Expansion of Blue Economy Startup Sea the Change Into New Markets

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An Interactive Qualifying Project
submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfilment of the requirements for the
degree of Bachelor of Science

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Date:
01 March 2024

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Abstract

Climate change is devastating the world's oceans through rising sea levels, acidification, and loss of biodiversity. Sea the Change, an Italian startup, markets marine conservation projects as carbon offsets and seeks to expand into the US, UAE, and Latin America. This project researched competitors, legislation, industries, and projects to assess the potential for entering voluntary carbon markets in each region. We compiled a comprehensive report of expansion resources and provided it to Sea the Change to support their business's growth.

Acknowledgements

The team would like to thank Luca Barani and Alberto Carpanese at Sea the Change for their guidance on this project. We would also like to thank our IQP advisors, Isa Bar-On and Michele Femc-Bagwell, who were invaluable resources for the team over the 14-week span of our project.

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Blue Carbon	Camille Gipson	Michael Demetriou
Carbon Credits and Verification	Michael Demetriou	Serena Gerome
Carbon Markets	Serena Gerome	Camille Gipson
Motivations for Participation in the Voluntary Blue Carbon Market	Maya Evohr	Serena Gerome
Challenges of the Voluntary Market	Maya Evohr	Camille Gipson
Sea the Change	Camille Gipson	Maya Evohr
Methodology		
Goals and Objectives	Michael Demetriou, Maya Evohr, Serena Gerome, Camille Gipson	Michael Demetriou
Objective 1	Maya Evohr	Serena Gerome
Objective 2	Serena Gerome	Michael Demetriou
Objective 3	Serena Gerome	Michael Demetriou
Objective 4	Camille Gipson	Serena Gerome
Results		
Competitor Analysis	Michael Demetriou, Maya Evohr, Serena Gerome, and Camille Gipson wrote an equal number of sub-sections	Camille Gipson and Maya Evohr
Laws and Legislation	Michael Demetriou, Maya Evohr, Serena Gerome, and Camille Gipson wrote an equal number of sub-sections	Maya Evohr
Expansion Options: Project and Industry Research	Michael Demetriou, Maya Evohr, Serena Gerome, and Camille Gipson wrote an equal number of sub-sections	Michael Demetriou
Discussion		
Discussion Overview	Maya Evohr	Serena Gerome
Competitor Analysis	Camille Gipson	Maya Evohr
Legislative Discussion	Maya Evohr	Camille Gipson
Regional Potential for Expansion	Michael Demetriou and Maya Evohr	Serena Gerome
Project Comparison	Serena Gerome	Michael Demetriou
Suggestions for Expansion	Serena Gerome	Camille Gipson
Ethical Considerations	Michael Demetriou	Serena Gerome
Challenges and Limitations	Michael Demetriou	Camille Gipson
Future Work	Michael Demetriou	Serena Gerome
Conclusion	Maya Evohr	Camille Gipson

Table of Contents

Table of Figures

Table of Tables

Chapter 1: Introduction

Climate change is a threat to the world's marine ecosystems. A rise in sea levels is jeopardizing seacoasts around the world, caused by globally rising temperatures that are melting polar ice caps and glaciers (European Union, n.d.). This puts coastal cities and towns in harm's way and endangers vital coastal ecosystems including mangroves and coral reefs.

The absorption of excess carbon dioxide is causing ocean acidification. This poses a serious threat to marine life, especially sea creatures with calcium shells such as corals and mollusks (Gattuso et al., 2018). Coastal ecosystems can serve as buffers against storms and provide critical habitats for marine species, but as these ecosystems are deteriorating, the loss of biodiversity is having profound consequences for millions of people who depend on the ocean for fishing, tourism, and other maritime activities (European Union, n.d.). The rapid deterioration of our climate and ecosystems highlights the urgent need for the mitigation of climate change. A plan is needed ensure the health of both marine ecosystems and humans. One of the many ways to mitigate the effects of climate change is through supporting the conservation of carbon sinks such as marine plants and ecosystems (National Oceanic and Atmospheric Administration, 2023).

Blue carbon focuses on carbon storage within marine ecosystems such as mangrove forests and seagrasses. By creating and conserving marine carbon sinks, carbon is trapped in leaves, roots, and sediment, keeping the carbon out of the water and avoiding acidification. These carbon sinks must be protected, as their deterioration would cause a rapid influx of carbon into the ocean. Conservation of carbon sinks and other marine environmental projects are partially funded by carbon credit systems. A carbon credit is a way for individuals or companies to offset their greenhouse gas emissions by paying a third party to reduce or remove emissions elsewhere.

Sea the Change is a startup that connects businesses with environmental projects that address the impacts of climate change on marine environments. Our team's goal was to create resources for Sea the Change to use to expand into markets in the United States, Puerto Rico, the United Arab Emirates, Costa Rica, and Colombia. Working with Sea the Change, we suggested methods for them to expand their business within these regions and supported our claims with research. This was accomplished by investigating competing companies involved in marine conservation projects, creating a summary of relevant legislation, and conducting in-depth project and industry research. This research was then compiled into a comprehensive report that will guide Sea the Change in their expansion efforts.

Chapter 2: Background

Impacts of Climate Change on Marine Ecosystems

Climate change is negatively impacting the environment worldwide as global temperatures rise. Climate change has primarily been caused by humans and the effects of their activities on the Earth's shifting makeup of greenhouse gases over the past two centuries (Mikhaylov et al., 2020). Greenhouse gases are any gases that trap the Earth's heat and include water vapor, carbon dioxide, methane, and ozone (Mikhaylov et al., 2020). Detrimental changes in the Earth's makeup of greenhouse gases are primarily caused by fossil fuel combustion and industrialization (IPCC, 2023). These human-caused changes have led to an estimated 1.07° C increase in global temperature since 1850 and have had negative impacts worldwide (IPCC, 2023). This problem has been escalating over time, with 42% of all carbon dioxide emissions since 1850 taking place in a twenty-nine-year period between 1990 and 2019 (IPCC, 2023). There are vast repercussions of climate change on vulnerable populations and ecosystems—including marine environments—globally.

Emission of greenhouse gases such as carbon dioxide are devastating the world's oceans, raising sea levels, increasing water temperatures, acidifying seawater, and lowering oxygen levels (US EPA, 2022). The oceans generate 50% of the world's oxygen, capture 25% of all carbon dioxide emissions, and absorb 90% of excess heat generated by these emissions (United Nations *The ocean*, n.d.). As such, the oceans play a crucial role in tempering the effects of climate change globally, but in the process, they are being negatively impacted. The excess heat absorbed by the oceans warms them and the increased concentration of carbon dioxide being captured causes ocean acidification (World Meteorological Association, 2022). Temperate seagrass ecosystems are threatened by increasing water temperatures, and ocean acidification is

causing extensive damage to coral reefs (Gattuso et al., 2018). In addition, sea levels rose an average of 4.5 millimeters per year from 2013-2021, threatening arctic biota, mangroves, and salt marshes (World Meteorological Association, 2022). These climate impacts have already begun to decrease marine biodiversity and threaten coastal communities.

Marine effects of climate change have a widespread impact on humans as well. Marine environments support 3.3 billion people who rely on fish for protein and marine industries employ nearly 60 million people (United Nations *How is climate change...*, n.d.). In 2021 alone, over two million people were displaced from their homes due to hydro-meteorological hazards, and flooding caused over 110 billion USD in economic losses (World Meteorological Association, 2022). Humans impact marine ecosystems in a much more widespread manner than they impact land-based ecosystems because human impacts on land-based ecosystems are more localized than human impacts on marine ecosystems (Hillebrand et al., 2020). As such, it is difficult to place blame for specific marine impacts on certain locations, corporations, or unsustainable practices. Therefore, a country-wide or global plan is needed to mitigate the harmful effects of climate change on marine ecosystems.

Blue Carbon

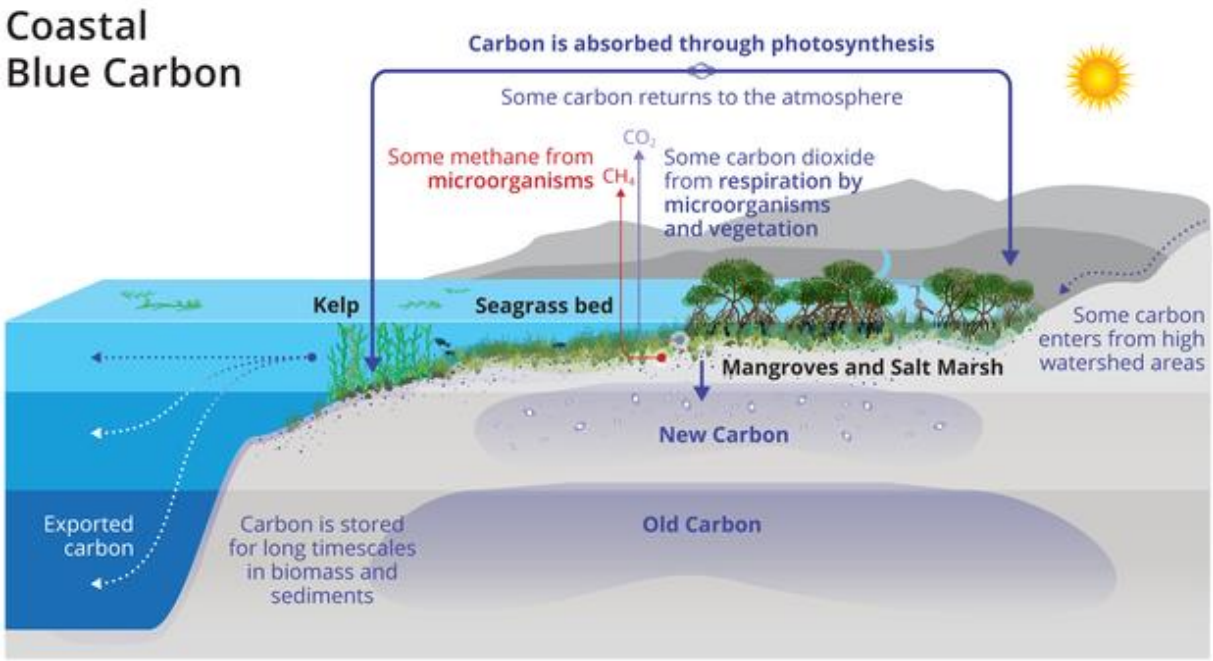
Blue carbon is carbon captured by the ocean and coastal ecosystems around the globe. A carbon sink is anything that absorbs more carbon from the atmosphere than it releases (ClientEarth Communications, 2020). Sea grasses, mangroves, and salt marshes along coasts capture and hold carbon, acting as carbon sinks. These coastal systems, though much smaller than the planet's forests, sequester carbon at a much faster rate and can continue to do so for millions of years, making them a valuable tool in carbon reduction (National Oceanic and Atmospheric Administration, 2013). They capture and store carbon dioxide from the atmosphere

through photosynthesis and the accumulation of organic matter in their soil. Coastal ecosystems, if disturbed or drained, can release substantial amounts of carbon dioxide back into the atmosphere. However, if they are protected or restored, they can become a valuable tool for offsetting carbon dioxide emissions (Lindsey, 2022). If coastal ecosystems are not protected, they will not only stop absorbing carbon, but will also release large amounts back into the atmosphere, making them an appealing area to focus carbon neutrality efforts.

On land, animals eat plants and spread the captured carbon throughout the ecosystem. When living things die on land, their remains usually land in the soil. Oxygen-using microbes typically go to work on those carbon-rich remains right away, breaking down dead matter and releasing carbon dioxide quickly. As depicted below in Figure 1, in places where the soil is flooded, oxygen levels are low and decomposition is slower keeping the carbon trapped for longer. (Lindsey, 2022) These factors make coastal carbon sinks much more effective at capturing and storing carbon dioxide than many land ecosystems.

Figure 1:

Coastal Blue Carbon



Note. Plants and trees in coastal ecosystems absorb carbon dioxide through photosynthesis. Some of that carbon dioxide is used to build roots and leaves, and some is buried in the soil or is carried farther away and buried in ocean sediments. Cut off from the atmosphere, these underwater soils and sediments make excellent long term carbon sinks. From Lindsey, Rebecca, Scott, Michon (2022, September 29). *Understanding blue carbon*. NOAA Climate.gov. https://www.climate.gov/news-features/understanding-climate/understanding-blue-carbon#:~:text=Blue%20carbon%20is%20any%20carbon,surge%20protection%2C%20and%20local%20economies.

Carbon Credits and Verification

A carbon credit is a unit of trade that represents the offset of one ton of carbon dioxide from the atmosphere. Carbon credits are used by companies or individuals as “permission slips” to offset their carbon emissions. There are three distinct types of carbon credits: credits from

reduced emissions, credits from removed emissions, and credits from avoided emissions, with popular projects including renewable energy, improving energy efficiency, carbon and methane capture and sequestration, and land use and reforestation ("The Ultimate Guide to Understanding Carbon Credits," 2022). A primary method of carbon removal is carbon capture, which involves capturing carbon dioxide and storing it underground or in certain types of plants (Herzog, 2020).

Blue carbon credits are a category of carbon credits that focus on the restoration and protection of coastal and marine ecosystems. In most regions, blue carbon credits have been associated with tropical environments such as mangrove forests. However, blue carbon projects in Europe are primarily based on seagrass meadows and salt marshes, which are a crucial part of the European ocean ecosystem (Hamerkop, 2021).

To ensure the reliability of the carbon credit, they often undergo a verification process. In the past there has been a problem of "greenwashing," in which companies deceptively advertise their projects and sell carbon offsets for actions that never occur. To address this issue the carbon market introduced the verification process. There are many companies that verify carbon credits, the most widely known and accepted ones are Verra, also known as Voluntary Carbon Standard, and Gold Standard. Both companies analyse each proposed project for relevance, accuracy of the carbon offset calculation, and transparency of the project. The verification process can take up to a year and involves multiple levels of verification. Verra's process involves a 30-day public review period and continued monitoring (*Verified Carbon Standard*, n.d.). Gold Standard requires a stakeholder consultation meeting, desk review and an in-person field visit (*Gold Standard*, n.d.). Both companies work to ensure the trustworthiness of each approved project to avoid "greenwashing."

Carbon Markets

Carbon credits are bought and traded within carbon markets. The two types of carbon markets are: voluntary market and regulated market. A regulated market, such as the European Union Emissions Trading System (EU ETS), has regulations set at state or national levels and operates under a "cap and trade" system. A cap is a set limit on the amount of "greenhouse gases that can be emitted by the installations and aircraft operators covered by the system" (Directorate-General for Climate Action, n.d.). The cap, which is expressed as an amount of credits, is reduced annually to work towards the goal of reducing emissions over time. This ensures that the credits have market value as it guarantees the scarcity of the credits. Each year, every company under a cap-and-trade system must fully account for their excess emissions using carbon credits, otherwise they will have substantial fines. Within the market, companies mainly buy credits but can also be given some for free such as those given out by the European Commission. Trading of carbon credits is also common. If a company needs more credits for the year, they can purchase them from a company that has excess credits for that year and is looking to sell.

A voluntary carbon market allows individuals or companies to offset their carbon emissions through the purchase of carbon credits. Carbon credits are sold by various companies and organizations targeting the removal or reduction of greenhouse gas emissions from the atmosphere (Favasuli & Sebastian, 2021). Voluntary carbon credits tend to be more available as they are not restrained by a governing body and can be accessed by every sector of the economy (Favasuli & Sebastian, 2021). Both the United States and the Middle East and North Africa have established voluntary carbon markets that are expected to grow in the next decade.

In 2021 the US voluntary carbon market nearly quadrupled its size from the previous year reaching two billion USD. The US voluntary market consists mainly of major corporations aiming for carbon neutrality and buying large sums of carbon offsets to reach this goal. For example, Microsoft, a company with a goal of becoming net negative by 2030, has purchased millions of credits to reach their sustainability goal (Segal, 2023b). Microsoft has bought more than 1.5 million carbon removal credits from a company focused on re-forestation in the Amazon Rainforest. They have also recently invested in blue carbon, purchasing 12,000 carbon credits from a company called Running Tide, focused on ocean carbon removal systems (Segal, 2023a). Alongside major, well-known companies, smaller local businesses are also participating in the voluntary carbon market. For example, Machias Savings bank, a small regional bank in Maine, supports the Down East Lakes Land Trust, another small organization. Located in the Grand Lake Stream of Maine, the Down East Lakes Land Trust focuses on protecting the lakeshore and wildlife habitats within the Down East area. They currently have two registered carbon credit projects for re-forestation (Downeast Lakes Land Trust, n.d.). Machias supports the organization and the carbon-offset projects (Downeast Lakes Land Trust, 2022). Machias then promotes their commitment to the community and advertises that they are environmentally friendly.

In 2022, the global trade value of the voluntary carbon market was estimated to be 150 million tons of CO2 emissions with a corresponding 2 billion of investments USD (Gomez & Milborrow, 2023). The voluntary carbon market allows more people to get involved in the market and countries to move closer to their sustainability goals. Of the sixteen countries in MENA, thirteen of them are actively involved in the voluntary carbon market (Gomez & Milborrow, 2023). Several countries and cities including Dubai and Saudia Arabia have launched emission schemes or plan to by 2025. Saudia Arabia created the platform Voluntary Carbon

Market in 2021. This initiative focuses on the carbon market within the Middle East and North Africa and has since conducted two carbon auctions that have sold more than 3.6 million tons of carbon credits (Takla & Hassan, 2023). The most recent auction occurred on June 14, 2023, in Nairobi, Kenya. Sixteen Saudi Arabian and international companies were present and oversaw the selling of 2.2 million tons of verified carbon credits (*Voluntary Carbon Market - Carbon Neutral Acceleration*, n.d.). Carbon auctions such as this one are the typical way for carbon credits to be purchased with both the US regulated markets and the EU ETS holding online carbon auctions.

Motivations for Participation in the Voluntary Market

For companies, the primary motivations for participation in the voluntary market include achieving emissions reduction goals, increasing market competitiveness, and participating in corporate social responsibility. One study of 232 companies found that promoting environmental conservation gave businesses a competitive advantage in both differentiation (setting one's company apart from similar companies) and cost leadership (presenting one's company as the most cost-effective provider of a product or service) (Do & Nguyen, 2020). As such, participating in an environmental conservation strategy such as the voluntary carbon market can benefit companies and add value, as perceived by the consumer, to their products.

In another study, Lou et al. (2023) studied 186 companies associated with 536 carbon offset projects worldwide to determine their motivations for participating in the voluntary carbon market and found that:

> Companies driven by values and market competitiveness demonstrated a willingness to invest in high-cost projects that provide significant local co-benefits. On the other hand, companies motivated by carbon management and efficiency showed a preference for lower-cost projects, particularly those related to renewable energy. (p. 1)

When choosing specific projects to invest in, the top criterion businesses identified was benefit to local communities. Additionally, 83% of companies surveyed reported that one of their reasons for participating in the voluntary market was to cost-effectively achieve their emissions reduction goals. 32% reported that one of their reasons was to increase their market competitiveness by using offset projects as a marketing tool, and 32% reported that one of their reasons was to "uphold and embody their corporate values" (Lou et al., 2023, p. 4).

The voluntary carbon market has the potential to help businesses reach their net-zero carbon emissions goals. As of June 2023, 49% of companies in the United States had set net-zero emissions commitments (Net Zero Tracker, 2023). However, only 4% of companies with these commitments worldwide meet UN criteria as set out in the 2022 revision to the UN Race to Zero campaign (Net Zero Tracker, 2023). The Net Zero Tracker, an independent research consortium focused on providing and analyzing data about net zero targets worldwide, claims that the integrity of these commitments must be improved, and more actionable steps must be taken to meet emissions targets on time (Net Zero Tracker, 2023). One such step is participation in the voluntary carbon market, where companies can offset some of their carbon emissions by purchasing carbon credits.

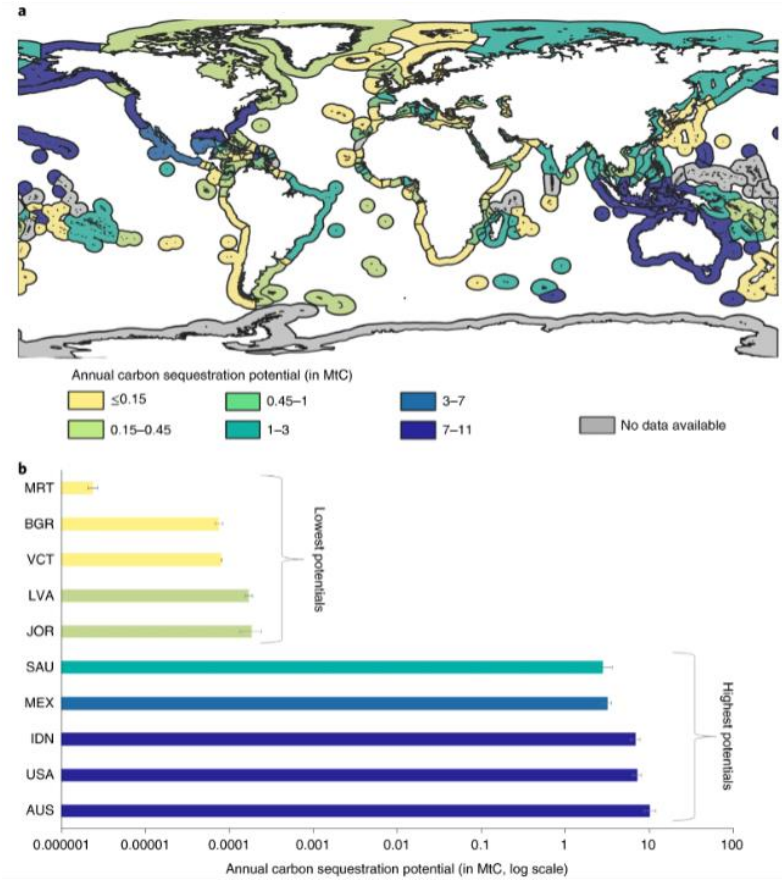
Within the carbon market, blue carbon is a specific area of interest for corporations, as it is a natural climate solution that also assists corporate social responsibility due to additional co-benefits of blue carbon solutions (Friess et al., 2022). These co-benefits include improved water quality, protection from coastal storms, and improving quality of life for coastal communities (Verra, 2022). From an environmental perspective, blue carbon holds immense promise for efficient carbon emission offsetting. For example, protection of seagrasses worldwide could

offset the equivalent of the emissions of the global shipping industry, or 650 MtC (Megatons of CO_2) annually (Diez & Castano-Isaza, 2023).

The annual blue carbon sequestration potential varies widely by location as shown in Figure 2, below. The United States and Saudi Arabia have some of the highest annual blue carbon sequestration potentials, at 7.5 MtC and 2.9 MtC, respectively (Bertram et al., 2021). For businesses located in the United States and Middle East, investing in blue carbon is a way to take actionable steps to reach their net zero emissions goals.

Figure 2:

Annual Carbon Sequestration Potential by Country



Note. Figure 2a is a map of mean carbon sequestration potential in Megatons of CO_2 (MtC). Figure 2b is a bar chart of countries with the lowest (Mauritania, Bulgaria, St. Vincent and the

Grenadines, Latvia, Jordan) and highest (Saudi Arabi, Mexico, Indonesia, United States, Australia) mean national carbon sequestration potentials. From Bertram, C., Quaas, M., Reusch, T. B. H., Vafeidis, A. T., Wolff, C., & Rickels, W. (2021). The blue carbon wealth of nations. *Nature Climate Change*, 11(8), 704–709. https://doi.org/10.1038/s41558-021-01089-4

Challenges of the Voluntary Market

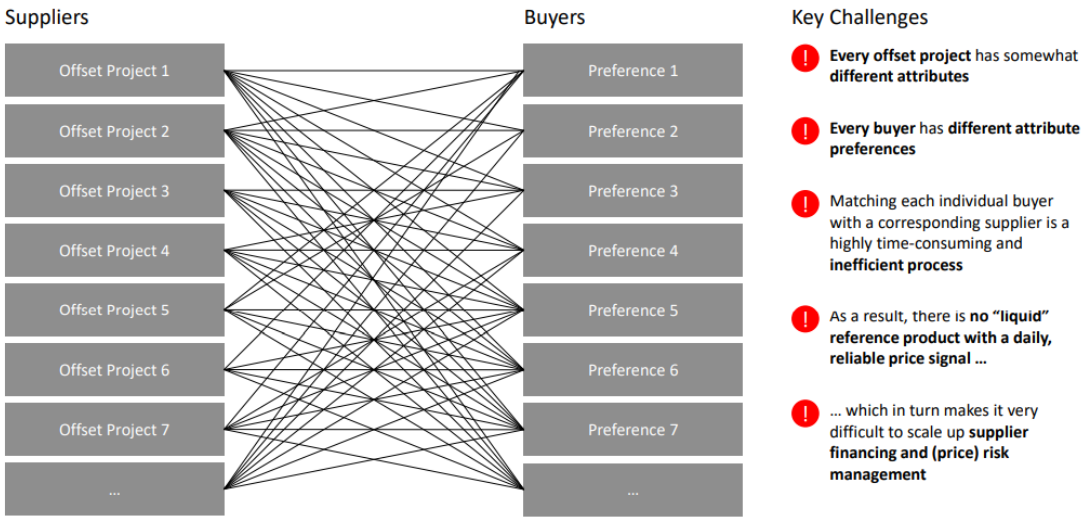
Despite the environmental and economic benefits of participating in the voluntary carbon market, there are some risks involved that businesses must contend with. In one study, more than 50% of corporations identified the following reasons for being unwilling to participate: a lack of transparency about real climate impacts of carbon credits, a lack of clarity on the quality of carbon credits, and market imperfections (Gawel et al., 2023). Additionally, according to the international Taskforce on Scaling Voluntary Carbon Markets, businesses that are hoping to enter the voluntary market have a hard time finding credits that are high-quality and offer transparent pricing (TSVCM, 2021). Assessing the co-benefits associated with carbon credits is also quite complex, so businesses may not be able to make the most informed choices without extensive knowledge and research on each credit they are looking to buy (TSVCM, 2021). Overall, there exists a need for more transparent knowledge and specialized services to assist businesses to participate in the voluntary carbon market.

On the other side of the voluntary market are the organizations that produce and sell carbon credits. These organizations face many challenges, especially when entering the market. For a project to be financially viable, large amounts of land or coastline are required, as are the funds to afford the high cost of assessing carbon sequestration project potential and verifying the project (Restore America's Estuaries, 2022, p. 6). Organizations selling carbon credits "face uncertainty in future demand, low prices, limited access to financing, and long lead times to

verify credits," which may lead to hesitancy to participate in the market in the first place (TSVCM, 2021, p. 5). Additionally, sellers have no guarantee that their credits will be sold quickly, meaning that they need to wait unknown amounts of time for funding of future projects or continuation of current projects (Restore America's Estuaries, 2022, p. 14). To mitigate these issues, a report from the Taskforce on Scaling Voluntary Carbon Markets recommends a platform where carbon credit suppliers can provide information on proposed projects and be matched with businesses interested in financing these projects (TSVCM, 2021, p. 13). This report claims that currently, "matching each individual buyer with a corresponding supplier is a time-consuming and inefficient process" (TSVCM, 2021, p. 82). Figure 3, below, is a depiction representing the complexity of this process matching carbon credit suppliers to buyers. Therefore, platforms or companies providing matching services such as Sea the Change, a startup company based in Venice, Italy have the potential to address challenges faced by carbon credit suppliers in voluntary markets.

Figure 3:

Challenges Matching Suppliers and Buyers



Note. Figure 3 depicts potential complexity and challenges for suppliers in the voluntary carbon credit market who are seeking buyers. From TSVCM. (2021). *Final report: Taskforce on scaling voluntary carbon markets* (p. 82). https://www.iif.com/Portals/1/Files/TSVCM_Report.pdf

Sea the Change

Sea the Change, our project sponsor, focuses on "sustainability and marine conservation" (Sea the Change, n.d.). Sea the Change aims to operate as a marketplace, connecting businesses with environmental projects. The company selects projects that generate a high impact on marine ecosystems and can make a lasting impact on the surrounding community for their portfolio. They then promote them as either a carbon credit or an environmental project on their platform. Sea the Change evaluates an investing company's climate emissions and matches them with a project that adheres to the buyer's values and needs (L. Barani, personal communication, January 19, 2024). Sea the Change currently has three projects available located in the Venice lagoon, the Adriatic Sea and the Catalan coast, the first of which is a verified blue carbon credit.

Sea the Change was founded in 2022 by three recent college graduates who were discouraged by the pandemic and job market. Luca Barani, Alberto Carpanese, and Francesco Suzzi met while studying environmental economics and entered the job market with a goal of making a difference in sustainability and protecting the environment. They considered becoming sustainability managers for big companies, but these jobs were not ethically appealing. Instead, Barani, Carpanese, and Suzzi decided to create their own startup, Sea the Change. They feel that it is their generational duty to try their best to fix the environment and are motivated by the possibility of positively impacting sea-based ecosystems (L. Barani, personal communication, January 19, 2024).

Sea the Change has a vision of an active marketplace with services embedded in it. This platform will lie somewhere in between a software and a marketplace. The marketplace is composed of projects companies can invest in, while the software is used to calculate emissions and handle the offered services. Sea the Change will charge a fee for each service that a company uses. The company currently offers basic communication services for businesses such as social media posts about their environmental conservation projects and sustainability reports. Additional services are available that can cater to a specific company's needs and may take the form of a campaign, a storytelling video or environmental content for employees or customers.

Sea the Change operates on a small scale in European voluntary markets and hopes to expand in two main categories: new geographical locations and specific economic sectors. The company is specifically interested in the United States and Middle Eastern region. They plan to select global blue carbon projects and build markets based on community and sustainability in these regions. Their services are targeting the marinas, private ports, and yacht companies and they hope to expand into the tourism and fashion sectors. They envision businesses being able to visit the local projects to see in real time what impact their contribution is having on the local community.

Chapter 3: Methodology

Goal and Objectives

Our team aims to help Sea the Change expand their activities into markets in the Americas and Middle East. To accomplish this goal, we developed the following objectives:

1. Understand the business structure of Sea the Change and similar companies and identify key motivations and challenges for participants in the voluntary market.
2. Understand the current legislative structure in each state or region of interest and identify key sustainability laws and regulations that are relevant to Sea the Change's expansion.
3. Define the current condition of the tourism, yacht, and marine industries and their commitments to sustainability in each state or region of interest to Sea the Change.
4. Create a comprehensive list of nature-based marine sustainability projects that meets Sea the Change's guidelines for potential expansion partnerships.

Objective 1: Understanding Business Models in the Voluntary Carbon Market

Understand the business structure of Sea the Change and similar companies and identify key motivations and challenges for participants in the voluntary carbon market.

Our team conducted in-depth conversations with our sponsor to understand their business model, motivations, goals, and ethical considerations. We presented our understanding back to Sea the Change to ensure that we had an accurate understanding of their business plan. Based on this business plan, the team identified companies in the United States and Middle East that may be considered competitors to Sea the Change as well similar companies that Sea the Change may

be able to learn from. This knowledge informed us of how companies like Sea the Change operate within carbon markets and what their goals were.

To understand the most effective methods for Sea the Change to recruit new conservation partners and companies looking to sponsor conservation efforts, our team researched motivations, risks, and benefits for companies to participate in the voluntary carbon market. This information was important to contextualize the markets Sea the Change is expanding into and gave the team concrete facts to later incorporate into an investor report to provide to our sponsor. Overall, there was a lack of reliable sources describing business motivations to participate in the voluntary market. While there was reliable information on risks and limitations of this market, information on motivations and benefits for businesses to participate was often only available in opinion pieces or from companies selling carbon credits. The team varied our search terms and opened our research up to include benefits from all corporate environmental action in order to gain information from reliable sources.

Objective 2: Laws and Legislation

Understand the current legislative structure in each state or region of interest and identify key sustainability laws and regulations that are relevant to Sea the Change's expansion.

Our team conducted in-depth research on legislation surrounding each location's sustainability efforts, government structure, participating carbon markets, marine environment, carbon emission, carbon offset outsourcing, and sustainability requirements for businesses.

Using government websites, we developed an understanding of the legislative structure in each state or region. Learning how state/emirate governments interact with the federal government and which laws take precedence allowed us to evaluate possible challenges for expansion and what organizations Sea the Change might encounter. Our team identified the

active carbon markets within each location and the government's role in regulating the selling and trading of carbon credits.

We identified each locations sustainability goals and using government websites, reports and bills we found laws restricting and taxing carbon emissions protecting marine environments. As well as laws restricting the outsourcing of carbon credits and requiring businesses to report their annual sustainability efforts. This information was compiled into a summary and used to advise Sea the Change in their expansion.

Objective 3: Industry Research

Define the current condition of the tourism, yacht, and marine industries and their commitments to sustainability in each state or region of interest to Sea the Change.

Our team conducted research on the market trends of the tourism, yacht, and marine industries. Using government and company economic reports we researched economic statistics including compound annual growth rate (CAGR), contribution to the gross domestic product (GDP), and contribution to the job market. We looked at the sustainability goals of each state and each industry, as well as actions taken in reaching these goals. We identified major companies within the tourism, yachting, and marine industries and looked at their sustainability goals and reports from the past few years. This gave us a better understanding of sustainability within each industry amongst non-government organizations (NGO).

Some of the industry data was quite recent (2022-2023), while other information was from previous years (2017 – 2019). Also, due to the size and specificity of the yachting industry, not all regions provided CAGR, GDP, or any statistics of yachting's impact on each region's economy. Thus, we used global data, deciding it was relevant and suitable information for our report.

Objective 4: Project Identification

Create a comprehensive list of nature-based marine sustainability projects that meet sponsor guidelines for potential expansion partnerships.

Our team used a general search engine and key words such as “blue carbon,” “marine conservation,” “environmental conservation,” “carbon removal,” and “carbon credit” to find projects in the Americas and Middle East. By collaborating with Sea the Change, we developed a list of criteria for viable partnership projects. The criteria are as follows:

- Blue carbon based
- Privately run organizations (not run by a government)
- Nature-based solutions (directly restoring an ecosystem not using manmade forms of capturing carbon)
- Run by an ethical organization
    - Excluding: Military/arms, oil, preparation or blending of petroleum derivatives, LPG mixing and bottling, manufacture of bitumen, tar and road binder emulsions, manufacture of coking plant products, hunting, trapping and other related services
- Reliable carbon removal
    - Not greenwashing (no misleading information on climate impact)
- Quantified environmental impact
- Project is either ongoing or will be running for more than two years
- Local Impact (domestic projects)

We identified an extensive list of projects from the regions of interest and assessed their viability using our determined list of requirements. Through discussion with Sea the Change, we reduced the list to eleven viable projects for further study: seven in the US, three in Latin America and one in the Middle East.

It proved difficult to find privately-operated organizations doing marine conservation projects, as many (especially in the United States) are run by the government. To address this, we searched for companies with grants from environmental agencies and for lists from overarching consortiums of organizations involved in specific areas of marine conservation. We also searched for organizations with projects verified by Verra or other carbon credit verification

entities, however there are few verified blue carbon projects. Many NGOs that Sea the Change would be interested in working with are small and local, but because of size or limited resources many of these projects do not have a large online presence or readily available information on the organization running the project.

We determined what essential information needed to be included about each project and followed the same format for each project description. Each description included the name and location of the project, the project's goal, a description of the organization running it (including where the company is based, how long they have been operating, their planned timeline for the project, their funding sources, and their primary investors), contact information for the relevant person at the organization, and what about the project can be sold.

Chapter 4: Results

Competitor Analysis

Below is a list of competitors of Sea the Change along with short descriptions. In-depth descriptions of each competitor are included in Appendix A.

Clear Blue Markets

Clear Blue Markets has an AI and machine learning tool called Vantage that returns credit price predictions. Clear Blue Markets provides market intelligence reports based on 450 carbon offset projects worldwide (*ClearBlue Markets: Home*, n.d.).

Terrapass

Terrapass offers services to both calculate and offset your carbon footprint. Terrapass currently has thirteen different projects in four different countries and nine states in the US. Each project is a verified carbon credit which they primarily sell to individuals (*Terrapass*, n.d.).

Numerco

Numerco is a seller of carbon offsets that has created a marketplace for projects to sell carbon credits. Other services Numerco offers include a carbon footprint calculator and portfolio construction for the client (*Numerco: Carbon*, n.d.).

Earthood

Earthood audits greenhouse gas reduction projects, aids in the creation of carbon credit projects, calculates carbon emissions for companies and suggests emissions reduction plans. They also verify carbon credits and offer agriculture and sustainability audits that are focused on mitigating climate change (Earthood, n.d.).

Carbonplace

Carbonplace aims to create an online marketplace that integrates existing registries of carbon credits with pre-existing bank software to allow companies to securely purchase verified credits ("About Us," n.d.).

Viridios

Viridios AI platform offers pricing for close to 17,000 projects across voluntary carbon markets. They are not partnered with these projects. but the AI program offers information on the bids, trades and asks of the market, which clients can use to pinpoint projects and price points. Viridios offers services such as corporate solutions and asset management (*Viridios Capital: Home*, n.d.).

Association for Coastal Ecosystem Services (ACES)

ACES's goal is to support communities who are looking to protect the mangroves in their environment. They sell verified carbon credits for two of their three blue carbon projects, and all this money goes back into the local community ("Our Story," n.d.).

Ecosecurities

Ecosecurities sources climate mitigation projects, develops carbon offsets including project finance and risk management. They support the project owners as well as provide regulated and voluntary buyers with carbon offset options (*Carbon Markets | Ecosecurities | Project Development*, n.d.).

Blue Marine Foundation

The Blue Marine Foundation has over fifty projects in twenty-four countries across the globe, all of which focus on conserving Marine Protected Areas (MPA). In each location they

also work with national, regional, and local governments to create legislation on overfishing and creating MPAs ("Blue Marine Foundation: About Us," n.d.).

One Tribe

One Tribe helps businesses to buy high grade certified carbon offsets directly from forest conservation projects or indigenous landowners to ensure maximum impact on the climate. One Tribe also helps individuals to track the impact of their offsets and see the improvement of their carbon footprint (*About Us*, n.d.).

Laws and Legislation

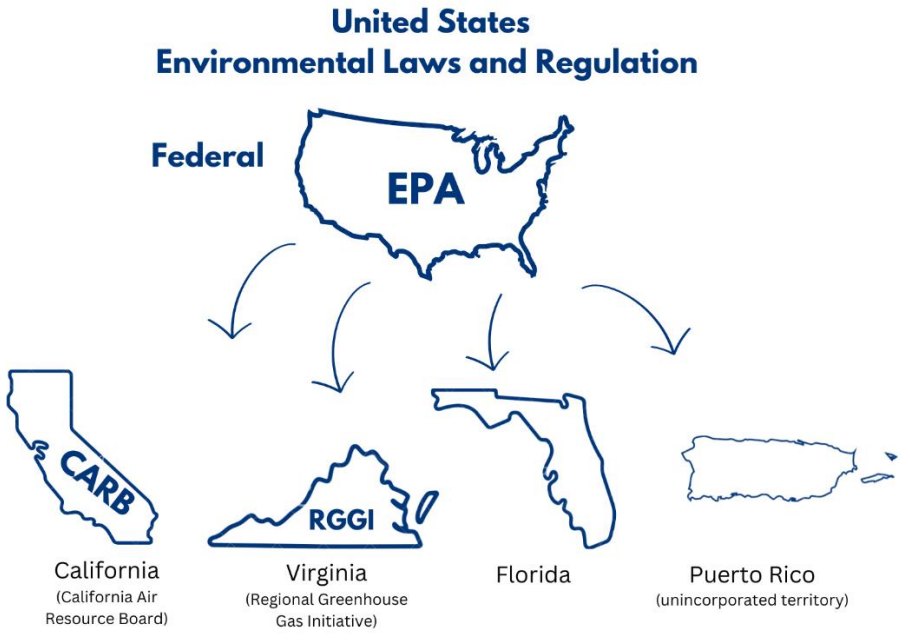
United States

After rejoining the Paris Agreement on January 20, 2021, President Biden created the National Climate Task Force which is working towards accomplishing several nationwide sustainability goals. These goals include reducing greenhouse gas emissions 50-52% below 2005 levels in 2030, reaching 100% carbon pollution-free electricity by 2035 and achieving a net-zero emissions economy by 2050 (*National Climate Task Force*, 2021).

When doing business in the United States, companies must adhere to the rules of multiple environmental regulatory bodies. There is the overriding Federal Environmental Protection Agency (EPA), then there are the individual state agencies. The EPA regulates emission of vehicles such as cars and trucks and creates guidelines for power plants and energy production (US EPA, 2023). The EPA has the overarching power to implement and enforce federal environmental laws, but states may also make their own laws about emission, carbon credits, and clean energy plans, as depicted below in Figure 4 (*U.S. Federal vs. State Environmental Regulations*, 2019).

Figure 4:

Environmental Laws and Regulation



Note. Figure 4 depicts the structure of environmental legislation in the United States: all states are subject to the Environmental Protection Agency at the federal level, and some states have additional regulations at the state level. California is subject to the California Air Resource Board, Virginia is subject to the Regional Greenhouse Gas Initiative, and Florida is not currently subject to any additional regulations.

In the US, companies of all sizes have are encouraged to produce environmental, social, and corporate governance (ESG) reports to guide internal decisions and give investors further company insights (Nodoph, 2022). The aim of this is to lead companies towards a more sustainable and socially responsible future; however, this is not mandatory. The proportion of companies disclosing sustainability and ESG information was 56% in 2022, and increased to 63% in 2023 (Breg, 2023). Currently, the federal Greenhouse Gas Reporting Program (GHGRP) requires all large corporations that emit over 25,000 mt CO2e (Metric tons of carbon dioxide)

per year to report their emission data. This also includes supply of certain products that would result in over 25,000 metric tons CO_2e of GHG emissions if those products were released, combusted, or oxidized (US EPA, 2014).

Virginia

The Regional Greenhouse Gas Initiative (RGGI) is a regional effort of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia to reduce CO_2 emissions. The initiative is run by government delegates from each state. The initiative strives to "support the development and implementation of each state's CO_2 Budget Trading Program" (RGGI, 2022) The program has put caps (limits) on the total yearly emissions of energy companies and oversees the selling and trading of CO_2 credits. In 2017, the Climate Change Action Plan created by governors in the northeast US was updated to include blue carbon projects as promising candidates for greenhouse gas reduction (US EPA, 2023).

Virginia is one of eleven RGGI members, which will collectively reduce power sector carbon dioxide emissions by 30% by 2030. Virginia has also passed regulations establishing an annual cap on carbon dioxide emissions from power plants. To comply with the regulations, power generators must reduce emissions to meet the cap or buy additional allowances through an auction administered by RGGI (*Carbon Trading | Virginia DEQ*, n.d.).

The 2020 Virginia Clean Economy Act seeks to decarbonize the state's electric grid by 2050 by setting targets for the amount of renewable energy produced for regulated utilities and mandating increasing portions of production be carbon-free. However, when Governor Glenn Youngkin was elected in 2021 most state level climate legislation was changed. The state energy plan passed by Youngkin last fall allows the continued use of natural gas and Youngkin's

administration is pushing for Virginia to leave RGGI, which is facing legal opposition (Paullin, 2023).

California

Over the past 10 years, the State of California has taken legislative action to achieve their goal of reducing carbon emissions. To reduce greenhouse gas (GHG) emissions, the state government has created a cap-and-trade program. The program targets businesses and organizations that are collectively responsible for 85% of California's GHG emissions. The California Air Resources Board (CARB) creates and assigns businesses allowances, the total amount of "allowed" carbon emissions, in which one metric ton of CO2 is equal to one allowance (California Air Resources Board, 2023). This program allows for the purchase of carbon offsets to meet up to 4% of a business's compliance obligation (California Air Resources Board, 2023).

California Governor Gavin Newsom recently signed into law three landmark climate bills: the Climate Corporate Data Accountability Act (SB 253), the Greenhouse Gases: Climate-Related Financial Risk Act (SB 261), and the Voluntary Carbon Market Disclosures Act (AB 1305). The first two laws require companies to disclose their greenhouse gas emissions and climate-financial risks on an annual basis if they meet certain annual revenue requirements. The third law, AB 1305, mandates additional reporting regarding the use of carbon offsets (McClure et al., 2023). AB 1305 is the first bill passed in the U.S. that requires detailed disclosures about a company's voluntary carbon credit purchases (Hargreaves & Frisch, 2024). This bill will help target greenwashing and add transparency to the voluntary carbon trading in California.

Under the Voluntary Carbon Market Disclosures Act, carbon credit projects and companies that market carbon credits are required to disclose detailed information on each specific project,

accountability measures in the case the project is not completed or does not meet its targets, and the data and calculation methods needed to independently reproduce and verify the number of emissions reduction or removal credits issued Companies or suppliers that fail to report under AB 1305 will be subject to civil penalties of up to 2,500 USD per day, not exceeding a total of 500,000 USD (Hargreaves & Frisch, 2024). The full list of requirements (adapted from Hargreaves & Frisch, 2024) is below:

- The specific protocol used to estimate emissions reductions or removal benefits
- The location of the offset project site
- The project timeline
- The date when the project started or will start
- The dates and quantities when a specified quantity of emissions reductions or removals started or will start, or was modified or reversed
- The type of project, including whether the offsets from the project are derived from a carbon removal, an avoided emission, or, in the case of a project with both carbon removals and avoided emissions, the breakdown of offsets from each
- Whether the project meets any standards established by law or by a nonprofit entity
- The durability period for any project that the seller knows or should know that the durability of the project's greenhouse gas reductions or greenhouse gas removal enhancements is less than the atmospheric lifetime of carbon dioxide emissions
- Whether there is independent expert or third-party validation or verification of the project attributes
- The amount of emissions reduced or carbon removed on an annual basis
- The actions the entity, either directly or by contractual obligation, shall take if carbon storage projects are reversed or the future emissions reductions do not materialize

In addition to carbon credit suppliers, companies that make claims such as "net zero" or that buy carbon credits will be required to disclose certain information about their climate claim and the credits they have purchased on their websites (Hargreaves & Frisch, 2024).

Florida

Florida is not a part of any regulated carbon credit market, so all trading operates under the voluntary market. Florida does not currently mandate any publishing of sustainability reports or

information on the trading of carbon credits. The state follows all federally mandated climate change legislation but has not passed much of their own.

Puerto Rico

Puerto Rico is an unincorporated territory of the United States and must comply with any federal laws set by the United States Government on sustainability and greenhouse gas emission. They are a part of the US Climate Alliance and have also created their own laws focused on decreasing emission through renewable energy (*Puerto Rico Climate Change Resources*, 2021). In 2019 Puerto Rico adopted the Puerto Rico Public Policy Act, setting a goal of using 100% renewable energy by 2050 (*Puerto Rico Climate Change Resources*, 2021). This was preceded by a series of executive orders passed by Governor Luis Fortuno in 2009-2010 that developed the Energy Policy Committee, Puerto Rico Renewable Energy Commission, and Green Energy Incentives Act. The goal of these executive orders was to provide clean energy at reasonable and stable costs, oversee compliance of renewable energy goals, support renewable energy projects, and create an economically beneficial carbon scheme (*Puerto Rico Grid Resilience and Transitions to 100% Renewable Energy Study (PR100)*, n.d.). In 2010, Puerto Rico enacted the Renewable Energy Policy Act. The purpose of the act was to introduce the use of renewable energy certificates and create a renewable energy carbon credit system, however this has yet to be developed (Mateo-Santos & Gonzalez-Tosado, 2017).

United Arab Emirates

In efforts to reach net zero by 2050, Dubai developed a pilot carbon credit market that concluded in January 2024. The program was a part of the COP28 (conference) EU and UAE climate plan and ended the 10th of January 2024 with about a year of trading beforehand (*Voluntary Carbon Credit Market*, n.d.). The Dubai Financial Market (DFM) ran this pilot

program along with seventeen affluent Dubai companies and three carbon credit suppliers. The pilot program primarily focused on clean energy and reforestation and did not implement any blue carbon credits. The UAE hopes that this pilot program leads into a successful carbon credits trading platform that can unlock new opportunities for sustainability. Additionally, the country aims to secure Dubai's position as a global hub for green economy innovations and opportunities. The UAE voluntary market is expected to grow significantly by 2030 and is projected to have a value of around 50 billion USD (*DFM Launches Pilot for Carbon Credits Trading at COP28*, 2023).

The UAE is developing a carbon registry aimed at tracking companies' efforts to reduce emissions. The carbon registry is also likely to be a first step to developing a nationwide trading program for carbon credits. The UAE plans to start implementing initial laws and regulations to work toward net zero across industries such as energy, transportation, construction, and agriculture (Zawaya, 2023).

In 2020, the UAE Securities and Commodities Authority (SCA) issued a requirement for public joint stock companies listed on the Dubai Financial Market or the Abu Dhabi Securities Exchange to publish a sustainability report. The requirement mandates that the sustainability report must include details on the company's long-term strategy and the impact of its activities on the environment, society, economy, and governance ("ESG Reporting Requirements in the UAE," 2023).

Article Six of the Paris Agreement provides a framework for an international carbon market that Middle Eastern markets can be integrate into. Article 6 enables country-to-country trade of carbon credits where an emissions reduction project host nation can transfer credits from the project to a funding nation that can use those credits (*Navigating Article 6*, 2023).

In April 2023, the UAE Carbon Alliance, which includes a coalition of companies formed to develop and grow a carbon market in the Emirates, pledged to purchase 450 million USD worth of African carbon credits by 2030. The agreement unlocks Africa's carbon sequestration potential as well as support climate action on the continent, while helping the UAE meet its climate pledges (Moneer, 2023).

The federal legislation marks just one layer of regulatory governance in the UAE, as regulations are also enacted at the emirate level, with the emirates maintaining a high degree of autonomy. At the Emirate level, other than the creation of protected areas, there are no specific laws addressing blue carbon elements. The Abu Dhabi Emirate, however, applies a general mangrove compensation policy, which requires the reforestation of two trees for every mangrove tree destroyed (*National Blue Carbon Policy Assessment Arab Emirates*, 2016).

Costa Rica

Costa Rica has extensive laws regarding environmental conservation and protection. In addition to the United Nations Convention on Climate Change and the Paris Agreement, they are part of the Central American Climate Change Agreement, the Independent Alliance of Latin America and the Caribbean, and the Regional Climate Change Strategy (Sánchez & Mauri, 2023).

Costa Rica first banned exploration for and extraction of fossil fuels in 2002, and this ban has been extended until 2050 (Rodriguez, 2022). In 2017, the country launched a campaign against all types of single-use plastic, as the country suffers significantly from mismanaged plastic waste. In 2019, they passed Law 9876, the "law to combat plastic pollution and protect the environment," which makes the sale or distribution of plastic bags illegal (Schachter et al., n.d.). The Organic Law on the Environment states that polluters are liable for any pollution they

cause and must restore the environment to its pre-polluted state. The National Plan of Development and Public Investments for 2019-22 highlights the need for waste management that is environmentally sound and focuses on sustainable development (Environment Policy Committee, 2020). The Tax Simplification and Efficiency Law taxes fuel, and 3.5% of this revenue is used to pay landowners for carbon credits generated from their land (Sánchez & Mauri, 2023).

In 2012, the government created the National Programme for Carbon Neutrality, which established a domestic voluntary carbon market that businesses can participate in once they have reduced their emissions as much as possible. Regulation No 37926-MINAE outlines the rules for this carbon market, which trades Costa Rican Compensation Units, or 'UCCs,' at Costa Rica's National Stock Exchange or privately (Sánchez & Mauri, 2023). The National Programme for Carbon Neutrality was expanded in 2017 and again in 2021 and has also established a carbon neutral certification that businesses, products, events, municipalities, and educational institutions can earn (*Costa Rica: Policies & Action*, 2023). Costa Rica's Institute of Tourism has also created the "Certification for Tourism Sustainability," which ensures that companies with this certification use sustainable practices and do not provide consumers with misleading or "greenwashed" information (*Impacto Del CST*, n.d.). There is not currently any legislation mandating that companies publish emissions or sustainability reports; however, many companies voluntarily publish this information (Sánchez & Mauri, 2023). It is mandatory for businesses to report biodiversity protection and water, waste, and energy management (OECD, 2020).

Colombia

Colombia operates under a carbon tax that was introduced in 2016 in order to raise revenue following the international decline in oil prices. The carbon tax was introduced as part of a larger

simplified series of tax reforms aimed at preventing emissions evasion, modernizing regulation, and coordinating with national improvements of sustainability. The original tax was set at five USD per ton of carbon dioxide emissions with an increase annually until it gets to ten USD per ton. The tax applies to producers and direct importers of fossil fuels. The tax applies to gasoline, diesel, kerosene, fuel oil, natural gas used for refining of hydrocarbons and petrochemicals, and industrial uses of liquefied petroleum gas. As an incentive, entities are able to waive part or all taxes with the submission of carbon offset certificates accredited by the UNFCCC (United Nation's Framework Convention on Climate Change), or the international accreditation forum. Due to the absence of a strong monitoring and verification system, the impact of the carbon revenues eligible for tax breaks (almost a third of the total revenues) could not be measured. The tax generated a revenue of 159 million USD, which fell short of the projected 200 million USD. The next year was even worse at 98 million USD. Diverting revenue to the Peace Fund received significant backlash as it was viewed as a large deviation from the original plan of funding environmental protection activities. The tax also received heavy criticism for its exemption of coal through the lobbying of coal interest groups. The international price for coal is expected to fall in the coming years and Colombia is the sixth largest exporter of coal. This may result in the increase of coal burning as it will be a cheaper alternative, which will result in an increase in greenhouse gas emissions.

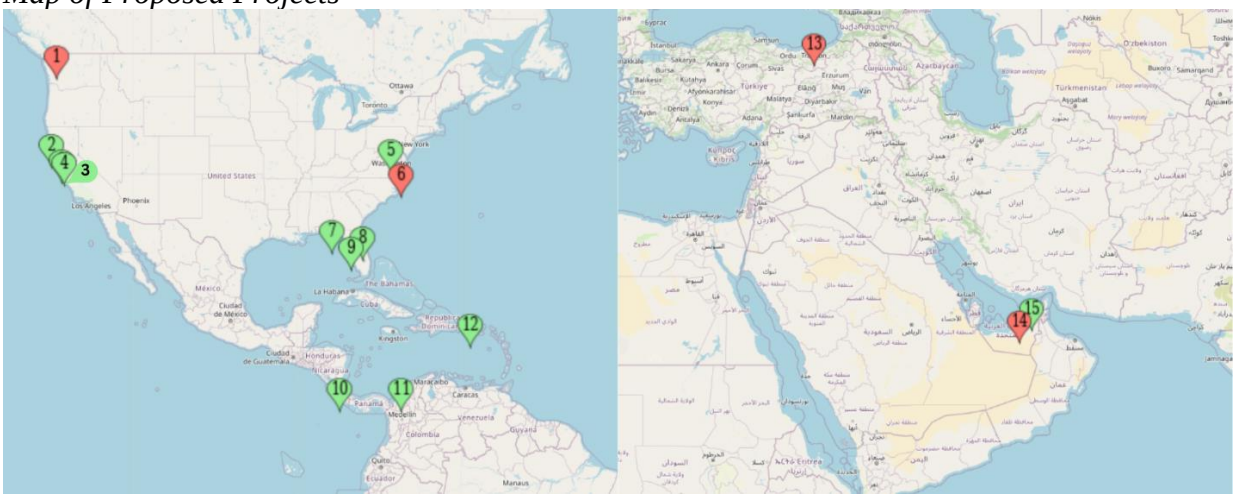
Expansion Options: Project and Industry Research

Outlined in our results is industry research for three US states, Virginia, California, and Florida, as well as Puerto Rico, the United Arab Emirates, and Latin American countries Costa Rica and Colombia. Within these regions we describe one project in Virginia, three in California, three in Florida, one in Puerto Rico, one in the UAE, one in Costa Rica and one in Colombia, as

can be seen in Figure 5 below. The projects are all nature-based projects and range from biodiversity, carbon capture, to restoration projects. Of the eleven projects, we identified three projects focusing on seagrass, two on marshes, three on mangroves, and one each on coral reefs, kelp, and living shorelines.

Figure 5:

Map of Proposed Projects



1. Ebb Carbon – Sequim, Washington
2. Bull Kelp Planting – Sonoma and Mendocino counties
3. Salt Pond Restoration – San Francisco Bay
4. Save the Bay – San Francisco Bay
5. Eelgrass Restoration – Arlington, Virginia
6. Coastal Carbon Capture – Duck, North Carolina
7. Foster Seagrass Restoration – Indian Lagoon, Florida
8. Shoreline Restoration – Edgewater, Florida
9. Tampa Bay Watch – Tampa Bay, Florida
10. Marine Conservation – Costa Rica
11. Vida Manglar – Colombia
12. Blue Resilience Initiative – Puerto Rico
13. Rewind – Turkey
14. Dugong and Seagrass Conservation – Abu Dhabi, UAE
15. Azraq – Dubai, UAE

Note. The green locations highlighted in Figure 5 represent the eleven projects viable for partnership with Sea the Change. These projects fulfill the criteria laid out in the methods section and have been approved by Sea the Change. The red locations highlighted in this figure represent projects that did not fulfill all required criteria. More information on these projects is provided in Appendix B.

Virginia

Virginia has the 13th highest GDP in the United States with a GDP of 728.1 billion USD (2023) (*Economy of Virginia Statistics and Data Trends*, 2023). Virginia has considered sustainability an important trait for some time and has many prior efforts such as proper recycling, reduction of harmful single use plastics, clean transportation, clean energy, and reduction of electronic waste (Boehmer, 2023). There is a significant tourist market as well as yachting and maritime industries.

Tourism has been on the climb post-pandemic; in 2022, 108 million visitors spent 30.3 billion USD in the Virginian economy. Of the 30.3 billion USD spent 29% was spent on transportation, 28% or 8.5 billion USD was spent on food and beverage; lodging, including second homes, accounted for 19% of spending. Recreation accounted for 13% and retail came in at 12% of the total spending (Tourism Economics, 2023). This 30.3 billion USD was an increase of over five billion USD from the previous year and also surpassed 2019 levels (Tourism Economics, 2023). Tourist spending increased 20% in 2022, which was a second consecutive year of double-digit growth since COVID-19. Overall tourism had a 46.1 billion USD economic impact on Virginia in 2022 (Tourism Economics, 2023).

Virginia has a large maritime industry that accounts for nearly 730,000 jobs and over eight billion USD in state and local taxes. (*Virginia's Maritime Industry Economic Impacts on the*

Commonwealth of Virginia, n.d.). The industry also accounted for 20% of Virginia's employment. There was 87.8 billion USD in value added, making 14% of Virginia's GSP. In 2022, the maritime industry accounted for 56.9 million USD in labor income and 178.1 billion USD in total sales (*Virginia's Maritime Industry Economic Impacts on the Commonwealth of Virginia*, n.d.). In June 2023, Virginia was ranked 20th in the US when it comes to recreational boating with more than 4.4 billion USD annually in economic impact and supporting over 16,800 jobs (*Top Recreational Boating States by Economic Impact*, n.d.). With boating comes marinas, which is also a large industry in Virginia with over 260 businesses, 1,015 jobs, and a market size of 111.9 million USD. (*IBISWorld - Industry Market Research, Reports, and Statistics*, n.d.).

Virginia: Eelgrass Restoration

The Nature Conservancy operates a seagrass restoration project that extracts eelgrass seeds from the sea floor in the spring and stores them in a holding tank where they are cured and eventually, in the fall, sown back into the seafloor. The goal of this is to restore seagrass in Virginia's coastal bays and reduce emissions. Seagrass is a major source of carbon removal, as it captures and stores a great amount of carbon dioxide.

Based in Arlington, Virginia, The Nature Conservancy was founded in 1954 and has been operating for the past 70 years. As of 2021, it has work based in seventy-nine countries and territories as well as across every state in the US. They've played a large role in fighting climate change and protecting ecosystems. They aim to protect 30% of the earth's land and water ecosystems by 2030. Primary investors include The Duke Energy Foundation, Salesforce, Australian Ethical Investment, The Champlin Foundation, Onpoint Community Credit Union, Entergy Corporation, and the John Deere Foundation. The Nature Conservancy's seagrass restoration is the only verified blue carbon credit in the United States; it is a carbon removal

project verified by Verra. To reach Global Head Matthew Arnold, email his scheduling contact at sarah.linehan@tnc.org. To reach Chief Conservation Officer David Banks, email his scheduling contact at trayment@tnc.org. To reach Chief Operating Officer Neel Broker, email his scheduling contact at lydia.oconnor@tnc.org. To reach Managing Director for North America Jan Glendening, email her scheduling contact at ksuckling@tnc.org (*Restoring Eelgrass on Virginia's Eastern Shore*, 2023).

California

California is the wealthiest state in the United States followed by New York, Florida, and Texas. Within California, the wealthiest communities are found in coastal areas (*Here's What California Accomplished in 2022 on Climate*, 2022). The San Francisco Bay Area, where the average county has a net worth over 450,000 USD per resident, is the state's wealthiest region. Sections of Los Angeles, Orange, and San Diego counties also have considerable wealth (Uhler & Chu, n.d.). The state has been a pioneer in environmental conservation efforts and in recent years has created drastic plans to advance their climate change goals. California plans to reach net zero carbon pollution no later than 2045, while also ensuring an 85% cut in greenhouse gas emissions. Additionally, the state adopted a new target of 90% clean energy by 2035 and 95% by 2040 (*Here's What California Accomplished in 2022 on Climate*, 2022).

Tourism is a leading industry in California and brought in 267.7 million domestic visitors in 2019 and around 278 million in 2023. On top of domestic visitors, in 2019 California hosted around 15 million international tourists. San Francisco alone was visited by 25.8 million people, while Los Angeles welcomed a record-high 50 million tourists (Lindner, 2023). California saw 14.4 billion USD in international travel spending in 2019. This money fuels the tourism industry and supported over 1.2 million jobs in 2019 (Lindner, 2023). This means that over 1 in 10 jobs in

California are supported directly or indirectly by travel. In 2019, the hotel industry in California was valued at 33.1 billion USD, making the industry lucrative for investors. Additionally, in 2019, 27% of all domestic trips made to California were for outdoor recreation (Lindner, 2023). This demonstrates that outdoor activities, including coastal activities, are highly popular in California. Popular coastal activities are whale watching, recreational boating, recreational fishing, swimming, and going to the beach (Barringer, 2019).

The recreational boating market is expected to grow at a CAGR of 6% during the forecast period of 2023 to 2031. This growth is driven by factors such as increasing disposable incomes, rising tourism and travel activities, and a growing interest in outdoor recreational pursuits. The marina industry's market revenue has witnessed a steady increase, with around 396 million USD of revenue in 2023 and a projection of over 400 million USD in 2024 (*Forecast*, n.d.). Boating offers a unique experience for travelers, allowing them to explore coastlines, lakes, and rivers in an immersive and enjoyable way. Many tourist destinations offer boating and water-based activities, attracting both domestic and international tourists (Statista Research Department, 2023). In the San Francisco Bay area alone, there are 115 harbors, marinas, or yacht clubs, which together house thousands of recreational boats (*San Francisco Bay Area Marinas*, n.d.).

In addition to the recreational boating industry, the California has a strong yachting industry. Yacht charter companies are popular in California where wealthy tourists have the opportunity to rent a yacht and a crew. Additionally, there are many yacht brokers along the coast of California. Los Angeles is one of the most popular southern California destinations for California yacht charters. San Francisco is also a popular destination as there is wildlife such as whales, sea lions, dolphins, and a variety of birds ("California Yacht Charters | Pacific Delights," n.d.).

California: Bull kelp planting

The Greater Farallones Organization is planting bull kelp on the coastline of northern California. The goal of the project is to restore lost kelp forest habitats within the Greater Farallones National Marine Sanctuary. It is a blue carbon ecosystem that has fallen into a severe and prolonged decline beginning in 2014. Bull kelp forests support dense populations of fish, invertebrates, and other algal species, and play a role in the carbon cycle. California is heading into the seventh year of severe kelp loss on the west coast. The extended loss of kelp forests has led to an 80% decline in the commercial red urchin fishery, a three million USD market value. As well as the complete closure of the recreational red abalone fishery, a 44 million USD market value (*Greater Farallones Association*, n.d.).

Kelp forests in northern California have declined by over 90% in the past decade causing local organizations to focus their efforts on restoration. The Greater Farallones Organization received federal appropriations to restore the kelp forests in March of 2022. They selected four coves where the organization is planting bull kelp bulbs and removing sea urchins who feed on the kelp. The Greater Farallones Organization is a 501c3 non-profit organization founded in 1995 to help ensure the ecosystem within Greater Farallones National Marine Sanctuary remains protected and biologically diverse. They are partnering with federal, state, fisheries, and academic partners to complete the kelp restoration project over the course of approximately five years. This project is not currently verified but could be sold as a carbon offset. The Kelp Restoration Project Manager is Rietta Hohman, who can be contacted at rhohman@farallones.org. The two relevant websites for this project are https://farallones.org/kelp/ and https://farallones.noaa.gov/eco/kelp/

California: South Bay Salt Pond Restoration

South Bay Salt Pond Restoration is focused on restoring tidal marshes and wetland in San Francisco Bay. The pond restoration is the largest tidal wetland restoration project on the West Coast. When completed, it will restore 6110 hectares of industrial salt ponds to a rich mosaic of tidal wetlands and other habitats. San Francisco Bay has lost an estimated 85 percent of its wetlands. This dramatic decline in tidal marsh habitats has caused populations of marsh-dependent fish and wildlife to dwindle. It has also decreased water quality and increased local flood risks. South Bay Salt Pond Restoration acquired the South Bay Salt Ponds in 2003 and funds for the acquisition were provided by federal and state resource agencies and several private foundations. The 6110-hectare property transfer represents the largest single acquisition in a larger campaign to restore 16187 hectares of lost tidal wetlands to San Francisco Bay. Their restoration plan calls for turning at least 50%, and potentially as much as 90%, of the project's 6110 hectares into tidal marsh over the next few decades. The project will not restore more than 50% of the acreage unless additional restoration can be done without significant impacts to birds that depend upon the existing salt ponds. The project is community based as the public can attend meetings, review plans, visit sites, and provide their thoughts and recommendations. The organization is interested in collaboration with partners and public to carry out the project (*The Restoration Project*, n.d.). The executive project manager is Dave Halsing, who can be contacted at dave.halsing@scc.ca.gov, +1 (650) 814-0588. General questions can also be directed to sbrfeedback@sfei.org. The organization's website is https://www.southbayrestoration.org/page/restoration-project.

California: Save the Bay

Save the Bay is a nonprofit that restores wetlands in San Francisco. San Francisco Bay is the largest Pacific estuary in the Americas. Over the last two hundred years, 90 percent of the

Bay's wetlands have been lost due to human activity (*Restore*, n.d.). These vital ecosystems not only provide habitats for thousands of species, but they also protect shoreline communities from rising sea levels and help ensure the San Fransisco region is resilient in the face of climate change. San Francisco Bay needs 40468 hectares of tidal marsh to remain a healthy and thriving estuary (*Restore*, n.d.). The bay currently has 21448 hectares of healthy tidal marsh, 10117 hectares of protected shoreline under restoration, and 8903 hectares awaiting restoration and protection. Save The Bay has researched the techniques of wetland restoration and growing native plants to create productive habitats. Across its 60-year history, Save The Bay has preserved and restored thousands of hectares of wetland and is working on some of the largest natural climate adaptation projects on the West Coast of the United States (*Restore*, n.d.). Save The Bay collaborates with partners at sites throughout the Bay Area, including in Novato, Oakland, Hayward, Redwood City, Menlo Park, and Palo Alto. They operate four native plant nurseries to support their work and propagate and outplant 35,000–100,000 plants per year. Save the Bay also offers volunteer events for corporate partners where they can take a tour and work in the nursery for 3 hours at a time (*Restore*, n.d.). The organization's email address is info@savesfbay.org and their phone number is +1 510-463-6850. Their website is https://savesfbay.org/restore/.

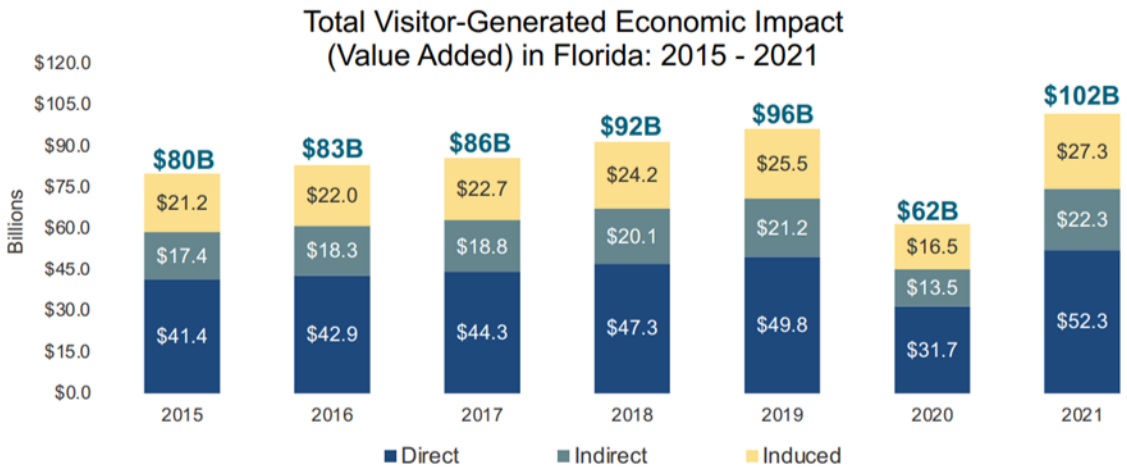
Florida

Florida's economy relies heavily on tourism. It was the state's fourth largest industry in 2021 and made up 8.8% of total employment within the state (Rockport Analytics, 2022). The visitor-generated economic impact has risen more than 20 billion USD from 2015, as seen in Figure 6 below, and is expected to continue rising. It is estimated that the tourism industry

contributed 101.9 billion USD to Florida's GDP in 2021, with tourists spending 105.1 billion USD while visiting (Rockport Analytics, 2022).

Figure 6:

The Economic Impact of Tourism in Florida.



Note. Figure 6 depicts the overall visitor-generated economic contribution from 2015 to 2021 in Florida. The impact is shown in three categories: direct, indirect, and induced impact. From Rockport Analytics. (2022). *Travel & Tourism Make a Convincing Recovery From The COVID-19 Pandemic*. Visit Florida. https://www.visitflorida.org/media/30679/florida-visitor-economic-impact-study.pdf

In Fiscal Year 2022, Florida received 137 million tourists and are on track to meet that number again with 105 million so far in Fiscal Year 2023 (Rockport Analytics, 2022). This high activity of tourism affects the job market, directly supporting 1.1 million jobs.

The yachting industry had a global value of 11.04 billion USD in 2022 with an estimated CAGR of 6.7% for 2023 (*Yacht Market Size & Share Analysis | 2023-2032 Growth Report*, n.d.). The industry is on the rise, experiencing a 22% growth between 2014 and 2022 as well as an

expected value of 13.5 billion USD by 2024 (*Global Luxury Yacht Market Report*, n.d.). Florida is home to the biggest yachting show in the world, the annual Fort Lauderdale International Boat Show. With over 100,000 attendees representing fifty-two countries, 1,000 exhibitors, and over 1,300 boats, the show brings a lot of business to the state (*Fort Lauderdale International Boat Show*, n.d.). Florida-based yacht companies made an estimated 709.7 million USD in sales from the 2022 show and contributed 1.3 billion USD to Florida's economy (*Fort Lauderdale International Boat Show*, n.d.). The company, Fort Lauderdale International Boat Show has set a goal of becoming net zero in carbon emissions by 2030. They have reduced their use of diesel generators and invested in renewable electricity, as well as purchasing 3,345 tonnes of carbon offsets from Yacht Carbon Offset (*Fort Lauderdale International Boat Show*, n.d.).

Florida's domestic maritime industry is the second largest within the United States, with a total gross economic impact of 14.6 billion USD annually (*Florida Maritime Industry – Florida Maritime Partnership*, n.d.). The industry is directly connected to 52,140 jobs, bringing in a state income of around 2.97 billion USD (*The Economic Impact of America's Domestic Maritime Industry in the State of Florida*, 2018). As of 2021, there are 1,004,240 registered boats in Florida (National Marine Manufacturers Association, 2023). In recent years, the state has made efforts to become more sustainable, creating multiple programs to promote a clean marine environment (*Clean Boating Programs | Florida Department of Environmental Protection*, n.d.). The Clean Marina Program is a voluntary program that allow marinas and boatyards to learn more about the environment and become designated "Clean & Resilient" facilities. To be considered, the marina must adhere to all federal regulatory requirements and implement at least 60% of the voluntary management practices such as protection of rare and endangered species and vegetation (*Clean Boating Programs | Florida Department of Environmental Protection*,

n.d.). These facilities will then receive financial support from the state to upkeep their sustainable practices. The city of Fort Lauderdale has established goals to be net-zero in greenhouse gas emissions by 2040 for the city government and 2050 for the community (*Clean Boating Programs | Florida Department of Environmental Protection*, n.d.). The city has invested in planting trees and optimizing energy usage to reach this goal.

Florida: FOSTER Seagrass Restoration

FOSTER (Florida Oceanographic Seagrass Training, Education and Restoration) aims to train volunteers to assist in seagrass restoration and monitoring, while also educating the public on the issues seagrasses face. The goal of the organization is to restore and conserve the Indian Lagoon's seagrass population. Since it began the restoration project in 2016, FOSTER has replanted over 20,000 seagrass shoots covering approximately 75 square meters (*FOSTER*, n.d.).

Seagrass is important to the health of Florida's waterways. It serves as a habitat and food for many species, prevents erosion by stabilizing the sediment on the seafloor, improves water quality with the absorption of nutrients, and provides long term carbon storage. Florida has seven seagrass species, making it the most biodiverse seagrass population in the U.S.A. (*FOSTER*, n.d.).

FOSTER's restoration process has four steps, the first being recovery which entails volunteers collecting seagrass fragments that have washed ashore. The collected fragments are replanted in the nursery, which is maintained by volunteers weekly to ensure the seagrass is healthy and thriving. The nursery serves as an educational tool and is available to the public. FOSTER's team researches the seagrass and uses applied science to conduct informed restoration projects and give the seagrass a higher chance of successful restoration. Following sufficient growth, the seagrass is fixed into "planting units" to use in the restoration projects. The

mats that are made are transplanted into the Indian Lagoon where the seagrass grows and expands over time (*FOSTER*, n.d.). The Executive Director and CEO of the organization is Mark D. Perry, who can be contacted at mperry@floridaocean.org. Their website is https://www.floridaocean.org/foster.

Florida: Riverside Conservancy Park Shoreline Restoration

The Riverside Conservancy identified three estuarian waterside parks in the city of Edgewater, Florida. The parks are Menard-May, George R. Kennedy Memorial, and Veteran's Memorial. The Riverside Conservancy is facilitating the restoration of these coasts through the creation of living shorelines, which are riverfronts or coastal areas populated by native plants (*Park Shoreline Restorations*, n.d.).

The Riverside Conservancy plants aquatic grasses and mangroves, (as well as restores oyster beds) which filter pollution from the waterways, greatly benefiting the ecosystem. These shorelines are natural water filters cleaning waterways and drinking water, creating healthy habitats for many wildlife species, and protecting homes and businesses from storm surge (*Park Shoreline Restorations*, n.d.).

These three parks are very popular and important for restoration because they drain into the Indian River Lagoon. The restorations will not only be beneficial to the environment, but the highly visible areas they are in will be great for the public to recognize the visual and ecological benefits of them as well. This can help educate many about living shorelines and aid in future restoration (*Park Shoreline Restorations*, n.d.). The Executive Director of the organization is Kelly McGee, and the contact information is info@riversideconservancy.org. The website for this project is https://www.riversideconservancy.org/park-shoreline-restorations.

Florida: Tampa Bay Watch Seagrass Restoration

Tampa Bay Watch's Seagrass Restoration project is located in the Tampa Bay on the western side of Florida. The organization has a history of conducting successful transplanting projects throughout the bay by pulling seagrasses from a permitted donor area and transplanting them into the permitted project areas. The seagrass species they work with are shoal grass (*halodule wrightii*), turtle grass (*thalassia testudinum*), and manatee grass (*syringodium filliforme*). The goal of the project is to maintain 15,378 hectares of seagrass located in the Tampa Bay.

The Tampa Bay Watch also conducts annual seagrass monitoring surveys as part of the Tampa Bay Interagency Seagrass Monitoring Program, cleans up marine debris, documents bay scallop populations annually, plants native plants on the bay's coastline, and runs an oyster shell recycling project that collects shells and uses them to create habitats for oyster restoration. They also run a marine education center that hosts community and education programs, including summer camps for children. The organization is "dedicated to fostering a healthy Tampa Bay watershed through community-driven restoration projects, education programs, and outreach initiatives" (Tampa Bay Watch, n.d.). The Tampa Bay Watch is located in Tierra Verde, a small town located on an island at the mouth of the Tampa Bay in Florida. It was established as a nonprofit organization in 1993 and has been conducting restoration projects in the area since 1994. They received four out of four stars from Charity Navigator, an independent organization that evaluates nonprofits in the United States.

The Tampa Bay Watch offers memberships to both individuals and companies. They currently have thirteen "Lifetime" corporate members in addition to thirty-one corporate members and six corporate partners. The amount of seagrass planted can potentially be sold, and while the organization does not currently focus on carbon credits, the project has the possibility

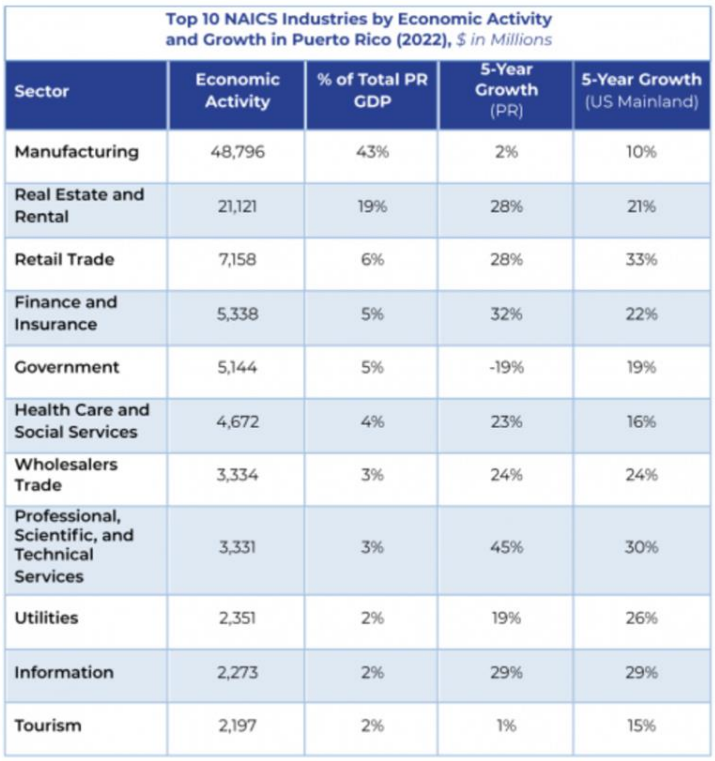
of being converted into carbon credits in the future (*Seagrass – Tampa Bay Watch*, n.d.). The contact person at Tampa Bay Watch for seagrass restoration is Serra Herndon at sherndon@tampabaywatch.org. The contact phone number for Tampa Bay Watch's corporate membership program is +1 727-867-8166, x232.

Puerto Rico

Puerto Rico tourism has been on the rise in the last few years with 5.1 million passengers arriving in 2022. This has brought 8.9 billion USD and 91,500 jobs to the island in 2022 (Discover Puerto Rico, 2023). From 2021 to 2022 air travel, hotel demands, and tourism related jobs have increased by at least 20% (*Discover Puerto Rico Announces 2022 as a Record Setting Year in Visitation, Spending, and Tourism Industry Jobs*, 2022). This increase of tourism demand is expected to continue with hotels and rentals generating 500 million USD in the first quarter of fiscal year 2023. The industry is projected to reach 4.2 million visitors and 611 million USD by 2026 (*Discover Puerto Rico Announces 2022 as a Record Setting Year in Visitation, Spending, and Tourism Industry Jobs*, 2022). Despite the large quantity of tourism, the tourism industry makes up 2% of Puerto Rico's GDP with a predicted growth of 1% over the next five years (*The Foundation for Puerto Rico's Economy*, 2023). Figure 7 below shows the full breakdown of Puerto Rico's GDP and each industry's expected growth compared to that in the United States.

Figure 7:

Breakdown of Puerto Rico's Gross Domestic Product



Top 10 NAICS Industries by Economic Activity and Growth in Puerto Rico (2022), *$ in Millions*

Sector	Economic Activity	% of Total PR GDP	5-Year Growth (PR)	5-Year Growth (US Mainland)
Manufacturing	48,796	43%	2%	10%
Real Estate and Rental	21,121	19%	28%	21%
Retail Trade	7,158	6%	28%	33%
Finance and Insurance	5,338	5%	32%	22%
Government	5,144	5%	-19%	19%
Health Care and Social Services	4,672	4%	23%	16%
Wholesalers Trade	3,334	3%	24%	24%
Professional, Scientific, and Technical Services	3,331	3%	45%	30%
Utilities	2,351	2%	19%	26%
Information	2,273	2%	29%	29%
Tourism	2,197	2%	1%	15%

Note. Figure 7 shows the breakdown of Puerto Rico's GDP by industry. From *The Foundation for Puerto Rico's Economy*. (2023, October 18). Financial Oversight and Management Board for Puerto Rico. https://oversightboard.pr.gov/ the-foundation-for-puerto-ricos-economy/

The tourism sector has begun investing in sustainable tourism, creating the Green Hotel Program. This program seeks to ensure that facilities endorsed by the Puerto Rico Tourism Company meet sustainability principles. There are two main sections of the program, Agro-lodgings (inns located at a site of agricultural activity that offer agricultural experiences) and Ecotourism. The agrotourism program focuses on agriculture and promoting sustainable farming while ecotourism promotes community-based initiatives (*Sustainable Tourism,* n.d.).

The Puerto Rican government made a recent deal to expand their yachting industry. Currently, there are about thirty yachts that visit Puerto Rico annually and their ports can only

handle two yachts at a time (Spicknell, 2023). In November 2023, Governor Pedro Pierluisi made a deal with Safe Harbor Marinas to build a new marina expected to generate over 10 million USD a year. The marina design is over 54,000 square meters and can hold over six yachts. In the agreement, Puerto Rico's Port Authority will receive 200,000 USD a year for the 40-year lease. The project is scheduled to start by the end of 2024. Safe Harbor is a private US-based company that provides docking space and services for yachts. They have a network of 134 marinas and 48,000 members (*Safe Harbor Marinas*, n.d.). Safe Harbor has sustainability goals of becoming carbon neutral by 2035 and net zero by 2045. They have made efforts to reach these goals by reducing their electricity usage and installing solar panels on their buildings (*Sustainability*, n.d.).

With hundreds of miles of coastline Puerto Rico contains a number of marinas around the island, the biggest being Puerto del Rey. This is the most complete marina in the Caribbean with over 1,000 slips and over 650 dry stack spaces (*Marina Puerto Del Rey*, n.d.). Recreational boating is popular, and the CAGR from 2022-2030 is 6.5% for the recreational boat market (*Recreational Boat Market Size Global Report, 2022 - 2030*, 2022). Based on a 2012 study, there are 65,000 registered boats in Puerto Rico with 13.6% of the population participating in recreational boating (*National Recreational Boating Survey*, 2012).

Puerto Rico: Blue Resilience Initiative, Aguirre State Forest and Mata Redonda

The Blue Resilience Initiative, a part of the Ocean Foundation, is focused on restoring and conserving coastal habitats. The initiative is based in Puerto Rico while also working in other Latin American countries. Using seagrasses, mangroves, coral reefs, seaweed, and salt marshes

the project restores and grows coastline ecosystems. The initiative has established a living shoreline in Puerto Rico by planting 1,080 red mangrove trees and restoring a 0.2-hectare bay. This has improved the migration of birds and manatees. A new mangrove forest restoration project is set to start with the Jacob Bay national Estuarine Research Reserve and Aguirre State Forrest. This past year, the initiative has designed and gathered permits for the 281.3-hectare project. Still awaiting a final permit, it is scheduled to begin in 2024. No carbon credits are sold through the initiative. The Ocean Foundation does sell carbon offsets through a seagrass planting program, but it is not connected to the Blue Resilience Initiative. The Ocean Foundation is a non-profit organization. The foundation, having the goal of improving global ocean health and the blue economy, financially supports many small projects and initiatives around the world. The Ocean Foundation was established in 2003, and Blue Resilience was established in 2018. The foundation is funded through grants, contributions, and investors. Investors include Marriott International, Loreto Bay Golf Resort and Spa, JetBlue, and the Philadelphia Eagles (*Ocean Conservation Projects*, n.d.). For partnerships, contact grants@oceanfdn.org

United Arab Emirates

The United Arab Emirates has a strong economy and is dedicated to promoting many causes including sustainability. The government has dedicated 2023 and 2024 as the "Year of Sustainability" (Al Fahaam, 2024). In the United Arab Emirates, tourism is a rapidly growing sector, accounting for 11.9% of the country's GDP (Department of Economic Studies, 2020). In 2019, the total tourism expenditure was 182.2 billion AED (approximately 49.6 billion USD), with 77.6% of spending coming from non-UAE citizens (Department of Economic Studies, 2020). The top five countries of tourists were India, Saudi Arabia, China, Oman, and the United Kingdom (United Arab Emirates Government, 2023). The 2021-2026 CAGR for the tourism

sector is 17.13% and the projected market volume by 2026 is almost one billion USD (UAE Ministry of Economy, 2021). In 2019, 749,200 jobs in the country were in the travel or tourism sector, which is 11.2% of the jobs in the country (United Arab Emirates Government, 2023).

The yacht charter service industry in the UAE has a CAGR of 6.8% and the industry's total revenue within the Gulf Cooperation Council (composed of Saudi Arabia, United Arab Emirates, Oman, Kuwait, Qatar, and Bahrain) is expected to reach 1.117 billion USD by 2034 (Shah, 2023). Some yacht companies in Dubai include Xclusive Yachts and Sunset Yacht Dubai. Some yacht companies in Abu Dhabi include Captain Tony's and Dream Yacht Charter (Shah, 2023).

The UAE has twelve major ports, the majority of which are in Dubai (United Arab Emirates Government, n.d.). These ports are internationally ranked as being among the top ten for container handling volume (Hussein & Nashar, 2023).

Dubai: AZRAQ

Azraq is a non-profit marine conservation organization based in the UAE whose mission is to safeguard and protect the oceanic ecosystem. Established in 2017, Azraq aims to educate people about climate change while offering them ways to get involved. They have multiple projects around the UAE which include mangrove conservation, coral restoration, beach clean ups, and studying marine life. Azraq's Magic Mangrove initiative aims to plant mangrove trees across the Emirates and increase awareness about the importance of mangroves. In 2022, they planted 1,116 mangrove trees, which have sequestered 320kg of carbon. Azraq currently has nine partnerships and twenty-eight sponsorships with companies and other non-profit organizations. 98.3% of their revenue comes from sponsors and partners, most of which are other sustainability companies. Their biggest sponsors being Mubadala, Mandarin Oriental, and Beetle and Goliath. Azraq does not have any carbon credit projects and focuses on helping their partners develop an

ecofriendly brand for their company. Azraq is accredited by the United National Environment Assembly of the UN Environment Program (*Mangrove Conservation*, n.d.). The President/Managing Director of the organization is Hala Dahmane, and the contact email for the organization is info@azraqme.org. Their website for mangrove conservation is https://azraqme.org/mangrove-conservation.

Latin America

Costa Rica

Costa Rica has a long history of environmental conservation and is considered a "global leader for its environmental policies and accomplishments" according to the Green Fiscal Policy Network ("Costa Rica - Country Profile," 2019). The country has implemented a plan to achieve net zero emissions by 2050 and has the Costa Rican Voluntary Domestic Carbon Market, which is domestic and countries outside of Costa Rica cannot sell credits in this market. However, there is no legislation prohibiting an external company from matching domestic suppliers and buyers. Costa Rica has also had a program called Payments for Environmental Services since 1997, which allows landowners to sell carbon credits generated by their land to the government ("Costa Rica - Country Profile," 2019).

A disproportionally high amount-- six percent-- of the world's diversity is in Costa Rica. Costa Rica is considered the "birthplace of ecotourism," with up to 80% of visitors to the country participating in eco-tourism activities (Embassy of Costa Rica in Washington DC, n.d.). Some of the most popular tourist destinations are Manuel Antonio National Park, Corcovado National Park, Tortuguero National Park, Arenal Volcano, and Monteverde Cloud Forest Reserve (Tellier, 2023). Tourism is an extremely important part of Costa Rica's economy and earnings from the tourism sector are greater than 1.7 billion USD per year (Embassy of Costa Rica in Washington

DC, n.d.). The GDP contribution for the tourism sector was 7.8 billion USD in 2022, with 1,962,087 tourists visiting the country and 152,345 direct jobs generated (Tellier, 2023).

In 2022, the country announced a new tourism development plan based on the pillars of sustainability, innovation, and inclusiveness. Their goal is to achieve 400,000 cruise ship passengers, 4.9 billion USD in foreign income, and 3.8 million tourists arriving per year by 2027 (Hepple, 2023). Costa Rica's CAGR for the tourism sector is estimated to be greater than 5% for the 2024-2029 period (Mordor Intelligence, 2023).

Major ports in Costa Rica include the Port of Caldera, Port of Limon, Port of Moin, Port of Puntarenas, Port of Quepos, Port of Golfito, and Terminal Punta Morales, and yacht-compatible marinas include Papagayo, Los Sueños, Pez Vela, Bahía Golfito, and Banana Bay (Ingram, 2021; Joshi, 2022). In 2021, a new marine law was passed that reduced restrictions on how long yachts can stay in Costa Rica (Ingram, 2021). This law was aimed at increasing the country's revenue from tourists, as passengers on yachts spend an average of 3000 USD while in the country (Tico Times, 2022).

Costa Rica: Marine Conservation Costa Rica

Marine Conservation Costa Rica's coral restoration project is located in the Manuel Antonio area of Costa Rica. They practice outplanting, where they transplant multiple species of coral from the organization's nurseries into native reefs. In the first seven months of 2023, they planted over 500 coral colonies, which is significant growth since the project began in 2020. Marine Conservation Costa Rica (MCCR) was founded in 2019 by Georgia King and Katherine Evans. The organization's goal is to "Foster marine conservation through education and action" (Marine Conservation Costa Rica, 2023). They are located in Quepos, Costa Rica and are currently running two projects.

Their primary project is coral reef restoration and their secondary project is environmental education (primarily for children). MCCR also monitors the health of local coral reefs, runs volunteer and internship programs, holds beach and underwater litter cleanups, and seeks to help local businesses and tourism services grow in sustainable ways. As of November 2023, the organization offers a membership program allowing local businesses to contribute to their projects. This project has definite biodiversity benefits: in their coral outplanting areas, species diversity has increased by 46.8% since their project began (Marine Conservation Costa Rica, 2023). They do not currently sell carbon credits or have verification. MCCR has plans to expand and build a new sustainable reef structure (*Current Projects - Marine Conservation Costa Rica*, 2019). MCCR can be contacted by phone or WhatsApp at +506 8871 2333 or by email at info@marineconservationcostarica.org. Their website is https://marineconservationcostarica.org/current-conservation-projects/.

Colombia

Colombia's economy grew at a rate of 1.2% in 2023 and is forecasted to grow 1.5% in 2024 and 2.3% in 2025. Their inflation is expected to decline from nearly 10% in 2023, to 5.4% in 2024, and 3.8% in 2025. The improved inflation will allow banks to lower their interest rate throughout 2024 ending at around 7%. (*Colombia Economic Outlook. December 2023 | BBVA Research*, n.d.).

Colombia's tourism sector has grown to be a big part of its economy after the large dips seen in 2020 and 2021 due to COVID-19. Colombia hit a record high of 4.5 million international visitors in 2022. The size of their tourism sector has grown to 17.3 billion USD. In 2022, international visitors spent over 2.5 times more money than natives traveling within the country. In recent years, the government has dedicated more resources toward promoting tourism and

improving the experience (*Tourism In Colombia - Tourism Teacher*, 2023). They have invested heavily in their infrastructure such as roads, airports, and public transportation networks. Colombia has also implemented improved security measures which helps mend its identity as a dangerous place and therefore appeals more to tourists. Sustainable development, promoting environment friendly tourism, and protecting fragile ecosystems have become major priorities for Colombia (*Tourism In Colombia - Tourism Teacher*, 2023). Collaboration between the government, locals, and private stakeholders aids greatly in achieving an efficient balance between economic development and environmental conservation. In an effort to promote sustainable tourism, Colombia has turned to advertising community-based tourism and an enhanced experience with respect to cultural authenticity. This diversification of tourism helps grow the sector while still promoting sustainability. According to a survey taken in 2023, Colombian travelers are eager to consider ways of making future travel more sustainable. Nine out of ten travelers want to find ways to increase sustainability in their travel, so much so that they are willing to pay more for sustainable travel options (*Tourism In Colombia - Tourism Teacher*, 2023).

The yachting and marine industries in Colombia are present as there is a significantly large coastline in the country. The industries are growing but are not yet at the level of other countries where we highlighted yachting and marine sectors. Our team wasn't able to locate any current relevant quantitative data.

Colombia: Vida Manglar Carbon Project

Vida Manglar is a mangrove forest restoration project based in Cispata Bay in Colombia. Vida Manglar Carbon Project is in collaboration with the Conservation International, a non-profit organization focused on protecting and restoring nature. Vida Manglar is one of more than

twenty-four projects connected through the Conservation. The project has been active for the last thirty years, restoring 7,486.7 hectares of forests to date. The project plans to expand their operations in the following years restoring 10,926.5 hectares of mangrove forests and sequestering almost one million tons of carbon. Vida Manglar became a certified carbon credit in 2021 with Verra while also receiving gold-level climate community and biodiversity certification. The project receives 45% of their funding through local governments and organizations. The remainder of the project funds come from various corporations, non-government organizations, individuals, and other investments (*Vida Manglar Carbon Project*, n.d.). The contact for this project is Colombia@conservation.org. It may also be useful to contact Lisa Jackson, who is the vice president of environment, policy and social initiative as well as a board member.

Chapter 5: Discussion

Discussion Overview

The team's results will help Sea the Change achieve their goal for marine conservation by providing them with necessary context as well as a list of potential projects to partner with in each region they are interested in expanding into.

The team's results were synthesized for our sponsor in the form of a report, with the intention that Sea the Change can use it to inform their decision about what region to expand into first. This report began with information from the background chapter on motivations and risks for companies entering the voluntary market, in-depth descriptions of companies similar to Sea the Change, and organizations that may serve as resources to Sea the Change. While Sea the Change may already be aware of some or all of this information, we included it in our team's report so that they can use it as supporting evidence for their investors. The bulk of the report contained the team's project results.

By giving a legislative summary of each region, then the economic context, then the project suggestion list, the report is organized in such a way that all relevant information about the region as a whole is given first, to allow our sponsors to read each project description with the region's context in mind. The legislative summary was intended to inform sponsors of legislation that gives important context about sustainability or may affect their operations in that region. Research on the economic context of three markets within each region: tourism, yacht, and marine was provided to give our sponsors information about which of these markets of interest to pay the most attention to in each region. Projects meeting Sea the Change's criteria for expansion in each region, with a description of their environmental impact, organizational history, and

contact information for the appropriate employee were compiled to give our sponsor a list of promising options that they can consider as they begin their expansion.

In the following chapter, a discussion of our results is provided, including suggestions for the most promising regions and projects for Sea the Change to consider first.

Comparison of Competitors

Table 1 below compares the similarities and differences between Sea the Change and the previously identified competitors. The competitor analysis may provide Sea the Change with helpful insights into what current services are being provided in the carbon offset market and how they can fit into a gap in the market. Sea the Change has the following components in their business operations: providing additional services, connecting clients with projects, calculating carbon emissions, selling carbon credits and focusing on blue carbon are all services that Sea the Change provides. Other than Sea the Change there are no competitors completing all five categories. However, these competitors have several differences which may inform Sea the Change as they seek to expand and improve their business.

Table 1:

Comparison of Competitors to Sea the Change

Competitors	Provides additional services	Connects clients with projects	Calculates carbon emissions	Sells carbon credits	Focuses on blue carbon	Differences
Clear Blue Markets	✓	✓				Less ethical standards for clients, mainly provides market intelligence reports
Terrapass	✓	✓	✓	✓		Mainly sells to individuals, not businesses
Nemerco	✓	✓	✓	✓		Focuses on renewable energy and industrial products
Earthood			✓			Verifies carbon credits, creates carbon projects
Carbonplace		✓		✓		Uses bank software for secure transactions
Viridios Capital	✓	✓	✓			Provides market and price point reports
ACES				✓	✓	Also creates projects
Ecosecurities		✓	✓	✓		Supports the creation of projects, less ethical standards for clients
Blue Marine Foundation					✓	Creates projects and legislation
One Tribe		✓	✓	✓		Tracks offsets after the sale of credits

Note. The table above compares the similarities and differences between Sea the Change and the ten identified competitors.

Legislative Discussion

With regards to current legislation, one similarity is that all regions of interest are part of the Paris Agreement (although the United States has accepted, withdrawn, and re-accepted the agreement within the past eight years due to multiple changes in leadership). All regions have mandatory emissions reporting for at least some companies, with most regions only having legislation mandating that very large companies or public companies must adhere to. One unique region is Puerto Rico, which as an unincorporated territory of the United States is subject to all federal regulations and has additional unique laws regarding the environment.

Legislative trends to pay attention to are present in California, Virginia, and the United Arab Emirates. California is consistently passing new legislation to improve their environmental impact, which may affect companies such as Sea the Change. Virginia is currently attempting to legally withdraw from the Regional Greenhouse Gas Initiative, in which case legislative and market changes will be expected. The United Arab Emirates is in the process of creating various carbon credit programs, which will most likely lead to policies emerging in the future as the market continues to expand. From a legislative standpoint, the least is likely to change in Costa Rica, which has the longest history of environmental protection legislation. The most legislative change can be expected in the United Arab Emirates and the United States (especially in Virginia if they leave the RGGI and in Florida, which does not currently have any in-depth state-specific legislation).

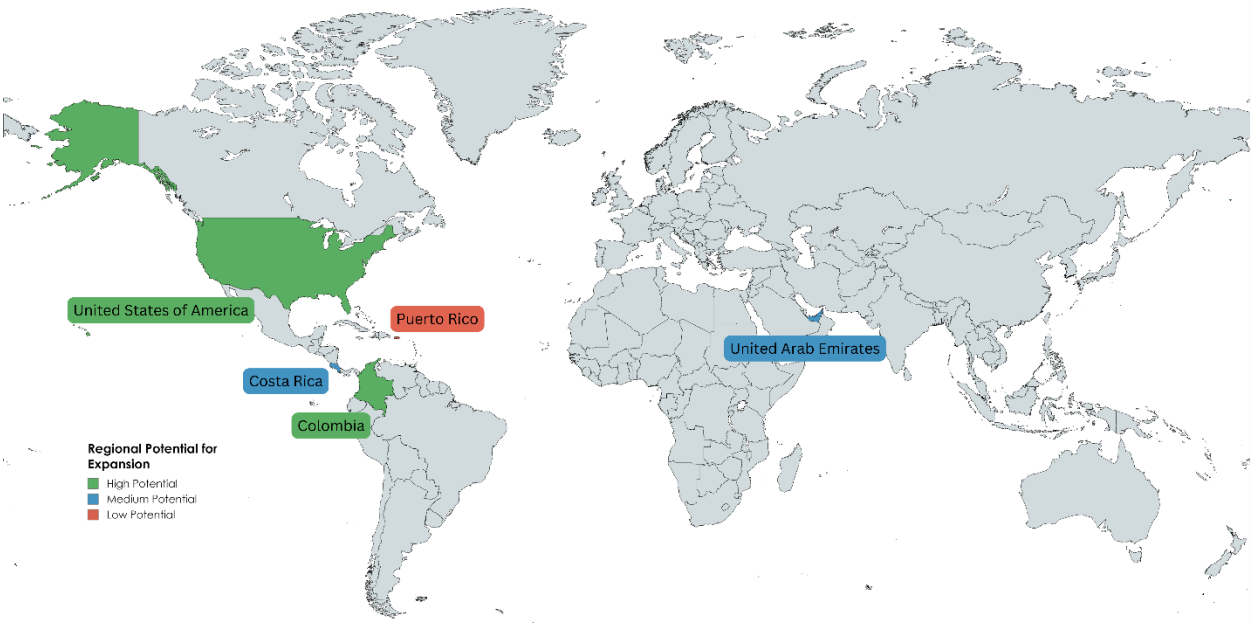
Regional Potential for Expansion

There are many pros and cons of each potential expansion region for Sea the Change. Using a chart (provided in Appendix C) of each market's performance/potential (tourism, yachting, marine), legislation's requirement of sustainability reports, prior sustainability efforts,

opportunities in the voluntary carbon market, and potential for blue carbon, we graded each potential expansion region using a point system and quantified which would be most opportunistic for expansion. Figure 8, below, is a visual representation of the results of this analysis.

Figure 8:

Map of Regional Potential for Expansion



Note. Figure 8 is a map of the world, with regions of interest highlighted. Regions depicted in green (United States of America, Colombia) gained nine or more points during our analysis, regions depicted in blue (United Arab Emirates, Costa Rica) gained between seven and nine points, and regions depicted in red (Puerto Rico) gained less than seven points.

The United States has a lot of market potential as it has massive tourism, yachting, and marine industries. There have been prior sustainability efforts in the US, and it is a constantly evolving focus. The US has large coastlines with many carbon sinks and great potential for blue

carbon sequestration moving forward. Given the size of the US, the voluntary carbon market still has room for expansion, however, there is plenty of want and need to become more economically sustainable in the US as it will not only help the environment but also attract business. The US government does not yet require sustainability reports from all companies, impacting whether or not companies will purchase offsets as without a public report there may not be a need.

Puerto Rico is similar to the US because it is an unincorporated US territory. It has large tourism and marine industries, along with prior efforts in sustainability. There is some blue carbon potential in Puerto Rico, but it does not have huge potential given its small size. There are limited requirements for sustainability reports and there is some opportunity within the voluntary carbon market.

The United Arab Emirates is another region that Sea the Change may look to expand to; along with large tourism and yachting sectors, the UAE has had many prior sustainability efforts and is a very modern area. The UAE requires all large companies to submit sustainability reports. There are some blue carbon opportunities in the UAE, however, there is not much of a marine industry. The UAE has a relatively large voluntary market with significant opportunity for business.

Costa Rica has large tourism and marine industries and has already put a lot of effort into sustainability, both generally and within these industries. Furthermore, Costa Rican legislation does require sustainability reporting from companies which is a huge step in getting them to be accountable and purchase offsets. However, with these enthusing positives come a couple unfortunate negatives that restrict the potential for expansion into Costa Rica. There are almost no opportunities within the voluntary market as Costa Rica has committed to keeping everything internal. It is very difficult to work around this and become part of the Costa Rican market. Also,

Costa Rica has limited blue carbon potential, which partially hinders its ability to grow in the sector. Given Costa Rica's dedication to being independent in the carbon market and Sea the Change's blue carbon base, it will prove difficult for expansion.

Colombia is an intriguing expansion option as it is advanced in sustainability practices. Not only is it already involved in carbon offsetting practices, leading the charge in Latin America, but it also has a quickly growing tourism sector with a large focus on sustainability. Much of Colombia's population and tourists are eager to make travel more sustainable. Colombia has a lot of market opportunity given the attitude towards sustainability and the desire to keep improving. There is some blue carbon potential in Colombia as well. The negatives are limited yacht and marine industries as well as limited requirements for sustainability reports, but this does not stop Colombia from being a great spot for future sustainability business.

Overall, the most promising market sector is tourism. All of the countries or regions we investigated have large tourism sectors. On top of that, they have begun sustainability practices within their tourism. Colombia is a perfect example in that its tourism sector is on the rise, setting record amounts of visitors while also practicing sustainability within its tourism market. There is a widespread desire to make tourism and travel more sustainable and limit its carbon footprint. This characteristic is not unique to Colombia, as the other countries are also trying to make their tourism sustainable.

Project Comparison

Table 2:

Comparison of Project Qualities

Project	Verified	Non-profit	Nature Based	Reliability (not greenwashing)	Quantified Environmental Impact	Local Impact
USA						
Eelgrass restoration	✓		✓	✓	✓	✓
Bull kelp planting		✓	✓	✓	✓	✓
South Bay salt pond restoration			✓	✓	✓	✓
Save the Bay		✓	✓	✓	✓	✓
FOSTER Seagrass restoration			✓	✓	✓	✓
Riverside Conservancy Park			✓	✓	✓	✓
Tampa Bay Watch		✓	✓	✓	✓	✓
Coastal Carbon Capture				✓	✓	✓
Ebb Carbon					✓	
Middle East						
AZRAQ		✓	✓	✓	✓	✓
Rewind					✓	
Dugong Seagrass			✓	✓		✓
Latin America						
Blue resilience initiative		✓	✓	✓	✓	✓
Marine Conservation			✓	✓	✓	✓
Vida Manglar	✓	✓	✓	✓	✓	✓

Note. Table 2 compares the qualifications of the projects our team researched excluding the requirements of blue carbon-based, privately-run organizations, longevity, and ethical organization since all the projects fulfilled these requirements.

The projects highlighted in red above are projects that our team researched but were ultimately vetoed after discussion with Sea the Change. Each failed our list of requirements in at least one category and are described below.

Coastal Blue Carbon is not nature based, as they use a mineral that captures carbon and add it to the sand along the North Carolina shoreline. This introduced an un-naturally occurring product into the ecosystem.

Ebb Carbon is not nature based, taking water from the ocean and using industrial equipment to process it, decreasing its acidity and returning it to the ocean. Their project was not focused on improving the local environment and they are partnered with industries that were actively removing water from the ocean putting into question the company's ethical reliability.

Rewind is not nature based and poses reliably concerns. They collect green waste (leaves, branches) and drive it from the surrounding five countries to submerge it in the black sea. The transporting of green waste raised concerns that greenwashing was occurring. Rewind is focusing on storing carbon in the black sea which does not help a specific local community.

Dugong Seagrass is based in Abu Dhabi but has conservation projects in Indonesia, Madagascar, Malaysia, Mozambique, the Solomon Islands, Sri Lanka, Timor-Leste, and Vanuatu. The project focuses on planting seagrass for the Dugong's to eat and supporting legislation for Dugong protection. The project did not have a focus on blue carbon.

Our accepted projects fulfil every requirement previously described in our methodology section. Some accepted projects fulfil additional “bonus” criteria such as verification of blue carbon credits and being run by a non-profit organization. The two Verra certified projects are eelgrass restoration in Virginia, USA and Vida Manglar in Columbia. Having a project with verified blue carbon credits poses a significant advantage for Sea the Change as it is easier to

market and sell a verified carbon credit. Many clients may be hesitant about buying a non-verified carbon credit as they are not always reliable. Several projects are run by a nonprofit organization which positively impacts the price and reliability of the carbon offset. These projects are Bull kelp planting, Save the Bay, Tampa Bay watch, AZRAQ, Blue Resilience Group and Vida Manglar. A nonprofit reflects positively on the carbon project and on Sea the Change as all the money used to buy carbon credits will be used to restore the ecosystems. Occasionally, buying carbon credits from a for profit organization can be more expensive than from a nonprofit because they can add a percentage to the price to generate profit.

Some projects have set goals that are quickly approaching such as the California Bull Kelp project, which plans to finish their restoration by 2027. Other projects have set smaller goals that are not anticipated to take more than five years. The Florida Riverside Conservancy Park has identified three waterside parks for their work and have already begun. Blue Resilience's living shoreline is designed at 0.2 hectare and due to the small space will not take a long time to complete.

Projects that have no definite goals of completion, plans to expand their influence, or have not started are better suited for a long-term expansion plan. FOSTER restoration in Florida, Save the Bay in California, Eelgrass restoration in Virginia, and AZRAQ in Dubai have projects with no set end and have been active for at least five years. Tampa Bay Watch in Florida has a goal of maintaining 15,378 hectares of seagrass and given the vulnerability of seagrass; the project will continue for the foreseeable future. However, they are not continuously planting seagrass; the planting is on an as-needed basis. Costa Rica Marine Conservation, Vida Manglar in Colombia, and South Bay Salt Pond Restoration have all expressed interest in expanding their efforts, indicating that they have goals to grow each project and will not be finishing within the next five

years. The Jacobs Bay Project in Puerto Rico, a part of the Blue Resilience, is a project that has not begun as of 2023. The project is still awaiting permits and is set to begin by the end of 2024. As the project has not begun it is not currently a prime candidate for expansion. It does have potential and Sea the Change should re-visit the project in a few years.

Some projects have shown an interest in collaborating with outside organizations or communities which may highlight a willingness to partner with Sea the Change. South Bay Salt Pond Restoration and Greater Farallones Kelp Restoration Project both have statements on their website that they are open to working with organizations. The FOSTER seagrass restoration project in Florida has a business partner program. They provide business with the opportunity to be "hands-on" within the organization and provide contact information for those interested in becoming business partners. This information should be considered when deciding in which areas to expand.

Suggestions for Expansion

Based on our regional potential for expansion analysis the US ranked the highest followed by Colombia. We believe that California is the best place to expand followed by Virgina and Colombia. The US has the largest market potential with strong industries and evolving sustainability efforts. California has strong tourism, yachting, boating, and fishing industries as well as a developed carbon market with existing legislation restricting carbon emissions. The proposed projects in California also have the most potential. The state also offers short- and long-term projects, two non-profits, and two projects that have expressed interest in business collaboration. Additionally, the projects are located close together, both focusing on the San Franciso Bay offering Sea the Change a variety of options in a small area.

Virginia and Colombia are also prime candidates for expansion that are both offering verified carbon credits, which ensures the project's reliability and marketability. Virginia, being in the US has a market of high potential and multiple sustainability laws. The eelgrass restoration project is a long-term project, having been active for the last 70 years and would offer a lasting partnership. Colombia has a high potential market with a growing tourism sector. The country is environmentally conscious, having focused on sustainable travel and passing legislation such as the carbon tax. The Vida Manglar project has been active for more than 30 years and plans to expand their operation in the next few years.

Ethical Considerations

Our team had several ethical considerations to contend with as we progressed with our project. With regards to conversations with Sea the Change, we tried to avoid advising them as if they were an American business. They are in a separate region and market that has different demands and tendencies. We brought aspects of American markets into our discussions with Sea the Change as they hoped to learn more about it and potentially expand, but we will still needed to recognize their company’s base market.

One of the issues we came across was Aramco’s mangrove restoration project. It is the only verified blue carbon project in the UAE and looked promising to present to Sea the Change. However, Aramco is a Saudi Arabian oil company that is responsible for 4.5% of global greenhouse gas emissions (Riley, 2017). Not only is Sea the Change against partnering with any oil companies, but the amount of emissions they produce is what Sea the Change is trying to work against.

When it came to competitor analysis it was important that our team remain neutral. Therefore, used only public information that would be available to Sea the Change regardless. We did not dig for private information that would give them a competitive advantage.

Greenwashing was also a concern of ours when searching for projects for Sea the Change. Many companies deceptively use green marketing to persuade the public and potential customers that an organizations products or services are environmentally friendly. This is why we made sure any potential project or business partners were transparent in their sustainability practices.

Challenges and Limitations

Our team faced several challenges throughout the span of our project. One of our most important obstacles was learning to work in a startup environment. Startups often must be extremely flexible in their work and change course frequently before finding a path that works for their company. Sea the Change is no exception to this, and our project was continuously evolving causing our team to rethink priorities frequently. This was a new work dynamic for our team, and we had some challenges keeping ourselves organized with the relatively short timeline. Additionally, Sea the Change was not expecting a project group for another year, but they accepted even if they were not ready to define a project. This created a need for many meetings between our team and our sponsor to clearly define the scope and purpose of our project. In future projects with a startup like Sea the Change, it would be beneficial to meet with the sponsors and map out potential shifts in focus that may arise throughout the project. This way when a transition is needed, a smooth transition can be made to keep work efficient.

Our group faced limitations when conducting industry research. Many comprehensive market and financial reports are blocked by a paywall causing us to find the information in less succinct and reliable resources. An additional team limitation was our lack of general knowledge

on the Middle Eastern region. When researching the United States, we had an advantage due to our understanding of the existing economic structure and consumer environment of the country. In the United Arab Emirates, we also faced limitations in finding information on the future plans for the carbon market, as it is not publicly available.

Future Work

Future project groups could continue our work in several ways. The sustainability market is relatively new to much of the areas we are studying and is continuously evolving, therefore, market research will continue to be necessary in order to grasp the current market. Our team was only able to find one viable blue carbon project in the UAE, but their market is rapidly developing so further product research in the region will be necessary. Future work could also include marketing materials and sales presentations. Using market research and information about Sea the Change, sales presentations could be built to target certain audiences. It would be most efficient to create several different presentations based on the companies and projects being focused on, or at least one for project partners and one for potential business partners and investors. It would be very useful for a future project group to collaborate with Sea the Change and contact some potential project and business partners in the US., Latin America, and the UAE. This would allow companies to speak with Sea the Change and perhaps move towards a future partnership.

Chapter 6: Conclusion

This project effectively synthesized research on legislation and the economic trends of select industry sectors with conservation projects to provide suggestions for our sponsor's expansion into new regions of blue carbon. Our work will benefit our sponsor, who will be able to use it as a starting point to decide which market to focus on and how to enter each market. It may also benefit future IQP students continuing our project and may serve as an example for IQP projects that involve the expansion of a startup, blue carbon, or the voluntary carbon market. The approach our team took to researching for our project could be used as a model for not only future WPI students, but also for small startups who are similar to Sea the Change and are aiming to expand into new markets, whether they are related to the environment or not. There is also no centralized database of blue carbon conservation projects or organizations similar to Sea the Change, so our work may inform companies or organizations searching for either. Environmental conservation is rapidly becoming a well-funded industry, and the more support there is for it, the healthier our planet will hopefully become.

Promoting conservation, especially marine conservation, is crucial to the health of our planet and its inhabitants. By helping our sponsor expand, the team hopes that Sea the Change can promote marine conservation and encourage businesses in these new regions to invest in blue carbon.

References

ACES. (n.d.). *Our story*. Retrieved February 20, 2024, from https://www.aces-org.co.uk/our-story/

Al Fahaam, T. (2024, February 4). *Building on success: UAE President extends Year of Sustainability into 2024 on the UAE's National Environment Day*. Emirates News Agency WAM. https://wam.ae/en/article/13qze3j-building-success-uae-president-extends-year

American Maritime Partnership. (2018). *The Economic Impact of America's Domestic Maritime Industry in the state of Florida*. https://www.rubio.senate.gov/wp-content/uploads/_cache/files/20f2a4c0-8cf4-4c3f-a41f-6b8018feab95/60E2598CC39ED8094CB65F6DAB5A66BA.florida-economic-information-2014.pdf

AZRAQ. (n.d.). *Mangrove Conservation*. Retrieved February 21, 2024, from https://azraqme.org/mangrove-conservation

Barringer, D. (2019, June 11). *California's best beaches to visit this summer*. https://www.beach-house.com/pdf/thrillist-hermosa-beach-061119-4.pdf

BBVA Research. (2023, December). *Colombia Economic Outlook*. https://www.bbvaresearch.com/en/publicaciones/colombia-economic-outlook-december-2023/

Bertram, C., Quaas, M., Reusch, T. B. H., Vafeidis, A. T., Wolff, C., & Rickels, W. (2021). The Blue Carbon Wealth of Nations. *Nature Climate Change*, *11*(8), 704–709. https://doi.org/10.1038/s41558-021-01089-4

Blue Marine Foundation. (n.d.). *About Us*. Retrieved February 20, 2024, from https://www.bluemarinefoundation.com/about/

Boehmer, E. (2023, January 5). *Environment Virginia's 2023 Priorities*. Environment Virginia. https://environmentamerica.org/virginia/resources/environment-virginias-2023-priorities/

Breg, D. (2023, September 21). *More Companies Are Disclosing Their ESG Data, but Confusion on How Persists*. WSJ pro Sustainable Business. More Companies Are Disclosing Their ESG Data, but Confusion on How Persists

CA Governor's Office. (2022, December 22). *Here's What California Accomplished in 2022 on Climate*. CA.Gov. https://www.gov.ca.gov/2022/12/22/heres-what-california-accomplished-in-2022-on-climate/

California Yacht Charters | Pacific Delights. (n.d.). *CKIM Group Inc. Luxury Yacht Charters*. Retrieved February 16, 2024, from https://luxuryyachtcharters.com/north-america-yacht-charters/california-yacht-charters/

Carbonplace. (n.d.). *About Us*. Retrieved February 20, 2024, from https://carbonplace.com/about/

Certification for Tourism Sustainability (CST). (n.d.). *Impact of the CST*. Retrieved February 21, 2024, from https://www.turismo-sostenible.co.cr/es/acerca-del-cst/impacto-del-cst-indicadores

ClearBlue Markets. (n.d.). *Home*. Retrieved February 20, 2024, from https://www.clearbluemarkets.com

ClientEarth Communications. (2020, December 22). *What is a carbon sink?* https://www.clientearth.org/latest/news/what-is-a-carbon-sink/

Climate Action Tracker. (2023, April 5). *Costa Rica: Policies & action*. https://climateactiontracker.org/countries/costa-rica/policies-action/

Climate Change Resources. (2021, December 3). *Puerto Rico*. https://climatechangeresources.org/learn-more/states/puerto-rico/

Code of Virginia: 10.1-1186.6. Carbon market participation; submerged aquatic vegetation. (2020). LIS Virginia Law. 10.1-1186.6. Carbon market participation; submerged aquatic vegetation.

Communication. (2023, August 31). Carbon tax reform in Colombia, a 2023 update. *ALLCOT Trading*. https://allcottrading.com/uncategorized-en/carbon-tax-reform-in-colombia-2023-update/

Conservation International. (n.d.). *Vida Manglar Carbon Project*. Retrieved February 21, 2024, from https://www.conservation.org/projects/vida-manglar-carbon-project

Department of Economic Studies. (2020). *The Annual Economic Report* (Ed. 28). United Arab Emirates Ministry of Economy. https://www.moec.gov.ae/documents/20121/302471/English%20Version%20_MOE_Annual%20Report.pdf/e89802b5-b321-126f-ccae-62c2103cac5b

Diez, M., & Castano-Isaza, J. (2023, November 21). *What You Need to Know About Blue Carbon*. World Bank. https://www.worldbank.org/en/news/feature/2023/11/21/what-you-need-to-know-about-blue-carbon

Directorate-General for Climate Action. (n.d.). *What is the EU ETS?* European Commission: Energy, Climate Change, Environment. Retrieved January 26, 2024, from https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/what-eu-ets_en

Discover Puerto Rico. (n.d.). *Marina Puerto del Rey*. Retrieved February 20, 2024, from https://www.discoverpuertorico.com/profile/marina-puerto-del-rey/776

Discover Puerto Rico. (2022). *Discover Puerto Rico Announces 2022 as a Record Setting Year in Visitation, Spending, and Tourism Industry Jobs*. https://www.discoverpuertorico.com/industry/download/600786-discover-puerto-rico-announces-2022-record-setting-year-visitation-spending-tourism-industry-jobs.pdf

Discover Puerto Rico. (2023, January 31). *Puerto Rico Reflects on 2022 as Strongest Year in Tourism History, this National Plan for Vacation Day*. https://www.prnewswire.com/news-releases/puerto-rico-reflects-on-2022-as-strongest-year-in-tourism-history-this-national-plan-for-vacation-day-301734786.html

Do, B., & Nguyen, N. (2020). The Links between Proactive Environmental Strategy, Competitive Advantages and Firm Performance: An Empirical Study in Vietnam. *Sustainability*, *12*(12), 4962. https://doi.org/10.3390/su12124962

Downeast Lakes Land Trust. (n.d.). *Carbon Program*. Retrieved January 24, 2024, from https://downeastlakes.org/forest-activities/carbon-program/

Downeast Lakes Land Trust. (2022). *Corporate Partners*. Downeast Lakes Land Trust. https://downeastlakes.org/who-we-are/corporate-partners/

Dubai Electricity & Water Authority. (2023, November 23). *DFM Launches Pilot for Carbon Credits Trading at COP28*. https://www.dewa.gov.ae/en/about-us/media-publications/latest-news/2023/11/dfm-launches-pilot-for-carbon-credits-trading-at-cop28

Dubai Financial Market. (n.d.). *Voluntary Carbon Credit Market*. Retrieved February 20, 2024, from https://www.dfm.ae//investing/products/carbon-credits

Earthood. (n.d.-a). *Climate Change*. Retrieved February 20, 2024, from https://www.earthood.in/

Earthood. (n.d.-b). *Earthoodies*. Retrieved February 20, 2024, from https://www.earthood.in/

ecosecurities. (n.d.). *Project development*. Retrieved February 20, 2024, from https://www.ecosecurities.com

Embassy of Costa Rica in Washington DC. (n.d.). *Costa Rica at a Glance*. About Costa Rica. Retrieved February 20, 2024, from http://www.costarica-embassy.org/index.php?q=node/19

Environment Policy Committee. (2020). *OECD Accession Review of Costa Rica in the Fields of Environment and Waste Summary Report*. https://one.oecd.org/document/ENV/EPOC%282019%2918/FINAL/en/pdf

Environmental Justice Foundation. (2022, June 22). *EU nature restoration law should help protect blue carbon and the…*. https://ejfoundation.org/news-media/eu-nature-restoration-law-should-help-protect-blue-carbon-and-the-climate

Favasuli, S., & Sebastian, V. (2021, June 10). *Voluntary carbon markets: How they work, how they're priced and who's involved*. S&P Global. https://www.spglobal.com/commodityinsights/en/market-insights/blogs/energy-transition/061021-voluntary-carbon-markets-pricing-participants-trading-corsia-credits

Financial Oversight and Management Board for Puerto Rico. (2023, October 18). *The Foundation for Puerto Rico's Economy*. https://oversightboard.pr.gov/the-foundation-for-puerto-ricos-economy/

Florida Department of Environmental Protection. (n.d.). *Clean Boating Programs*. Retrieved February 16, 2024, from https://floridadep.gov/RCP/Clean-Marina

Florida Maritime Partnership. (n.d.). *Florida Maritime Industry*. Retrieved February 16, 2024, from https://floridamaritimepartnership.com/florida-maritime-industry/

Florida Oceanographic Society. (n.d.). *FOSTER*. Retrieved February 16, 2024, from https://www.floridaocean.org/foster

Florida Yachts International. (n.d.). *Global Luxury Yacht Market Report*. Retrieved February 16, 2024, from https://fyiyachts.com/yacht-market-report/

Fort Lauderdale International Boat Show. (n.d.). Retrieved February 16, 2024, from https://www.flibs.com/en/home.html

Friess, D. A., Howard, J., Huxham, M., Macreadie, P. I., & Ross, F. (2022). Capitalizing on the global financial interest in blue carbon. *PLOS Climate*, *1*(8). https://doi.org/10.1371/journal.pclm.0000061

Gattuso, J.-P., Magnan, A. K., Bopp, L., Cheung, W. W. L., Duarte, C. M., Hinkel, J., Mcleod, E., Micheli, F., Oschlies, A., Williamson, P., Billé, R., Chalastani, V. I., Gates, R. D., Irisson, J.-O., Middelburg, J. J., Pörtner, H.-O., & Rau, G. H. (2018). Ocean Solutions to Address Climate Change and Its Effects on Marine Ecosystems. *Frontiers in Marine Science*, *5*, 337. https://doi.org/10.3389/fmars.2018.00337

Gawel, A., Pour, N., Brechenmacher, C., Hardcastle, D., Huenteler, H., Siml, A., & Wilde, E. (2023). *The Voluntary Carbon Market: Climate Finance at an Inflection Point*. World Economic Forum and Bain & Company. https://www3.weforum.org/docs/WEF_The_Voluntary_Carbon_Market_2023.pdf

Giovanni, E., Khalid, F., & Richards, K. (2022). *Case Study: Carbon Tax in Colombia*. Gnarly Tree Sustainability Institute. https://gnarlytreesustainability.com/wp-content/uploads/2022/07/Case-5_Colombia.pdf

Glavan, J., Shamsi, O. O. A. H. A., Herr, D., McGivern, A., Laffoley, D., & von Unger, M. (2016). *National Blue Carbon Policy Assessment United Arab Emirates*. Abu Dhabi Global Environmental Data Initiative. https://iwlearn.net/resolveuid/eabee1cb-f8f7-450f-aed1-007d179ae025

Global Marine Commodities. (n.d.). *Costa Rica*. Retrieved February 20, 2024, from https://globalmarinecommodities.org/en/costa-rica/

Gold Standard. (n.d.). *Vision + Impacts*. Retrieved February 16, 2024, from https://www.goldstandard.org/about-us/vision-and-mission

Greater Farallones Association. (n.d.). Greater Farallones Association. Retrieved February 21, 2024, from https://farallones.org/

Green Fiscal Policy Network. (2019, September 23). *Costa Rica—Country profile*. https://greenfiscalpolicy.org/policy_briefs/costa-rica-country-profile/

Grid Deployment Office. (n.d.). *Puerto Rico Grid Resilience and Transitions to 100% Renewable Energy Study (PR100)*. Energy.Gov. Retrieved February 20, 2024, from https://www.energy.gov/gdo/puerto-rico-grid-resilience-and-transitions-100-renewable-energy-study-pr100

Hamerkrop. (2021, May 21). *The potential for blue carbon offsetting projects in Europe*. Hamerkop Climate Change & Finance. https://www.hamerkop.co/blog/blue-carbon-offsetting-projects-in-europe

Hargreaves, L., & Frisch, L. (2024, January 18). *What is California's AB 1305, and what does it mean for carbon credit buyers? | Patch*. Patch. https://www.patch.io/blog/what-is-californias-ab-1305-and-what-does-it-mean-for-carbon-credit-buyers

Hepple, J. (2023, January 18). *Costa Rica: National Tourism Development Plan 2022 - 2027*. Tourismanalytics.Com. http://tourismanalytics.com/2/post/2023/01/costa-rica-national-tourism-development-plan-2022-2027.html

Herzog, H. (2023, January 20). *Carbon Capture*. MIT Climate Portal. https://climate.mit.edu/explainers/carbon-capture

Hillebrand, H., Jacob, U., & Leslie, H. M. (2020). Integrative research perspectives on marine conservation. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *375*(1814), 20190444. https://doi.org/10.1098/rstb.2019.0444

Hussein, H., & Nashar, K. (2023, November 29). *UAE demonstrates its maritime contributions and competencies at IMO*. Emirates News Agency WAM. https://wam.ae/article/apvvmsu-uae-demonstrates-its-maritime-contributions-and

IBIS World. (2023, October 11). *IBISWorld—Industry Market Research, Reports, and Statistics*. State Industry Research Reports.

Ingram, R. (2021, July 23). *How Costa Rica's New Marine Law Is A Game Changer For The Superyacht Industry*. Forbes. https://www.forbes.com/sites/rachelingram/2021/07/23/how-costa-ricas-new-marine-law-is-a-game-changer-for-the-superyacht-industry/

Intergovernmental Oceanographic Commission. (n.d.). *Blue Carbon*. Retrieved February 20, 2024, from https://www.ioc.unesco.org/en/blue-carbon

IPCC & Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. (2023). *Climate Change 2023: Synthesis Report*. Intergovernmental Panel on Climate Change. doi: 10.59327/IPCC/AR6-9789291691647

Joshi, R. (2022, June 1). 7 Major Ports in Costa Rica. *Marine Insight*. https://www.marineinsight.com/know-more/ports-in-costa-rica/

Lindner, J. (2023, December 20). *California Tourism Statistics: Market Report & Data*. Gitnux Market Data Report 2024. https://gitnux.org/california-tourism-statistics/#:~:text=Tourism%20supported%20over%201.2%20million,25.8%20million%20visitors%20in%202019.

Lindsey, R., & Michon, S. (2022, September 29). *Understanding blue carbon*. Climate.gov. http://www.climate.gov/news-features/understanding-climate/understanding-blue-carbon

Lou, J., Hultman, N., Patwardhan, A., & Mintzer, I. (2023). Corporate motivations and co-benefit valuation in private climate finance investments through voluntary carbon markets. *Npj Climate Action*, *2*(1), 32. https://doi.org/10.1038/s44168-023-00063-4

Marine Conservation Costa Rica. (2019, April 4). *Current Projects*. https://marineconservationcostarica.org/current-conservation-projects/

Marine Conservation Costa Rica. (2023). *2019-23 Summary MCCR Impact Report*. https://www.canva.com/design/DAFuQLVhsrE/XTW3hG_pQIgZ6iKQ8ag_sg/view?utm_content=DAFuQLVhsrE&utm_campaign=designshare&utm_medium=link&utm_source=viewer#4

Mateo-Santos, L., & Gonzalez-Tosado, E. (2017). *Environmental and Climate Change Law 2017* (14). Global Legal Group. https://ferraiuoli.com/wp-content/uploads/ENV17_Chapter-20_Puerto-Rico.pdf

McClure, C., Arias, D., & Marine. (2023, December 11). *CA's voluntary carbon offset law: What you need to know*. Crowe. CA's voluntary carbon offset law: What you need to know

Mikhaylov, A., Moiseev, N., Aleshin, K., & Burkhardt, T. (2020). Global climate change and greenhouse effect. *Entrepreneurship and Sustainability Issues*, *7*(4), 2897–2913. https://doi.org/10.9770/jesi.2020.7.4(21)

Moneer, Z. (23 C.E., October 9). *Carbon trading in the MENA region: Opportunities and challenges*. Middle East Institute. https://www.mei.edu/publications/carbon-trading-mena-region-opportunities-and-challenges

Mordor Intelligence. (2023). *Costa Rica Tourism Market Size*. Market Analysis. https://www.mordorintelligence.com/industry-reports/costa-rica-tourism-market

N. O. W. Money. (2023, October 18). ESG Reporting Requirements in the UAE. *NOW Money*. https://nowmoney.me/blog/esg-reporting-requirements-in-the-uae/

National Climate Task Force. (2021, January 27). https://www.whitehouse.gov/climate/

National Marine Manufacturers Association. (2023). *Recreational Boating Impact in Florida*. https://www.nmma.org/statistics/article/24433

National Marine Manufacturer's Association. (2023, June 14). *Top Recreational Boating States by Economic Impact: Virginia*. http://www.nmma.org/press/article/24353

National Oceanic and Atmospheric Administration. (2013, June 1). *What is Blue Carbon?* National Ocean Service. https://oceanservice.noaa.gov/facts/bluecarbon.html

Net Zero Tracker. (2023, June 12). *Net zero targets among world's largest companies double, but credibility gaps undermine progress*. https://zerotracker.net/insights/net-zero-targets-among-worlds-largest-companies-double-but-credibility-gaps-undermine-progress

NOAA. (2016). *Puerto Rico's Ocean Economy Data*. NOAA. https://coast.noaa.gov/data/digitalcoast/pdf/econ-report-summary-puerto-rico-english.pdf

Nodoph, L. (2022, September 24). Sustainability Reporting: US. *Makersite GmbH*. https://makersite.io/insights/sustainability-reporting-us/

Numerco. (n.d.). *Carbon*. Retrieved February 20, 2024, from https://numerco.com/products-services/carbon-and-renewables/

Oceanology International. (2024). *Marine Tech & Ocean Science Events*. https://www.oceanologyinternational.com/global/en-gb.html

OECD. (2020). *Responsible Buisness Conduct Country Fact Sheet- Costa Rica*. OECD Paris. https://mneguidelines.oecd.org/responsible-business-conduct-country-fact-sheet-costa-rica.pdf

One Tribe. (n.d.). *About Us*. One Tribe. Retrieved February 20, 2024, from https://onetribe.com/about-us/

Paullin, C. (2023, October 4). Virginia begins crafting new plans to reduce greenhouse gas emissions. *Virginia Mercury*. https://virginiamercury.com/2023/10/04/virginia-embarks-on-new-plans-to-reduce-greenhouse-gas-emissions/

Polaris Market Research. (2022, January). *Recreational Boat Market Size Global Report, 2022—2030*. https://www.polarismarketresearch.com/industry-analysis/recreational-boat-market

Puerto Rico Tourism Company. (n.d.). *Sustainable Tourism*. Retrieved February 20, 2024, from https://tourism.pr.gov/sustainable-tourism/

Reichheld, A., Peto, J., & Ritthaler, C. (2023, September 18). Research: Consumers' Sustainability Demands Are Rising. *Harvard Business Review*. https://hbr.org/2023/09/research-consumers-sustainability-demands-are-rising

Restore America's Estuaries. (2022). *A National Blue Carbon Action Plan*. https://estuaries.org/wp-content/uploads/2022/02/Blue-Carbon-National-Action-Plan-Final.pdf

Riverside Conservancy. (n.d.). *Park Shoreline Restorations*. Retrieved February 15, 2024, from https://www.riversideconservancy.org/park-shoreline-restorations

Rockport Analytics. (2022). *Travel & Tourism Make a Convincing Recovery From The COVID-19 Pandemic*. Visit Florida. https://www.visitflorida.org/media/30679/florida-visitor-economic-impact-study.pdf

Rodriguez, S. (2022, November 3). *Costa Rica backs away from leading oil and gas phaseout coalition*. Climate Home News. https://www.climatechangenews.com/2022/11/03/costa-rica-cop27-oil-gas-phase-out-coalition/

Safe Harbor Marinas. (n.d.-a). *About*. Retrieved February 20, 2024, from https://shmarinas.com/about/

Safe Harbor Marinas. (n.d.-b). *Home*. Retrieved February 20, 2024, from https://shmarinas.com/

Safe Harbor Marinas. (n.d.-c). *Sustainability*. Retrieved February 20, 2024, from https://shmarinas.com/sustainability/

San Francisco Bay Area Marinas. (n.d.). Boatharbors.Com. Retrieved February 14, 2024, from https://www.boatharbors.com/san_francisco_bay_area_marinas.htm

Sánchez, J. P., & Mauri, C. (2023, July 27). *Climate Change Regulation 2023—Costa Rica*. Chambers and Partners. https://practiceguides.chambers.com/practice-guides/climate-change-regulation-2023/costa-rica#:~:text=However%2C%20Decree%20No%2037926%2DMINAE,Units%20(%E2%80%9CUCCs%E2%80%9D).

Save The Bay. (n.d.). *Restore*. Retrieved February 21, 2024, from https://savesfbay.org/restore/

Schachter, J., Karasik, R., & Virdin, J. (n.d.). *Costa Rica | UNEP Law and Environment Assistance Platform*. UN Environment Programme. Retrieved February 21, 2024, from https://leap.unep.org/en/countries/cr/case-studies/costa-rica

Sea the Change. (n.d.). *Sea the Change Home Page*. Retrieved February 20, 2024, from https://seathechange.eu/en/

Segal, M. (2023a, March 13). *Microsoft Signs its First Ocean-Based Carbon Removal Agreement*. ESG Today. https://www.esgtoday.com/microsoft-signs-its-first-ocean-based-carbon-removal-agreement/

Segal, M. (2023b, December 6). *Microsoft Signs One of the Largest-Ever Nature-Based Deals to Remove 1.5 Million Tons of Carbon*. ESG Today. https://www.esgtoday.com/microsoft-signs-one-of-the-largest-ever-nature-based-deals-to-remove-1-5-million-tons-of-carbon/

Shah, R. (2023). *Yacht Charter Service Industry Analysis in GCC* (Services and Utilities). Future Market Insights. https://www.futuremarketinsights.com/reports/yacht-charter-service-industry-analysis-in-gcc

South Bay Salt Pond Restoration Project. (n.d.). *The Restoration Project*. Retrieved February 21, 2024, from https://www.southbayrestoration.org/page/restoration-project

Spicknell, S. (2023, November 20). *Puerto Rico signs multi-million dollar deal to build new yacht marina*. Super Yacht Times. https://www.superyachttimes.com/yacht-news/puerto-rico-multi-million-dollar-new-marina

Statista Research Department. (2023, December 21). *Industry revenue of "marinas" in California 2012-2024*. Statista. https://www.statista.com/forecasts/1204902/marinas-revenue-in-california

Takla, R., & Hassan, N. (2023, October 11). *MENA carbon market likely to reach around 150m tons by 2030*. Arab News. https://arab.news/y7ke6

Tampa Bay Watch. (n.d.-a). *Homepage*. Retrieved February 23, 2024, from https://tampabaywatch.org/

Tampa Bay Watch. (n.d.-b). *Seagrass in Tampa Bay*. Retrieved February 21, 2024, from https://tampabaywatch.org/restoration/seagrass/

Tellier, G. (2023, October 2). Costa Rica Projecting Record Number of Tourists This Year. *Costa Rica Immigration Experts*. https://crie.cr/costa-rica-expecting-a-record-number-of-tourists/

Terrapass. (n.d.). *Buy Carbon Offsets to Reduce Carbon Footprint*. Terrapass. Retrieved February 20, 2024, from https://terrapass.co.uk/

The Blue Carbon Initiative. (n.d.-a). *Climate Initiatives Platform*. Retrieved February 20, 2024, from https://climateinitiativesplatform.org/index.php/The_Blue_Carbon_Initiative

The Blue Carbon Initiative. (n.d.-b). *The Blue Carbon Initiative*. Retrieved February 20, 2024, from https://www.thebluecarboninitiative.org

The Nature Conservancy. (2023, March 24). *Restoring Eelgrass on Virginia's Eastern Shore*. https://www.nature.org/en-us/about-us/where-we-work/united-states/virginia/stories-in-virginia/vcr-marine-eelgrass-collection/

The Ocean Foundation. (n.d.-a). *About The Ocean Foundation*. Retrieved February 20, 2024, from https://oceanfdn.org/about-us/

The Ocean Foundation. (n.d.-b). *Ocean Conservation Projects*. Retrieved February 21, 2024, from https://oceanfdn.org/projects/

The Ocean Foundation. (n.d.-c). *Offset Your Carbon Footprint Calculator*. Retrieved February 20, 2024, from https://oceanfdn.org/calculator/

The Ocean Foundation. (n.d.-d). *Serving Global Ocean Environments*. Retrieved February 20, 2024, from https://oceanfdn.org/

The Ultimate Guide to Understanding Carbon Credits. (2022, January 26). *CarbonCredits.Com*. https://carboncredits.com/the-ultimate-guide-to-understanding-carbon-credits/

Tico Times. (2022, October 15). *Scenic Eclipse Mega-Yacht Makes Waves in Costa Rica*. The Tico Times | Costa Rica News. https://ticotimes.net/2022/10/15/scenic-eclipse-mega-yacht-makes-waves-in-costa-rica

Tourism Economics. (2023). *Economic Impact of Visitors in Virginia 2022*. Oxford Economics. https://www.vatc.org/wp-content/uploads/2023/08/Virginia-Tourism-Economic-Impact-2022.pdf?_gl=1*o2037*_ga*MTgxOTE2MTYwOC4xNzA3OTgyMzc1*_ga_CGQ753F582*MTcwODA3Mzk0Ny4yLjAuMTcwODA3Mzk1My4wLjAuMA..

Tourism Teacher. (2023, October 24). *Tourism In Colombia*. https://tourismteacher.com/tourism-in-colombia/

TSVCM. (2021). *Final report: Taskforce on scaling voluntary carbon markets*. https://www.iif.com/Portals/1/Files/TSVCM_Report.pdf

UAE Ministry of Economy. (2021). *Tourism*. Promising Sectors. https://www.moec.gov.ae/en/-/tourism-1#:~:text=Recent%20trends&text=Revenue%20is%20expected%20to%20show

Uhler, B., & Chu, C. (2019). *California's Geography of Wealth*. Legislative Analyst's Office. https://lao.ca.gov/reports/2019/4093/ca-geography-wealth-090519.pdf

United Arab Emirates Government. (n.d.). *Fact Sheet*. About the UAE. Retrieved February 15, 2024, from https://u.ae/en/about-the-uae/fact-sheet

United Arab Emirates Government. (2023, July 11). *Statistics and most-visited destinations*. Information and Services. https://u.ae/en/information-and-services/passports-and-traveling/statistics-and-most-visited-destinations

United Nations. (n.d.-a). *How is climate change impacting the world's ocean*. United Nations. Retrieved November 19, 2023, from https://www.un.org/en/climatechange/science/climate-issues/ocean-impacts

United Nations. (n.d.-b). *The ocean – the world's greatest ally against climate change*. United Nations Climate Action. Retrieved November 12, 2023, from https://www.un.org/en/climatechange/science/climate-issues/ocean

United Nations Framework Convention on Climate Change. (n.d.). *The Paris Agreement*. United Nations Climate Change. Retrieved January 26, 2024, from https://unfccc.int/process-and-meetings/the-paris-agreement

United States Coast Guard. (2012). *National Recreational Boating Survey*. https://uscgboating.org/library/recreational-boating-servey/USCG-2012-NRBS-Report.pdf

United States Environmental Protection Agency. (2022, July 29). *Climate Change Impacts on Coasts* [Overviews and Factsheets]. Climate Change Impacts. https://www.epa.gov/climateimpacts/climate-change-impacts-coasts

US EPA, O. (2014, September 22). *Learn About the Greenhouse Gas Reporting Program (GHGRP)* [Overviews and Factsheets]. https://www.epa.gov/ghgreporting/learn-about-greenhouse-gas-reporting-program-ghgrp

US EPA, O. (2023, May 11). *Affordable Clean Energy Rule* [Other Policies and Guidance]. https://www.epa.gov/stationary-sources-air-pollution/affordable-clean-energy-rule

USAFacts. (2023, August 30). *Economy of Virginia*. USAFacts. https://usafacts.org/topics/economy/state/virginia/

Verra. (n.d.). *Verified Carbon Standard*. Retrieved February 16, 2024, from https://verra.org/programs/verified-carbon-standard/

Verra. (2022). *Area of Focus: Blue Carbon*. https://verra.org/programs/verified-carbon-standard/area-of-focus-blue-carbon/

Virginia DEQ. (n.d.). *Carbon Trading*. Virginia Department of Environmental Quality. Retrieved February 20, 2024, from https://www.deq.virginia.gov/our-programs/air/greenhouse-gases/carbon-trading

Virginia Maritime Association. (2023, December 8). *Virginia's Maritime Industry Economic Impacts on the Commonwealth of Virginia* [Press Release]. https://vamaritime.com/Web/Web/Resources/News/Economic Impacts of Virginia's Maritime Industry.aspx

Viridios AI. (n.d.). *Viridios AI: Home*. Retrieved February 20, 2024, from https://viridios.ai/

Viridios Capital. (n.d.). *Viridios Capital: Home*. Retrieved February 20, 2024, from https://viridioscapital.com/

Voluntary Carbon Market. (n.d.). *Carbon Neutral Acceleration*. Retrieved January 26, 2024, from https://vcm.com.sa/

Wadhwani, P. (2023, October). *Yacht Market Size & Share Analysis | 2023-2032 Growth Report*. Global Market Insights Inc. https://www.gminsights.com/industry-analysis/yacht-market

Wolters Kluwer. (2019, October 10). *U.S. Federal vs. State Environmental Regulations: What to Follow?* https://www.wolterskluwer.com/en/expert-insights/us-federal-vs-state-environmental-regulations-what-to-follow

World Bank. (2023, October 4). *Costa Rica*. https://www.worldbank.org/en/country/costarica/overview

World Economic Forum. (2023). *Navigating Article 6: Opportunities for the Middle East and North Africa*. World Economic Forum. https://www3.weforum.org/docs/WEF_Navigating_Article_6_Opportunities_for_the_Middle_East_and_North_Africa_2023.pdf

World Meteorological Organization. 2022. State of the Global Climate, 2021. World Meteorological Organization. (n.d.). *State of the Global Climate, 2021* (WMO-No. 1290). ISBN 978-92-63-11290-3

Zawaya. (2023, November 17). *UAE to establish carbon registry to measure companies' emission cuts—Bloomberg*. https://www.zawya.com/en/business/energy/uae-to-establish-carbon-registry-to-measure-companies-emission-cuts-bloomberg-r8jya2vc

Appendix A: Competitor Information

Clear Blue Markets

Clear Blue Markets is a private organization located in Toronto, Canada that offers market insights and carbon neutrality services. They have an AI and machine learning tool called Vantage that returns credit price predictions with more than 90% accuracy. Anyone planning to purchase an offset credit can assess the current and future market value of offset credits, understand the market value of their portfolio to ensure the accuracy of financial statements, establish a basis for competitive negotiation and compare prices between project opportunities. In addition, they offer four services, market intelligence, market transactions, advisory services and project development. Market Intelligence clients receive carbon pricing, policy and regulation updates, and supply and demand fundamentals. Market transactions manage client's carbon exposure and find credits to meet the client's needs. Advisory services support clients in voluntary and regulated markets by developing carbon pricing strategies that help clients plan and achieve net-zero targets and optimize their carbon position. Project development works with clients to develop offset projects and supports them through the carbon offset credit creation process, including origination, implementation and commercialization.

Clear Blue Markets has over 450 carbon offset projects worldwide including removal, avoidance and reduction. These projects are not specifically blue carbon or nature-based carbon offsets. Clear Blue Markets operates in both the global voluntary market and various regulated markets around the world. They support over 150 clients and helps to manage more than 100 million tCO2e of Scope 1 and 2 emissions collectively per year. Some of their bigger clients include Shell, Chevron and General Motors (*ClearBlue Markets: Home*, n.d.). Clear Blue Markets' website is https://www.clearbluemarkets.com/.

Terrapass

Terrapass is a private organization located in Houston Texas. Established in October 2004, their goal is to reduce individual carbon footprints. Since their establishment the company has expanded and is now supporting both individuals and businesses. In 2022 they sold 408,321 metric tons of carbon offsets. They offer services to both calculate and offset your carbon footprint. Focused on sales to individuals, they have a heavy presence within the travel and specifically aviation industry. Many of their clients are rental car companies and private jet charter companies. Some big clients include Adobe, Tradewind Aviation, and Enterprise. Terrapass currently has 13 different projects in 4 different countries and 9 states in the US. Each project offers a verified carbon credit that is registered with Gold Standard, Verra, or the American Carbon Registry. These projects focus on four topics, farm power, landfill gas capture, wind power, and abandoned coal mine methane capture (*Terrapass*, n.d.). Terrapass's website is https://terrapass.co.uk/.

Numerco

Numerco is a private company established in 2013 and located in the UK. They are a wholesaler of carbon offsets that has created a marketplace for projects to sell carbon credits. They have over 200 partners in 38 countries for carbon offset projects. All available projects are verified through Verra, Gold Standard, Climate Action Reserve, Renewable Energy Certificate Registry or Power Purchase Agreements. Other services Numerco offers are a carbon footprint calculator and portfolio construction for the client. Further company information is blocked behind a paywall (*Numerco: Carbon*, n.d.). The Nemerco website is https://numerco.com/products-services/carbon-and-renewables/.

Earthood

Earthood was founded by Dr. Kaviraj Singh and Ashok Gautamin in 2012 and they are a for-profit company with more than 70 employees (Earthood, n.d.). Their headquarters are in Gurugram, India, and they have additional offices in the United Kingdom, Brazil, China, South Korea, and Turkey. Their services include auditing greenhouse gas reduction projects, submitting project proposals to the government of Quatar for their new voluntary carbon program the Global Carbon Council, and calculating carbon emissions for companies and suggesting emissions reduction plans (Earthood, n.d.). Earthood validates and verifies voluntary carbon credits using the following frameworks: Voluntary Carbon Standard, Gold Standard, Global Emissions Standard (United States), and the Social Carbon Standard (Earthood, n.d.). Earthood also offers a variety of services for agriculture and sustainability audits that are focused on mitigating climate change. Earthood has verified over 2,500 carbon credit projects, but has not been involved with any blue carbon projects yet. Their clients include, but are not limited to, QuestCapital, eco securities, Himpanzee, Permian Global, Lestari Capital, Ecoeye, Commonland, TASC, Mootral, UpEnergy, Me Climate Community, and Aera (Earthood, n.d.). Earthood's website is: https://www.earthood.in/.

Carbonplace: Competitor

Carbonplace aims to create an online marketplace that integrates existing registries of available credits with pre-existing bank software to allow companies to securely purchase verified credits. Carbonplace was founded in 2020 by a collection of banks seeking to improve the voluntary carbon market: National Australia Bank, CIBC, BNP Paribas, NatWest, Standard Chartered, UBS, Itaú, SMBC, and BBVA. It is based in London, United Kingdom and has less than 20 employees ("About Us," n.d.). The company is for profit, and only works in the voluntary market. Carbonplace's website is https://carbonplace.com/.

Viridios Capital

Viridios Capital is a private organization with offices in Sydney Australia, Brisbane Australia and London UK. Viridios AI platform offers pricing for close to 17,000 projects across voluntary carbon markets, covering the five main standards (VERRA, Gold Standard, American Carbon Registry, the Climate Action Registry and the Clean Development Mechanism). They are not partnered with these projects; however, the AI platform offers comprehensive information on the bids, trades and asks of the market which clients can use to pinpoint projects and price points (*Viridios AI: Home*, n.d.). In addition to their AI platform, Viridios offers services such as origination, corporate solutions and asset management. For origination they invest in technology and nature-based projects to help resolve social inequity and biodiversity loss. Corporate solutions entail helping clients structure their offset programs with net-zero goals by providing carbon credit and managing funds. Viridios offers asset management providing investors access to carbon as an asset class through individual managed accounts. Additionally, Pangolin Associates, which is part of the Viridios Group of companies, can map a client's carbon footprint (*Viridios Capital: Home*, n.d.). Viridios's websites are viridioscapital.com and viridios.ai.

Association for Coastal Ecosystem Services

The Association for Coastal Ecosystem Services (ACES) is a non-profit charity based in Scotland that was founded in 2008 along with its first project, the Mikoko Pajoma mangrove conservation project in Kenya. This project was the first mangrove project in the voluntary carbon market ("Our Story," n.d.). ACES's goal is to support communities who are looking to protect the mangroves in their environment, which they do free of charge. They sell verified carbon credits for two of their three blue carbon projects, and all of this money goes back into the local community. ACES also has a seagrass protection program, but due to the difficulty in

quantifying the benefits of seagrass for carbon capture, this project will not generate carbon credits ("Our Story," n.d.). The ACES website is https://www.aces-org.co.uk/.

Ecosecurities

Ecosecurities is a private organization created 25 years ago with their head office in Carouge, Switzerland. They have offices in Geneva and London, serving the major regulated markets across the EU, North America, Japan, Korea and the voluntary markets globally. Brazil is their regional hub for Latin America, Kenya for Africa and the Middle East, and Australia for the broader Asia-Pacific market. Within these markets Ecosecurities sources climate mitigation projects, develops carbon offsets and delivers tailored climate solutions including project finance to risk management. They support the project and asset owners as well as provide regulated and voluntary buyers with carbon offset options. Ecosecurities has nature-based solutions, community projects, and renewable energy projects. They have some blue carbon projects such as mangrove conservation in Mexico, but most of their carbon offsets are land based (*Carbon Markets | Ecosecurities | Project Development*, n.d.). The Ecosecurities website is https://www.ecosecurities.com/.

Blue Marine Foundation

Blue Marine Foundation is a private company established in 2010 in the UK dedicated to protecting marine environments and establishing sustainable fishing. Their goal is to ensure the protection of at least 30% of the ocean by 2030.

They have over fifty projects across the globe in twenty-four countries, all focused on securing Marine Protected Areas (MPA). In each location they work with national, regional, and local governments to create legislation on overfishing and creating MPAs. So far, they have

established over 4 million square kilometers of MPA including the world's largest MPA in the Chagos Archipelago with a protection of the Indian Ocean.

Blue Marine Foundation received the Transformation Project of the Year award in September 2023 at the Emissions Reduction Plan awards. In 2023 their total income was 11,300,376 euros, mostly funded by corporate donations their biggest donor being the Blue Marine Yacht Club ("Blue Marine Foundation: About Us," n.d.). The Blue Marine Foundation website is https://www.bluemarinefoundation.com/about/.

One Tribe

One Tribe enables businesses and individuals to conserve the environment and offset their carbon emissions through many carbon offsetting projects, most notably rainforest protection projects. Their mission is to become one of the globe's largest protectors of forests and biodiversity, providing indigenous peoples and smallholders with funds for the protection of forests. Through land purchase and designation, One Tribe and its conservation partners save acres of rainforest. Each of such projects have been identified as critical to preserving a threatened rainforest that sequesters carbon from the atmosphere (*About Us*, n.d.).

One Tribe operates as a B-corporation. A B-corp is a for profit organization that is certified by B-Lab for its social and environmental impact. They must meet a certain criteria and pass a test based on their social and environmental benefit. One Tribe enables businesses to be more sustainable through the funding of rainforest protection projects that increase the storage of carbon and prevent it from being released into the atmosphere. One Tribe allows businesses to buy high grade certified carbon offsets directly from forest conservation projects or indigenous landowners to ensure maximum impact on the climate. One Tribe also allows individuals to track the impact of their offsets and see the improvement of their carbon footprint (*About Us*, n.d.).

To date One Tribe has protected 78,476,936 trees, stored 7,288,023 tonnes of carbon, saved 101,403 acres of land, and removed 10,107,288 car emissions from the atmosphere (*About Us*, n.d.). One Tribe's website is https://onetribe.com/.

Appendix B: Rejected Projects

Coastal Carbon Capture:

The Coastal Carbon Capture Project is run by Vesta, a new carbon capture company established in 2019. Vesta is a public benefit corporation that has been active for 3 years. Their goal is to use coastal carbon capture to remove atmospheric carbon dioxide and reduce ocean acidity. The project in Duck focuses on placing 6,150 cubic yards of olivine sand along 1500 ft of shoreline in Duck, NC. Olivine is a naturally occurring silicate mineral ($MgSiO_4$) that removes atmospheric CO2 as it dissolves in water. When placed on the shoreline the seawater will dissolve the olivine while the olivine captures and permanently stores carbon in the ocean as alkalinity. Vesta has conducted a previous pilot program in Southampton, New York to determine the effect of olivine sand on the beaches and surrounding ecosystems and after 1 year of monitoring, there was no harm recorded.

The project is awaiting permit permission from Duck to begin production. The project plans to operate for at least 2 years before being reevaluated and is projected to begin in spring 2024. The project has started a verification application with Gold Standard, has received preliminary verbal conceptual approval from Gold Standard and is on track to receive accreditation by 2025.

The Project is funded by donations and grants from non-profit organizations such as Additional Adventures and Coastal Carbon Capture Development Fund. Additional Adventures is a non-profit made up of multiple entities that develop grants and invest in companies and projects focused on creating a healthier and more equitable world. The Coastal Carbon Capture Development Fund is a public charity solely in collaboration with Vesta.

2022 Report: https://drive.google.com/file/d/1f0Nepfxxdqhx_jqgm6KFBL7EbyMBCTgf/view

https://www.vesta.earth/duck#Project-Objectives-and-Scope

Ebb Carbon:

Ebb Carbon is a company that uses seawater to remove carbon and safely store it. Their project intercepts seawater and runs it through a series of ion-selective membranes using electricity. This separates the seawater into hydrochloric acid and alkaline water containing sodium hydroxide. The alkaline seawater is tested to ensure that it is within the ocean's natural pH balance and is then released back into the ocean, where the sodium hydroxide splits into sodium and hydroxide ions. The hydroxide ions then bond with dissolved CO2 to create bicarbonate (HCO_{3-}), which is naturally found in the ocean and stores carbon for up to 10,000 years. This then frees up the ocean to sequester more CO2.

Ebb Carbon's first deacidification project is in the Sequim Bay in Sequim, Washington, at the U.S. Department of Energy's Pacific Northwest National Laboratory (PNNL). Ebb Carbon is working with PNNL, the National Ocean and Atmospheric Administration, and the University of Washington to measure how much CO2 is being removed using the Ebb Carbon system and research the system's effect on marine life. The project's goal is to reduce ocean acidification and remove CO2 from the air.

Ebb Carbon, Inc was founded in February 2021 by Ben Tarbell, Dave Hegeman, Dr. Matthew Eisaman, and Todd Pelman. It is based out of San Carlos, CA (source). There are no plans for the company to cease operating, and they are planning to expand significantly over the next 5 years.

Ebb Carbon raised 20 million Series A (USD) in March of 2023 (source). Their partners and investors include Congruent Ventures, evok innovations, The Grantham Environmental Trust's Neglected Climate Opportunities, Ocean Visions, Prelude Ventures, Propeller, and stripe.

This project generates carbon credits that can be sold on the voluntary market. It removes CO2 from the atmosphere. They are working to reduce their energy costs associated with carbon removal, and switch to solar or wind power. They are not currently verified. Ebb Carbon can be contacted at https://www.ebbcarbon.com/contact.

Rewind:

Rewind is a company who aims to restore the earth's carbon balance by storing organic carbon in anoxic water. Biomass such as leaves and branches decompose on land and the carbon that they absorb gets emitted back to the atmosphere. By relocating biomass to the deep bottom of the Black Sea, Rewind will prevent large amounts of carbon from being released into the atmosphere. In anoxic waters, plants decompose extremely slowly, effectively storing the carbon much longer. The black sea is the largest anoxic body of water on earth making it the perfect setting for large scale carbon removal. They collect agricultural residues and municipal green waste, transport it in trucks and ships down the rivers and out to sea where it is then stored safely for centuries. The total transportation energy used to bring biomass to the bottom of the Black Sea is less than 3% of the carbon Rewind removes. This company offers an unverified carbon credit and is hoping to tenfold their carbon removal every year. The project is located in Trabzon, Turkey surrounded by six countries with fertile land, forests, and agriculture, with millions of tons of biomass residue every year. Rewind can be contacted at info@rewind.earth and their website is https://www.rewind.earth/.

Dugong and Seagrass Conservation Project:

The Dugong and Seagrass Conservation Project is based in Abu Dhabi and supports conservation projects worldwide. They are supported by the Global Environment Facility (GEF), the Mohamed bin Zayed Species Conservation Fund, the United Nations Environment Program (UNEP), and the Dugong MoU. They do not sell blue carbon credits, but do conservation related to seagrass and the Dugong species of herbivorous mammal. These conservation projects are located in Indonesia, Madagascar, Malaysia, Mozambique, the Solomon Islands, Sri Lanka, Timor-Leste, and Vanuatu. There is a coordination team based out of Abu Dhabi.

Their local representative is Maya Bankova Todorova, +97126329117, mbankova@mbzfund.org. The website for the Abu Dhabi division of this organization is: https://www.dugongconservation.org/where-we-work/abu-dhabi/

Appendix C: Regional Potential for Expansion Analysis

Table C 1:

Regional Potential for Expansion Analysis

Regional Potential for Expansion Analysis	Market Economic Potential			Legislation Requiring Company Sustainability Reports (0-2 scale)	Country's Prior Sustainability Efforts (0-3 scale)	Country's Voluntary Market Opportunities (0-2 scale)	Country's Potential for Blue Carbon Sequestration (0-3 scale)	Total Points
	Tourism	Yacht	Marine					
United States	1	1	1	1	2	1	3	10
Colombia	1	0	0	1	3	2	2	9
United Arab Emirates	1	1	0	1.5	2	1	2	8.5
Costa Rica	1	0	1	2	3	0.5	1	8.5
Puerto Rico	1	0	1	0.5	2	1	1	6.5