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Policy Briefing

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OCEAN ACIDIFICATION: A HIGHWAY TO HELL FOR AUSTRALIA

Urgent Action: Proceed to a Nation-Wide Energy Transition

The Honorable Josh Frydenberg MP, Australian Minister for Environment and Energy

Mr. Frydenberg is responsible for developing and implementing national policies that ensure the protection and the conservation of Australia's environment, acting as the liaison between the executive and environmental activists[1]. His powerful platform offers opportunities for collaboration and funding for sustainable development projects.

Executive Summary

Ocean acidification is a planetary boundary[2] and represents a global threat to biodiversity and the economy[3]. It is particularly dangerous for Australia's development[4]. This issue requires urgent governmental action.

Atmospheric CO_2 concentration has been growing exponentially, causing seawater pH to decrease at alarming rates[5], producing serious effects on marine ecosystems and threatening the growth and the survival of corals and other sea creatures[3]. The perturbation of ecosystem services can produce a domino effect, significantly damaging the social, environmental and economic development of the country[6]. The disruption of marine ecosystems could cost 1.3 trillion AUD annually to the global economy by 2100[7]. Australia's economy will undoubtedly suffer from rising unemployment and slower growth if its unique natural marine heritage is degraded[8].

Australia currently has inefficient ecosystem protections and CO_2 limitations in place[9], and is lagging behind in terms of renewable energies[10]. There is a concerning disregard to sustainability from the population, which will only aggravate the consequences of climate change[42]. Thus, the government needs to initiate nation-wide awareness campaigns. In order to reduce CO_2 emissions, Australia needs to proceed to an energy transition to renewable energies. Therefore, this proposal suggests to implement deterrent tax measures on polluting industries. Australians also need to switch to a sustainable lifestyle, encouraged by the subsidization of greener alternatives and tax deductions.

A

B

The Great Barrier Reef has been named one of the seven natural wonders[11] of the world and is a UNESCO World Heritage Site[12]. Its exceptional beauty strongly benefits the Australian economy by supporting tourism and commercial fishing[13].

Empirical Analysis

The Challenge

Atmospheric CO_2 emissions have grown exponentially since the 1800s[14] (Fig.1), which caused a global increase of acidity in oceans (-0.1 pH)[15]. Today, the atmospheric CO_2 concentration is 401 ppm in Australia, for a pH of 8.2 in the ocean[16]. The two variables are related: 30% of atmospheric CO_2 is absorbed by oceans, where it dissolves and reacts with seawater[17]. A sequence of chemical reactions (Fig.2) causes the pH of oceans to decrease (acidification)[18]. Estimations reveal that Australian waters will have a pH of 7.8 by 2100, a severe decrease of 0.4 pH if the trend is not reversed[19].

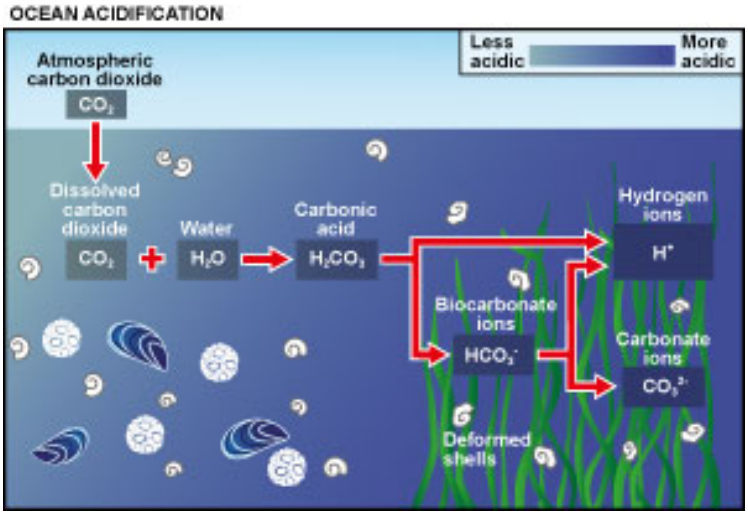

Fig.2:[18] Chemical reactions leading to ocean acidification.

The Consequences

Ocean acidification has considerable consequences on biodiversity, as it jeopardizes the growth and the survival of corals and other sea creatures[19]. An excessive atmospheric CO_2 concentration will result in a shortage of calcium carbonate in seawater, which is essential to shellfish[19]. The increased acidity threatens their shells of dissolution (Fig. 4)[21]. The situation is dramatic: the Great Barrier Reef is severely endangered, having already lost up to 67% of its corals in some areas (Fig.3)[22].

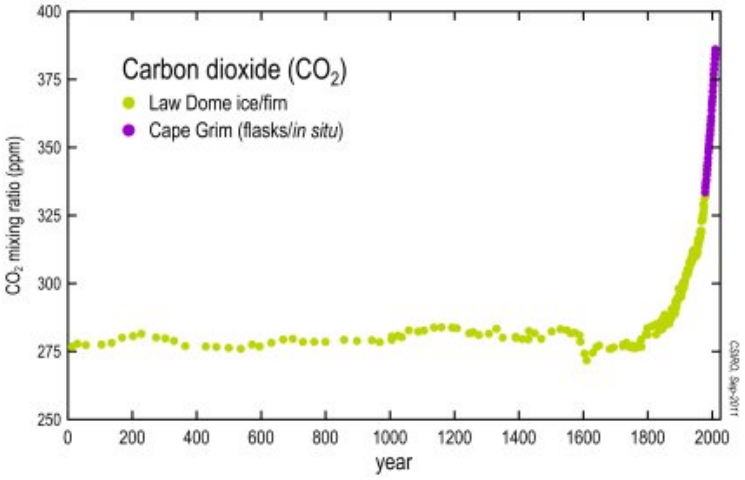

Fig.1:[14] Atmospheric CO_2 concentration in Tasmania, Australia in the last 2000 years. The growth has been exponential in the last 200 years, epoch often qualified as the Anthropocene[20].

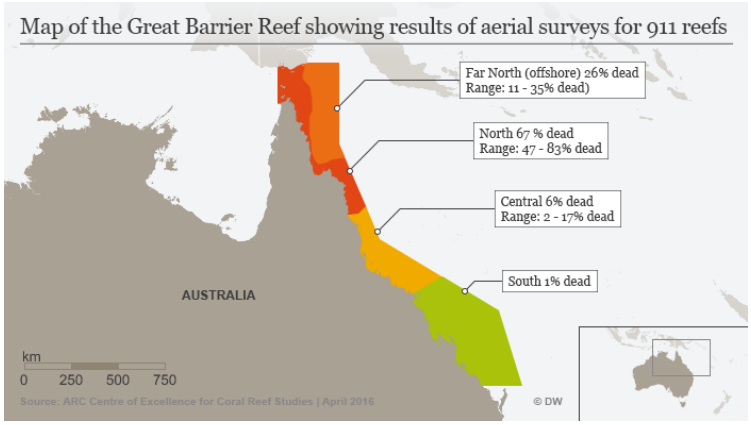

Fig.3:[26] Ocean acidification has led to severe degradations of the Great Barrier Reef, with a considerable percentage of reefs dying.

Fig.4:[21] Shells dissolving in lab-simulated ocean acidification conditions.

Current Response

No solutions have been found to noticeably mitigate ocean acidification[23]. Australia invested 2 billion AUD in its Reef 2050 Plan, which sets 151 actions to protect the Great Barrier Reef[32]. The government concedes that an acceleration of the recovery process is necessary[24]. The Plan has taken the first steps to facilitate collaborative research and community awareness[24]. However, as of 2013, the country did not have any type of CO_2 emission standards to reduce greenhouse gas emissions from fossil fuels[25]. Australia has since tightened its vehicle emissions based on the EURO 5 standard[26] (1.0g/km of CO for petrol cars and 0.5g/km of CO for diesel cars)[27]. The average age of a registered vehicle is 10 years old, which reveals a significant number of non-compliant vehicles[28].

Economic Impact

Ocean acidification could cost 1.3 trillion AUD annually to the global economy by 2100[7]. The phenomenon endangers important ecosystem services (Supporting, Provisioning and Cultural[6]). Coral reefs boost tourism, protect shorelines and provide fish habitats[29]. Their disappearance would cost 40 billion AUD per year[29]. Additionally, the death of marine organisms, such as fish and shellfish, would cost 104 billion AUD to the world economy every year[29].

The Great Barrier Reef alone contributes 7 billion AUD to the national economy[4]. Its death would significantly raise unemployment[4]. Tourism represents more than 2.4% of the annual Australian GDP and Agriculture, Forestry and Fishing contribute to 2.2%, as they are essential to agribusiness. Agribusiness and Tourism are highly productive in the country (127% and 146% respectively on the Productivity Index[30]). Australian tourism represents nearly 1 million direct and indirect jobs (8% of the active population[31]). Thus, the Australian economy strongly relies on the Great Barrier Reef and would be largely impacted by the consequences of ocean acidification[4] (Fig. 5,6). What is more, the phenomenon could impact keystone species[10] and disrupt the food web, which could have unpredictable social and economic consequences[5].

C

Fig.5: The Great Barrier Reef represents more than 70,000 jobs. Its death would significantly raise unemployment and cause a social, economic and environmental crisis[4].

D

Fig.6: The value of Australian fisheries and aquaculture is estimated to 2.4 billion AUD annually[33].

Assessment

The main cause of ocean acidification is excessive atmospheric CO_2 concentration[2]. The current response represents a solid foundation upon which to build. Four discussion points are pertinent to the limitation and reversal of ocean acidification.

RESEARCH AND INNOVATION

There are uncertainties regarding the impact of ocean acidification on marine organisms[34]. The rate of the phenomenon and the interactions with other climate-related effects are unknown, representing a gap in the existing research and knowledge required to make further changes[34]. Although slow and expensive[35], research needs to become a priority as no appropriate mitigations can be found without an in-depth knowledge of ocean chemistry[36]. Australia needs to multiply the Reef 2050 research initiatives, currently underfunded.

It is argued that a green lifestyle is expensive and too restrictive[37]. Encouraging innovation through social entrepreneurship will lead to the development of green technologies, which will enable Australians to adopt a sustainable lifestyle without such costs[38].

MITIGATION

The negative social and economic impacts of ocean acidification are questionable[39], as it is difficult to evaluate the costs and value of marine biodiversity through these aspects alone[39]. However, its environmental impact is undeniable and requires urgent action[40]. While industrial fishing largely contributes to the national economy[30], we need to offer short-term relief to endangered species. Fishing restrictions have a negative short-term economic impacts but in the long-term reduce very significant costs[39].

The reticence of the government to implement strict emission standards and to introduce deterrent taxes are obstacles to the reversal of ocean acidification[23]. The revenue from deterrent carbon taxes has to be reconverted in sustainability policies and not simply absorbed in the general revenues. In the short-term, deterrent taxes raise prices and impact economic growth[41] but this effort is necessary to reduce CO_2 emissions and limit the aggravation of ocean acidification.

Vehicle emission standards are positive, but the majority of cars remain noncompliant[28]. This renders standards ineffective on the short-term. The transition from noncompliant vehicles to electric cars can be subsidized.

AWARENESS

The popular disregard of sustainability is problematic, as community participation is essential for the decrease of atmospheric CO_2 emissions and the achievement of a long-term energy transition[42].

ENERGY TRANSITION

The energy transition is a long-term process. However, the decrease of CO_2 emissions will be noticeable very quickly[43,44], with the efforts from the community and the gradual reduction of coal power plants. This energy transition will also help Australia keep its COP21 commitment.

Recommendations

Urgent action is needed to mitigate serious risks for biodiversity and the national economy[39]. Four pillars are essential to limit and reverse ocean acidification: Mitigation, Awareness, Innovation and Energy Transition. The following recommendations offer immediate relief for marine ecosystems as well as policies that will have a long-term impact and that will tackle the problem at its roots, to ensure sustainable change.

Policies that can provide funding for other recommendations are underlined in red.

Short-Term Change

MITIGATION

While being a Marine Protected Area, the Coral Sea remains a fishing zone[45]. Working with the Department of Agriculture, Forestry and Fishing, impose short-term restrictions on the Coral Sea Fishery until atmospheric CO_2 emissions are back to safe levels, by either:

1- Restricting the commercialization of species under stress

2- Canceling fishing licenses and closely monitoring access to the Coral Reef Fishery.

A fully enforced restriction will avoid inefficient quotas like Queensland's catch limit on sharks based on inaccurate and outdated data[46], and protect species from extinction.

MITIGATION & ENERGY TRANSITION

While Australia has implemented the equivalent of EURO 5 standards on vehicle emissions[26], the government needs to encourage greener alternatives for petrol/diesel cars. Working with the Department of Infrastructure and Regional Development, establish a federal bonus for drivers who switch from a noncompliant diesel/petrol car to an electric car. This will boost electric car sales, which will create revenue for the Federal Government and increase economic activity. France has been highly successful in introducing a 10,000€ bonus, with electric car sales doubling in a year[47].

ENERGY TRANSITION

Introduce federal tax deductions for households which take significant steps in limiting their CO_2 emissions. Such initiatives include: Installing solar panels, wind turbines, sustainable home insulation etc. An incentive to limit CO_2 emissions will boost economic activity and employment in sectors such as construction. The success of tax deductions has been proven in France[48].

Medium-Term Change

AWARENESS

Run nation-wide awareness campaigns on the dangers of ocean acidification. Include the protection of the national environmental heritage in all school curriculum to raise awareness to the threats and encourage a clean lifestyle.

INNOVATION

Encourage innovation and social entrepreneurship by facilitating the setting up of startups for sustainable development. Innovative technology will encourage Australians to adopt a green lifestyle, and can be commercialized abroad. The success of such measures was proven by Japan and the US[49]. The Federal Government needs to pay the Administrative Services Organization fee (2500 AUD[50]) to facilitate paperwork. The government also needs to provide micro loans to entrepreneurs to help them launch their startup for sustainable development.

INNOVATION & MITIGATION

Create a collegium of researchers from Oceania (Australia, Indonesia, Papua New Guinea, France: New Caledonia) with the aims of:

1- Gaining a deeper understanding of ocean chemistry and the interactions of various climate-related effects

2- Developing approaches to limiting and reversing ocean acidification

The Australian Government and other participant countries need to allocate funding to researchers, hence the importance of transnational collaboration. This will allow Australia to be highly competitive internationally and to become a leader in sustainable development research and innovation.

Long-Term Change

ENERGY TRANSITION

Proceed to a nation-wide energy transition by switching to renewable energies. The following long-term recommendations are essential to this transition.

1- The Federal State needs to subsidize wind and solar farms across the country as soon as possible. It needs to make significant efforts to link these farms with densely populated areas.

2- Impose strict deterrent taxes on coal to make renewable energies competitive and attractive.

3- Impose import taxes on foreign polluting industries.

4- Set rigorous CO_2 emission standards on all industries to lower CO_2 emissions per capita. In parallel, reinforce monitoring systems regarding air pollution regulations.

1 and 2 need to be done in parallel, so as to not create an energy shortage.

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