ENGINE
CARBON CLEAR

Marine Permaculture Arrays in Action

(Benefits, Specifics and Details)

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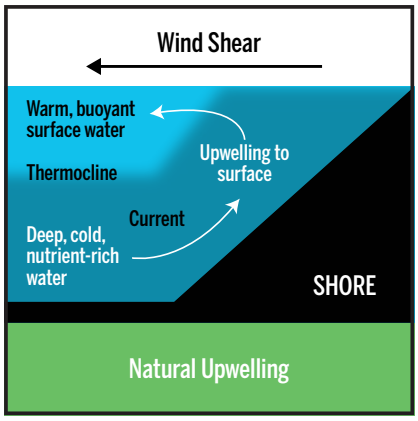
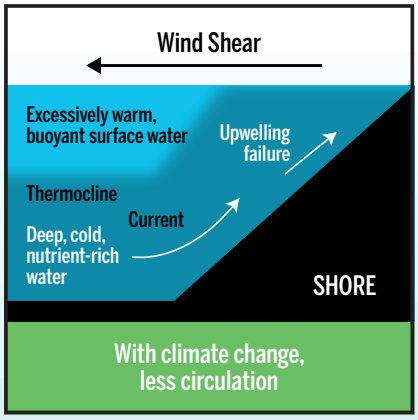
Forests around the world are disappearing at a rapid state. Billions of dollars are used every year, to combat deforestation in North and South America. According to the World Bank, as of 2021, approximately 30% of the Earth's land area is covered by forests. However, this figure has been declining over time due to deforestation and other land use changes.

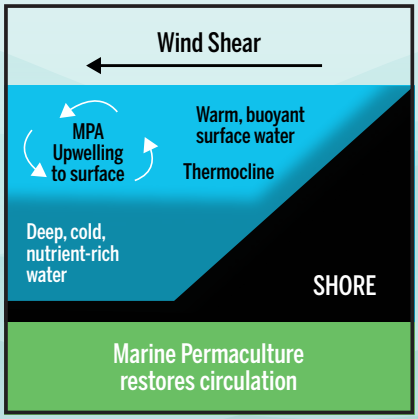
As a species, humans seem to be drawn to what we can see, touch and feel, whether that is an accurate representation of true standings, or true environmental consequences. Approximately 71% of the Earth's surface is covered by oceans, which means that land forest cover only 10% of the earth.

Because we live on land, many of us do not realize that oceans have forest, forest made of kelp, seaweed, and algae.

The forests are crucial for the oceanic environment and the habitats of all ocean creatures. Yet, 90% of natural seaweed forest have been lost off the coasts of California and Tasmania. Imagine losing nighty percent of a land forest mass in California. This is happening every single day, it's just beneath the surface of our oceans, and out of our minds.







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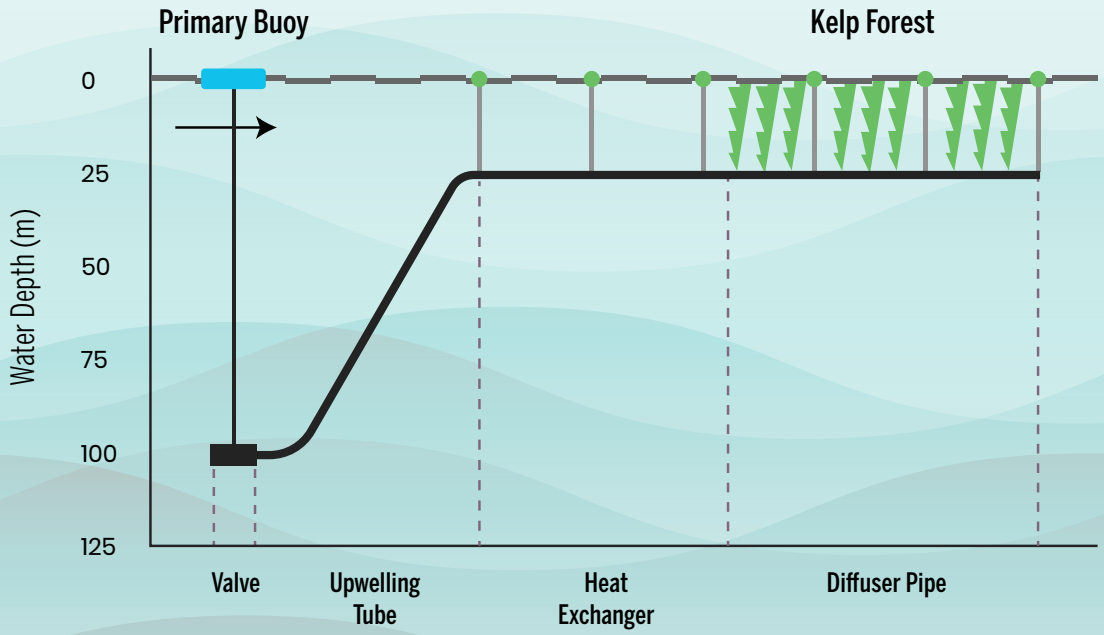
Engine Carbon Clear is on mission to change that. We will build and cultivate Marine Permaculture Arrays, around the world. Think of Marine Permaculture Arrays (MPA's) of replanted forest in the ocean, however instead of using pesticides or fertilizer an MPA will use a solar powered water pump to pump cold water from an ocean depth of approximately 100 meters, to the surface. The colder ocean water is filled with dense nutrients, allowing the new kelp forest to thrive, and all other creatures as well.

Over 3 billion humans rely on oceans for their primary source of protein. If something is not done soon, fishing stock will die.

What is truly unique about oceans is international waters. If a country in the Eastern hemisphere destroys their own fishing stock, there is nothing to stop them from traveling to the Western hemisphere and overusing a fishing stock there. Overtaxing the local environment and destroying that fishing stock.

Engine Carbon Clear's MPA system can solidify an ocean environment for an entire area of country. That same area can take steps to protecting this new natural forest, by creating a Marine National Park.



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Test Projects

It is important to understand that cultivating and building MPA's is difficult. An MPA that functions in a symbiotic environmental status off the coast in Japan, is not guaranteed to work off the coast of California. All though the general engineering aspect of MPA's will remain the same, the cultivation of kelp will differ.

Engine Carbon Clear is committed to not only working with the top academic professionals around the world in the field of kelp cultivation, but also the local academic, Universities and labs in the jurisdictions that we will place Test MPA Projects.

There are estimated to be over 30,000 different species of algae, which are classified into several different groups or divisions based on their physical and biochemical characteristics. Some of the most common groups of algae include diatoms, green algae, red algae, brown algae, and blue-green algae. Each of these groups contains a diverse range of species with unique adaptations and ecological roles.

In additional to Algae, there are over 30 different genera of kelp, each containing multiple species. Some of the most commonly cultivated kelp species include Saccharina japonica (also known as kombu or dashima), Undaria pinnatifida (also known as wakame), Macrocystis pyrifera (also known as giant kelp), and Alaria esculenta. However, there are many other species of kelp that can be found in different parts of the world, each with its own unique characteristics and ecological roles.

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Questions

WHAT IS A MARINE PERMACULTURE ARRAY?

Marine Permaculture Arrays are floating structures designed to support marine life and enhance the productivity of the ocean ecosystem. They are essentially a type of oceanic farm, where seaweed, shellfish, and other organisms are cultivated using a combination of natural and human-made techniques.

The arrays consist of a series of interconnected buoys that are anchored to the sea floor, forming a large, open platform on the water's surface. The buoys are designed to move with the waves, which helps to create a constant flow of water and nutrients around the array.

Seaweed and other organisms are grown on ropes and nets that are suspended below the surface of the water. These organisms help to absorb excess carbon dioxide and other pollutants from the water, while also providing habitat for fish and other marine life.

The aim of Marine Permaculture Arrays is to create sustainable food sources for humans while also promoting the health and biodiversity of the ocean ecosystem. By cultivating marine life in a controlled environment, it is possible to reduce the need for wild harvesting and to protect vulnerable species from overfishing.

Marine Permaculture Arrays are still a relatively new concept, but they have shown great promise in early trials. They could be an important tool in the fight against climate change, as well as a valuable source of food and income for coastal communities.

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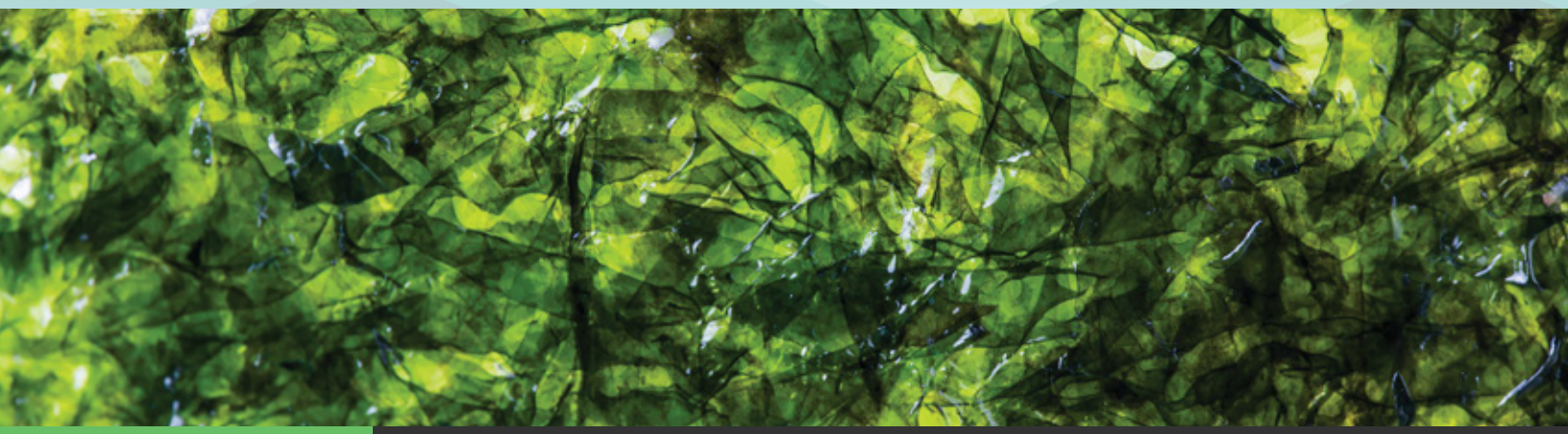

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HOW ARE MARINE PERMACULTURE ARRAYS CONSTRUCTED? ?

Marine Permaculture Arrays are typically constructed using a combination of natural and human-made materials. The specific design of the array may vary depending on the location, water conditions, and type of organisms being cultivated, but the general construction process is as follows:

1 **Platform design:** The array is designed to be a floating structure that is anchored to the sea floor. The platform is usually made up of a series of interconnected buoys that are arranged in a grid pattern.

2 **Buoy assembly:** The buoys are typically made of a durable material such as plastic or metal, and are designed to withstand the harsh conditions of the ocean. They may be hollow or filled with air to provide buoyancy.

3 **Netting and ropes:** Netting and ropes are hung from the buoys to support the seaweed and other organisms that will be grown in the array. The netting and ropes are often made of a durable, synthetic material that can withstand the salty and corrosive conditions of the ocean.

4 **Seaweed cultivation:** Once the netting and ropes are in place, seaweed is seeded on them. Seaweed grows quickly and can absorb large amounts of carbon dioxide from the water, making it a valuable crop for reducing ocean acidification.

5 **Shellfish cultivation:** In addition to seaweed, shellfish such as oysters, mussels, and clams can also be cultivated in the array. The shellfish help to filter the water and remove excess nutrients, improving water quality and reducing the risk of harmful algal blooms.

6 **Monitoring and maintenance:** Once the array is in place, it requires regular monitoring and maintenance to ensure that the seaweed and shellfish are growing properly and that the array is not causing any harm to the surrounding ecosystem.

Overall, the construction process for Marine Permaculture Arrays requires careful planning, design, and maintenance to ensure that the array is effective, sustainable, and safe for the environment.

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WHAT DEPTH IN THE OCEAN SHOULD MARINE PERMACULTURE ARRAYS BE?

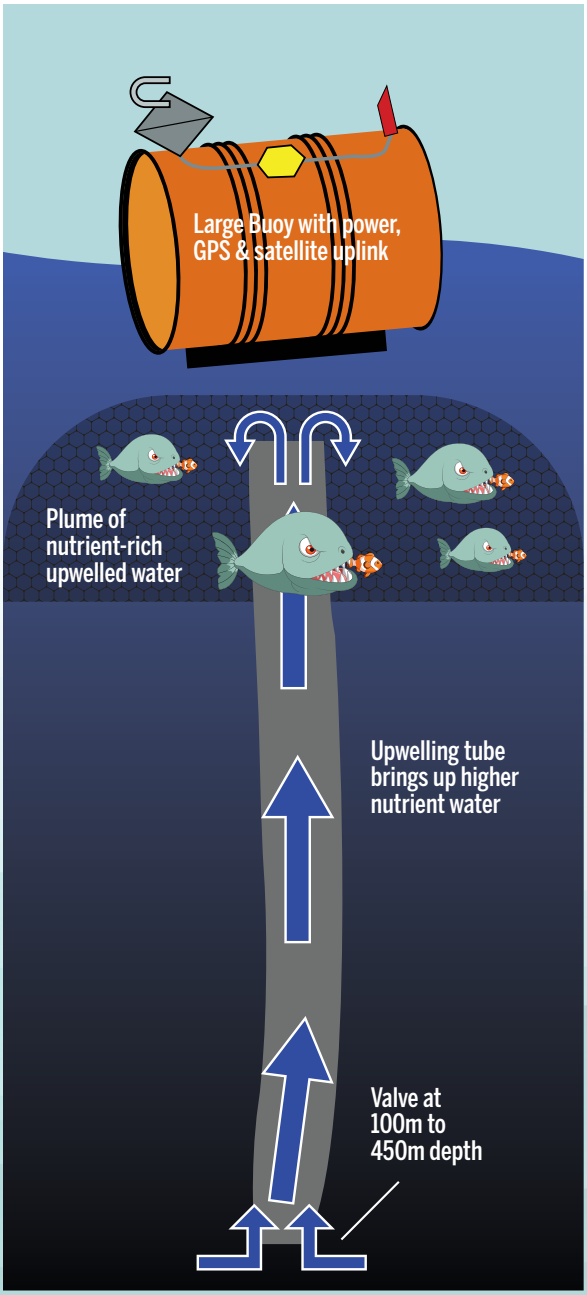
The depth at which Marine Permaculture Arrays are placed depends on several factors, such as the type of organisms being cultivated, the water temperature, and the local oceanographic conditions.

In general, Marine Permaculture Arrays are typically located in shallow coastal waters, where there is sufficient sunlight for photosynthesis and nutrient-rich water for the growth of marine organisms.

The depth of the array can vary from a few meters to several tens of meters, depending on the specific design and location. Some arrays may be placed near the surface of the water, while others may be anchored to the sea floor.

The depth of the array can affect the productivity of the organisms being cultivated. For example, seaweed requires sunlight for photosynthesis and grows best at depths where there is sufficient light penetration. However, too much sunlight can also be harmful to some organisms, so the depth of the array must be carefully chosen to balance the needs of different species.

Overall, the depth of Marine Permaculture Arrays is an important consideration in the design and construction of these structures, and must be carefully chosen to optimize the growth and health of the organisms being cultivated.



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WHAT ARE THE BEST TYPES OF KELP FOR MARINE PERMACULTURE ARRAYS?

There are many different species of kelp that can be used in Marine Permaculture Arrays, but some species are better suited for cultivation than others. The choice of kelp species will depend on several factors, such as the local oceanographic conditions, the depth of the array, and the intended use of the kelp.

Some of the most commonly cultivated species of kelp in Marine Permaculture Arrays include:

1. **Saccharina latissima:** Also known as sugar kelp, this species is native to the North Atlantic and is widely cultivated for its high nutritional value and rapid growth rate.

2. **Macrocystis pyrifera:** This species, also known as giant kelp, is native to the Pacific Ocean and is known for its large size and high productivity. It is commonly used in aquaculture and has many commercial applications.

3. **Undaria pinnatifida:** Also known as wakame, this species is native to Japan and is widely cultivated in Asia for its nutritional value and flavor. It is also used in the production of various food products such as miso soup and sushi.

4. **Laminaria digitata:** This species is native to the North Atlantic and is commonly used in the production of alginates, which are used in a variety of food and industrial applications.

In general, the best types of kelp for Marine Permaculture Arrays are those that are fast-growing, have high nutritional value, and are resistant to disease and other environmental stressors. The specific choice of kelp species will depend on the local conditions and the intended use of the kelp.

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HOW FAST CAN DIFFERENT TYPES OF KELP GROW?

The growth rate of different species of kelp can vary depending on several factors, such as water temperature, nutrient availability, light levels, and other environmental conditions. However, some species are known to grow faster than others.

Here are some estimates of the growth rates of different kelp species:

1 **Saccharina latissima:** This species is one of the fastest-growing kelps and can grow up to 60 cm per month under optimal conditions.

2 **Macrocystis pyrifera:** This species is known for its rapid growth and can grow up to 60 cm per day in ideal conditions. It is one of the largest kelp species and can reach lengths of up to 30 meters.

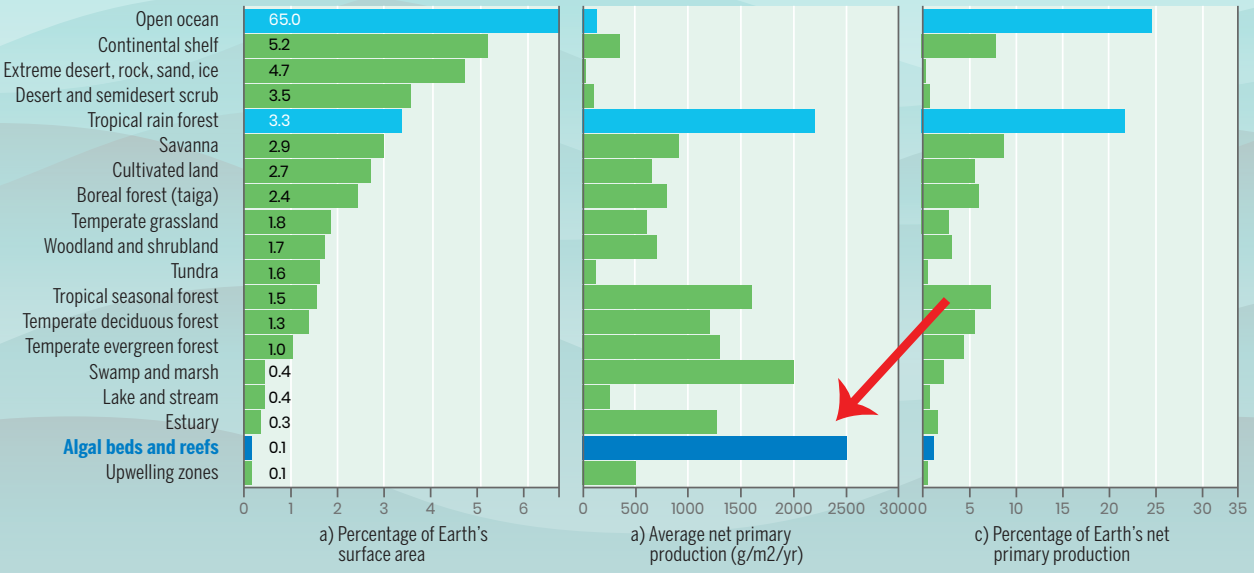
3 **Undaria pinnatifida:** This species can grow up to 30 cm per month and is known for its high nutritional value and unique flavor.

4 **Laminaria digitata:** This species is a slower-growing kelp and can grow up to 20 cm per month.

The growth rate of kelp can be influenced by many factors, including the presence of predators and competition from other organisms. In addition, the growth rate of kelp can vary throughout the year, with faster growth rates in the summer months when there is more sunlight and warmer water temperatures.

Overall, the growth rate of different species of kelp is an important consideration in the design and management of Marine Permaculture Arrays, as it can affect the productivity and efficiency of the system.

Primary Productivity of ecosystems showing seaweed (algae) beds as the most productive per unit area.



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WHAT TYPES OF JOBS CAN MARINE PERMACULTURE ARRAYS GENERATE?

The implementation of Marine Permaculture Arrays can generate a variety of jobs for a local area, including:

1. **Aquaculture Technicians:** Individuals responsible for the day-to-day management and maintenance of the Marine Permaculture Arrays, including monitoring water quality, feeding, and caring for the marine organisms, and maintaining equipment.

2. **Harvesting and Processing Workers:** Individuals responsible for harvesting and processing the marine organisms grown in the arrays, such as kelp, mussels, and oysters, for sale and distribution to local markets.

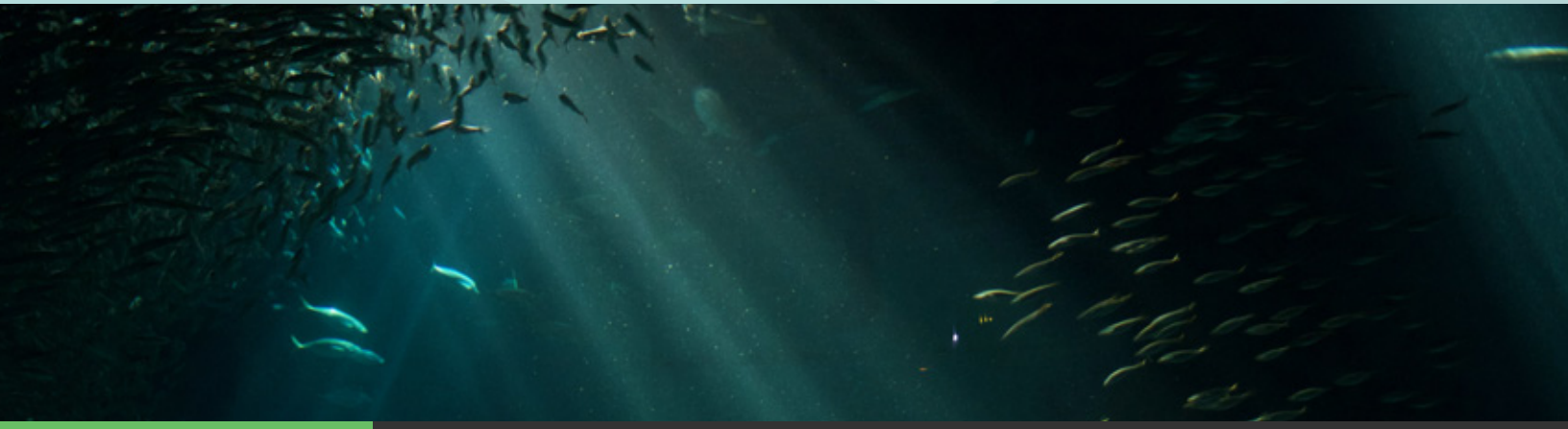
3. **Researchers and Scientists:** Individuals responsible for conducting research and development on the design and implementation of Marine Permaculture Arrays, as well as studying the marine organisms and ecosystems that are impacted by the arrays.

4. **Engineers and Technicians:** Individuals responsible for designing, building, and maintaining the equipment and infrastructure necessary for the Marine Permaculture Arrays to function, such as pumps, filters, and buoys.

5. **Sales and Marketing Professionals:** Individuals responsible for promoting and selling the products and services produced by the Marine Permaculture Arrays to local and global markets.

6. **Logistics and Transportation Workers:** Individuals responsible for the logistics and transportation of the products and equipment associated with Marine Permaculture Arrays, such as shipping, delivery, and storage.

Overall, the implementation of Marine Permaculture Arrays can generate a range of job opportunities for a local area, creating economic and social benefits for the community.



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WHAT ARE THE ENVIRONMENTAL BENEFITS OR MARINE PERMACULTURE ARRAYS?

Marine Permaculture Arrays can provide a variety of environmental benefits, including:

1 **Carbon Sequestration:** Kelp and other seaweeds grown in Marine Permaculture Arrays are known to absorb large amounts of carbon dioxide (CO2) from the atmosphere, which can help to mitigate the effects of climate change.

2 **Habitat Creation:** Marine Permaculture Arrays can provide a habitat for a variety of marine organisms, including fish, crustaceans, and mollusks, which can help to support biodiversity and ecosystem health.

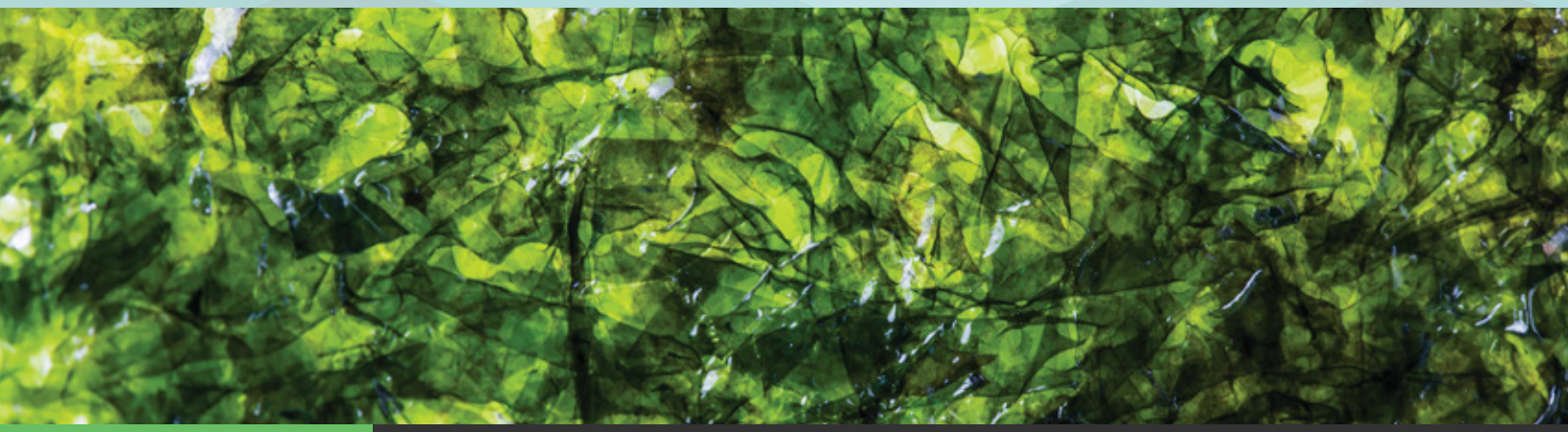
3 **Nutrient Cycling:** Marine Permaculture Arrays can help to recycle nutrients, such as nitrogen and phosphorus, from waste products and other sources, which can reduce nutrient pollution in surrounding waters and support the growth of other marine organisms.

4 **Coastal Protection:** Marine Permaculture Arrays can help to protect coastlines from erosion and storm damage by absorbing wave energy and reducing the impacts of strong currents.

5 **Water Quality Improvement:** The growth of kelp and other seaweeds in Marine Permaculture Arrays can help to improve water quality by absorbing nutrients and other pollutants from surrounding waters.

6 **Reduced Fishing Pressure:** The cultivation of marine organisms in Marine Permaculture Arrays can help to reduce fishing pressure on wild populations, which can help to support the sustainability of marine ecosystems.

Marine Permaculture Arrays have the potential to provide a range of environmental benefits, supporting the health and resilience of marine ecosystems and contributing to global efforts to mitigate the effects of climate change.



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WHAT TYPES OF INDUSTRIES CAN MARINE PERMACULTURE ARRAYS SPUR?

Marine Permaculture Arrays can spur the development of various industries, including:

1 **Aquaculture:** Marine Permaculture Arrays can be used to cultivate a range of marine organisms, including seaweeds, shellfish, and finfish, which can support the growth and development of the aquaculture industry.

2 **Biotechnology:** The cultivation of seaweeds in Marine Permaculture Arrays can provide a source of biomass for the development of biofuels, bio-based materials, and other products in the biotechnology industry.

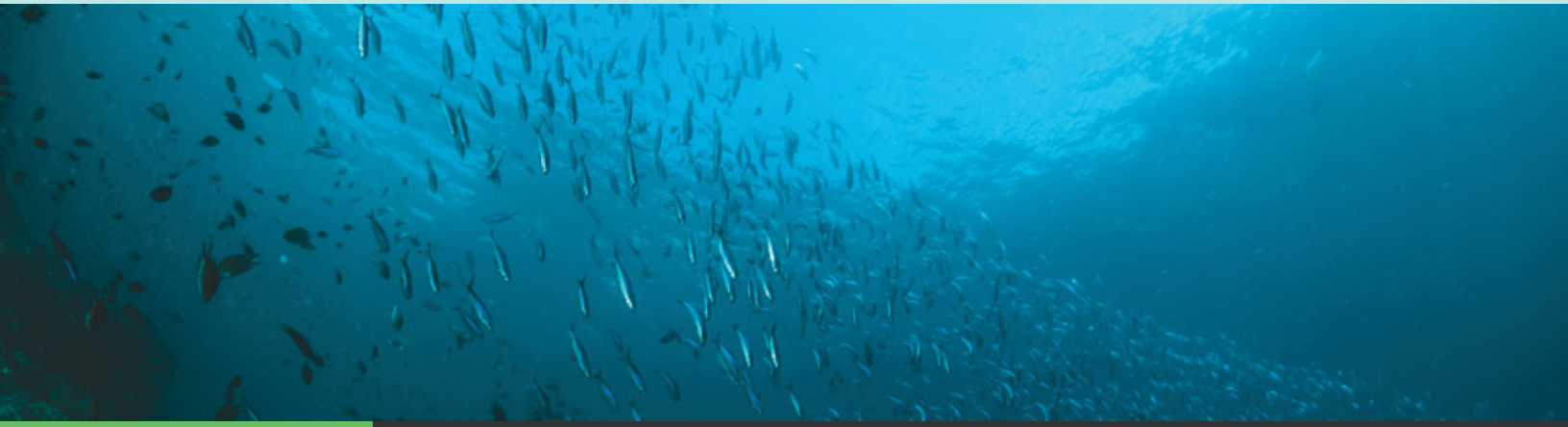
3 **Food and Beverage:** The cultivation of seaweeds, shellfish, and finfish in Marine Permaculture Arrays can provide a source of food and ingredients for the food and beverage industry.

4 **Renewable Energy:** The cultivation of seaweeds in Marine Permaculture Arrays can be used to generate renewable energy through the production of biofuels and other forms of energy.

5 **Tourism:** Marine Permaculture Arrays can be used as a tourist attraction, providing visitors with an opportunity to learn about marine ecosystems and sustainable agriculture.

6 **Research and Development:** Marine Permaculture Arrays can support research and development in the fields of marine biology, ecology, engineering, and other disciplines.

The development of Marine Permaculture Arrays can spur the growth of various industries, providing economic and social benefits to local communities and contributing to the sustainable development of coastal regions.



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CAN VESSELS NAVIGATE AROUND MARINE PERMACULTURE ARRAYS?

Marine Permaculture Arrays are designed to be placed in open ocean waters, away from busy shipping lanes and navigation routes. However, vessels can navigate around or through these arrays if necessary, as they are typically located in areas where there is no exclusion zone or restricted access. However, it is important for vessels to exercise caution and avoid causing damage to the arrays or the marine organisms grown within them. In some cases, Marine Permaculture Arrays may be marked with buoys or other navigation aids to help vessels avoid collisions or other accidents.

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