Here's the Blue Deal

Compiled by
AltaSea at the Port of Los Angeles
2021

Photo by Heiko Schuff on Unsplash

AltaSea
AT THE PORT OF LOS ANGELES

2456 South Signal Street
Berth 58, Door 6
San Pedro, CA 90731

Dear Reader,

The following articles are from AltaSea's series *Here's the Blue Deal 2021*, one of our web-based ocean education resources.

These articles honestly explore the story of our contemporary ocean—a story in which crisis, uncertainty, and hope intertwine and compete. It is a story whose outcome is still unknown; the story of the defining feature of our blue planet, and its natural capacity to solve the existential environmental challenges of our time—if only we let it.

Above all, this is the story of innovators who know that not only can we not survive without the ocean, we are most likely to thrive when we work alongside it. This immutable truth is the foundation of the blue economy—the ocean is the key to a livable future for humanity. The power of the blue economy informs the future that AltaSea will create for the Port of Los Angeles. We seek to tip the scales towards hope as we collectively write the next chapter of the ocean's book, determined to pass a story worth reading to future generations.

We hope you enjoy this collection.

Sincerely,

Timothy B. McOsker
Chief Executive Officer

Jenny Krusoe
Founding Executive Director

2456 South Signal Street
Berth 58, Door 6
San Pedro, CA 90731

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2456 South Signal Street
Berth 58, Door 6
San Pedro, CA 90731

OCEAN CHALLENGES

THE OCEAN DECADE – TEN YEARS TO SAVE OUR OCEANS AND OUR PLANET

April 26, 2021

By Emily Vidovich

When the United Nations (UN) published its first world ocean assessment in 2017, the report's overarching conclusion was that humanity is running out of time to start managing the ocean sustainably. As a response, the UN established the years from 2021 to 2030 as the UN Decade of Ocean Science for Sustainable Development, or the Ocean Decade for short. AltaSea is proud to be selected as a Partner Organization for this movement.

The current decade is crucial for our oceans because it is crucial for our planet. Human activity has already raised the average global temperature approximately 1°Celsius above pre-industrial levels. Scientific consensus maintains that we must limit warming to 1.5°C above pre-industrial levels to prevent the most severe consequences of climate change. Globally, this requires reducing our greenhouse gas emissions by at least 40 percent by 2030.

According to the International Union for the Conservation of Nature, the oceans have prevented humans from already surpassing the 1.5°C warming threshold. This is because the oceans, "absorbed more than 93% of the excess heat from greenhouse gas emissions since the 1970s." The oceans serve as a climate change buffer, taking in excess heat as well as approximately 30 percent of the carbon dioxide released into the atmosphere. But they have been protecting us to their own detriment—rising ocean temperatures damage ecosystems, threaten the survival of marine species, and endanger the global supply of seafood, while excess carbon dioxide in the seas leads to ocean acidification, which could collapse the entire ocean food web by impacting the development of crucial shell-building species.

Coral reefs are crucial biodiversity hubs that have already been harmed by ocean acidification and rising sea temperatures. Photo by Biorock Indonesia on Unsplash.

The oceans are also struggling under the pressure of overfishing. Data from the World Bank shows that almost 90 percent of global marine fish stocks are already categorized as fully exploited or overfished. With the human population expected to reach 10 billion by 2050, it is clear that our relationship with the ocean needs to be restructured in order to restore and protect ocean biodiversity and sustain the global food supply.

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San Pedro, CA 90731

The impact of the oceans on the climate, and vice versa, means that Sustainable Development Goals 13 and 14, Climate Action and Life Below Water, are completely intertwined. Source: United Nations Website

The Ocean Decade underscores that we need to stop climate change to protect the oceans just as much as we need the oceans to help us stop climate change. From the ability of algae to draw down carbon, to clean energy in the form of offshore wind farms and wave-generated power, blue technology is key to a future in which we halt our reliance on fossil fuels and reabsorb our past emissions. If we protect biodiversity and ecosystem health by reimagining the fishing industry and curbing pollution, we can magnify the ability of the oceans to combat climate change through natural processes.

The goal of the Ocean Decade is to achieve UN Sustainable Development Goal 14, Life Below Water, which encompasses all aspects of ocean sustainability. Because the challenges facing our oceans are diverse and vast, the Ocean Decade has identified ten key challenges to overcome over the next ten years:

1. Understand and beat marine pollution
2. Protect and restore ecosystems and biodiversity
3. Sustainably feed the global population
4. Develop a sustainable and equitable ocean economy
5. Unlock ocean-based solutions to climate change
6. Increase community resilience to ocean hazards
7. Expand the global ocean observing system
8. Create a digital representation of the ocean
9. Skills, knowledge, and technology for all
10. Change humanity's relationship with the ocean

The Ocean Decade plans to address these challenges by increasing ocean data and developing a comprehensive understanding of the ocean. AltaSea's work—including using innovations in aquaculture to sustainably feed the population, developing a responsible use of ocean resources through a blue economy, and providing a home for innovative ocean research—coincides with multiple Decade Challenges.

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At the heart of the Ocean Decade is the concept of transformation—transforming the capacity for ocean science to understand and heal the oceans, restructuring humanity's relationship with the ocean from harmfully extractive to mutually beneficial, and expanding the field of blue technology to address some of the most pressing problems our planet faces. At the end of the Ocean Decade, the UN hopes that the ocean will be clean, healthy, resilient, and sustainable.

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Berth 58, Door 6
San Pedro, CA 90731

ARTIFICIAL INTELLIGENCE IN THE OCEAN: WHAT IT IS AND HOW IT FACILITATES OCEAN CONSERVATION

May 24, 2021

By Emily Vidovich

Earth is 70 percent ocean, yet many aspects of it remain a mystery. We have better maps of the surface of Mars than we do of our own planet's ocean floor, and an estimated 91 percent of ocean species have not been classified. Faced with the need to increase understanding of the ocean in order to better protect it, scientists are increasingly turning to artificial intelligence (AI) to speed up knowledge-gathering and improve data collection.

Artificial intelligence is an umbrella term for software systems capable of making decisions that traditionally would require a human brain. The algorithms behind AI analyze real-time data—from various sources such as sensors, digital data, and remote inputs—and then act based on the insights gained from the data. Through this process of machine learning, algorithms are able to find patterns in collected data in order to make educated predictions about future events.

The ability for machine learning to process massive amounts of data, extract useful information, and identify trends is invaluable when it comes to learning about the ocean. The enormity of the ocean and the challenges of exploring the underwater environment meant humans were discovering the ocean at a snail's pace prior to the rise of technology. Formal oceanography started with the expedition of the H.M.S. Challenger in the 1870's, and underwater vehicles were not created until the late 1950's. That means we have only been able to investigate the oceans' 3.8 billion years of history, 332 million cubic miles of water, and myriad species from below the surface for less than a century.

Now artificial intelligence has enabled scientists to complete monumental tasks, like identifying and locating humpback whale songs in 180,000 hours of underwater recordings, with a relative speed that means we are gaining more ocean knowledge more quickly than ever before.

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As the New York Times explains, machine learning is even more valuable in the age of climate change because, "animals move their habitats [as] temperatures rise and currents shift." As the makeup of the ocean changes, data quickly becomes obsolete and the need to collect and understand updated metrics becomes critical to managing threatened marine populations.

Along with facilitating a better understanding of the impacts of climate change, AI enables natural ocean processes to be harnessed for climate change mitigation. For example, the company Hypergiant has created a bio-reactor that uses AI to optimize the growth of carbon-sequestering algae. The system uses AI to monitor its algae tank and adjust factors such as light, pH, and temperature to maximize the growth of CO2-eating algae. According to Forbes, "the system is 400 times more effective at absorbing CO2 than trees."

Researchers have also used artificial intelligence to improve performance and increase revenues of offshore wind farms. Such developments help bolster the renewable energy industry and fight climate change by maximizing the ability to harvest clean energy. As the world rapidly shifts away from fossil fuels, ensuring the reliability and efficacy of new energy technology is a vital component of an emissions-free future.

When it comes to threats facing the ocean, AI is used to confront issues as disparate as plastic pollution and illegal fishing. Currently, an estimated 20 percent to 32 percent of wild-caught fish imported to the United States are illegally caught. To address this, OceanMind uses satellite data and AI to trace ships' movements and fishing methods, improving the transparency of the seafood supply chain. The Google-affiliated Global Fishing Watch also harnesses AI to identify and address illegal fishing. Illegal and unsustainable fishing practices that were historically hard to monitor on the high seas can now be tracked and eradicated thanks to AI technology.

Jenny Krusoe, the Founding Executive Director of AltaSea, says that artificial intelligence is integral to addressing anthropogenic threats to the environment and reducing the impact of the shipping industry.

"Data is the key to moving forward quickly and solving these problems for our planet," she said during a panel discussion with AI LA about the role of artificial intelligence in ocean health.

From exploring ecosystems, to understanding wildlife behavior, to facilitating a responsible human-ocean relationship, artificial intelligence has become a crucial component of ocean science and conservation.

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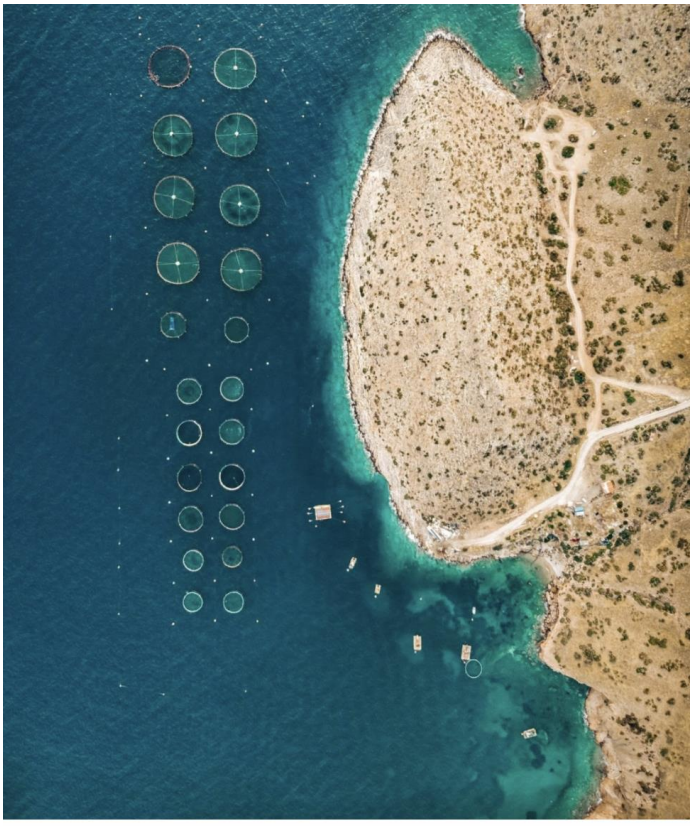
AVOIDING FOOD SCARCITY ON AN OVERPOPULATED PLANET—AQUACULTURE'S ROLE IN THE SOLUTION

June 7, 2021

By Emily Vidovich

The future of food is fraught. By 2050, human population growth will increase the demand for food by 60 percent, while climate change, soil degradation, and urban expansion simultaneously reduce our ability to produce crops. According to the United Nations Foundation, crop yield could decline up to 30 percent over the next three decades.

Ensuring food security requires amending agricultural practices, supplanting wild-caught fish—many of which are already overfished—with sustainably farmed seafood alternatives, and collectively changing the way we consume food. In addition to safeguarding our species, these changes will also combat climate change, protect the environment, and expand economic opportunities.



Aquaculture off the coast of Greece. Photo by Alex Antoniadis on Unsplash

On land, farming practices such as tilling, which depletes soil and releases carbon dioxide (CO_2) into the atmosphere, must be replaced with regenerative agriculture techniques that absorb CO_2, restore soil health, and support the water cycle. Instituting better farming practices will also aid the fight against climate change, since nearly a quarter of global emissions come from agriculture and deforestation.

In the sea, expanding aquaculture could provide a less impactful food alternative to both wild fish and land-based livestock. According to the Nature Conservancy, raising fish takes less food, fresh water, and land than raising domestic farm animals. Moreover, farming shellfish and seaweed requires next to no resource inputs, and these species help the ecosystem by filtering the water, removing harmful excess nutrients, and absorbing CO_2. These benefits, plus the fact that seaweed and shellfish farms provide habitats for wild fish, classify these modes of aquaculture as regenerative—reflecting their capacity to improve and restore ecosystems.

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In society, people need to optimize their diets by obtaining a majority of their nutrition directly from plants. This would lead to a much more effective use of available farmland—100 grams of protein from beef requires approximately 20 times more land to produce than the equivalent amount of protein from legumes.

Cultural shifts in food consumption will be the slowest of the three aspects of restructuring the global food system, since such changes largely fall outside the realm of legislation and will require long-term educational campaigns as well as individuals altering their dietary choices. As such, the shift towards regenerative agriculture and sustainable aquaculture—which can be incentivized and regulated—must be accelerated if humans hope to avoid a global food shortage.

AltaSea's Blue + Green 2021 webinar series focused on the oceanic component of restructuring the food system by exploring the expansion of sustainable aquaculture. All types of aquaculture have seen continual growth over the past three decades—The United Nations Food and Agriculture Organization calculates that aquaculture production has risen 527% since 1990. In 2018, global aquaculture produced 54 million tons of finfish compared to 18 million tons of shellfish. Algaes such as seaweed were the second most farmed category after finfish, weighing in at 32 million tons.

As the farming of algae and shellfish continues to expand, experts anticipate increased benefits to ecosystems. Doctor Charles Yarish, who leads the Seaweed Marine Biotechnology Lab at the University of Connecticut, showcased aquaculture-derived ecosystem services during a yearlong experiment where he grew seaweed and shellfish in New York City's East River.

The results were impressive. As Yarish explained in the first segment of AltaSea's webinar series, the seaweed cultures not only thrived, they also filtered out excess nutrients that had been detrimentally affecting the river's ecosystem.

Algaes, such as seaweed, and shellfish are nutrient-dense foods that can be sustainably harvested through aquaculture. Photo by Silas Baisch on Unsplash

Discussing the future of aquaculture necessitates acknowledging that much change is needed in order to make this type of sustainable aquaculture mainstream. Over the past few decades, aquaculture has been coupled with negative environmental impacts. Farming finfish such as salmon contributes to overfishing, since a large percentage of wild-caught fish are used to feed farmed fish. In parts of Asia, the shrimp farm industry is a major driver of the deforestation of ecologically important mangrove forests.

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This environmental degradation underscores the importance of creating regulatory frameworks at local, national, and international levels that promote sustainable aquaculture practices, phase out detrimental ones, and support farmers so they can utilize best practices.

Effective management strategies must also be used to increase the sustainability of aquaculture—reliance on wild fish can be reduced by obtaining a majority of the food for farmed fish from algae, and marine spatial planning can identify areas where installing shellfish and seaweed aquaculture would be the most beneficial.

If aquaculture expansion operates under an ethos of environmental integrity, it will be an irreplaceable component of a restructured, sustainable global food system. Avoiding severe food shortages will be one of the major challenges of the coming decades, but as with many of the challenges facing our blue planet harnessing ocean solutions is integral to solving it.

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OCEANIC PATHWAYS FOR CARBON SEQUESTRATION

August 2, 2021

By Emily Vidovich

Since the day in 1988 when a NASA scientist testified to the U.S. Senate about the certainty of anthropogenic climate change, the global response to the climate crisis can be represented by various points on a Venn diagram of denial, indifference, and insufficient action. Only over the past few years has the impetus to address the crisis begun to match the severity of the challenge. Currently, 38 countries—including the member states of the European Union and the United Kingdom as well as New Zealand and Japan—have declared a climate emergency, encouraging their governments to take comprehensive action as they would with any other state of emergency.

Treating climate change as an emergency is a critical step in the response, because lackluster effort over the preceding three decades and slow movement towards fulfilling the commitments of the Paris Agreement mean that it is time to enter triage mode—it is no longer enough to stop emitting greenhouse gases, we must also draw down past emissions.

Reabsorbing past emissions from the atmosphere is known as carbon sequestration, and it has become a necessary component of the climate response. According to the Center for Climate and Energy Solutions, "More than half of the models cited in the Intergovernmental Panel on Climate Change's Fifth Assessment Report required carbon capture for a goal of staying within 2 degrees Celsius of warming from pre-industrial days." To limit global warming to 1.5 degrees Celsius, one trillion tons of carbon dioxide (CO2) emissions must be removed from the atmosphere this century.

The ocean is our planet's largest carbon reservoir, capable of containing a larger quantity of carbon than the biosphere and the atmosphere combined. Natural oceanic carbon capture occurs through photosynthesis and chemical reactions. Scientists have started to harness these natural processes to create effective carbon sequestration technology. At the Ocean Visions Summit, held virtually in May of this year, experts discussed two key developments in oceanic carbon sequestration technology—algae farming and artificial ocean alkalinization.

Through the process of photosynthesis, algae captures and stores carbon. When algae is grown in bioreactors that use artificial intelligence to optimize growing conditions, it can remove carbon from the atmosphere 400 times more effectively than a tree. Algal carbon sequestration is particularly promising because it results in value-added products—algae can be used as a food source for humans as well as nourish livestock in both land-based farming and aquaculture. It can also be incorporated into products such as cosmetics and pharmaceuticals, and be converted into biofuels that produce 50 to 70 percent less life cycle CO2 emissions than fossil fuels. Due to its effectiveness and co-benefits, scaling up algae farming will be critical to the climate response over the coming decades.

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Berth 58, Door 6
San Pedro, CA 90731

Artificial ocean alkalinization increases the ocean's ability to absorb carbon by adding alkaline substances, such as naturally occurring minerals or artificially produced lime, to the ocean. This can be done by spreading small particles of alkaline substances over the open ocean or depositing alkaline sand and pebbles onto the coastline or coastal sea beds. As the Center for Carbon Removal Law & Policy at American University explains, "adding alkalinity to the ocean removes CO2 from the atmosphere through a series of reactions that convert dissolved CO2 into stable bicarbonate and carbonate molecules, which in turn causes the ocean to absorb more CO2 from the air to restore equilibrium."

Adding alkaline sand and rocks to the coast would increase the ocean's pH, and as such make it able to capture more carbon from the atmosphere. Photo by Matt Bango on StockSnap.

This strategy has the significant co-benefit of counteracting ocean acidification, which is the decrease of the ocean's pH as seawater absorbs the CO2 emitted from burning fossil fuels. The ocean has become 30 percent more acidic since the beginning of the industrial revolution, negatively impacting marine ecosystems and shell-building organisms. Artificial alkalinization would increase the ocean's pH, restoring balance to the seawater. However, this methodology is a recent development, and it is not yet clear if there are harmful side effects on ocean ecosystems when the alkaline sediments are deposited.

More research is required to determine if ocean alkalinization is a practicable strategy for large-scale sequestration. Fortunately, support for research into oceanic carbon sequestration technologies is gaining momentum. According to the Natural Resources Defense Council, CO2 removal technology research has recently received bipartisan support in congress through the Ocean Based Climate Solutions Act, the Sea Fuels Act, and the Carbon Capture Prize Act, underscoring that the federal government understands that ocean policy and climate policy must be approached jointly.

Between the ocean's natural carbon sequestering abilities and the development of sequestering technologies, there remains room for optimism that we will be able to sequester the amount of CO2 necessary to prevent the worst effects of climate change.

2456 South Signal Street
Berth 58, Door 6
San Pedro, CA 90731

THE BENEFITS OF HEALTHY OCEANS

August 16, 2021

By Emily Vidovich

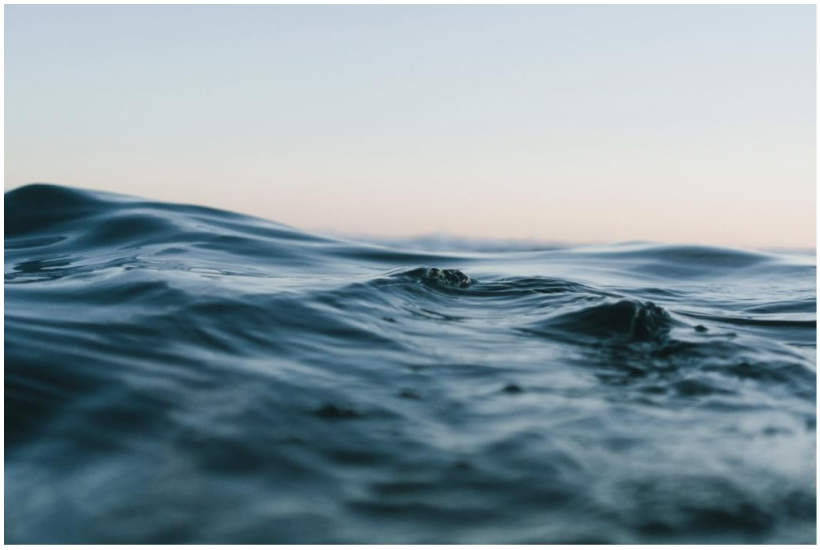
When the oceans are healthy, they sustain life on earth by providing oxygen production, ecosystem services, and climate regulation. Over the past century, human activity has increasingly altered the environment, imposing strains on the ocean that threaten its ability to provide these crucial benefits. But if we choose to reduce our impact on the natural world, we can continue to reap the rewards that come from prioritizing a protected, thriving ocean.

While rainforests are often celebrated as the lungs of the earth, there is increasing recognition that on our blue planet—over two-thirds of which is covered in water—it is the oceans that truly deserve this title. Between 50 and 80 percent of the oxygen produced on earth originates in the ocean. Most of this is created by photosynthetic plankton, algae, and bacteria. This oxygen is then used by the marine species that are a primary food source for 3 billion people globally.

However, ocean oxygen levels are projected to decrease by an average of 3 to 4 percent by 2100 due to climate change and increased nutrient pollution. According to the International Union for the Conservation of Nature, the consequences of this deoxygenation include, "decreased biodiversity, shifts in species distributions, displacement or reduction in fishery resources and expanding algal blooms." Ocean ecosystems require oxygen in order to support marine life, so in order for deoxygenation to not drastically alter marine systems, and consequently threaten food security, humans must reduce carbon emissions and curtail nutrient runoff from fertilizer, sewage, and aquaculture.

The oceans also benefit people by providing ecosystem services—processes that keep our planet healthy and functioning, such as pollination and filtration of air and water. In the ocean, ecosystem services include coastal protection, carbon storage, food production, and water quality enhancement. Ecosystem services are dependent on the health of the ecosystem that produces them. Since ecosystems are delicately balanced webs in which creatures and the environment interact and depend on each other, when humans disrupt or damage an ecosystem through climate change, habitat loss, species exploitation, or pollution, the ecosystem's equilibrium is lost and ecosystem services are reduced or eliminated as a result.

In 2006, research published in an article in the journal Science analyzed the impacts of biodiversity loss on ecosystem services in the ocean and found that, "marine biodiversity loss is increasingly impairing the ocean's capacity to provide food, maintain water quality, and recover from perturbations." With the continued environmental damage that has occurred since that research was published, one can only imagine the extent of the impact humans are currently having on marine ecosystem services.



Keeping oceans healthy benefits humans in numerous ways. Photo by Matt Hardy on Unsplash

However, there is hope that ecosystem restoration—defined as efforts to assist the recovery of a degraded ecosystem—can help damaged ecosystems recover, and consequently recuperate the associated ecosystem services. Unfortunately, fully healing a damaged ecosystem is a time-intensive and difficult process, and some scientists think that complete recovery of a damaged ecosystem may not be possible. As such, prioritizing conservation and protection of the ocean is critical, so that ecosystems can maintain their health and continue providing ecosystem services without interruption.

The oceans also keep our planet livable by regulating climate and creating weather. The oceans absorb solar radiation and distribute the heat around the globe via ocean currents, which circulate warm water from the equator and cold water from the poles. This water movement regulates global climate and counteracts the uneven distribution of the sun's heat, while also driving much of earth's weather. If the oceans did not absorb solar radiation and distribute heat throughout the globe, regional temperatures would be more extreme and much of earth would be unable to support life.

The oceans have absorbed approximately 93 percent of the excess heat resulting from human-induced global warming, and the resulting increase of water temperature has had several consequences. Warmer waters in the upper levels of the ocean have led to increased ocean stratification, meaning that waters of different temperatures are mixing less due to different properties of the water masses. The warming of the oceans has also changed current patterns and led to a growth of oxygen-depleted zones. As the oceans warm and its characteristics change, weather patterns are shifting and extreme weather events are occurring more frequently.

Ultimately, when the oceans are healthy, everyone benefits. That is why it is imperative that we use the coming decades to rectify our relationship with the ocean and stop climate change. Because without healthy oceans our species, and our planet, cannot survive.

2456 South Signal Street
Berth 58, Door 6
San Pedro, CA 90731

PREPARING FOR A FUTURE MARKED BY SEA LEVEL RISE

August 30, 2021

By Emily Vidovich

The new Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) states that human-driven climate change is "very likely" the primary driver of increased rates of sea level rise over the last fifty years. Even if humans reduce greenhouse gas emissions in alignment with scientific recommendations, our emissions to date will still warm the oceans and melt ice sheets—making it likely that the global sea level will rise 12 inches above its year 2000 level by 2100.

The National Oceanic and Atmospheric Administration (NOAA) calculates that in a worst-case scenario where humans do not address climate change, there could be over eight feet of sea level rise during this century. In any likely future scenario, sea level rise will have repercussions on landscapes and livelihoods, including the loss of coastlines as well multi-billion dollars worth of damage to property and infrastructure. In 2019, the Los Angeles Times described how sea level rise is already affecting the state of California:

"The coastline is eroding with every tide and storm, but everything built before we knew better—Pacific Coast Highway, multimillion-dollar homes in Malibu, the rail line to San Diego—is fixed in place with nowhere to go…Seaside cliffs are crumbling in Pacifica, bringing down entire buildings. Balboa Island, barely above sea level, is spending $1.8 million to raise the wall that separates it from the ocean…Winter storms pummeled a Capistrano Beach boardwalk, turning the idyllic shoreline into a construction zone as bulldozers rushed to stack boulders into a barricade. From San Diego to Humboldt counties, homeowners scramble to fend off increasing erosion and storm surges, pleading with officials for bigger seawalls that can hold back the even bigger ocean…For every new seawall protecting a home or a road, a beach for the people is sacrificed."

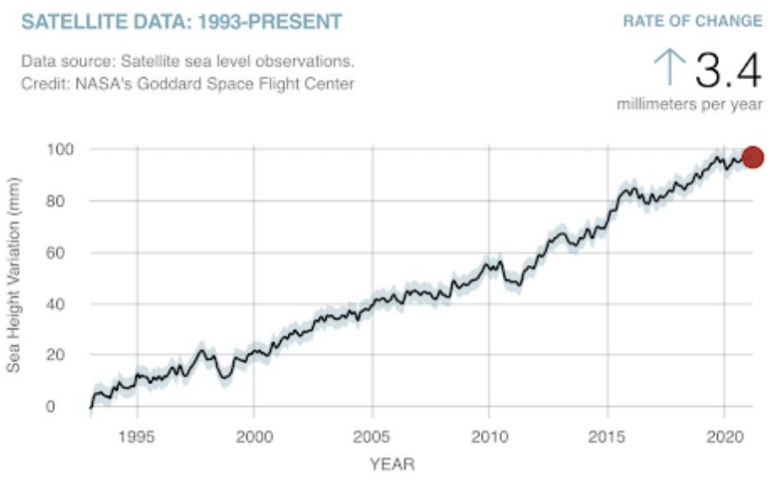
Seawall in Ventura County, California. Credit: Al Seib/Los Angeles Times

Low-income communities, people of color, and indigenous populations often are exposed to climate change's worst impacts, with sea level rise exemplifying this in various ways—low-income coastal communities have less resources to fund solutions such as seawalls, and a recent study predicts that sea level rise will force 500,000 people to relocate from New Orleans, a city where nearly 60 percent of the residents are African American. In the Pacific Islands, indigenous communities are already facing 0.5 inches of sea level rise annually.

Eight islands have already been completely submerged, and experts warn that 48 more could be completely underwater by 2100.

In the coming decades, people displaced by sea level rise will join the nascent population of climate refugees—people whose places of residence have been made unlivable by climate change due to factors such as sea level rise, drought, famine, and extreme temperatures. The World Bank estimates that just within the regions of Sub-Saharan Africa, South Asia, and Latin America, climate change will force 143 million people to move by 2050.

Hoping to stop sea level rise is not a realistic approach, since greenhouse gas emissions will not be eliminated overnight and the impacts of climate change play out on a timescale that surpasses the human lifespan. A special report on the oceans and climate change from the IPCC projects that sea level rise will continue for hundreds of years, with next century's rate of sea level rise likely surpassing that of the 21st century. The certainty of continued sea level rise, along with the fact that its effects are already being experienced, makes adaptation and preparedness of coastal communities the appropriate response.



Change in sea level since 1993. Credit: NASA

In California, seawalls have been the default tactic for protecting coastal buildings from sea level rise. But these partitions between humans and nature aren't just unsightly, they result in significant fiscal and environmental costs. The Center for Climate Integrity calculates that California taxpayers could spend $22 billion on seawalls to protect the state by 2040. Since seawalls inhibit the coast's natural sand replenishment process, beaches adjacent to them will shrink and disappear.

Despite the risk they pose to coastlines, approximately 30 percent of Southern California's coast is currently obstructed by seawalls of some sort. The damage to shorelines caused by seawalls has prompted several coastal states—including Oregon, North Carolina, and Maine—to ban new seawalls, while other states have imposed restrictions on their construction.

Unfortunately for coastal property owners, the alternative to building walls in a failing attempt to hold back the surging tide is acquiescing to the immutable forces of nature intensified by human activity. The concept of "managed retreat," accepting that some coastal communities will be made unlivable by sea level rise and

encouraging people to move inland, has understandably been unpopular with people whose homes, livelihoods, and senses of identity are intertwined with the coast. Sea level rise will undoubtedly alter coastal living over the next century, and if we do not mitigate climate change, the idyllic coastal way of life will cease to exist as we know it.

Sea level rise cannot be stopped, but it can be limited by effective climate action. A recent study modeling sea level rise scenarios found that if humanity limits global warming to 1.5 degrees Celsius, it could cut the contributions of melting ice to sea level rise in half by 2100 compared to a 3 degrees Celsius warming scenario, which is what we are on track to reach if current global emissions trends and insufficient emission reduction pledges remain unaltered. But seeing as the latest IPCC report projects that the planet will very likely reach 1.5 degrees of warming by 2050, it will take decisive, sweeping global action immediately to maintain the possibility of avoiding worst-case scenarios for both climate change and sea level rise.

Island nations have been leading the charge in advocating for halting fossil fuel use in order to limit climate change to 1.5 degrees Celsius. For example, leaders of Pacific nations have been increasingly critical of the Australian government for its expansion of coal mining. But it is not only the governments of these nations that are taking action—the Pacific Climate Warriors is a coalition of grassroots, frontline, and indigenous people from throughout the Pacific region that educates youth on climate action and spearheads a fossil fuel divestment campaign aimed at limiting global warming. The members of the Warriors, whose ancestors have been stewards of the ocean for millennia, are carrying on this stewardship by fighting climate change and raising awareness about sea level rise while proclaiming, “we are not drowning, we are fighting.”

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ALTASEA PARTNERS & BLUE ECONOMY SOLUTIONS

THE ENERGY OBSERVER DOCKS AT ALTASEA AND SHOWCASES ZERO-EMISSIONS HYDROGEN POWER

May 10, 2021

By Emily Vidovich

On April 28th, the first zero-emissions ocean vessel to be completely self-sufficient in energy production docked at AltaSea in the Port of Los Angeles. The catamaran, named the Energy Observer, creates and stores its own hydrogen, solar, wind, and hydro power onboard. The Energy Observer advocates for the future of renewable energy and serves as a floating laboratory for the ecological transition needed to restructure humanity's relationship with our planet.

Since 2017, the France-based Energy Observer has been sailing around the world conducting onboard research and educating people worldwide about hydrogen power. The catamaran uses its 60 computers and 1,700 sensors to collect data that can be used by the suppliers of the boat's green technology.

The Energy Observer docked at AltaSea in the Port of Los Angeles

Photo courtesy of Energy Independence Now

Louis-Noël Viviès, the general manager of the Energy Observer, jokes that the intense and variable conditions of the ocean result in the ultimate "torture chamber" in which to put technology to the test. He states that the goal is to provide information that helps companies make their technology simple, lightweight, and affordable, so that renewable energy innovations can be more widely used.

Above all, the boat showcases what is possible in a future that harnesses hydrogen power. Brian Goldstein of Energy Independence Now (EIN), a nonprofit advancing hydrogen-powered vehicles and renewable infrastructure, describes hydrogen power as the "Swiss army knife" of energy.

"[Hydrogen] has very diverse applications," he explained in a speech at the Energy Observer welcome event that EIN co-hosted with AltaSea.

The appeal of hydrogen power lies in its ability to be stored long-term, as well as in its lightweight yet energy-dense nature. Hydrogen's advantage over other renewable energy sources is its lack of dependence on natural variables. While the amount of energy harvested from the sun and wind can vary based on daily weather conditions, hydrogen power can be created at a consistent rate.

These characteristics position hydrogen to potentially be a zero-emissions rebuttal to claims that renewables alone cannot power the world. Hydrogen power can provide a carbon-free means to support the energy grids of population centers at times when other renewable sources are limited, such as at night or on days when there is no wind. Hydrogen can also directly power cars, trucks, and boats. Because it is so dynamic, hydrogen could supplant fossil fuels and strengthen grids powered entirely by renewable energy.

But in order for hydrogen to be a zero-emissions fuel source, it must be produced using renewable resources. Currently, 95 percent of hydrogen produced in the United States is obtained through an emissions-heavy process called steam-methane reforming. Many facilities that utilize the alternative process of hydrogen electrolysis, which does not create greenhouse gas emissions itself, are still powered by electricity obtained from fossil fuels. However, this does not have to be the case—the creation of "green" hydrogen at plants fueled by renewable energy is gaining traction globally.

The Energy Observer promotes the adoption of zero-emissions hydrogen power. The boat's hydrogen electrolyzer is fueled by electricity sourced from the solar energy created onboard. The electrolyzer first desalinates seawater, then uses electricity to separate the water molecules into their component elements—oxygen and hydrogen—to isolate hydrogen in a gaseous state. When hydrogen electrolysis is powered by renewable energy, the only byproducts are oxygen, which could potentially be retained for medical use, and water. Onboard the Energy Observer, this water is used to fulfill the crew's water needs.

The electrolyzer onboard the Energy Observer is relatively small, with the ability to create four to five kilograms (kg) of hydrogen per day. The boat can store 63kg of hydrogen, enough to power the average electricity needs of a four-person household for about forty days.

The Energy Observer is designed to maximize energy production from every accessible source. The top of the smooth white catamaran is blanketed in a quilt of black solar panels. These panels, which can be walked on as one explores the vessel, have the capacity to produce 52 kilowatts of solar power, which is then stored onboard. Propellers below the boat create hydropower from water movement and add to the vessel's energy creation.

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The top of the Energy Observer, covered in solar panels.

Photo courtesy of Energy Independence Now

The catamaran also has two wings—futuristic sail replacements that use artificial intelligence to adjust themselves to the wind conditions. By optimizing efficiency, the wings reduce the energy needed to power the craft by 25 percent to 30 percent. These energy savings mean that even while the vessel is moving, it has enough excess energy to be able to electrolyze hydrogen on the go.

The result of these interconnected systems is a fully autonomous floating microgrid. If it were not for the need to restock food for the crew, the vessel would not have to come ashore. Viviès says that the Energy Observer serves as a microcosm for the future energy grid and showcases a system that could be used to power not only maritime fleets, but also towns and cities.

AltaSea CEO Tim McOsker notes that while it is inspiring to watch multiple renewable energy technologies work together onboard the Energy Observer, it is also exciting to know that a maritime vessel could reduce its reliance on fossil fuels by incorporating even one of these innovations.

“All of these technologies are stepping stones to a cleaner, more sustainable future,” McOsker says.

The technology onboard the Energy Observer displays what is possible when renewable energy is harnessed to the fullest extent. Viviès recalls sublime days in the Mediterranean where optimal conditions meant that the boat was able to collect more renewable energy than it had the capacity to store onboard, demonstrating the ability for technology to provide renewable energy in abundance.

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INVESTING IN THE OCEANS—ACCELERATING THE BLUE ECONOMY THROUGH MARKET-BASED SOLUTIONS

June 21, 2021

By Emily Vidovich

Economic prosperity and environmental conservation, while often framed as disparate goals, are better viewed as interdependent components of creating a livable future for humanity. Ocean-based industries constitute 3.5% of global GDP and are projected to double in value by 2030. Harnessing ocean solutions to environmental challenges can simultaneously protect the oceans, address climate change, and provide economic benefits to millions of people.

Nurturing a symbiotic relationship between ocean health and economic growth is a foundational tenet of the blue economy—a conception of economic activity that seeks to sustainably use ocean resources to promote the wellbeing of ocean ecosystems, enable economic growth, create jobs, and improve livelihoods.

The blue economy seeks to conserve the oceans and sustainably use marine resources to enable economic prosperity. Photo by Hanna Obersteller on Unsplash

Investable Oceans is an organization working to accelerate market-based innovations in sectors of the blue economy such as energy, aquaculture, shipping, and tourism. The company provides a platform for creators of ocean-based solutions to connect with investors who can help them grow their businesses. By providing a directory of vetted companies that can be searched by accredited investors, Investable Oceans exposes users to investment opportunities that may have otherwise been missed.

Ted Janulis, an avid SCUBA diver and Columbia Business School graduate with 30 years of experience in the financial sector, founded Investable Oceans in 2019 because he saw the multitude of investable opportunities in the blue economy and realized that it was often difficult for ocean innovators and potential investors to find each other.

Janulis sees market-based solutions as mechanisms for helping the oceans and fighting climate change. He says that philanthropy, impact investing, and market investing must all be utilized if humanity hopes to address the dual crises of deteriorating ocean health and runaway global warming. He explains that environmentally beneficial investing opportunities broaden the spectrum of participants involved in creating a sustainable future.

"There is a large pool of capital out there, and it is available to go towards the blue economy instead of the brown economy," Janulis says, using a term for economic growth that depends on environmentally destructive activities such as fossil fuel use.

Some schools of thought assert that capitalism and its market economy must be abandoned for a truly sustainable future to be realized, citing, among other arguments, the fact that humanity is already using resources beyond Earth's capacity—a phenomenon known as ecological overshoot. It currently takes our planet a year and eight months to regenerate what we collectively use in a year, keeping natural resources in perpetual decline.

But a global shift into post-capitalism or democratic socialism, the feasibility of which is largely unclear, would likely not happen under the time constraint needed to save our planet from climate change and ecological crisis, if it happens at all. A more actionable approach would be to amend the existing system so that it works better for people and the planet. Some even argue that a sustainable world is only possible if capitalism is used as a means to achieve it.

Decarbonizing international shipping is a sector of the blue economy projected to yield significant return on investment. Photo by Andy Li on Unsplash

Effectively addressing the harm humans are causing the planet requires money, and current global spending on the environment is nowhere near the necessary level. The International Energy Agency estimates that avoiding the worst effects of climate change will require global spending of $359 trillion between 2015 and 2050. In addition, accomplishing the conservation and sustainable use of the oceans by 2030—in alignment with United Nations Sustainable Development Goal 14—will require spending $175 billion per year this decade, according to a study published in the journal Marine Policy.

Investing in the blue economy makes sense for investors as well as the planet. Analysis by the High Level Panel for a Sustainable Ocean Economy found that investing $2 trillion to $3.7 trillion in four key sectors of the blue economy—restoring mangroves, decarbonizing international shipping, increasing sustainable food production, and expanding offshore wind production—would yield a 400% to 615% return on investment over the next 30 years. According to the World Resources Institute, this means that, “every $1 invested in sustainable ocean solutions yields at least $5 in return.”

Investable Oceans hopes to accelerate this shift in investing. Janulis says that stakeholders are increasingly demanding the sustainability of investments. Because of this, Janulis remains optimistic that widespread sustainable investing could become economic reality sooner rather than later.

Janulis emphasizes that the main goal of Investable Oceans is to foster community building. He is most proud of the collaboration that has been facilitated between passionate people sharing a common goal. He sees this cooperation as integral to solving the crises facing the ocean.

“There is no silver bullet solution,” he says, “we need to collaborate and bring solutions together.”

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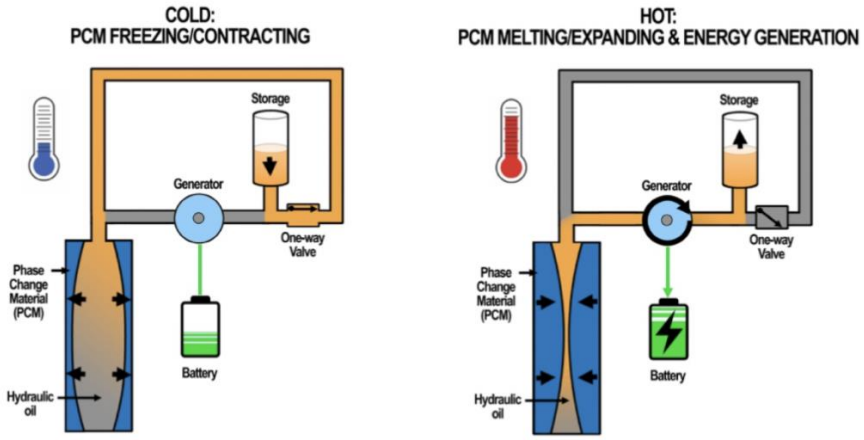
SEATREC GENERATES RENEWABLE ENERGY UNDER THE SURFACE OF THE OCEAN

July 5, 2021

By Emily Vidovich

While there is an abundance of renewable energy sources on the surface of the ocean, including solar, wave, and wind power, methods for generating electricity within the ocean's depths are less developed. A company called Seatrec is unlocking underwater energy production by designing and manufacturing technology that creates renewable energy from the naturally occurring temperature differences in ocean water.

Seatrec's modules are designed to be affixed to robots that move up and down the water column collecting data for oceanographers. The technology generates electricity by using phase change materials (PCMs)—substances that expand when heat changes them from solid to liquid. As the robots rise towards the surface and the water temperature increases, the solid wax PCM within Seatrec's system melts and expands in volume. This change in volume causes the liquid wax to be pushed through a pipe system, and it spins a generator as it circulates. The rotating generator creates electricity, which is then stored in a rechargeable battery.

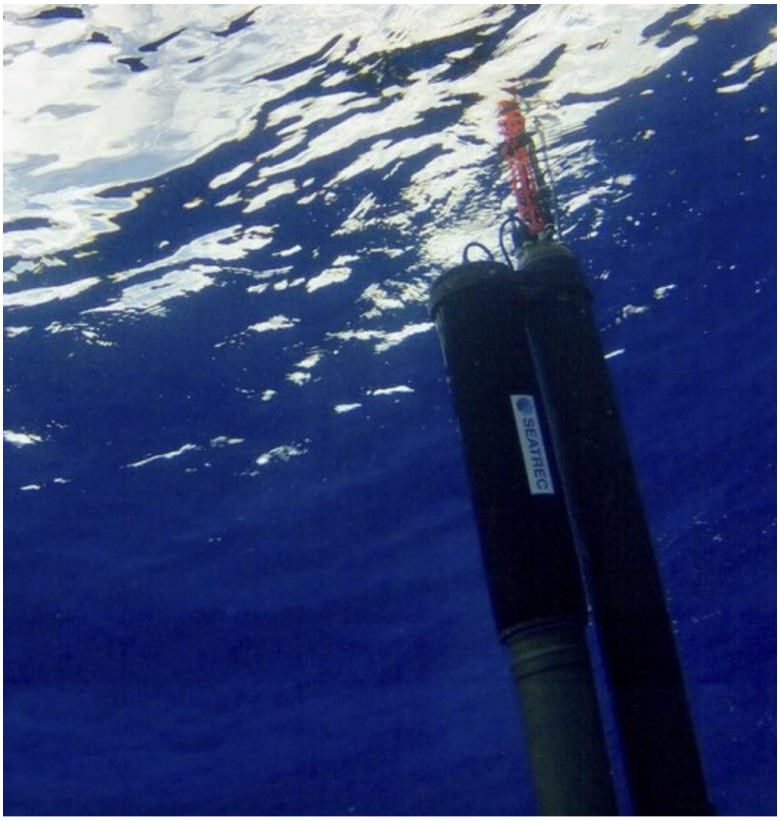


A diagram showcasing how phase change materials turn a generator when they expand from solid to liquid. Credit: Seatrec

Since this system activates every time the robot it is attached to moves from cooler to warmer waters, robots rising to the surface are automatically able to regenerate the energy expended exploring the depths of the ocean. Consequently, having an attached, renewable source of electricity enables longer and more complex missions unhindered by energy limitations.

Yi Chao, the founder and CEO of Seatrec who holds a Ph.D. in Atmospheric and Ocean Sciences from Princeton University, is known as the "armchair oceanographer" due to his tendency towards seasickness. Chao jokes that he wants to send robots out to sea in a sustainable manner so that he doesn't have to go himself.

According to Chao, powering underwater robots is one of the biggest challenges facing oceanographers. Typically, the robots and sensors used by oceanographers require batteries to operate, which means that either a ship must be deployed to facilitate battery changes or equipment is left in the sea once the battery is depleted. Both options are considerably costly and resource-intensive.



Seatrec's SL1 creating renewable energy under the ocean's surface. Credit: Seatrec

With Seatrec's technology, there is now a third option. Providing a sustainable, unlimited power source that is attached to research equipment simultaneously removes the need to send out a research vessel and reduces the likelihood of equipment abandonment. Supplanting traditional batteries also benefits the marine environment by reducing battery pollution from unrecovered research equipment.

While the concept of transforming thermal energy to electricity using ocean temperature changes was originally developed by Henry Stommel in 1989, only over the past decade has science developed to the point where such a system could be built on the small scale necessary to affix it to an underwater robot. Seatrec's main focus has been developing this technology to this end, but that is not the system's only potential use. The United States Office of Naval Research has sponsored Seatrec's research into increasing the energy output of their system so that it can be used to create large-scale submerged charging stations for underwater naval vessels.

Seatrec's products are currently more expensive than the environmentally unfriendly traditional battery, a common problem emerging green technologies face as they attempt to supplant unsustainable alternatives. But as Seatrec transitions from the lab testing phase to commercial availability, Chao remains optimistic that the company can work with early adopters and government agencies to make their innovations more cost effective.

Ultimately, Chao's vision is to use underwater renewable energy to power diverse industries, from research to defense to aquaculture. Above all, he hopes Seatrec's technology can facilitate an expansion of environmental data collection and deep sea monitoring. He hopes to see tens of thousands of robots exploring the ocean powered by an energy source that is "renewable, unlimited, and sustainable."

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SOURCING MATERIALS FOR A RENEWABLE ENERGY FUTURE: DEEPSEA METAL MINING AS AN ALTERNATIVE TO LAND-BASED METAL EXTRACTION

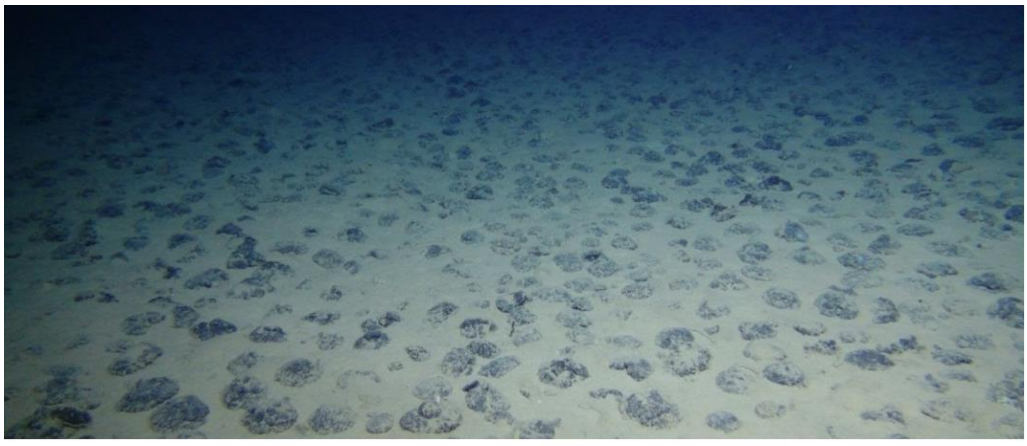
July 19, 2021

By Emily Vidovich

A report from the World Bank estimates that 3 billion tons of metals and minerals will be needed to create the renewable energy infrastructure necessary to keep global warming below 2°Celsius, raising concern about sourcing the necessary materials. On the ocean floor, rocks called polymetallic nodules contain the metals needed to create the batteries that power electric vehicles, providing an alternative to land-based metal extraction.

The Metals Company is at the forefront of exploration for and mining of these nodules in the deep sea. Based on field studies, the company estimates that one of their designated undersea exploration areas alone would be able to provide metals for 140 million electric vehicle batteries. Additionally, the company estimates that within their three exploration areas, there are enough polymetallic nodules to "electrify a quarter of the world's passenger vehicle fleet (approximately 280 million EVs)."

The company visualizes a future in which the reuse and recycling of all metals in circulation means extraction from earth is no longer needed. In order for that to happen, there first needs to be enough harvested metals to support a global population driven by technology and renewable energy. Doctor Gregory Stone, the company's chief ocean scientist who spent most of his career working in environmental conservation, says that The Metals Company's sole focus is harvesting nodules from the seafloor because they view it as the least impactful way to source the amount of metal humanity requires.



Polymetallic nodules resting on the ocean floor in the deep sea. Credit: The Metals Company

According to Forbes, deepsea mining is a better alternative to land-based mining from both environmental and social perspectives. The refinement of nodules does not create soil and water contamination or toxic runoff, unlike its land-based counterpart. Additionally, deepsea mining results in much less habitat loss—deforestation

is part and parcel with metal mining on land—and seems to eschew the exploitative labor practices found in land-based mining. Nodule mining is also less impactful than other forms of deepsea mining, since nodules are not attached to the ocean floor and do not require breaking the earth's crust in order to be collected.

Deepsea mining is much less carbon-intensive than the land-based alternative as well. A paper in the Journal of Cleaner Production found that deepsea mining of nodules reduces the emissions from obtaining metals by up to 80 percent, and puts 94 percent less sequestered carbon at risk of re-release into the atmosphere compared to land-based mining. The study also calculated that making 1 billion electric vehicle batteries from nodules would reduce atmospheric carbon dioxide by 11.5 gigatons.

However, deepsea mining is not an infallible process. Because it is such a new industry, scientists warn that we do not yet understand the full extent of its ramifications on deepsea ecosystems, or the ocean as a whole.

One concern is that sediment clouds created underwater when the seafloor is disturbed could be carried by currents and affect organisms in other parts of the ocean. Researchers at the Scripps Institute of Oceanography and the University of California San Diego that study plume movement found that underwater turbulence quickly dilutes sediment levels. However, more data is needed to comprehensively understand plume behavior.

Additionally, since sediment accumulates on the ocean floor at an average rate of several centimeters every thousand years, it could take the habitat a long time to recover from the collection process—even if only a few centimeters of seafloor are disturbed. Stone points out that the area of the abyssal plain that The Metals Company is exploring has some of the lowest biomass on the planet—an estimated 3,000 times less biomass than the rainforests where much land-based mining occurs. However, the impacts of habitat disturbance and sediment plumes on deepsea organisms are still unknown.

Stone says a cost-benefit analysis of any activity must consider how the entire planetary system is affected. If the deepsea mining of nodules is not utilized, the increasing demand for metals will inevitably lead to further expansion of land-based mining and its coupled deforestation, water contamination, and human rights infringements. Therefore, if supplanting mining on land with mining in the sea has fewer negative impacts while providing the materials humanity requires more efficiently, utilizing deepsea mining could prove to be the most sustainable path forward.

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CONSERVATION THROUGH EDUCATION: EARTHECHO INTERNATIONAL'S MOBILIZATION OF YOUNG ENVIRONMENTAL LEADERS

October 18, 2021

By Emily Vidovich

Historically, the environmental movement has underinvested in education. "There has been investment in tactical environmental solutions, but not in the grand strategy of building a society that cares," explains Philippe Cousteau Jr., one of the co-founders of EarthEcho International.

"EarthEcho aims to fill that gap and be part of the growing group of voices advocating for education."

Growing up, Cousteau was influenced by his grandfather, renowned ocean explorer and conservationist Jacques Cousteau. He recalls that his grandfather liked to say, "Before we talk about conservation, we have to talk about education." When beginning his career, Cousteau kept coming back to his grandfather's aphorism—he knew that creating a society that cared about the environment started with educating youth.

EarthEcho International co-founder Philippe Cousteau Jr. and his wife, journalist Ashlan Cousteau, work with students at an EarthEcho event. Photo Courtesy of EarthEcho International.

To champion the cause of engaging diverse youth in ocean conservation, Cousteau co-founded EarthEcho International in 2005 alongside his sister, Alexandra, and mother, Jan. The organization provides STEM education to youth through afterschool programs with partner institutions, facilitates community water monitoring, and engages the next generation of environmental leaders.

Cousteau takes pride in watching young people develop skills and build confidence over the course of their involvement in EarthEcho's Youth Leadership Council. He notes that youths are capable of making tremendous positive change when provided with "opportunity, hope, and respect."

Through EarthEcho, Cousteau hopes to provide students with opportunities and role models. He defines success as enabling youth to empower other youth—EarthEcho aspires to build a community, equip young people with the necessary tools, and then step back so they can shine. The organization has reached tens of thousands of young people globally, and many of them have said their involvement with EarthEcho has changed their life trajectory and inspired their career choices.

One component of EarthEcho's amplification of youth-led environmentalism is its annual Youth Leadership Summit. Typically, the summit brings a group of young people together in the nation's capital. However, the COVID-19 pandemic required the summit to take place virtually in 2020—and EarthEcho was amazed to see the response. More than 400 young people from over 50 countries, including Saudi Arabia, Cameroon, Australia, and Brazil, attended the virtual forum. Cousteau thinks the demand for such a program stems from the high levels of climate anxiety that young people experience in the face of coinciding environmental crises.

"The greatest cure for this anxiety is building a community of positive action," he says.

The second virtual Youth Leadership Summit was held this past August. It brought together almost 300 young changemakers from 28 countries around the shared purpose of protecting the ocean and the planet. In total, the summit provided 20 sessions and over 1,000 hours of engagement. As part of its partnership with EarthEcho, AltaSea provided a webinar at the summit designed to encourage and facilitate entrepreneurship in the blue economy. The session featured a panelist of four young blue economy entrepreneurs discussing their pathways to success in the blue economy and culminated with the opportunity for youth in attendance to present ideas, business models, and products to the panelists.

The summit was the latest of EarthEcho's events and resources designed to give youth a pathway to take action for the planet. With its mission of inspiring young people worldwide to actively pursue a sustainable future, EarthEcho is both carrying on the legacy of the Cousteau forefathers and allowing the Cousteau's new guard to carve out their own niche within the conservation world.

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In recognition of EarthEcho International's work educating future generations of conservationists, AltaSea honored Philippe Cousteau with the NextGen Award at its Blue Hour: Ocean of Inclusion event on October 9th. In his acceptance speech, he reminded attendees that creating a broad constituency of citizen environmentalists is crucial to achieving true sustainability. And, he said, building that constituency starts with engaging the younger generations.

"Youth challenge convention," he said, "They challenge the older generations to do better."

ABOUT THE AUTHOR

EMILY VIDOVICH

Policy & Programs Researcher

Emily was born and raised in the Port of Los Angeles, where the confluence of the ocean's beauty and pollution from port industries forged her passion for environmental protection. In 2019, she received a Bachelor of Arts in Art History with a minor in Journalism and Mass Communication from the George Washington University, graduating cum laude.

During her senior year of college, Emily was selected as a correspondent for Planet Forward, a platform for collegiate environmental journalism. After graduating, she worked as a sustainability analyst at the Natural Resources Defense Council and a Marine Protected Areas intern at Heal the Bay. She also served as an animal care volunteer at the Marine Mammal Care Center Los Angeles.

In her role at AltaSea, Emily enjoys advocating for the blue economy, because she sees it as the best way to protect the health of our planet and all who live on it. Her favorite sea creature is the Giant Pacific Octopus.