The Ramsey equation is broken down into two main components:

$$r = \delta + \eta g$$

The first is the rate of time preference (δ), or, the rate that utility is discounted for future generations. If the number is positive, present benefit realisation is given a higher utility weighting than benefits realised by future generations. If the time preference is zero, or close to zero, there is no discount placed on future generations and intergenerational utility is equally weighted. In the context of assessing the social and economic value of the GBR, it is ethically appropriate to distribute welfare equally across generations. As such, a near-zero pure rate of time preference is appropriate and we have adopted rate 0.05 per cent. This is the same rate as the Garnaut Climate Change Review 2008 and similar to the Stern Review 2007 (Table F.1).

The second component includes the elasticity of the marginal utility of consumption (η) and the growth rate of the economy (g). The marginal elasticity of utility of consumption measures society's concern for equity in income distribution. Again, turning to the Garnaut Climate Change Review 2008, an elasticity of 1 is a common choice in literature and while there are differing views, we have adopted an elasticity of 1. The growth rate of the economy is assumed as the average annual GDP chain volume measures percentage change from 1987 to 2017, 5204.0 Australian System of National Accounts. It is important to note that when considering the environment, and potential depletions of natural capital from development, that GDP growth is not necessarily a good measure of this or of wellbeing. However, in the absence of an Australian net national welfare measure, a long-term economic growth rate is appropriate.

Using the Ramsey equation and the assumed parameters, a social discount rate of 3.7% is produced. This discount rate applies to the total social and economic asset calculations over the selected time period.

F.1.2 Time period

The time period over which to model the asset value of the GBR takes into account several considerations. Fundamentally, the discounted present value of benefits should at a minimum be considered over the life span of the present generation. This requires the time period to usually exceed two decades, particularly when considering the value of environmental assets that typically take a long time to change. However, in the context of this study, the GBR is currently facing severe threats to its future health. Therefore, to model the benefits over a period of time as long as 50 years, for example, would not consider potential damage to the GBR, changes in people's values and the ultimate benefit they receive from it.

Table F.1: Key social discount rates considered

Study	Valuation	Activity/asset measured	Discount Rate	Logic
Costanza et al. (2008)	Non-use	Ecosystem service – Hurricane protection	3%	No explicit reasoning, standard social rate.
United states environmental protection agency	Environmental costs and benefits	General environment	2–3%	General guidance for natural capital future costs and benefits
Stern review (2007)	Climate change review	Climate change damages	1.4%	Based on the Ramsey equation
Garnaut Review (2008)	Climate change review	Climate change damages	1.35–2.65%	Based on literature and Stern Review parameters

We consider the time period of 33 years to be suitable for the asset value calculation. 33 years is the time period from present day out to the end of the Australian Government 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 for sustainable development to protect the Outstanding Universal Value of the Reef be developed. The Plan considers ecosystem health, biodiversity, heritage, water quality, community benefits, economic benefits and governance as priorities for action¹⁴. To measure the GBR’s value beyond the timeline of the long term sustainability plan would produce a degree of uncertainty in the results.

F.1.3 Sensitivity

The asset value of the GBR is sensitive to the discount rate and time period applied to its modelling.

Table F.2 presents a sensitivity analysis from applying different discount rates and time periods.

Table F.2: Sensitivity analysis

Discount rate	Time period	Total economic, social and icon value
1.5%	33 years	\$77 billion
7%	33 years	\$37 billion
3.7%	50 years	\$67 billion
1.5%	50 years	\$104 billion
7%	50 years	\$41 billion

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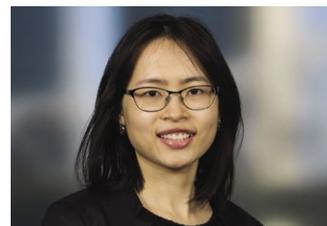
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