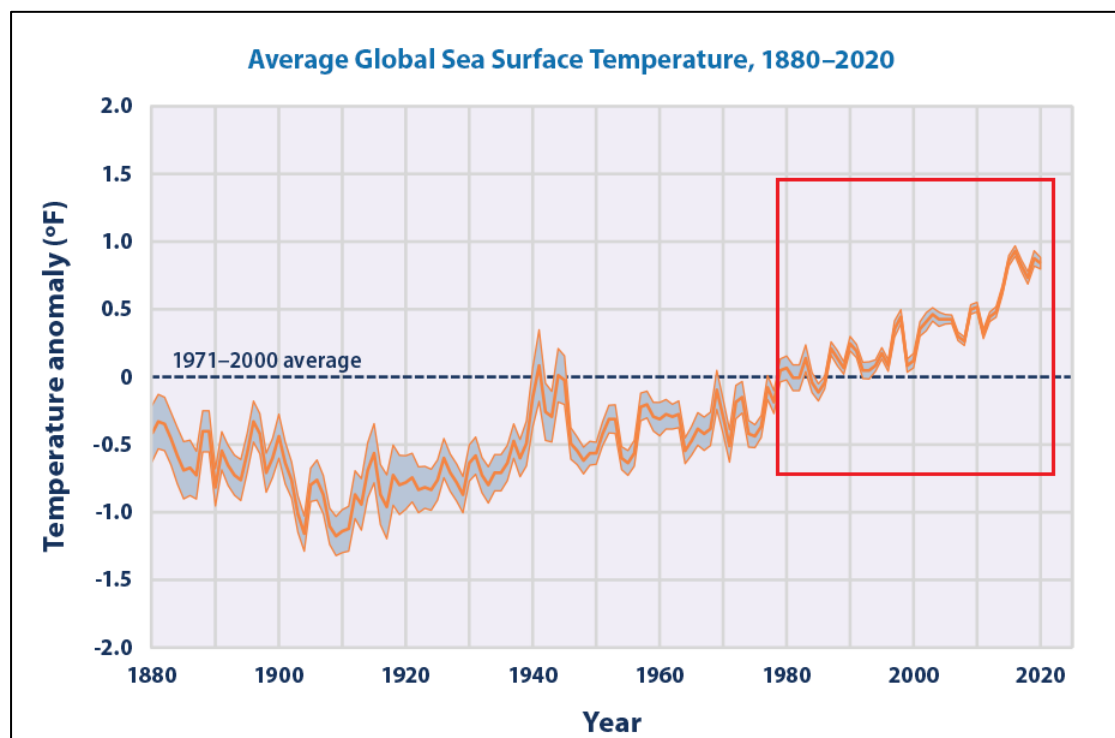


## China Coastal Decarbonisation

Since the world ocean covers with approximately 70% of the earth's surface. It is inevitable that the ocean is the major driver of the global economy, beside that it also sustains 40% of humanity that lives within 100km of the coast (World Meteorological Organization-WMO, 2021)<sup>[1]</sup>. Moreover, the ocean is also a major driver of the world's climate change, with two-way relationship between ocean and climate, it is understandable that ocean actually plays a central role in the climate change. On the same time, changes in weather can fundamentally alter many properties in the ocean.

Normally, the greenhouse gas (GHG) is the main reason of the earth's temperature rising each year or this phenomenon can be defined as climate change. Since the GHG traps more energy from sun, this has impacted the ocean to absorb more heat which result in increase of sea surface temperature and rising sea level. As stated before, it might alter many properties from the ocean. For example, warmer waters may promote the development of stronger storms in the tropics, which can harm the biotics and coastal ecosystem. In China, Liang, Xian and Pauly (2018)<sup>[2]</sup> recorded the ocean warming that occurred on Yellow Sea, East China Sea and South China Sea have impacted on overall China's marine fisheries. Below, it is the data of average global sea surface temperature from 1880 to 2020.



**Figure 1.** *Average Global Sea Surface Temperature between 1880 and 2020* (Data: National Oceanic and Atmospheric Administration – NOAA, 2021)<sup>[3]</sup>

The shaded band shows the range of uncertainty in the data, based on the number of measurements collected and the precision of the methods used. The left side of the graph represent the Temperature anomaly (°F) and the bottom is the time series from 1880 to 2020. NOAA<sup>[4]</sup> defines the temperature anomaly as the difference from the average temperature (in ratio),

- A **positive anomaly** indicates the observed temperature was warmer than the baseline,
- A **negative anomaly** indicates the observed temperature was cooler than the baseline.

On **Figure 1**, we set the baseline temperature (dash line) with the average of 29 years of global temperature from 1971 to 2000. It can be seen that starting 1980 the sea surface temperature is getting warmer than the average; this comes from the indication of positive temperature anomaly. Since then, the sea surface temperature is consistently higher than the average temperature. According to NOAA<sup>[5]</sup>, it reached the highest temperature in 2016. While in 2020, the ocean surface temperature just slightly smaller than 2016. However, this is still very concerning due to the fact that the 2020 sea temperature still far above average temperature. If there is no action to tackle this issue, it will ruin the prosperity of marine ecosystem in the future.

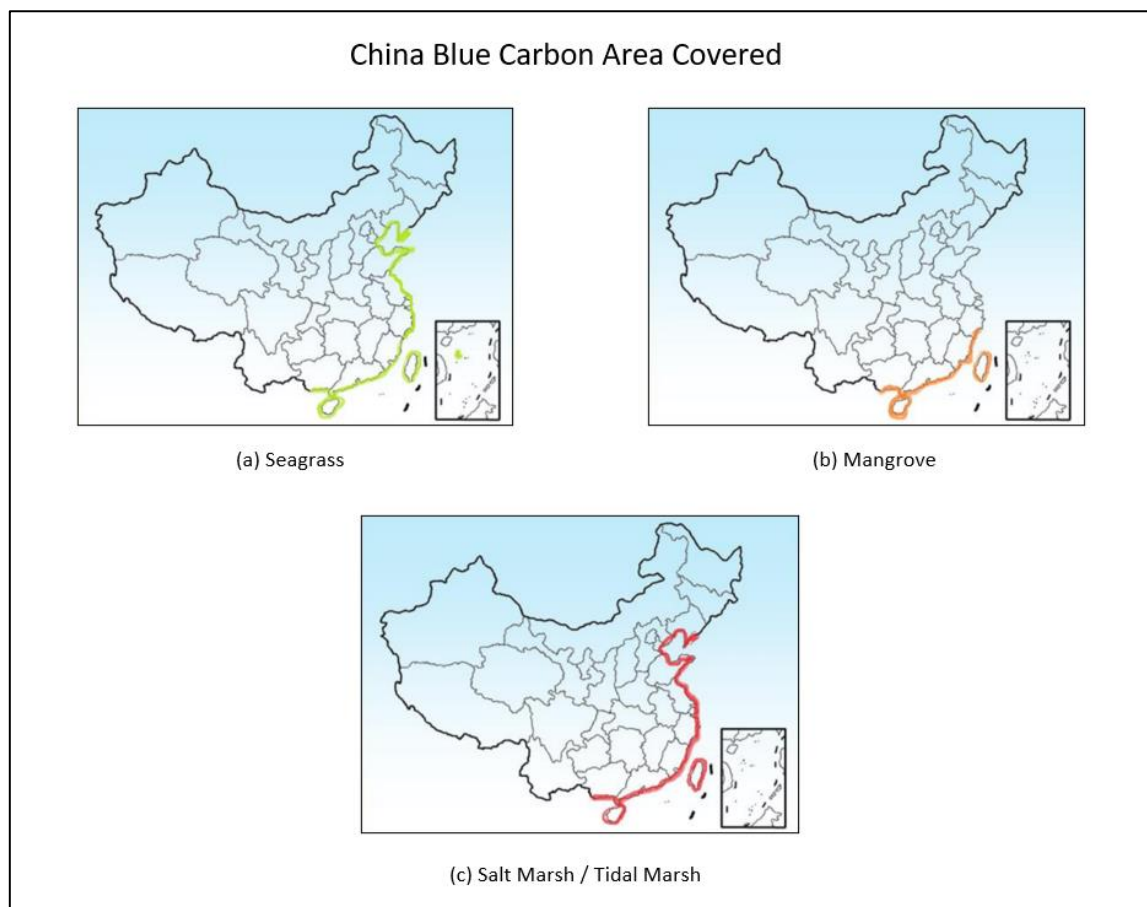
Another problem is the increase of the sea levels. As the global climate increases, it will affect the glacier or iceberg. They will melt and add to rising sea levels, which might increase coastal erosion and elevates storm surge due to warming air and ocean. Hancock (2021)<sup>[6]</sup> found that Greenland and Antarctic ice sheets are the largest contributors of global sea level rise. As sea level rises, dry land and wetlands can turn into open water especially the coastal area. Environment Protection Agency (EPA)<sup>[7]</sup> stated that the land sinking has occurred in many parts of Atlantic coast, this is due to low elevation and sea level rise. Moreover, this might also harm the coastal communities & cities, properties and coastal wildlife habitat. In 2021, Maizland (2021)<sup>[8]</sup> also projected if the global average temperature is rose by 2°C by the end of the century, some of China's coastal cities, such as Shanghai will potentially be submerged. Thereby, approximately forty-three million people in China live on land could be underwater by the end of the century.

Despite the climate change issue, the CO<sub>2</sub> emissions from the greenhouse gas that trapped in the sea also make the ocean more acidic. Scientifically, increasing levels of dissolved carbon are changing the chemistry of seawater and making it more acidic. This makes it more difficult for corals, some types of plankton, and other creatures to produce a mineral called calcium carbonate, which is the main ingredient in their hard skeletons or shells (EPA)<sup>[7]</sup>. As stated in Yuan et al. (2019)<sup>[9]</sup> report, the South China Sea also experienced pH decreased at a rate of 0.012-0.014/year in the recent decade. This acidification is due to the CO<sub>2</sub> and warming on corals calcification rates. As the result, many coral calcification processes are hindered.

With so many concerns towards the coastal areas, definitely solutions need to be brought up. Precisely, solutions to tackle the climate change and remove as much carbon that exist in the ocean. However, the problem of coastal climate change is mainly from the human activities such as mass illegal fishing, mass coral bleaching and coastal pollution. This eventually will result to the loss of the marine biodiversity. Therefore, to minimize or prevent further loss, the humankind can start from the small action such as reducing the coastal pollution and be more responsible towards the coastal ecosystem. Moreover, further encouragement from the government and coastal communities also required to achieve the coastal decarbonisation.

In order to reach the low carbon in coastal ecosystem, many initiatives can be done. For instance, apply the blue carbon initiative to reduce the carbon matter in the sea. More investment on coastal clean and renewable energy to reduce the greenhouse gases. Finally, carbon trading to reduce both the carbon and tackle climate change as well.

First, by apply the blue carbon initiative might remove as much carbon that exist in the ocean. According to Climate Analytics<sup>[10]</sup>, Blue carbon is a term for the carbon sequestered in coastal ecosystems, such as mangroves, tidal marsh and seagrass. In other words, the marine ecosystem that managed to store carbon which mitigate the carbon rate in the open ocean. Moreover, Zhao and Shi (2019)<sup>[11]</sup> also stated, out of all biological carbon captured in the world, around 55% of them are captured by the marine living organisms. This shows how dominant is the role of the marine carbon sequestration. On the same time, the underwater soil can play big role on coastal carbon sequestration as well, likewise the agriculture sector, the soil might capture the carbon and bring benefit for the seagrass and mangroves. However, unconsciously large coastal areas and ecosystem have been deforested and degraded by the human activities (Climate Analytics)<sup>[10]</sup>. This has led to carbon emission due to the carbon release from coastal deforestation. In China, Zhao (2018)<sup>[12]</sup> recorded the area of seagrass, mangrove and salt marsh covered respectively.



**Figure 2.**

- (a) The area covered by Seagrass in China (Green).**
- (b) The area covered by Mangrove in China (Orange).**
- (c) The area covered by Salt Marsh/Tidal Marsh in China (Red).**

He found that China has about 30,000 hm<sup>2</sup> of seagrass distribution near along the coastline. Yet, over 80% of seagrass has disappeared since 1950. Similarly, the mangroves are spread on the coast to the south of Zhejiang Province which covered 25,000 hm<sup>2</sup> and since 1950, over 40% of mangroves has disappeared. Finally, the nation-wide distribution of salt marsh is about 1,207 km<sup>2</sup> to 3,434 km<sup>2</sup>, and there is no record of the reduction rate (Zhao, 2018)<sup>[12]</sup>. As we

can see, the reduction rate of China's carbon storage has been significant since 1950 especially the population of seagrass, which are mainly due to human activities like coastal deforestation and climate change.

In order to tackle this issue, restoration or reforestation on seagrass and mangroves is required. Preserve the coastal ecosystem such as salt marsh is important for human to remove the carbon from the ocean as well. With this blue carbon initiative, it could provide numerous crucial services, both for the people and biodiversity. In December 2018, the Chinese Government declared The Second Biennial Report<sup>[13]</sup> ([Official Version](#)) in the issue to tackle the climate change. In the **Part 3; Chapter 2.6**, they brought the idea on developing the marine blue carbon sink. In the report, it stated that China carried out several blue carbon initiatives such as "South Mangrove and North Willow" wetland restoration program, "Eco-Island and Reef" project and "Blue Gulf" renovation program. On the same time, they also manage to strengthen the marine carbon sinks and increase blue carbon pilot program. Later in May 2019, China unveiled "The Implementation Plan for the National Ecological Civilization Pilot Zone (Hainan)" (Xinhuanet, 2019)<sup>[14]</sup>. The pilot zone aims to achieve as world leading level in terms of environmental quality and resource utilization efficiency.



*Sanya city, South China's Hainan province as the pilot zone (China Daily)*

Moreover, since Hainan which is the target of the pilot zone, is the coastal province. Not only optimizing distribution of land, but they also focus on the sea conservation and development as well. Thus, the blue carbon might be vital aspect for Hainan to achieve the ecological civilization as pilot zone.

Another way to tackle climate change is by reducing more of greenhouse gases. Beside the carbon sequestration, the coastal communities might also embrace the clean and renewable energy to produce electricity. By utilizing the coastal natural power such as offshore wind, sea tide and sea wave. Such input power will serve as kinetic energy by moving the turbines to produce the electricity. Since China pledged to achieve the 2030 carbon peak and 2060 carbon neutrality, the practice on replacing coal with the renewable and clean energy is essential. To

reach these goals and tackle the world climate change, China made several commitments through the 2015 Paris Agreement (UNFCCC)<sup>[15]</sup>. As part of the agreement, China committed to peaking its carbon emissions by 2030 and increasing the share of non-fossil fuels consumption to 20% of total consumption simultaneously. This means more investment in the clean and renewable energy in the future, this includes the offshore wind, tidal and wave energy. Furthermore, on 11 March 2021, Chinese Government<sup>[16]</sup> declared 14th Five-Year Plan. Specifically, in the **Chapter 11; Section 3**, they stated to increase the number of capacities and accelerating the offshore wind development. On top of that, the Chinese government also declared the Feed-in-Tariff (FiT) policy in 2019 to subsidize the China's offshore wind project until the end of 2021 (Russell, 2019)<sup>[17]</sup>. With the incentive and goals need to be achieved, the future of coastal clean and renewable energy is very promising.

However, both blue carbon projects and coastal renewable energy building require huge cost to make it happen. The coastal communities definitely will not have so much budget to cover big projects. Therefore, this is where blue carbon trading is come in handy to keep the community alive. Nowadays, many private enterprises and government start to promote the blue carbon trading as well. They hand in hand with the communities or local society to preserve the ocean, biodiversity and the coastal environment together. For instance, Apple Inc.<sup>[18]</sup> and coastal restoration organization Blue Ventures<sup>[19]</sup>, are investing in voluntary markets for blue carbon. Moreover, Jones (2021)<sup>[20]</sup> reported that a non-profit carbon credit regulator organization Verra has issued a grand total of just under 970,000 credits (which is equivalent to 970,000 metric tons of CO<sub>2</sub>) to blue carbon projects. Despite the market for private investment is still new, but such impact will help the progress to reach future coastal low carbon.

Looking all the schemes, the future of China's coastal decarbonisation is very desirable. Especially, in the blue carbon, the Chinese government agency actually managed to conserve the blue carbon with the Paulson Institute<sup>[21]</sup>. The Conservation Program delivers a lasting impact by addressing some of the most pressing environmental challenges facing China and the world. Moreover, since the blue carbon market capital is not as huge as the green carbon market. Thus, blue carbon could be a crucial pathway for increasing private investment in coastal and marine conservation projects as well. One reason it is not so popular is because the risk-reward of this investment is considered not being payoff, this is due to the uncertainties from natural occurrence still appeared in many blue carbon project (Climate Analytics)<sup>[10]</sup>. Regarding to same issue, The Blended Finance Task Force's Investor Roundtable<sup>[22]</sup> addressed the solutions, which to mitigate the blue carbon risk, the blue carbon revenue streams could be obtained by combining with projects such as sustainable fisheries, ecotourism and coastal infrastructure. To make these investments more viable in the future, it is suggested to be done with more standardized and measurable performance tool.

Future education on blue carbon initiative and long-term effect is required. Nowadays, people still have no idea about the blue carbon initiative. This education is very important, more people will become aware and concern by helping the communities to preserve the coastal ecosystem and its biodiversity. On the same time, it also helps the world to tackle the climate change as well. In addition, people will realise on how disastrous our world in the future, if the ocean keep heating up and its level rises each year.



On the bright side, with the 2030 carbon peak and 2060 carbon neutrality goals. China surely will be a pivot country to tackle the global climate change. Moreover, with implementation of Hainan as the pilot zone to achieve the national ecological civilization and the announcement to implement Hainan with Free Trade Port (FTP) system by year 2021. It is predicted that more investment will come from both locals and foreigners. As the coastal province, Hainan definitely is one of the biggest contributors for Blue Carbon Trading and Investments. Thus, with these programs, it is expected more people will take the blue carbon seriously and hope that Hainan could become a global example of a successful blue carbon initiatives. Furthermore, with the FiT policy for the offshore wind construction, it is also expected more investments for the clean and renewable energy in Hainan. Therefore, Hainan will be a vital asset for China and world to achieve the future low carbons.

In conclusion, there are two-way relationship between the ocean and climate. Carbon that are released from the ocean will result in climate change which has significant negative effect towards the ocean such as ocean warming and sea level rise. More CO<sub>2</sub> trapped in the ocean will make the ocean more acidic as well. As the result, biodiversity, coastal ecosystem and humans are being harmed. However, to remove carbon matter on the ocean, we can do the blue carbon initiative such as restoration of seagrass and mangroves and preserve the salt marsh ecosystem, in order to increase the carbon sequestration in the ocean. Build on clean and renewable energy is the solution to tackle climate change, especially the offshore wind, tidal and wave power for the coastal communities. Yet, the renewable energy and blue carbon project require big funds to make it happen, therefore the blue carbon trading is introduced to fund and realized all the big projects. More technology investment, research and education on blue carbon also need to be considered in the future. Despite all the hurdle, Hainan has been introduced as the pilot zone to reach the ecological civilization goal. The solutions on blue carbon, clean & renewable energy investments and blue carbon trading will be fitted with Hainan as a coastal province, especially after introducing the FTP system. It is expected that Hainan can be a pivot for the future global and China blue carbon instances, and be a vital asset for China to reach the 2030 carbon peak and 2060 carbon neutrality goals.

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