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The Grave Barrier Reef

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Global Studies

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Introduction:

1.1 Background

As the temperature of Earth is rising, living coral, especially ones living in the Great Barrier Reef off the Northern East coast of Australia, have been experiencing horrendous levels of coral bleaching. These levels of coral bleaching are due to climate change and other factors, causing many of them to lose their color and potentially die forever. Once corals lose their bright colors, it is very unlikely that they will regain them back fully. In order to get their color back, they need to live in stable conditions with proper water quality for a long period of time. Since climate change is happening at a fast rate, the water temperatures are not stable, preventing the corals from becoming colorful again.

The Great Barrier Reef is home to about 600 different types of corals. Corals come in all different colors and sizes, and they are closely related to jellyfish, even though they look like plants (GBRMPA; viewed on March 4, 2022). Some of the most common colors that corals can be are red, green, pink, and purple (WHOI, 2020). Most of the time, corals have a greenish-brown tone to them, which is caused by the algae living in them (WHOI, 2020). However, scientists need to make sure that they do not confuse this color tone with bleached coral. Another characteristic that defines the type of coral is if they are hard or soft. Hard corals produce limestone skeletons to support themselves and have six smooth tentacles, while soft corals lack solid skeletons, are supported by tiny limestone spicules, and half eight tentacles (GBRMPA; viewed on March 4, 2022). In total, the Great Barrier Reef is made up of about 3,000 reefs and spread over 14 degrees latitude (GBRMPA; viewed on March 4, 2022).

Climate Change

Climate change has been an ongoing problem that has been affecting natural patterns for decades but became a major known problem in the 1980s when scientists saw the first extremely sharp increase in global temperatures. As temperatures on Earth rise, there is an increase in the amount of carbon dioxide that gets trapped in the atmosphere due to greenhouse gases, the burning of fossil fuels, deforestation, and agricultural processes. Many bodies of water, such as oceans, absorb a lot of the excess heat that is produced from greenhouse gasses (IUCN, 2018). This process is called the greenhouse effect and causes the temperature of the water to increase at significant rates. As seen in the chart in Figure 1 below, the temperature in degrees Fahrenheit has increased by about 1.5 degrees over the past 40 years. Once water temperature has a sharp increase for a longer period of time, it is very uncommon for the average temperature to go back down. This is a major issue because so many marine organisms live in the specified water that they do, because that water is the temperature that they are able to survive in. Some organisms need warmer water to survive, while some need cooler water to survive.

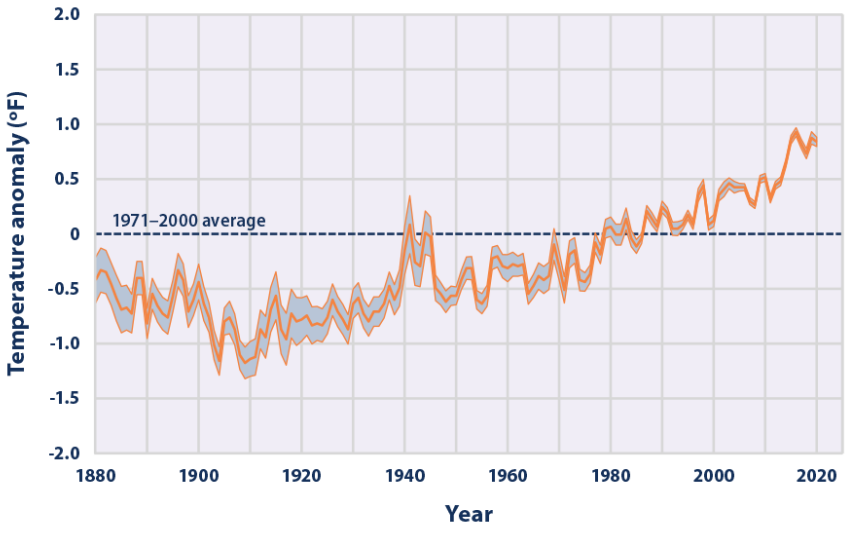

Figure 1: *Water Temperatures Overtime in Fahrenheit*

Coral Bleaching

Coral is a type of marine organism that flourishes in water temperatures between 73 and 84 degrees Fahrenheit (NOAA, 2014). However, corals can still survive for short periods of time in temperatures up to 104 degrees Fahrenheit (NOAA, 2014). Coral bleaching is the process of corals becoming white due to stressors. These stressors include changes in temperature, light exposure, and availability of nutrients. Coral and algae depend on each other to survive, and since the algae is their primary source of food, it gives them their color (NOAA, 2010). When the coral becomes under stress, such as living in warmer water, they will expel the algae that is living in their tissues (NOAA, 2010). This process causes them to lose their color and turn white (NOAA, 2010). Other factors that cause coral bleaching are that runoff water, pollution, and storm generated precipitation can dilute the water since they carry different pollutants, as well as overexposure to sunlight and high levels of solar radiation (NOAA, 2010). Figure 2 below shows the three stages of coral bleaching, as well as comparing the color of coral when they are healthy, stressed, and beached. Bleaching does not automatically cause the coral to die, however it makes them more subject to mortality is they are put under stress again.

Figure 2: *Stages of Coral Bleaching*

Sectors of the Great Barrier Reef

The Great Barrier Reef is composed of three different sectors known as the Northern, Central, and Southern Sectors. Australian Scientists decided to survey individual reefs in each sector to compare the percentages of corals that were unbleached in each one. For the Northern Sector, they surveyed 522 reefs and they discovered that 81% were severely bleached and there was less than 1% that were not bleached at all (JCU, 2020). Next, for the Central Sector, they surveyed 226 reefs and they discovered that 33% were severely bleached and 10% were not bleached at all (JCU, 2020). Finally, for the Southern sector, they surveyed 163 reefs and they discovered that only 1% were severely bleached and 25% were not bleached at all (JCU, 2020). Based on these findings, the Northern Section is dying at the fastest rate and needs the most help. If no actions are taken prevent coral bleaching in the Northern Sector, it could be completely dead by the year 2050. This is very important because this sector of the Great Barrier Reef is home to hundreds of different marine plants and animals, some of which are only found in this specific habitat.

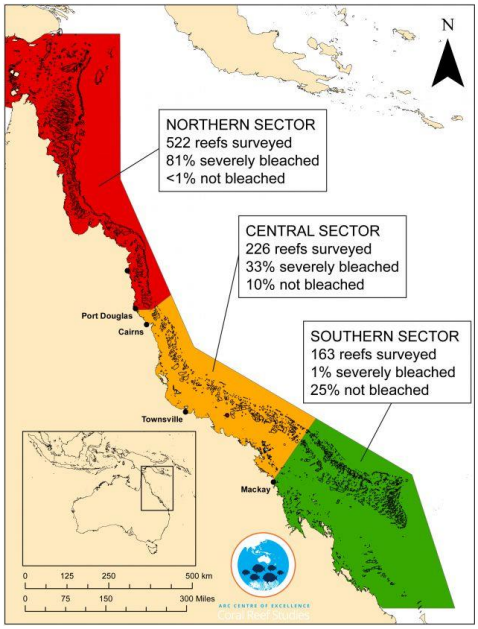

Figure 3: *Sectors of the Great Barrier Reef*

1.2 Problem Definition

During the hottest year on record, 1998, the Great Barrier Reef experienced its first mass coral bleaching (Guardian, 2020). Figure 4 below shows the difference between healthy coral and coral that has been bleached. Since then, it has experiences four more mass coral bleaching's in the years of 2002, 2016, 2017, and 2020 (Guardian, 2020). As temperature changed slightly during the summer months in Australia, it is common for the corals to lose a slight amount of color, but it would always come back. However, as climate change is getting worse, the corals are losing their color for good, and if temperatures keep rising at the fast rate that they are, the Great Barrier Reef might not survive much longer. Since 1998, coral bleaching has affected nearly 98% of the Great Barrier reef in some way.

Figure 4: *Healthy vs. Bleached Coral*

In the past two years, 2020 and 2021, scientific research has shown that the coral bleaching levels have decreased and not as many corals have been affected. The 2021 survey showed that less than 10% of the coral in the Great Barrier Reef were bleached during this year (AIMS; viewed on March 4, 2022). Some possible assumptions for why a lower percentage was

affected than usual is that during the Coronavirus lockdown, less people were going out, driving cars, and producing pollution, which all impacts and leads to climate change. If climate change is not increasing as fast, coral bleaching will most likely slow down. Even though there are other factors that contribute to coral bleaching, climate change is the most significant.

1.3 Urgency

Figure 5: *Progression of Coral Over 9 Months*

Due to climate change increasing year by year, coral bleaching in also increasing and occurring at a faster rate every year. The problem of coral bleaching in the Great Barrier Reef is not going to stop until the amount of greenhouse gasses and pollution in the area around the Great Barrier Reef is reduced. In just one year, as seen in Figure 5 above, corals can lose their color and die at an extremely fast rate. If this problem is not taken seriously and it is pushed off, the Great Barrier Reef will no longer be known as “the rainforest of the sea”. With coral dying, it is affecting many habitats, food webs, and the lives of other organisms, which will cause the entire Great Barrier Reef to fail as a thriving ecosystem. Many actions must be taken in Australia in order to slow down climate change throughout the continent. If not, the Great Barrier Reef and all of its inhabitants of marine mammals, fish, sea turtles, plants, and corals could potentially die

forever. The Great Barrier Reef needs to be able to continue to support marine life, because if it fails too, so many species will become endangered and potentially extinct.

1.4 Statement of Purpose

The purpose of this paper is to examine and evaluate the policies and plans that the Australian and Queensland governments have put in place to protect the corals that call the Great Barrier Reef their home. These policies and plans show the links between climate change, pollution, and coral bleaching. This paper will make people more aware of how their actions are impacting the Great Barrier Reef, and they will learn alternative actions to benefit the corals. By learning about the policies and plans that are already in place for the future, hopefully people will change their behaviors and have empathy for contributing to the leading cause of coral bleaching. After analyzing these policies and seeing them acting on the climate change and coral bleaching problems, the Great Barrier Reef should flourish again and look as it did in Figure 6 with bright colored corals and thousands of different marine species.

Figure 6: *Healthy Great Barrier Reef*

Policy Option I: The Reef 2050 Long-Term Sustainability Plan

2.1 Policy Overview

The Reef 2050 Long-Term Sustainability Plan, also known as the Reef 2050 Plan, was released in 2015 by the Australian and Queensland governments (GBRMPA; viewed on March 22, 2022). This plan provides strategies for managing the Great Barrier Reef in the future, up until the year 2050, as well as coordinates actions and guides that are adaptive to management. The main goal of this plan is to maintain and enhance the health of the Great Barrier Reef as climate change is becoming a major factor in causing it to die (AWE; viewed on March 22, 2022). The Australian government has created a Reef Trust of $40 million and another $35 million to improve the water quality (AWE; viewed on March 22, 2022). On top of this, the Queensland government has committed $100 million over a five-year period in order to help with scientific research, business transitions, and provide incentives (AWE; viewed on March 22, 2022). Between both the Australian and Queensland governments, $1.28 billion has already been committed for the next five years, and they have jointly invested $2 billion over the next ten years (AWE; viewed on March 24, 2022). It is estimated that the total cost of the plan will be above $4 billion. The Reef 2050 Plan is strongly supported by both the Australian and Queensland governments, as well as by most citizens living in Australia who can make an impact on the Great Barrier Reef. This plan is highly driven by moral and cultural values that relate to people believing in protecting the health and survival of the organisms living in the Great Barrier Reef. Figure 7 below goes into great detail about the Reef 2050 Long-Term Sustainability Plan, in terms of yearly outcomes and different pathways.

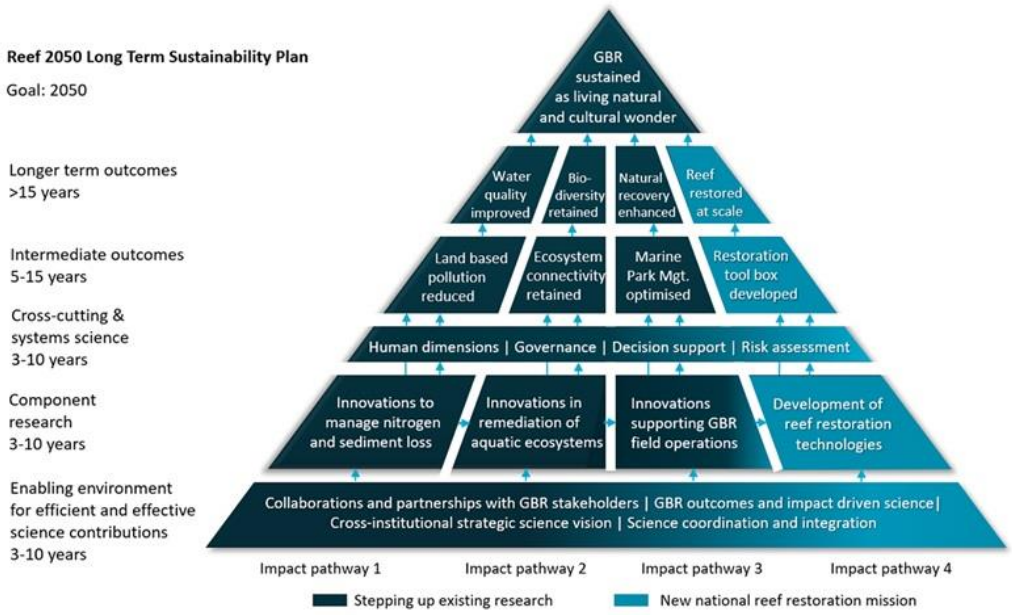

Figure 7: *The Reef 2050 Plan Details*

2.2 Pros

- This plan has incorporated five yearly revisions in order to ensure that it remains current and continues to address emerging issues that are found from the latest scientific data (GBRMPA; viewed on March 22, 2022).
- Instead of focusing on the past, since science and the natural patterns of the Earth are constantly changing, this plan has drawn together scientific expertise to protect the Great Barrier Reef for at least the next three decades and hopefully even further into the future (AWE; viewed on March 22, 202).
- This plan limits the impacts of climate change on the organisms living in this environment and reduces water quality. Some ways that it is accomplishing these two things are:

- It bans the disposal of dredge materials, which are sediments that are excavated or removed from the bottom of ocean waters in order to maintain docks and navigation channels (EPA; viewed on March 24, 2020).
- It restricts new port development.
- It strengthens engagement with Traditional Owners.
- It has established new net free zones, which are areas that are closed to all commercial fish netting. In Figure 8 below, the zoning areas of the Great Barrier Reef are shown in a detailed map.

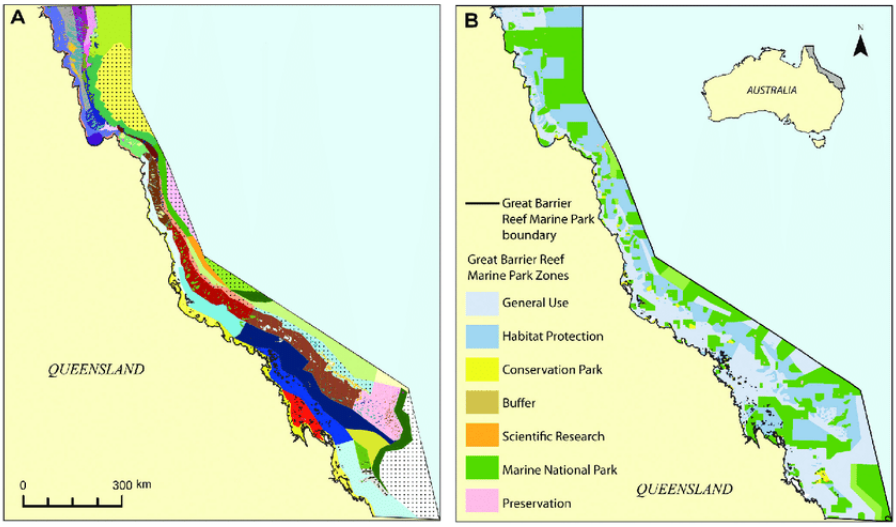

Figure 8: *Zoning Map of the Great Barrier Reef*

By taking the actions listed above, there will be:

- Reductions in sediment, nitrogen, and pesticides running into the reef.
- Improvements in ecological sustainability of fishing. Ecological sustainability is the maintenance or restoration of the processes of ecosystems including the diversity of plants and animals and the productive capacity of all ecological systems (US Forest Service; viewed on March 24, 2022).
- Higher levels of protection of natural wetlands and vegetation.

2.3 Cons

- Unfortunately, since this plan includes extremely high levels of research and management activities for a few decades, it is estimated to cost over $2 billion in total (AWE; viewed on March 22, 2022).
- Due to the rapid increase of climate change, expert scientists have said that this plan is no longer achievable. Since temperatures are rising to fast, it is unlikely to be able to prevent mass coral bleaching's in the future. Some experts have said that the plan should now focus more heavily on "maintaining the ecological function" of the reef (The Guardian, 2017).

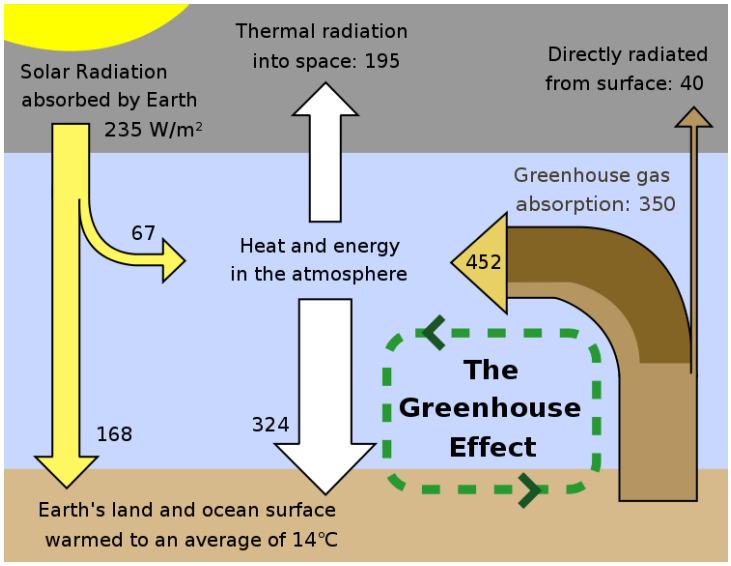

Figure 9: *Greenhouse Effect on the Great Barrier Reef*

- Environmental groups have said that the updated versions of this plan lack actions that will cut down and decrease greenhouse gas emissions. Figure 9 above shows the cycle of greenhouse gasses and how it contributes to the warming of ocean temperatures rising. Since the plan has been put in place in 2015, environmental scientific committees, such as the United Nations World Heritage Committee, have been concerned that the Reef

2050 Plan has made very insufficient progress regarding cutting down pollution levels in the waters of the Great Barrier Reef (The Guardian, 2021). Because of these observations of the plan from the committee, the United Nations have recommended that the Great Barrier Reef should be included in a list of "world heritage in danger". However, this suggestion has been criticized by the Australian government (UN News, 2021).

2.4 Evaluation

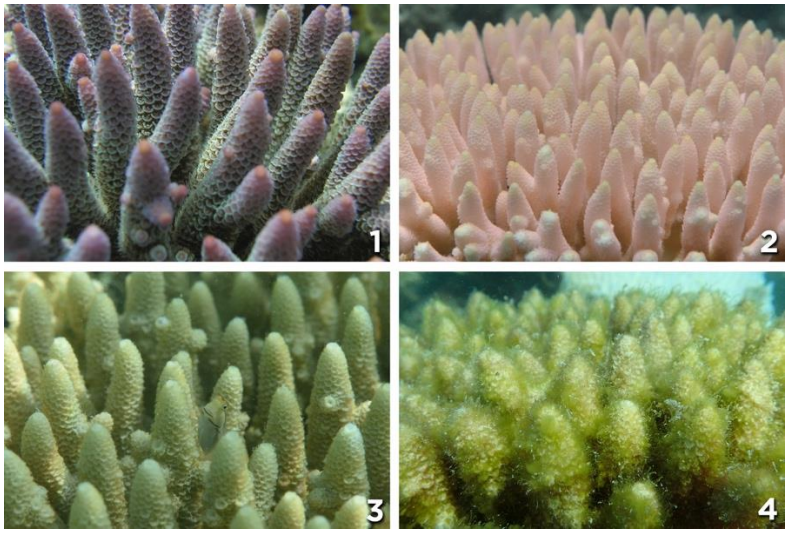

Figure 10: *Coral Bleaching Progression*

Overall, the Reef 2020 Plan is meant to maintain the health of the Great Barrier Reef in terms of coral bleaching, water quality, and marine life for the next few decades. With the continuous scientific research that is being done through the Australian and Queensland governments, this progress has been seen since it has been put in place in 2015. Figure 10 above shows the progression stages of coral bleaching taking place, and it is a great representation of what the Reef 2050 plan is trying to prevent from happening in the future. Changes are continuously being made to this plan to make it as sufficient and beneficial as possible. With help from scientific committees and the United Nations, the Reef 2050 plan will continue to evolve for the overall benefit of keeping the Great Barrier Reef alive.

Policy Option II: The Long-Term Emissions Reduction Plan

3.1 Policy Overview

Australia's Long-Term Emission Reduction Plan was passed in October 2021 and updated in November 2021 by the Australian government (Industry, 2021). The goal of this plan is to achieve net zero emissions in a practical and responsible way by 2050 in Australia, while still ensuring Australian jobs and creating new opportunities for industries throughout the continent (Prime Minister of Australia, 2021). The Long-Term Emission Reduction Plan is based on both existing Australian policies, as well as five principles that will guide the emission shift while not putting anything else at risk (Prime Minister of Australia, 2021). The five principles that are leading this plan are:

- Technology not taxes.
- Expand choices not mandates.
- Drive down the cost of a range of new technologies.
- Keep energy prices down with affordable and reliable power.
- Be accountable for progress (Prime Minister of Australia, 2021).

The Australian government currently has a $20 billion investment in low emission technology, and within the next ten years, it is expected to unlock at least $80 billion in both public and private investments (Prime Minister of Australia, 2021). These investments include clean oxygen and cheap, clean electricity (Prime Minister of Australia, 2021). Similarly, to the Reef 2050 Plan, the Long-Term Emission Reduction Plan is supported by the Australian government and citizens of the continent who feel strongly about decreasing emissions and care about the impact of climate change. Also, this plan is driven by moral values of people who do not want to keep contributing to polluting air and water in Australia. Since greenhouse gases and carbon dioxide

emissions are two of the key factors that lead to climate change, this plan could be very beneficial in preventing coral bleaching in the future if Australia can reach the net zero emissions that they are hoping by 2050. Figure 11 below shows the 8 main actions that will have to happen in order to reach the net zero emissions that are hoped for.

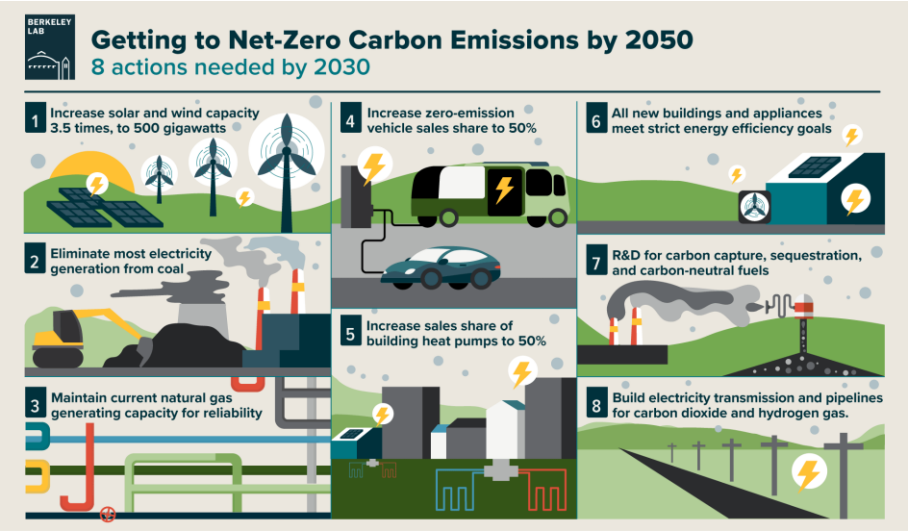

Figure 11: *Actions to achieve Net Zero Emissions*

3.2 Pros

- The effect of climate change on the environment as a whole is a main consideration of this plan, as well as its effects on smaller communities and regions (Industry; viewed on March 28, 2022). By the environment being so important in the creation of the plan, and the Great Barrier Reef being one of the most diverse ecosystems in the Earth's environment, the actions put in place will be a direct effect of its survival and will decrease the risk of the coral living in it from becoming bleached.
- This plan includes new low emission technologies, rather than focusing on old technologies. Low emission technologies include solar power, hydropower, and nuclear power (Industry; viewed on March 28, 2022).

- Solar power is energy that comes from the sun and is converted into either electrical or thermal energy (SEIA; viewed on March 28, 2022).
- Hydropower is energy that generates power and uses a diversion structure to alter the natural flow of a body of water (Energy; viewed on March 28, 2022).
- Nuclear power is a clean and effective way of making steam by boiling water through the process of turning turbines to produce electricity (GE Power; viewed on March 28, 2022).

These new technologies should grow from 39% of global power generation to a full 100% between the years 2020 and 2050 (Industry; viewed on March 28, 2022). Figure 12 below shows the three different types of power and new technologies that the Long-Term Emission Reduction Plan includes.

Figure 12: *Solar, Hydro, and Nuclear Power*

- It is stated in the plan that it will respect the choices of the people living in Australia by not enforcing new mandates about what they can do or buy (Prime Minister of Australia, 2021). It also ensures that Australia will continue to have traditional markets and take advantage of new economic opportunities (Prime Minister of Australia, 2021).

3.3 Cons

- Even though this plan is promising jobs and no new mandates, it is lacking to include any toughening of emission targets for the year 2030, which was asked for by world leaders at the most recent U.N climate summit in Glasgow, Scotland (The New York Times, 2021).
- As of now, low-cost abatement technologies do not exist for many applications throughout Australia's export-facing processes (Industry; viewed on March 28, 2022). Although Australia has reduced its overall emissions since 2005, emissions from export-facing sectors have increased by about 50% (Industry; viewed on March 28, 2022).

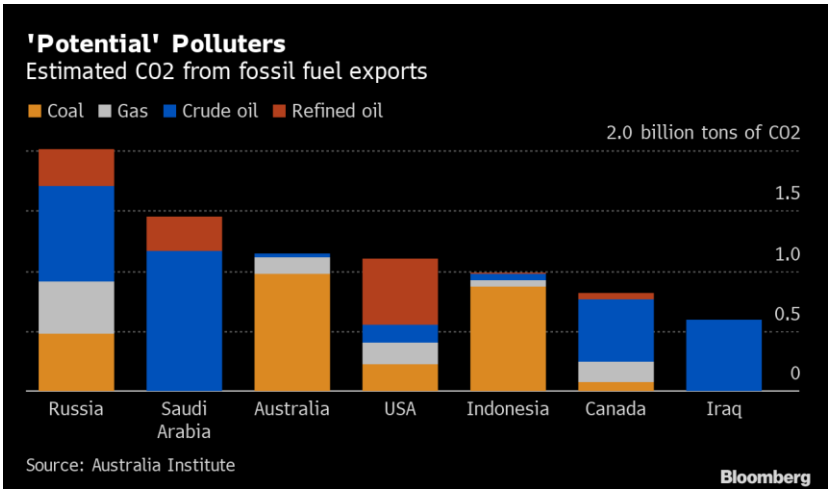

Figure 13: *Earth's Largest Polluters*

- The chief executive of Climate Analytics has suggested that the new technology led approach to decrease emissions could lead to as little as a 66% reduction in the emission by 2050 compared to the levels in 2005 (Guardian, 2021). Australia is currently the world's third largest contributor in carbon dioxide emissions due to burning fossil fuels. Figure 13 above shows how the majority of Australia's pollution comes from coal, which also impacts the life and health of the Great Barrier Reef.

3.4 Evaluation

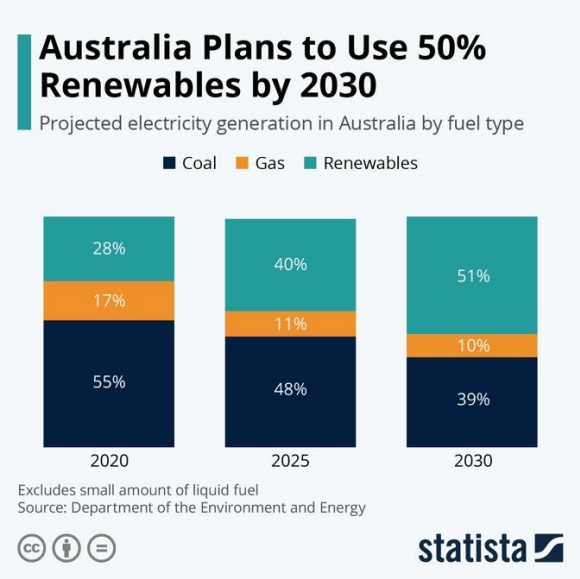

Figure 14: *Australia's 2030 Goal*

A reduction in Australia's emissions, especially carbon dioxide emissions, would be very beneficial to the coral who are trying to survive in the Great Barrier Reef. Overall, the Long-Term Emission Reduction Plan is meant to create a cleaner environment and decrease emissions, including Australia's extremely high contribution of fossil fuel emission that come from burning coal. Figure 14 above show Australia's emissions in 2020 and it is goals for the years 2025 and 2030. By 2030, Australia is hoping to achieve the goal of using 50% of renewables rather than using mainly coal and gas. If coal and gas emissions in this continent could be reduced within the next decade or so through the Long-Term Emissions Reduction Plan, scientists could see coral bleaching in the Great Barrier Reef becoming less extreme and see fewer mass bleaching's occurring every few years.

3.5 Comparison to Policy Option I

The Long-Term Emissions Reduction Plan has many similarities to the Reef 2050 Long-Term Sustainability Plan. Even though this policy option is more focused on Australia's

emissions, rather than the Great Barrier Reef itself, they are still directly related. Without focusing on decreasing emissions in Australia, such as carbon dioxide, it will be very challenging to improve the health of the Great Barrier Reef since climate change is the biggest factor in why the corals are dying becoming bleached and potentially dying. Figure 15 below is a cartoon that shows the amount of carbon dioxide in comparison to the amount of coral, which is why they are losing their colors and turning white. In order to prevent corals from becoming bleached, the hopeful net zero emissions by 2050 is necessary. Also, both policies focus on changes for the future, mainly the overall changes by 2050, and continue to be revised to ensure that they are working to fix current issues in both Australia and the Great Barrier Reef.

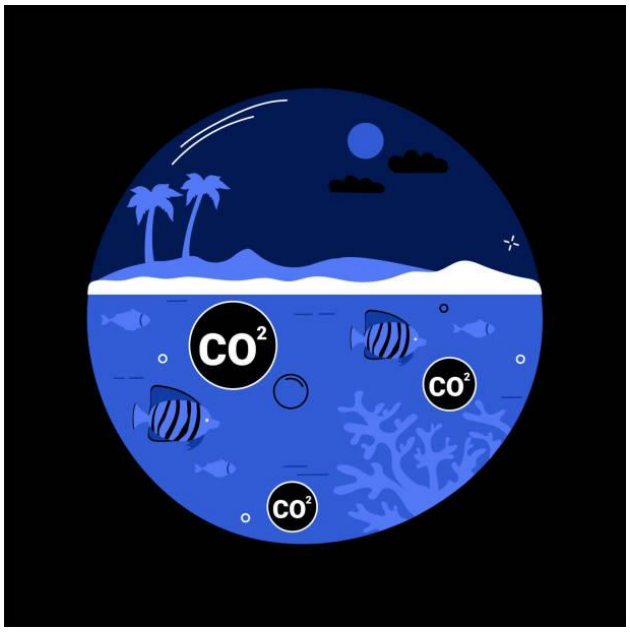

Figure 15: *Carbon Dioxide Mixed with Coral Cartoon*

Policy Option III: The Environment Protection and Biodiversity Conservation Act

4.1 Policy Overview

The Environment Protection and Biodiversity Conservation Act, also known as EPBC Act, is Australia's key piece of environmental legislation that was created in 1999 (AWE; viewed on April 5, 2022). This plan gives Australia legal framework that allows them to protect

and manage unique, animals, plants, habitats, and places, as well as threatened and migratory species (AWE; viewed on April 5, 2022). The main objectives of the EPBC Act are:

- To provide protection of the environment and matters of national environmental significance.
- To conserve the overall biodiversity of Australia. Biodiversity is a term that refers to the variety of living species in a specified area, including animals, plants, bacteria, and fungi (National Geographic, 2019).
- To improve the protection and management of natural and cultural places that hold a lot of importance to the continent. Some of these places include the Great Barrier Reef, the Daintree Rainforest, Purnululu National Park, and Litchfield National Park (Australia; viewed on April 7, 2022).
- To advocate for ecologically stable development.
- To control the international trade of animals and plants, and any products that are made from wildlife species.
- To acknowledge the role of Indigenous people in the conservation and sustainable use of Australia's biodiversity (AWE; viewed on April 5, 2022).

On top of these main objectives of the plan, the EPBC Act also covers nine different protected matters, one being the Great Barrier Reef Marine Park. Other protected matters include:

- World heritage areas.
- National heritage areas.
- Wetlands of international importance.
- Threatened species and ecological communities.
- Migratory species.

- Commonwealth marine areas.
- Nuclear actions.
- Water resources (AWE; viewed on April 5, 2022).

Since this plan includes so many different objectives and protected matters, in 2016 the Australian government implemented cost recovery under the EPBC Act for environmental and strategic assessments that are being done under this act (AWE; viewed on April 7, 2022). Connecting to both the Reef 2050 Plan and the Long-Term Emissions Reduction Plan, the Environment Protection and Biodiversity Conservation Act is heavily supported by the Australian government and citizens who want to continue to live in a diverse, healthy, and beautiful continent. This plan is also driven by moral and cultural values of people who want to protect and conserve areas and wildlife that are important to their heritage and continent. Since the Great Barrier Reef is one of the major protected matters under the EPBC Act, Australia has seen beneficial changes to the reef since 1999, even though coral bleaching is getting worse with the increase of climate change. Figure 16 below shows some examples of Australia's biodiversity that is protected and managed under the EPBC Act. These species include marine mammals, grasslands, native birds, and drylands.

***Figure 16**: Australia's Biodiversity*

4.2 Pros

- Even though this act was passed in 1999, there have been many act amendments made to the original plan, which is helping it improve and become beneficial to the most current and important issues. The most major amendment that was made was in 2013 to focus on water triggers, since water resources are one of the matters of Australia's environmental significance (AWE; viewed on April 5, 2022).
- Through the EPBC Act, an energy management team has been created to integrate energy efficiencies into already existing telecommunications infrastructure and monitor the consumption of electricity and greenhouse gas emissions throughout Australia (SEC Gov; viewed on April 7, 2022). This management became a signatory to the Australian Greenhouse Challenge which is a joint initiative between the Australian government and industries across the continent to improve the management of greenhouse gasses and encourage the decline of greenhouse gasses overall (IEA; viewed on April 7, 2022).
- Relating to the health of the Great Barrier Reef, the EPBC Act made an addition called *Great Barrier Reef Marine Park and Other Legislation Amendment Act* (AWE; viewed on April 5, 2022). The main goal of this amendment is to continue to provide long term protection and conservation of the environment, biodiversity, and heritage of the Great Barrier Reef (Legislation, 2008). Figure 17 below shows marine biologists working to help the organisms living in the Great Barrier Reef in order to follow the goals of this plan.

Figure 17: *Marine Biologists Working to Save the Great Barrier Reef*

4.3 Cons

- A problem that scientists have found regarding this plan is that the EPBC Act does not have an inclusive mechanism that describes the environmental outcomes that it is trying to achieve, and it also does not ensure that decisions are made in a way that will contribute to the entire nation (Independent Review, 2020).
- One of the main objectives of the EPBC Act is to recognize the role of Indigenous people in the conservation and sustainable use of Australia's biodiversity as stated above. However, scientists have discovered that this plan is failing to do so. It has been seen that the Australian government is not taking the knowledge and views of the Indigenous people into consideration when making important decisions relating to this plan (Independent Review, 2021).
- The EPBC Act also does not enable the Commonwealth to effectively protect the environmental matters that are important for the nation as a whole (Independent Review, 2020). The Commonwealth of Australia is a federation of six states and two self-governing territories (DFAT; viewed on April 5, 2022). Figure 18 below shows a map of

how the Commonwealth is split up. Scientists believe that the Commonwealth should make national environmental standards that will act as the binding and enforceable regulations that are set out in the EPBC Act (Independent Review, 2020).

Figure 18: *Commonwealth of Australia Map*

4.4 Evaluation

By protecting all parts of Australia's environment and making many amendments to the plan, the Environment Protection and Biodiversity Conservation Act has been able to impact and slightly slow down the fast rates at which the Great Barrier Reef is dying. Creating an amendment that solely focused on the Great Barrier Reef Marine Park was very important and beneficial, because it is in need of direct attention and should not just be placed with the rest of the Australian environment. Figure 19 below shows all of the threats that are created by climate change to coral reefs in general. This is heavily connected to the Great Barrier Reef, and the EPBC Act has sections and amendments that focus on every single threat that is shown in the figure. By having so many different parts of the act and being a part of the Australian

Greenhouse Challenge, there are declines in greenhouse emission and Great Barrier Reef is definitely benefiting.

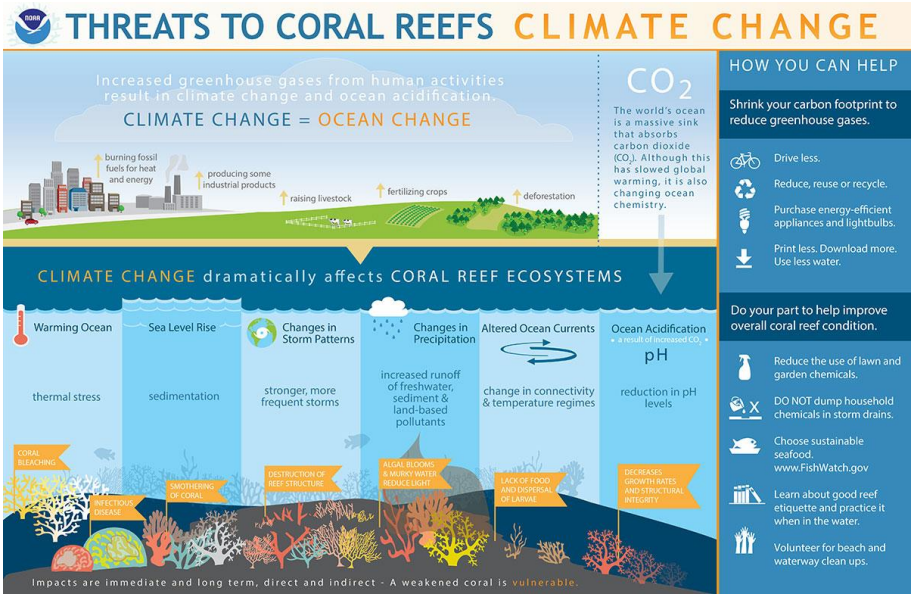

Figure 19: *Climate Change Threats to Coral Reefs*

4.5 Comparison to Policy Options I and II

The Environment Protection and Biodiversity Conservation Act has many things in common with both the Reef 2050 Plan and the Long-Term Emissions Reduction Plan. This plan is focused on both directly protecting the health of the Great Barrier Reef, while also focusing on greenhouse gas emissions that are affecting the entire Australian environment as a whole. The main goal of all three of these policies is to decrease climate change, greenhouse gas emissions, and other harmful human activities that are ultimately the leading cause of coral bleaching and leading to the decreasing life span of corals and other organisms that call the Great Barrier Reef their home. Also, all three policies have plans for the future, and are not just focusing on protecting the Great Barrier Reef right now for a short period of time. Figure 20 below is a cartoon that shows the harsh reality of what is happening in the Great Barrier Reef. The Reef 2050 Plan, the Long-Term Emissions Reduction Plan, and the Environment Protection and

Biodiversity Conservation Act are all attempting to turn this tragedy around and bring the Great Barrier Reef back to the beautiful and diverse ecosystem that it once was.

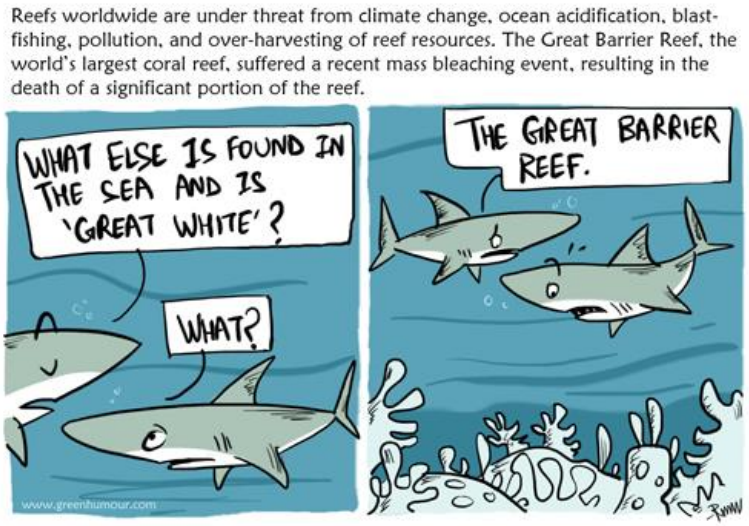

Figure 20: *Coral Bleaching Cartoon*

Conclusion and Recommendations:

5.1 Synthesis of Major Findings

With the efforts that the Australian and Queensland governments have made, as well as those of the citizens and Indigenous peoples of Australia, the Great Barrier Reef has definitely benefited in multiple ways, even if there has not been a clear change. Although climate change is still rising at a rapid rate and greenhouse gas emissions are still a major problem, Australia has been able to slow down and decrease both of these factors, even if it is very minimal. Any slight decrease in temperature, pollution levels, and greenhouse gas emissions will still aid in the movement to prevent coral bleaching throughout the entire Great Barrier Reef. The Reef 2050 Long-Term Sustainability Plan, the Long-Term Emissions Reduction Plan, and the Environment Protection and Biodiversity Conservation Act have all helped slow down the rate at which the Great Barrier Reef is experiences high levels of coral bleaching and biodiversity loss. Figure 21

below shows a sea turtle swimming through a patch of dead coral, which needs to be prevented from happening in other areas.

Figure 21: *Sea Turtle Swimming by Bleached Coral*

If changes continue to be made to all three of these policies to keep them updated and valuable for addressing the most current issues, the corals in the Great Barrier Reef should be able to push through and survive the rising water temperatures that are being seen. Without these revisions and amendments, the policies would not be able to benefit the corals or the Great Barrier Reef that far into the future. While these revisions and amendments are in place, the Australian government needs to make sure that everyone's views and opinions are being heard about this problem. So many different aspects go into making these policies successful, and that cannot be done unless there is scientific data, multiple views, and reliable management efforts.

Regarding the Reef 2050 Plan, billions of dollars have been committed to maintaining the health of the Great Barrier Reef by both the Australian and Queensland governments (AWE; viewed on April 13, 2021). Not only does it limit the impacts of climate change on the organisms living in the Great Barrier Reef, but it also reduces water quality by establishing net free zones and restricting the development of new ports (AWE; viewed on April 13, 2022). Concerning the Long-Term Emissions Reduction Plan, billions of dollars have also been committed to this

policy to include new low emission technologies, rather than old technologies that include the burning of fossil fuels and greenhouse gases (Prime Minister of Australia, 2022). If these new technologies become more available and affordable, there can be major changes seen in the levels of coral bleaching. Relating to both of these plans, the Environment Protection and Biodiversity Conservation Act is meant to improve the protection and management of all the organisms that call the Great Barrier Reef their home (AWE; viewed on April 13, 2022). If this act can continue to make amendments and work towards including the Commonwealth of Australia, more actions and better management to help the Great Barrier Reef could be possible.

5.2 Policy Recommendations

While the three policies the Reef 2050 Plan, the Long-Term Emissions Reduction Plan, and the Environment Protection and Biodiversity Conservation Act all have many positives and contribute to the overall goal of preventing coral bleaching in the Great Barrier Reef, there are things that can be added or changed in the policies that would benefit the corals more directly and also take everyone's views into consideration. Below are three recommendations for these policies.

1. Regarding the Reef 2050 Plan, it is devastating that scientists have said that this plan could no longer be achievable since the water temperatures are increasing at such a fast rate that seems to not be slowing down (The Guardian, 2017). With the fact that mass coral bleaching's in the Great Barrier Reef are most likely never going to be fully prevented, scientists and the Australian government needs to focus more heavily on maintaining the physical and biological processes of the Great Barrier Reef as a whole. By working to benefit all of the organisms that are being affected by climate change in the reef, on top of focusing on the corals, scientists can make sure that the rest of the

Great Barrier Reef will not die at such as a fast rate as well. Unfortunately, Figure 22 below is assuming the fate of the Great Barrier Reef by the year 2050, which this plan is working to fix, because the reef does not deserve to look like a graveyard for corals and marine organisms.

Figure 22: *Past, Present, and Future of the Great Barrer Reef*

2. Even though the Long-Term Emissions Reduction Plan includes the use of low emission technologies, scientists have found that these technologies do not exist for export-facing processes, and they may not be able to reduce emissions significantly by the year 2050 (Industry; viewed on April 13, 2022). In order to fix this problem, Australia needs to focus on making these new technologies available and affordable so they can lead to an actual reduction in greenhouse gas emissions. Figure 23 below shows possible low emission technologies that could be very beneficial is they become more widely available. Without these technologies being accessible to the entirety of Australia's industries, which produce some of the highest levels of pollution, there will only be slight levels of emission reductions that will not be very beneficial for the environment and the Great Barrier Reef as pollution levels and temperatures are continuing to rise.

Figure 23: *Possible Low Emission Technologies*

3. For the Environment Protection and Biodiversity Conservation Act, there needs to be more consideration of the citizens and Indigenous people in Australia, rather than only the ideas and values of scientists and the people in the Australian government (Independent Review, 2021). The Commonwealth of Australia needs to design national environmental standards that will help aid and regulate the EPBC Act (Independent Review, 2020). Also, the Indigenous people of Australia are supposed to play an important role in the conservation process, which does not seem to be happening. In order to make sure that the EPBC is including the views of everyone for the overall benefit of the biodiverse Australian environment, these two groups need to be considered and share their ideas.

5.3 Concluding Remarks

The fast rate that coral bleaching is occurring in the Great Barrier Reef needs to be slowed down in order to prevent the majority of the reef from dying forever. Once the corals are bleached, it is very unlikely for them to gain their color back, since the armer temperatures cause them to repeal the algae that gives them their color. Even if the coral does not die from becoming

bleached, they still become more vulnerable to getting further bleached and to dying from other factors. Also, if the corals are dead and diminished, the rest of the diverse ecosystem in the Great Barrier Reef is also affected. It is a continuing connection between the corals, fish, algae, sea turtles, and other marine mammals that use the corals for protection and as part of the food chain. If the majority of the corals are dead, the algae will have less places to live since they are no longer living inside the tissues of the corals. Also, fish and smaller marine animals will have less places to hide from larger marine predators, which will just lead to a decrease of many other organisms living in the Great Barrier Reef. Coral bleaching can only be slowed down if climate change stops rising at such a fast rate, since they go hand in hand with each other. In order for this to happen, people need to be more aware of what they do in their everyday life's. Driving around aimlessly releasing greenhouse gasses into the atmosphere, constantly using single-use plastics, littering, and so many more common daily actions need to be prevented and taken seriously so climate change can stop increasing at such a fast rate. With these actions, the corals in the Great Barrier Reef can get back to looking extremely colorful like the ones in Figure 24 below.

Figure 24: *Corals*

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