# Marine Aquaculture, Reefs, Renewable Energy, and Ecotourism for Ecosystem Services

## Webinar Guide
## With Highlights

31 December 2023

# Contents

# Foreword

ADB has approved a knowledge support technical assistance (TA 6619) on Marine Aquaculture, Reefs, Renewable Energy, and Ecotourism for Ecosystem Services (MARES) on 31 December 2020 to facilitate future investment in sustainable ocean economy development. One of the TA's outputs is the conduct of capacity building activities to increase the understanding of ADB's developing member countries (DMCs) on healthy oceans particularly the integration of marine renewable energy development.

During its implementation, the TA has organized a total of 26 webinars and forums to present a wide range of areas of practice and experience in optimizing marine resource value and regenerating the marine environment. Experts were invited to discuss various aspects of MARES' four focus areas, aiming to encourage DMCs to leverage ocean-based renewable energy to enhance and diversify mariculture, promote marine ecotourism, and rehabilitate coral reefs for both food sources and coastal protection.

This document summarizes the highlights and key takeaways of each of the events.

For easier reference, the events were segregated into three major headings: blue economy, innovations and marine renewable energy.

Also included are the sessions on ocean energy initiated in two ADB major events: the Asia Clean Energy Forum (2021 and 2022) and the Healthy Oceans Tech and Finance Fourm.

The full recordings and presentation materials are compiled in the MARES ADB Data Room.

# Blue Economy

## The Business of our Ocean

**Rear Admiral Nick Lambert, Co-founder and Director, NLA International**
**23 April 2021**

Rear Admiral Nick Lambert discussed the importance of our oceans and how to harness their potential sustainably. He emphasized the need to overcome "sea blindness" and integrate the blue economy into mainstream socioeconomic activities. Lambert highlighted the significance of understanding and utilizing marine resources for sustainable development, addressing environmental threats, and leveraging modern technologies. He also discussed the challenges and opportunities related to rising sea levels, ocean acidification, and sustainable fishing practices. His presentation concluded with a call for innovative solutions and substantial investment in the blue economy to support global populations and mitigate climate change impacts.

Highlights:

- Oceans have untapped potential and innovative approaches are necessary to harness their resources sustainably. We are faced by some challenges posed by rising sea levels and ocean acidification, stressing the urgency of addressing these issues.
- The blue economy concept focuses on integrating ocean resources into mainstream socioeconomic activities while ensuring environmental sustainability. A collaborative approach involving various sectors to maximize the benefits of the blue economy is necessary.
- There is a need to shift from a "take, make, and dispose" model to a regenerative approach.
- The emerging concepts of blue carbon credits and blue bonds were highlighted, which are financial instruments aimed at supporting sustainable ocean activities.
- There is a need for innovative technologies and sustainable practices to harness the potential of the blue economy. Space-based technologies, drones, and autonomous vessels play a critical role in providing valuable data for managing marine resources.
- The collaboration among various sectors, including finance, law, and engineering, to address challenges such as illegal fishing, ocean acidification, and rising sea levels is important. There is an urgency of scaling up efforts and investments to achieve a sustainable and prosperous future for our oceans.

## Regenerative Marine Aquaculture

**Tom Bowling, CEO of Biota Inc. (Palau)**
**3 May 2021**

The webinar highlighted the regenerative marine aquaculture, focusing on the efforts of Biota, a company specializing in breeding fish, corals, and giant clams for the ornamental trade, with facilities in Palau, Hawaii, North Carolina, and Florida. The company has expanded into food fish research, particularly with species like the bump head parrotfish. Biota aims to produce and sell exclusively aqua cultured fish, ensuring quality and reducing the impact on wild populations. Their fish are raised in aquariums, making them easier to feed and less stressed, leading to longer lifespans and fewer diseases. The presentation covered various aspects of Biota's operations, and their work on breeding and restocking fish species, coral production, and sustainable practices.

Highlights

- Biota is currently undertaking research and innovation by studying bump head parrotfish and red snapper for potential in food fish aquaculture. Bump head parrotfish is considered as challenging to breed; Biota successfully collecting eggs from natural spawning.
- As part of its sustainability efforts, Biota is producing ornamental corals and focusing on sustainability. They are avoiding impacts on wild coral populations by using mariculture and are planning to use coral farms for feeding bump head parrotfish.
- Biota is researching sustainable food fish like red snapper, aiming to reduce reliance on unsustainable feed sources by developing alternative methods.
- It is important to work with local farmers and communities to support sustainable aquaculture and provide food security.
- Biota's future plans include (i) expanding training programs for students and local communities; (ii) exploring renewable energy options to reduce dependence on traditional power sources; and (iii) developing more efficient and sustainable transport and logistics methods.
- The dependency on cargo shipping has its environmental impact and this is one of the challenges of Biota. They are seeking ways to offset carbon emissions and improve sustainability.

## How Singapore is Modernizing Fish Farming with Low Carbon Alternative Methods: ECO-ARK and its underlying Business Model

**Leow Ban Tat, Owner & Chief Executive Officer at ACE's "Eco-Ark"**
**6 August 2021**

Mr. Leow Ban Tot explained how Singapore is modernizing fish farming with low-carbon alternative methods. The presentation focused on the development and benefits of the Eco Arc, an offshore enclosed marine environment for growing marine biomass. Mr. Ban Tot highlighted the importance of sustainable and cost-effective fish farming methods to meet the food security goals of Singapore by 2030. He explained the advantages of closed containment systems over traditional open net systems, emphasizing their environmental benefits and higher production yields. The presentation also covered various global examples of floating closed containment systems and their impact on sustainable aquaculture.

Highlights

- There are two main types of sea-based aquaculture systems: the Open Containment system which uses net cages, relies on external ecosystems for oxygen and clean water and closed containment system, which is separated from the external environment, providing better control over fish farming conditions.
- The floating closed contain systems (FCSS) adopts land-based recirculating aquaculture system (RAS) technologies. Its benefits include reduced energy consumption by using seawater flow-through; flexibility in design (rigid, semi-flexible, or flexible structures) and necessity for water treatment in both inlet and outlet.
- Singapore aims for a 30% self-sufficiency in nutritional needs by 2030. FCCS is seen as key to achieving this goal and ensuring food security.
- FCCS must address sustainability, cost-effectiveness, and environmental impact compared to open-net cages. Site selection is critical to avoid pristine environments and manage waste effectively. Systems should incorporate automation and new technologies to enhance efficiency.
- The future of aquaculture is expected to be dominated by FCSS. As the global population grows, competition for land space will increase, pushing aquaculture towards near-coastal and offshore areas, as well as freshwater bodies. FCCS offer several advantages such as it saves land space, high production yield, potential for economic return, environmentally and ecologically friendly, easy to install and scalable with technological advancements. FCSS can incorporate green technologies such as wind, solar, current, and wave energy, thereby can contribute to achieving the Sustainable Development Goals (SDGs).


## Using the Rigs to Reefs Approach to Accelerate Ocean Regeneration

**Emily Hazelwood & Amber Sparks, M.A.S. Scripps Institute of Oceanography, Founding Partners, Blue Latitudes LLC**
**17 August 2021**

The presenters talked about the "Rigs to Reefs" approach, which repurposes decommissioned offshore oil and gas platforms into artificial reefs to support marine ecosystems. They explained how these structures, once their economic life ends, can be transformed to continue benefiting marine life. They highlighted the ecological value of these platforms, the process of decommissioning, and the global examples of successful reefing programs. The challenges and benefits of this approach were also discussed, including legislative hurdles, public perception, and the potential for enhancing local fisheries and reducing pollution.

Highlights

- When offshore platforms reach the end of their economic life and cease hydrocarbon production, they undergo a process called decommissioning. Instead of complete removal, platforms can be modified to function as artificial reefs, either by towing them to new locations, toppling them on their sides, or removing part of the structure to ensure safe navigation for ships. Despite the oil companies retaining liability for sealed wells, these structures continue to provide important ecological functions.
- Oil platforms are particularly effective due to their large, complex structures that offer extensive surface area and numerous crevices for marine organisms. They can be valuable for fish spawning, feeding, and overall ecosystem health.
- Globally, oil platforms are present in nearly every ocean, with varying levels of acceptance for repurposing them as reefs. While California has not yet implemented a significant rig reef program despite legislation, the Gulf of Mexico has successfully converted over 500 platforms into reefs for over 30 years. Other regions, such as South Carolina, Malaysia, and Thailand, have also explored innovative uses for these structures, including ecotourism ventures like the Sea Ventures dive rig.
- There are challenges associated with this approach. The lack of global legislation and public skepticism about the environmental benefits of repurposing oil platforms pose significant hurdles. Issues such as the potential spread of invasive species and the impact on fishing practices also need to be addressed. Despite these challenges, the benefits of repurposing oil platforms include enhancing local fisheries, compensating for nearshore habitat loss, reducing pollution, and supporting ecotourism.
- Repurposing existing materials can help mitigate the environmental impact of dismantling platforms, especially in regions with inadequate infrastructure for proper decommissioning.

## Revealing What Works for Investment Decisions in the Blue Economy – Experience from Island States

**President James Michel, Former President of The Republic of the Seychelles**
**6 October 2021**

This webinar explored the importance of the blue economy and the need for sustainable investments to maintain healthy oceans. It highlighted the potential of the ocean economy in Asia and the Pacific, emphasizing the need for increased investment and innovative solutions to address challenges in food supply, energy security, health, and the environment.

Highlights

- Seychelles, despite its small landmass, boasts a vast economic space as one of the largest ocean states. The initial challenge of promoting the blue economy in Seychelles was met with skepticism but eventually gained recognition at the Rio+20 Summit in 2012. Since then, numerous discussions and workshops have complicated the blue economy concept, but the urgency to act has only increased.
- The blue economy, as defined by Belgian economist Gunter Pauli, emphasizes sustainability, innovation, and better stewardship of ocean resources. Unlike the green economy, which focuses on restoring damaged environments, the blue economy aims to prevent harm and promote the conservation of marine resources. This involves balancing economic growth with ecological and social justice, ensuring that the needs of current and future generations are met while addressing climate change and enhancing resilience.
- Seychelles has implemented a comprehensive blue economy strategy, marked by innovative financial reforms and a commitment to marine conservation. By renegotiating its debt and using conservation funds to support its blue economy initiatives, Seychelles achieved significant milestones, such as establishing protected marine areas well ahead of international targets. The country has set up a strong governance structure and an ambitious roadmap to guide its blue economy efforts through 2030.

## Singapore's High Relief Artificial Reef

**Dr. Santosh Kumar, Head of Engineering Department, HSL Constructor Pte Ltd, Singapore**
**Prof. Chou Loke Ming, Emeritus Professor, National University of Singapore**

Dr. Kumar and Prof. Loke Ming tackled the development and implementation of high-relief artificial reefs in Singapore to enhance marine biodiversity. The presentation covered the design, construction, and ecological benefits of these structures.

Highlights

- HSL Construction Private Limited is a regional infrastructure development company engaged in various projects related to water, energy, food, and environment. Among their notable projects are desalination plants that supply 15% of Singapore's water needs, urban farming initiatives, flood mitigation projects such as the Bedok canals, and ventures into clean energy including solar, wind, and tidal energy. A significant part of their environmental work includes the development of artificial coral reefs, which is a key project they are proud to discuss.
- Artificial reefs can be categorized into two types: high relief and low relief. High relief artificial reefs extend significantly into the water column, while low relief reefs cover the seabed minimally. The decommissioned oil rigs can serve as effective artificial reefs due to their large steel frameworks which support marine life. Additionally, marker buoys and offshore wind turbines also contribute to marine ecosystems by providing structures for coral growth and fish habitation.
- Singapore has faced substantial loss of natural coral reefs due to coastal development. To address this, a collaborative project was initiated by JTC and the National Parks Board, with HSL Construction joining as a design and build partner. The project aims to enhance marine biodiversity through the creation of artificial reefs.
- By 2018, the construction of high relief structures was completed, and since 2019, these reefs have hosted various coral colonies. The project's design emphasizes height and structure complexity to optimize light penetration and support diverse marine life.
- Artificial reefs have broader benefits, including their role in reducing wave energy and shoreline erosion. The structures can also generate economic benefits through tourism and fisheries, enhance biodiversity, and contribute to pharmaceutical research.

## Alternative Proteins Power by Marine Renewable Energy

**Marcel Kroese, Marine Biologist Consultant, International NGOs**
**20 May 2022**

Marcel Kroese discussed the potential of alternative proteins powered by marine renewable energy. He presented the importance of fish and seafood in the region, the environmental impact of the global food system, and the benefits of alternative proteins. He also highlighted the challenges and solutions related to marine renewable energy and alternative protein sources.

Highlights

- In regions where fish and seafood are major sources of animal protein—such as in Asia, where consumption is significantly higher than the global average—there is a pressing need to consider alternative proteins. Fish provides around 42% of total animal protein intake in this area, and seafood consumption is notably high in countries like China.
- The global food system contributes significantly to greenhouse gas emissions, with protein production being a major contributor. The food system as a whole accounts for 34% of global greenhouse emissions, with protein production and associated activities like fishing and transport contributing heavily. Traditional seafood production also has a considerable carbon footprint, with fishing practices causing habitat destruction and high emissions.
- Alternative proteins can reduce carbon emissions by 80 to 90% compared to conventional meat production, highlighting their potential in mitigating environmental impacts.
- The challenges in seafood production include illegal fishing practices, habitat destruction, and the use of unsustainable gear. These practices contribute to overfishing and environmental degradation.
- Aquaculture is not the most carbon-efficient sector, and there's a significant difference in emissions between traditional fisheries and aquaculture. The impact is more severe in regions like Southeast Asia, which face high climate vulnerability and significant environmental changes.
- Alternative proteins can come from various sources, including fish waste, insect proteins, microbial and microalgae proteins, and food waste. These alternatives offer a way to reduce dependence on traditional protein sources and their associated environmental impacts.
- Integrating renewable energy with alternative protein production can lead to more sustainable practices. Marine renewable energy can power aquaculture systems, reduce energy costs, and support ecological balance. Renewable energy sources can help in creating circular production systems that reduce waste and emissions, thus offering a viable path towards more sustainable seafood and protein production.

## Blue Economy: A Powerful and Persuasive New Concept for Sustainable Development Based on Economic Activities Associated with the Ocean

**Dr. Stefan Kraan, Chief Scientific Officer, Seaweed Company, Ltd.**

The presentation centered on the role of seaweed in the blue economy. Dr. Stefan Kran, Chief Scientific Officer of The Seaweed Company, Ltd., presented on the sustainable use of seaweed for economic growth, improved livelihoods, and ocean ecosystem health. He highlighted the benefits of seaweed in renewable energy, fisheries, maritime transport, tourism, and climate change mitigation. The presentation also covered the global seaweed industry, its market potential, and the environmental and social impacts of seaweed cultivation.

Highlights

- The rising significance of seaweed within the context of the blue economy has gained prominence in recent years. The blue economy focuses on the sustainable use of ocean resources to support economic growth, improve livelihoods, and enhance ocean ecosystem health. Seaweed plays a key role in this concept due to its benefits, including its potential for renewable energy production, its use in sustainable fisheries and aquaculture, and its contributions to climate change mitigation and waste management.
- Seaweed aligns with the blue economy's five main pillars: renewable energy, fisheries, maritime transport, tourism, and climate change. Seaweed's utility in producing bioethanol from renewable biomass, its minimal land and fertilizer needs, and its role in supporting ocean ecosystems can be emphasized.
- The global seaweed industry is substantial, with major producers in China and Indonesia. European markets are growing, projecting a market size of $9.3 billion and 115,000 jobs by 2030. Despite this growth, challenges such as limited access to finance and commercial scalability remain. Further, the Seaweed's market is expanding, with current figures indicating a production of around 36.8 million tons, with growth rates of 6-8% annually.
- Seaweed's environmental benefits include its capacity to absorb CO2, mitigate ocean acidification, and support sustainable diets. It can also help with nutrient recycling, improve soil health, and provide a sustainable alternative to traditional plastics. Seaweed-based products are emerging in various sectors, including bioplastics, fertilizers, health supplements, and even food products like meat substitutes.
- The seaweed industry faces some challenges and opportunities, including the need for sustainable practices and innovative solutions. The development of seaweed-based materials, such as biodegradable plastics and agricultural products, offers promising alternatives to traditional methods.
- The seaweed industry is positioned to contribute significantly to sustainable development and environmental conservation, if it addresses current limitations and leverages its potential effectively.

# Innovations

## Growing Reefs Faster Than We're Killing Them

**Scott Countryman, Executive Director of the Coral Triangle Conservancy**
**7 May 2021**

Scott Countryman presented the use of ocean-based renewable energy to regenerate coral reefs. Scott shared his experiences and challenges in the field, highlighting the importance of marine conservation. He founded the Coral Triangle Conservancy in 2012, focusing on creating no-take marine protected areas to combat the loss of marine biodiversity. His presentation covered various methods for coral restoration, including structural, biological, and physical approaches. Scott emphasized the need for cost-effective and replicable projects that can be managed by locals. He also discussed the benefits of using renewable energy to enhance coral growth and the potential for commercializing marine conservation efforts. The presentation concluded with a call to action for governments and corporations to invest in marine conservation to save the oceans and, ultimately, the planet.

Highlights

- The Coral Triangle Conservancy's Lifeboat Project in Nasugbu aims to boost marine conservation through the establishment of large, isolated No-Take Marine Protected Areas (MPAs) to enhance biomass and biodiversity, address overfishing, and contribute to climate change mitigation.
- The project focuses on cost-effective coral reef restoration, using methods like Biorock technology, which applies electric currents to accelerate coral growth. Challenges include managing rapid coral growth and maintaining genetic diversity. Innovative approaches like capturing hydrogen gas and a hub-and-spoke nursery system help optimize efficiency, transport structures with minimal loss, and support fish migration, further enhancing reef restoration.
- The project utilizes various reef forms, such as domes, wedges, and tables, each suited to different functions like breakwaters, nurseries, and general reef restoration. A crucial part of the project involved detailed habitat mapping of 69 kilometers of coastline, breaking the area into manageable sections for assessment. The project emphasized prioritizing reefs with the best potential for recovery while acknowledging that some areas were beyond saving due to environmental stressors.
- Efforts to combat fish bombing included deploying sensor networks and utilizing technology to detect and respond to illegal activities. The team significantly reduced fish bombing incidents through social programs and local patrols. Additionally, technological solutions such as hydrophone systems, GPS tracking, and drones were employed for monitoring and enforcement. Despite these advances, challenges such as climate change impacts and funding limitations remain. Nonetheless, the project demonstrated that rapid coral growth and resilience could be achieved with the right techniques and emphasized the need for ongoing efforts to address broader environmental issues.

## We Live on Planet Sea and its Acidifying

**Dan Millison, Consultant, ADB**
**21 May 2021**

The presentation focused on critical issue of ocean acidification and its implications for marine ecosystems and human life. It highlighted the importance of addressing sea blindness and wealth blindness, which are psychological barriers to recognizing the value of oceans. The presentation emphasized the need for sustainable and regenerative marine practices, such as cultivating reefs and renewable energy projects. It also explored the potential of hydrogen production from offshore renewable energy sources as a solution to reduce carbon emissions and support ocean health. The video concluded with examples of successful projects and the role of the Asian Development Bank (ADB) in financing and supporting these initiatives.

Highlights

- There is an urgent need to address both the energy transition and ocean health. While onshore renewable energy advancements like wind farms are making progress, they alone are not enough to meet global challenges. Clean energy should be framed as a commercial opportunity like oil and gas fields but without the environmental negatives.
- There are three major problems impacting marine ecosystems: sea blindness, wealth blindness, and ocean acidification. Sea blindness refers to the neglect of ocean-related issues in climate discussions, while wealth blindness concerns the undervaluation of the ocean's natural capital. Ocean acidification, driven by rising atmospheric CO2 levels, poses the greatest threat, potentially causing irreversible damage to marine life.
- Faster calcification processes can be achieved through reef and seagrass growth to counteract acidification. The shift towards a sustainable ocean economy, including marine aquaculture, renewable energy, and ecotourism is aligned with ADB's sustainable development goals and investment strategies.
- The Rig-to-Reef program, which began in 1987, has proven effective, supporting sport diving, fishing, and commercial seafood production. Research has shown that marine biodiversity around these rigs often surpasses that in protected areas, indicating their positive impact on marine life.
- ADB's strategy emphasizes not just electricity supply but the productive use of energy. This includes considering offshore renewable energy as part of a broader value chain, potentially leveraging it for various applications beyond electricity generation.
- There are various approaches to harnessing marine resources and renewable energy. For example, In West Papua, Indonesia, the focus is on converting declining natural gas fields into floating solar installations, which could be used to produce hydrogen and other products. This repurposing strategy leverages existing infrastructure for renewable energy. In the Pacific, countries like the Maldives and the Marshall Islands have potential for large-scale renewable energy projects, e.g., floating solar systems could be implemented to power resorts and contribute to local energy needs. Additionally, integrating ocean-based renewable energy with regenerative practices like marine aquaculture could lead to sustainable tourism and local seafood production.

## Explaining Ocean Acidification – Science, Observation and Mitigation

**Dr. Jan Newton, Co-Director, Washington Ocean Acidification Center, University of Washington; Dr. R. Duncan McIntosh, Senior Regional Maritime Specialist, ADB; and Dr. Steve Widdicombe, Director of Science and Deputy Chief Executive, Plymouth Marine Laboratory**
**7 January 2022**

This webinar explained the science, observation, and mitigation of ocean acidification. It features experts from the Global Ocean Acidification Observing Network (GOA-ON) discussing the causes, impacts, and potential solutions to this environmental issue.

Highlights

- Ocean acidification results from the absorption of atmospheric carbon dioxide by seawater, which alters the water's chemistry, reducing pH and carbonate levels. This process impacts marine life, particularly organisms that rely on carbonate for their structures, such as shellfish and corals. Accelerating changes in pH and carbonate levels could have profound effects on marine ecosystems.
- It is important to consider multiple stressors, such as rising temperatures and decreasing oxygen levels, alongside ocean acidification. The complex interactions among these factors can significantly alter marine ecosystems and biodiversity.
- GOA-ON was established to monitor and understand ocean acidification on both global and local scales. With participation from over 900 scientists across 105 countries, GOA-ON coordinates efforts to track ocean acidification's status, biological impacts, and projections.
- There are several mitigation strategies for ocean acidification. While limiting CO2 emissions through green energy is the primary approach, additional methods such as alkalinization, direct air capture, and blue carbon restoration are being explored. Continued research and coordinated efforts have to continue to address both global and local aspects of ocean acidification.
- The Pacific Islands Regional Hub (PI TOA) and its project, the Pacific Partnership on Ocean Acidification aims to address ocean acidification through research, capacity building, adaptation strategies, and policy support. Key activities include the establishment of pilot sites in Fiji, Kiribati, and Tokelau for research and adaptation. Notable achievements include publishing vulnerability assessments, offering PhD scholarships for coral research, and distributing monitoring kits and autonomous buoys for tracking ocean acidification.
- The GOA-ON has developed a roadmap emphasizing outcomes rather than just outputs. The program has identified seven key outcomes to guide the ocean acidification scientific community, which include: identifying specific data needed for effective mitigation and adaptation strategies, providing high-quality ocean acidification data, supporting long-term observation systems, understanding the impacts on marine organisms, increasing public literacy on ocean acidification, and integrating ocean acidification measures into national policies.

## Jumpstarting Ocean Deep Tech

**Tom Chi, Founding Team Member, Google X**
**13 May 2022**

The webinar featured Tom Chi discussing the potential of ocean deep tech and its impact on the environment. He emphasized the importance of innovative solutions to address environmental challenges and improve our relationship with nature.

Highlights

- Ongoing developments in wave energy systems could offer sustainable and cost-effective alternatives to traditional energy sources, especially beneficial for island nations. There are also recent innovations in offshore wind technology and ecosystem restoration, particularly focusing on floating wind turbines and advanced restoration methods.
- Floating wind technology is emerging as a promising development in the offshore wind sector. Unlike traditional fixed offshore turbines, floating wind platforms offer the potential to access a wider range of sites, significantly expanding the areas suitable for electricity generation.
- Advances in ecosystem restoration are making a significant impact, e.ag., the use of drones for terrestrial restoration can plant up to 120 trees per minute. This technology promises a cost-effective solution for large-scale reforestation, potentially addressing substantial gaps in carbon dioxide reduction. The drones can restore various ecosystems, from drylands to rainforests, and have demonstrated success in restoring landscapes previously affected by mining. The goal is to significantly increase the scale of restoration efforts to mitigate climate change effectively.
- Efforts are underway to develop similar innovative technologies for coral reef restoration. A new robotic platform designed for coral planting can dramatically speed up the process compared to traditional methods. This robot can plant coral fragments in about 15 seconds, compared to the 5-10 minutes required by manual methods. The affordability of these robots also ensures that even less wealthy communities can contribute to reef restoration.
- Recent innovations are exploring diverse methods for enhancing environmental sustainability and improving technology accessibility. One notable development is marine permaculture, which has been piloted off the coast of Indonesia. This technology uses artificial upwelling to bring nutrient-rich, cold waters to the surface, where sunlight accelerates biological productivity. This process promotes rapid growth of seaweed forests, such as kelp, which act as significant carbon sinks. The potential impact is substantial: if such systems were deployed over 2% of the ocean, they could theoretically offset a trillion tons of atmospheric carbon dioxide within 50 years.
- Innovative technologies and shifts in consciousness can both play catalytic roles in addressing environmental and social challenges. In Ecuador, the incorporation of nature's rights into the constitution led to legal victories for the environment, demonstrating how shifts in legal frameworks can create significant ripple effects. This principle of changing perspectives to achieve better outcomes is echoed in another project in Guatemala, where a new approach to selling solar electric boxes transformed local energy access.

# Marine Renewable Energy

## Harnessing Marine Renewable Energy

**Dr. Michael Abundo, Managing Director, Ocean Pixel Pte Ltd, Singapore**
**14 May 2021**

The topic on marine renewable energy as presented by Dr. Michael Abundo talked about its potential and current state. The presentation covered various types of marine renewable energy, including offshore wind, floating solar, marine biomass, and ocean renewable energy resources like currents, tides, waves, salinity gradients, and thermal gradients. Dr. Abundo explained the technology readiness levels of these resources, their environmental impacts, and the challenges faced in harnessing them, especially in developing countries. He highlighted the importance of integrating marine renewable energy with other applications such as green transport, aquaculture, and water production to create sustainable and impactful solutions for island and coastal regions.
Highlights

- Marine renewable energy involves energy production using marine resources or space such as wind, floating solar, marine biomass, and various ocean resources such as currents, tides, waves, salinity gradients, and thermal gradients.
- Ocean renewable energy is a subset of marine renewables, specifically involving ocean-driven resources like tidal currents, wave energy, and temperature gradients. Offshore wind and floating solar are not ocean-driven but are still considered marine renewables. The technology in marine renewable energy spans from early-stage to commercial applications.
- The Orkney Islands serve as a notable example of successfully integrating renewable energy to exceed their demand. They utilize a mix of onshore wind and offshore sources, including wind, tides, and waves not only to meet their energy needs but also supports diverse applications such as vessel electrification, hydrogen production, and battery swapping. Such a model demonstrates the potential for island communities and archipelagic regions worldwide, including Southeast Asia, Micronesia, and Palau, to explore and expand their renewable energy capabilities.
- Globally, there is significant potential for ocean energy, with Southeast Asia alone estimated to have over a thousand sites suitable for development. In contrast, developed nations might deploy larger, more complex systems.
- Marine renewable energy can significantly impact sectors such as transport, food security, and digitalization, contributing to a more integrated and sustainable development for coastal and island communities.
- By focusing on a progressive approach that leverages existing ecosystems and develops hybrid systems, marine renewable energy can be more effectively utilized to support the blue economy and enhance environmental and economic benefits.

## Hydrogen: Introduction, Production from Marine Renewables and Applications

**Dr. Nguyen Dinh, Head of Power to X & Hydrogen, Offshore Wind Consultants (OWC)**
**16 July 2021**

This webinar featured Dr. Nguyen Dinh who discussed the production and application of green marine hydrogen. He covered various methods of hydrogen production, storage, and transportation, emphasizing the importance of green hydrogen derived from marine renewable energy sources.
Highlights

- Hydrogen has diverse applications, notably in transportation and electricity generation via fuel cells. This process emits only water and heat, making it a clean energy source. There are different methods for producing green hydrogen and each method has distinct characteristics. The polymer electrolyte membrane (PEM) technology is suited for renewable energy applications due to its rapid response time and efficiency.
- There are challenges of coupling hydrogen production with power grids and renewable energy plants, thus there is a need for effective system modeling and cost management to optimize hydrogen production and market integration.
- Germany is developing a significant renewable hydrogen projects and other European countries such as Denmark and UK. Together with India, the target is to build up to 10 GW by 2040 focusing on integrating hydrogen production with renewable energy sources, such as wind and marine energy, to advance green hydrogen technology.
- Innovative hydrogen production methods are being explored such as wave energy and tidal energy for their potential to produce hydrogen sustainably. Another promising method involves using seaweed and algae, which can be processed through thermochemical techniques to generate hydrogen. The production of green ammonia is also being looked at due to its lower energy requirements and potential market advantages.
- Ammonia presents a cost-effective solution for long-distance transport compared to hydrogen, with lower pipeline and shipping costs. The maritime industry faces pressures to reduce emissions, and hydrogen, along with ammonia, is being explored as a cleaner alternative.

## ADB's Activities in Hydrogen including MARES

**12th International Greentech & Eco Products Exhibition & Conference Malaysia (IGEM 2021)**
**Stephen Peters, Senior Energy Specialist (Waste to Energy), ADB**
**21 July 2023**

Mr. Stephen Peters from ADB made a presentation during the International Hydrogen Economy Forum and Strategic Lab on 21 July 2023. The Hydrogen Forum, which was part of the 12th International Greentech & Eco Products Exhibition & Conference Malaysia (IGEM 2021) explored the potential role of hydrogen in the country's energy mix. Stephen discussed ADB's initiatives in the hydrogen economy and the MARES project. The MARES project focuses on integrating marine renewable energy with hydrogen production and regenerative activities to support sustainable development. He also highlighted ADB's efforts in supporting government policy development, enhancing hydrogen trading platforms, knowledge sharing, pilot projects, and financing.
Highlights

- The ADB is actively involved in advancing the hydrogen economy through several key initiatives. These include supporting government policy development, enhancing hydrogen trading platforms, and scaling up pilot projects. ADB has conducted workshops and studies on hydrogen markets and has engaged in small-scale financing for fuel cell buses in People's Republic of China. Additionally, a handbook was produced for ADB's staff and its developing member countries to look at ways to assess projects related to hydrogen. ADB has also done several feasibility studies in Nepal, Maldives and Palau.
- A significant project under ADB's umbrella is the Marine Aquaculture, Reefs, Renewable Energy and Ecosystem Services (MARES) project, which focuses on integrating marine renewable energy, such as offshore wind and wave energy, with hydrogen production. The project aims to convert marine renewable energy into hydrogen and explore alternative fuels like ammonia or methanol. It also seeks to combine these efforts with regenerative activities like marine aquaculture and ecosystem restoration to create a sustainable and profitable energy model.
- ADB's approach emphasizes the importance of creating regenerative rather than extractive industries. This involves not only reducing CO2 emissions and mitigating ocean acidification but also enhancing marine biodiversity and promoting new industries. The goal is to develop a resilient energy sector with ESG (Environmental, Social, and Governance) principles at its core. Interested parties are encouraged to visit ADB's website or data room for more information and to get involved in these initiatives.

## Ocean Thermal Energy Conversion (OTEC) in Hawaii and Beyond

**Richard Argall, P.E., Division Head, Ocean Energy, Makai Ocean Engineering**
**14 January 2022**

The webinar discussed Ocean Thermal Energy Conversion (OTEC) technology, focusing on its application in Hawaii and potential for broader use. Richard Argall from Makai Ocean Engineering explained the basics of OTEC, its benefits, and challenges. He also covered related technologies like seawater air conditioning (SWAC) and the potential for OTEC to contribute to the hydrogen economy.
Highlights

- Ocean Thermal Energy Conversion (OTEC) uses the temperature difference between warm surface water and cold deep water to generate continuous, reliable electricity. It offers potential additional benefits like desalination, making it a unique renewable energy source compared to wind or solar.
- Onshore OTEC systems are complex and costly due to the need for large pipelines to transport deep-sea water, while offshore systems, though more expensive to build and maintain, are often more practical for large-scale operations due to direct utilization of thermal gradients.
- There are only two operational OTEC plants, both onshore—one in Okinawa and another in Hawaii. A notable development is the 1-MW floating OTEC plant, which has encountered challenges in testing and deployment.
- OTEC requires large-scale implementation to be cost-effective, as small-scale projects are not economically viable. Despite high costs, OTEC shows promise compared to diesel generation, with potential for cost reductions through technological advancements.
- While hydrogen was considered as an energy carrier for OTEC-generated electricity, it has limitations for large-scale use. Ammonia is proposed as a more practical alternative due to its easier handling and transport. OTEC is deemed technically feasible and economically viable, particularly for remote island communities, with ongoing development to scale up and compete with other renewables.

## Paddling to Create Cultured Reefs for New Habitats and Coastal Protection

**Dr. Will Bateman, CEO, C-Cell Renewables Ltd.**

The presentation detailed the efforts of Dr. Will Bateman and his team at C-Cell to combat coastal erosion by creating cultured reefs. They aimed to restore a sustainable balance to coastal environments using renewable energy and innovative technologies.
Highlights

- C-Cell is developing a project called "Living Reef," which is an evolution of their internal concept known as "Digital Reef." The initiative includes the use of renewable energy sources; the deployment of ocean structures; and the incorporation of biological elements such as corals, oysters, and seagrass. These elements work together to create a sustainable and integrated approach to marine and coastal management.
- The primary issue is coastal erosion. A significant contributor to this erosion is the increase in wave intensity caused by climate change and human activities like the construction of harbors and marinas that disrupt the natural flow of sand. The Living Reef project seeks to combat this problem by combining advanced technology with ecological solutions to improve coastal resilience and sustainability.
- Coral reefs, which have evolved over millions of years to protect coastlines, play a crucial role in mitigating this erosion. They work by absorbing wave energy and reducing turbulence, which helps in stabilizing the sediment and protecting beaches from further erosion. However, with the decline of coral reefs—about 50% have been lost globally—their effectiveness has diminished.
- C-Cell's mission is to revitalize coral reefs and extend their presence to areas in need of coastal protection through the employment of a multi-faceted approach involving modeling of coastal environments, development of wave energy devices, and the physical installation of reefs and their associated electronics.
- Recent projects include installations in Mexico's Yucatan Peninsula and planned expansions in other regions like Israel and the Indian Ocean. The company's pilot projects, such as the reef in Cozumel, have demonstrated successful deployment and functionality. Future efforts focus on scaling up reef installations and enhancing their attractiveness to marine life, with ongoing developments aimed at improving the performance and integration of their wave energy systems.

## Ocean Thermal Energy Conversion (OTEC) Viability as a Catalyst for Transformative Island Development


**Professor Ikegami Yasuyuki, Executive Committee Chair, Institute of Ocean Energy, Saga University, Japan and Benjamin Martin, Assistant Manager, Xenesys, Inc.**
**30 September 2022**

This webinar discussed the viability of Ocean Thermal Energy Conversion (OTEC) as a catalyst for transformative island development. The speakers, Professor Yasu Ikegami and Ben Martin, highlighted the potential of OTEC to provide renewable energy and contribute to carbon neutrality. They explained the technology, its applications, and its benefits for island communities, particularly in terms of energy, water, and food security. The webinar also covered the current state of OTEC technology, its scalability, and the economic impact on local communities.

Highlights

- In Okinawa, Japan, the local government established a 100-kW OTEC demonstration facility. The long-term goal is to scale up to a 100-MW offshore facility. The development roadmap includes progressing from this demonstration to a 1-MW facility that could supply power to a town, enhancing local energy security and development. OTEC's potential extends beyond Japan to regions with suitable temperature gradients, such as Indonesia, the Philippines, and Oceania, offering a significant opportunity for renewable energy and local resource utilization in these areas.
- Ocean Thermal Energy Conversion (OTEC) presents a promising approach to addressing multiple global challenges, including energy, water, food, and environmental security. By harnessing the natural temperature difference between warm surface water and cold deep-sea water, OTEC can generate electricity continuously and sustainably.
- In addition to energy production, OTEC offers secondary benefits such as seawater air conditioning and resource conservation, reducing reliance on depleting resources.
- On Kumijima, a small island in Okinawa Prefecture, Japan, OTEC has become central to local industry and development. The island has focused on leveraging its deep-sea water resources for various industries, including fisheries and cosmetics. The deep-sea water is used for diverse applications, such as growing algae, producing minerals, and supporting sustainable aquaculture, which has significantly boosted the local economy.
- OTEC offered a compact, reliable, and environmentally friendly alternative to traditional energy sources like solar and wind, with high-capacity factors and minimal maintenance costs. Its ability to provide both power and by-products such as fresh water and hydrogen makes it a versatile option for island communities.
- The potential for scaling up OTEC and integrating it with other renewable sources can significantly enhance sustainability and support local economies, making it a promising solution for energy, water, and food security in island and coastal communities.

## Why RED Blue Energy is ready for upscaling into megawatt-demonstration scale


**Pieter Hack, Founder/Chairman of the Board of REDstack BV and Geeta Singh, Co- Director and Lead REDstack Energy India Pvt Ltd.**
**14 April 2023**

The presentation stressed the potential of Blue Energy technology, specifically reversed electrodialysis (RED), for sustainable power generation. The presenters, Pieter Hack and Geeta Singh, explained how this technology works by using membranes to generate power from the natural process of salt moving from saltwater to freshwater. They highlighted the benefits of Blue Energy, including its sustainability, continuous power generation, and minimal ecological impact. The video also covered the company's progress from laboratory research to pilot plant operations and the challenges faced during upscaling. Additionally, the potential for global application, particularly in warmer climates, was discussed.

Highlights

- Blue Energy is a sustainable power generation technology that harnesses energy from the contact between freshwater and seawater using a process called reversed electrodialysis (RED). Blue Energy is environmentally friendly, requiring no chemicals or fossil fuels, and provides 24/7 power as long as there is a flow of freshwater into the sea.
- The technology shows significant potential both in the Netherlands, where pilot projects are underway, and globally, with estimates suggesting a potential of one million MW, especially in warmer regions like Southeast Asia and Latin America.
- A pilot plant located in an eco-sensitive area where saltwater from the North Sea and freshwater from the Rhine River are used to test Blue Energy technology. Key performance metrics include generating 1-MW of power from a cubic meter per second of freshwater and achieving 2 W/m2 of membrane. Challenges with scaling and maintaining membrane stacks have been addressed, leading to successful upscaling from small laboratory models to larger units with no loss in efficiency.
- Recent efforts have focused on refining the membrane stack design and solving issues such as clogging and fouling. The technology has been successfully scaled from a small 0.25-m2 stack to a 500-m2 stack, with plans to expand further to 2,000 m2. Ongoing improvements in stack design and operation aim to ensure stable, long-term performance, with future projects set to upscale to a two-megawatt scale.
- The initial investment for a 100-MW plant is estimated at 900 million Euros, with a projected cost of 11 to 12 cents per kWh. As more plants are built and technology advances, costs are expected to drop to around 5 cents per kWh by 2040. The technology shows promise for integration into infrastructure projects, particularly in regions like India, where lower construction costs and abundant river systems offer significant potential for Blue Energy power plants.


## Offshore Wind Development– Lessons from the United Kingdom

**David Still & Bill Grainger, Wind Energy Associates, NLAI Ltd**
**7 August 2023**

This webinar on offshore wind development focused on lessons learned from the United Kingdom. It features presentations by David Still and Bill Granger, who shared their extensive experience in the field.

Highlights

- Offshore wind energy in the UK in 2000, has seen rapid development over the past 25 years, growing from initial small-scale projects to nearly 14 gigawatts of installed capacity. The sector has advanced significantly, with turbine sizes now reaching up to 324 meters and outputs of 15 MW. The UK's success is due to a complex interplay between government policies, seabed ownership by the Crown Estate, and industry collaboration, with a robust framework for consenting, grid connections, and financial contracts.
- Globally, offshore wind energy is expanding rapidly, with significant contributions from countries like PRC and the UK. The industry is evolving with advancements in technology, including fixed and floating turbines, which allow operations in deeper waters. The energy generated can be used not only for the grid but also for other applications, highlighting its versatility and potential for diverse energy solutions.
- Designing an offshore wind program for a country involves addressing several key objectives: ensuring energy supply, reducing CO2 emissions, generating revenue and jobs, and enhancing energy security. To achieve these goals, it’s crucial to engage stakeholders early in the process, including government bodies, developers, and environmental and maritime interests.
- The process of establishing offshore wind projects is complex and can take several years, with significant time needed for policy formulation, permitting, and infrastructure development. Countries must carefully plan the construction and decommissioning phases, to ensure that regulatory, financial, and logistical aspects are addressed.
- From a developer's perspective, initiating an offshore wind project involves a comprehensive feasibility study to evaluate potential sites. This initial phase assesses wind speeds, seabed conditions, water depths, and environmental factors to determine suitability. Developers must also consider logistical aspects such as the availability of local ports, the required infrastructure for transmitting electricity to the shore, and whether the region has a framework for private electricity sales. Understanding these factors helps in estimating costs and navigating regulatory hurdles.
- The future of offshore wind farms looks promising as turbine sizes and global market demand continue to grow. Currently, the largest turbines feature 115-meter blades, highlighting the scale of advancements. This expansion is driven by increasing interest in offshore wind’s potential for producing green hydrogen, which could significantly enlarge the market.

## TA 6619 MARES Closing Workshop

**20 November 2023**

ADB held a closing workshop for TA 6619 Marine Aquaculture, Reefs, Renewable Energy, and Ecotourism for Ecosystem Services (MARES) at ADB HQ on 20 November 2023. The event was conducted in hybrid format and was attended by representatives from the Philippine government, the British Embassy in Manila, the private sector, and ADB staff. The experts presented the MARES principles and the significant accomplishments of the TA. The opportunities for marine renewable energy and blue economy in the Philippines were discussed and substantiated by the findings of the two scoping studies conducted in two islands in the Philippines: Dinagat and Surigao. During the panel discussion, the experts shared similar MARES-related initiatives and the possible next steps to further pursue sustainable blue economies moving forward. The technical handbook on "The Ocean-Energy Economy: A Multifunctional Approach," which is one of the outputs of the TA was also launched during the event.

# Marine Renewable Energy in Forums

## Spotlight Session: Waste, Energy and the Oceans

**Asia Clean Energy Forum 2021, 14-18 June 2021**
**16 June 2021**

The ocean plays a crucial role in supporting human life by providing livelihoods through fishing, tourism, and shipping, as well as serving as a major source of protein and oxygen. It absorbs up to 93% of the world's heat and acts as the largest active carbon sink, mitigating climate change impacts. The ocean is facing significant challenges, including pollution and declining fish stocks. In response, the Asian Development Bank (ADB) launched a $5 billion action plan in 2019 to promote healthy oceans and sustainable blue economies in Asia and the Pacific. This plan aims to boost investment and technical assistance for ocean protection and restoration, emphasizing the need for scalable and replicable solutions that benefit both the environment and people. This session was part of Asia Clean Energy Forum organized by ADB. The session explored the connections between waste, energy, and the ocean, highlighting the potential of ocean-based renewable energy sources, such as wave and tidal streams.

**Agenda**

| Time (Manila) | Activities |
|---|---|
| 10:30-10:35 a.m. | Remarks from Moderator<br>Introduction to ADB Healthy Oceans and Sustainable Blue Economies Action Plan and the challenge oceans face. |
| 10:35-10:42 a.m. | Opening remarks and scene setter talk |
| 10:42-10:54 a.m. | The Business of the Ocean: Describing the linkages between waste, energy, and the ocean in the current marine environment. Providing an overview of opportunities to create natural capital and economic growth. Talking about risks and how to overcome them. |
| 10:54-11:06 a.m. | Changes in the way we deal with waste: Changing the way we deal with waste, eco-industrial parks and new ways of dealing with flyash from waste to energy projects. |
| 11:06-11:18 a.m. | Integrating coastal defenses and aquaculture into Offshore Renewable Energy Solutions: Showcasing examples of where regenerative aquaculture can assist in re-inventing the sustainable seafood business (low carbon and climate-resilient) and application of |

| Time (Manila) | Activities |
|---|---|
| | cultivated/engineered reefs, mangroves and coastal infrastructure insurance policies |
| 11:18-11:55 a.m. | Panel Discussion; The way forward to align various solutions together for a healthier and more regenerative ocean |
| 11:55 a.m. -12:00 p.m. | Closing Remarks |

**Opening Remarks and Scene Setter**

**Woochong Um, Managing Director General, ADB**

The Asian Development Bank (ADB) has committed $5 billion to ocean health through its Strategy 2030 and is working on initiatives like the clean and sustainable oceans partnership with the European Investment Bank. ADB aims to tackle visible marine plastic pollution and less visible issues like micro carbon emissions and chemical pollutants. By exploring natural capital economics and collaborating with institutions like Stanford University, ADB seeks to create regenerative impacts and boost the marine economy. The focus is on integrating various sectors to build sustainable, livable cities.

**Presentations**

***Belinda Bramley, Associate, NLAI***

The rising concerns over plastic pollution, overfishing, and climate change underscore the need for holistic solutions. While significant initiatives like the Global Ocean Alliance and the High-Level Panel for a Sustainable Ocean Economy are making strides, challenges remain. Nature-based solutions such as seagrass restoration, regenerative ocean farming, and keystone species protection offer promising ways to mitigate ocean health issues. These solutions not only address pollution but also enhance carbon sequestration, nutrient cycling, and ecosystem resilience. By valuing and integrating natural capital into our economy, we can foster sustainable and regenerative practices that benefit both the environment and human communities.

***Sietse A. Agema, CTO, Amsterdam Waste Environmental Consultancy & Technology (AWECT)***

AWECT's focus is on reducing landfill methane emissions, which are highly potent greenhouse gases. They aim to replace uncontrolled landfills with efficient waste-to-energy systems that not only recover energy from non-recyclable materials but also ensure minimal environmental impact. This technology is designed to phase out unmanaged landfills and prevent waste from contaminating oceans through better waste management practices and stringent emission controls.

AWECT's advanced waste-to-energy plants in Amsterdam employ dry and wet systems to maintain emissions well below European regulations. They also focus on recycling and recovering materials and plans to include CO2 capture for greenhouse use. By developing eco-ports that integrate waste treatment, recycling, and energy recovery, AWECT creates a circular economy that minimizes waste and environmental harm. Effective policies and financing from institutions are crucial in supporting these clean technologies and ensuring that waste management practices contribute to a healthier environment rather than exacerbating pollution.

***Scott Countryman, Executive Director, Coral Triangle Conservancy***

Mr. Scott Countryman highlighted their NGO's decade-long efforts in coral reef restoration in the Philippines, emphasizing the importance of engaging local communities and developing effective restoration techniques. The process includes identifying key stakeholders, securing committed funding, conducting environmental surveys, and prioritizing restoration sites. Innovations such as electric mineral accretion and coral nurseries are employed to stabilize reef rubble and accelerate coral growth. Renewable energy is used for field operations and integrates the technology for monitoring reef health and combating illegal fishing activities.

Additionally, the speaker discussed the need for broader strategies to address coral reef degradation amid rising greenhouse gas levels. They proposed creating "Noah's Ark" seed banks for coral, capturing carbon with deep ocean techniques, and monetizing reef restoration through digital services and sustainable practices. The use of artificial reefs and domesticated fish farming were also suggested to support reef regeneration and fish population recovery. These initiatives aim to scale up restoration efforts and align conservation with economic incentives to ensure long-term success.

**Panel discussion**

- The potential of the "rigs to reef" approach, which repurposes decommissioned offshore oil and gas platforms as artificial reefs was discussed. This method has been successful in the Gulf of Mexico and is gaining traction in Asia, particularly in Malaysia and Thailand. The cost savings associated with reefing platforms—about $22 million per platform in the Asia-Pacific region—make it an attractive option for both environmental and economic benefits. However, differences in regulations and ownership structures between the US and Asia may pose challenges.
- The historical context and future potential of growing marine life and sustainable materials through offshore energy infrastructure was explained. Using electricity to stimulate calcium carbonate growth on platforms has been a key part of the "rigs to reef" program. This concept is now being explored for offshore wind farms and other renewable energy projects, which could encourage marine growth and provide economic benefits through the production of building materials or energy storage solutions.
- The discussion also touched on the lag of ocean-based renewable energy compared to terrestrial options. This lag was attributed to insufficient governmental commitment and the need for large-scale development to drive down costs. Integrating renewable energy technologies with decommissioned structures could offer new opportunities.

- The panel highlighted the importance of a multidisciplinary approach to waste management and energy transition, including improving small vessel technology and addressing the broader impacts of ocean regeneration efforts.

**Speakers**

- Sietse A. Agema, CTO-AWECT
- Belinda Bramley, NLAI
- Scott Countryman, Founder of Ree.ph
- Dan Millison, Consultant, SDCC-ENE
- Anna Oposa, Consultant Sustainable Blue Oceans, SDCC-ETG
- Stephen Peters, Sr Energy Specialist (Waste to Energy), SDCC-ENE
- Francesco Ricciardi, Safeguards Specialist, SDCC-ETG
- Amber Sparks, Co-Founder of Blue Latitudes Inc.
- Woochong Um, Managing Director General, Asian Development Bank

## Deep Dive Workshop: The Future of Ocean Energy and Hydrogen - Just Transition to a Safer World

**Asia Clean Energy Forum 2022, 14-17 June 2022**
**16 June 2022**

This session on ocean energy and hydrogen was part of the ADB's MARES TA. It focused on achieving a just transition to a sustainable, non-fossil fuel future. It aimed to address the challenges faced by developing countries in moving towards cleaner energy sources, with an emphasis on utilizing ocean resources in a regenerative and sustainable manner. The discussion featured examples of current transitions and explored how to better manage ocean resources to prevent overexploitation. Lead Consultant Rear Admiral (retired) Nick Lambert and Stephen Peters, ADB guided the session, highlighting the need for both sustainability and regeneration in the use of ocean resources.

**Agenda**

| Time (Manila) | Activities |
|---|---|
| 2:00 – 3:30 p.m. | Opening Remarks<br>Moderator: Stephen Peters, Senior Energy Specialist, Asian Development Bank |
| | Presentation on the Future of Ocean and Hydrogen<br>• Orion Energy Hub – Harry Thomson, Future Energy Project Manager<br>• Project Zeeport – Ferhat Acuner, General Manager, Navtek Naval Technologies, Inc |
| | Panel with Q&A<br>Moderator: Nick Lambert, Principal, NLA<br>• Pierre Rousseau, Independent Consultant in Sustainability and Finance<br>• Christine P. Chan, Senior Advisor to the Vice President (Private Sector and PPP), ADB<br>• Alex Rogers, Director of Science at REV Ocean<br>• Dr Monica Verbeek, Executive Director, Seas at Risk |
| | Closing Remarks<br>Karina Barquet, Senior Research Fellow, Stockholm Environment Institute |

**Presentations**

***Harry Thomson, Future Energy Project Manager, Shetland Islands Council***

The Orion Project was launched in April 2020 to transform Shetland into the UK's first green energy island. This initiative involves a strategic partnership among Shetland Islands Council, the Net Zero Technology Center, Highlands and Islands Enterprise, and the University of Strathclyde. The project aims to create a green hydrogen export hub, shift the island from fossil fuel dependency to renewable energy, and support the offshore oil and gas sector's transition to net zero. Shetland's long history with oil and gas, combined with its strong renewable energy potential from wind and tidal power, makes it a prime location for this transition.

The Orion Project will proceed in three stages: starting with a small-scale pilot using onshore wind, scaling up to 100 MW with additional tidal energy, and eventually using offshore wind for large-scale hydrogen production. This plan also includes repurposing existing industrial sites and collaborating with local industries to ensure a just transition. The Shetland Islands Regional Marine Plan is key to managing the environmental impacts and ensuring that new renewable projects coexist with existing marine activities. The project is set to position Shetland as a leader in green hydrogen production while maintaining a healthy marine environment.

**Q&A**

- The Orion Project is commendable for its regenerative and just transition goals, highlighting its potential to address fuel poverty in Shetland while leveraging the region's oil and gas legacy. The project's success hinges on securing substantial investment to transition from fossil fuels to hydrogen.
- While initial funding has been secured, significant financial backing is needed for full-scale development, and efforts are focused on attracting developers to invest in Shetland's green energy infrastructure.
- In response to inquiries, it was noted that the oil and gas sector, historically slow to embrace renewables, has recently shown a strong shift towards decarbonization. This change is pivotal for Shetland, as collaboration with oil and gas companies could prolong the operation of existing facilities and support the transition to renewables.

***Fehat Acuner, General Manager, Navtek Naval Technologies, Inc.***

The pioneering zero-emission electric tugboat, the ZEETUG, has been operational for two years and has exceeded expectations in operational savings. ZEETUG can reduce fuel costs by 50% and maintenance by 80% compared to traditional tugboats. Navtek has also developed a quick-charge station for the ZEETUG and is expanding its range of zero-emission boats, including larger models and charging infrastructure.

Navtek is now focusing on creating zero-emission ports, known as ZEEPORT, which will integrate renewable energy sources like wind and solar, and include energy storage solutions. These ports will also support future electric and hydrogen-powered ships. Farhat outlined that transitioning to such ports is financially viable, with a sample project showing promising returns on investment and

significant reductions in carbon emissions. This approach, while starting with smaller ports, demonstrates the feasibility of widespread adoption for greener maritime operations.

**Q&A**

- There is a growing demand for zero-emission port solutions, which stemmed from the success of ZEETUG tugboat. Clients, including island nations, are increasingly interested in adopting such technologies despite the higher initial costs. This demand is driven by environmental considerations and international pressures to reduce carbon emissions. As a result, there is a noticeable shift towards integrating zero-emission infrastructure in ports.
- Navtek is exploring various financial avenues to support these initiatives. They highlight the availability of funding, particularly from European Union sources and green shipping finance programs, which can aid in financing medium-sized and smaller projects. The financial support is expected to be more accessible for projects of a manageable scale, although larger investments may still face challenges.
- The feasibility study for zero-emission ports shows promising results, with calculations indicating that the costs are reasonable and the potential savings substantial. Farhat emphasized that while initial costs might seem high, technological advancements and potential government subsidies could further enhance the economic viability of such projects. He asserted that the calculations are based on current industrial rates and could improve with future developments and incentives.

**Panel Discussion**

- Gürdoğar Sarigül, a marine conservation expert from Navtek Naval Technologies, Inc. emphasized on the importance of incorporating community feedback and environmental considerations in projects like Orion. He stressed the urgent need to address the mismanagement of our seas and oceans, which has caused severe declines in biodiversity and ecological health. Gürdoğar called for international cooperation and an ecosystem-based approach to tackle these challenges, advocating for the integration of technological advancements, such as the ZEETUG project, with sustainable development practices to ensure a healthier planet and more effective protection of both marine and terrestrial environments.
- Alex Rogers, REV Ocean discussed the critical need for comprehensive environmental baseline data to understand the state of our oceans and marine biodiversity. Despite estimating around two million ocean species, only about ten percent are described, and many ecosystems remain poorly understood. He stressed that projects like Orion and ZEEPORT should prioritize data collection to inform sustainable development and prevent environmental harm. Alex advocated for strategic environmental assessments and suggested that maritime industries should contribute their data to enhance global knowledge and support broader sustainability efforts.
- In the discussion, Pierre Rousseau highlighted the importance of consortiums in financing sustainability and marine biodiversity projects. He explained that successful projects, like the restoration of a polluted lake, require collaboration among scientists, businesses, and communities. To achieve this, a blend of public and private financing is essential. Current financial systems struggle to support such long-term, high-risk projects, so he advocated

for creating blended finance mechanisms, including venture capital, equity, and debt, to manage and de-risk investments. Pierre emphasized the need for a coordinated platform to integrate various funding sources and support impactful, scalable projects.

- Christine Chan, ADB explained that the ADB is crucial in advancing regenerative and just transition approaches within the blue economy. ADB is actively working to reduce financial risks and demonstrate feasibility to attract major corporate investments. Initiatives include the Blue Southeast Asia Financing Hub, which supports innovative financing and de-risking projects, and the Blue Bond Incubator, which aims to scale up investments in ocean technologies. Christine highlighted ongoing projects, such as a solar initiative in the Maldives and support for small and medium-sized enterprises (SMEs) in eco-tourism, as examples of ADB's role in both upstream project development and blended financing. She also emphasized the importance of regional cooperation and supply chain development to reduce costs and enhance project scalability.

Speakers

- Ferhat Acuner, General Manager, Navtek Naval Technologies, Inc.
- Karina Barquet, Senior Research Fellow, Stockholm Environment Institute
- Christine P. Chan, Senior Advisor to the Vice President (Private Sector and PPP), ADB
- Nick Lambert, Principal, NLAI
- Stephen Peters, Senior Energy Specialist, ADB
- Alex Rogers, Director of Science at REV Ocean
- Pierre Rousseau, Independent Consultant in Sustainability and Finance
- Gürdoğar Sarigül, Senior Expert on Climate Change, Sustainable Development and Maritime Decarbonisation, Navtek Naval Technologies, Inc.
- Harry Thomson, Future Energy Project Manager
- Dr Monica Verbeek, Executive Director, Seas at Risk

## Using Marine Renewable Energy for Just Transition to a Regenerative Blue Economy

**Healthy Oceans Tech and Finance Forum, 26-28 January 2022**
**27 January 2022**

This session discussed the use of marine renewable energy for a just transition to a regenerative blue economy. It highlighted the importance of displacing fossil fuels and enhancing regenerative processes in the ocean to sustain life and reverse carbon emissions. The session featured experts from various organizations, including UNESCO, who explain the impacts of ocean acidification and the need for coordinated global efforts to address it. The webinar also emphasized the role of local actions in achieving global goals and the necessity of long-term support and investment in research and development to enhance observing capabilities and data generation.

**Agenda**

| **S**ession/Activity | **P**resentation/Speakers |
|---|---|
| Introduction | Welcome and Introduction from Moderator<br>Stephen Peters, Senior Energy Specialist (Waste to Energy), Energy Sector Advisory Group, SDCC, ADB |
| Scene Setter | Recorded Remarks |
| Presentation 1 | Ocean Acidification – the threat and its status<br>Kirsten Iseensee, Programme Specialist Ocean Carbon bei Intergovernmental Oceanographic Commission of UNESCO |
| Presentation 2 | The New Ocean Economy<br>Rear Admiral Nick Lambert, Founder, Nick Lambert International |
| Presentation 3 | Floating Solar and Use Cases in the Pacific<br>Agostinho Miguel Garcia, Consultant from the Pacific Floating Solar |
| Panel Discussion | Lending opportunities to ADB DMCs and Private Sector Participants to respond to these challenges and opportunities<br>• Cindy Cisneros, Tiangco, Principal Energy Specialist, PAEN<br>• Alix Burrell, Principal Investment Specialist, PSIF2<br>• Gary Krishnan, Senior Country Specialist, SERC |
| Questions and Answers | Stephen Peters, ADB |
| Closing Remarks | |

**Presentations**

***Kirsten Iseensee, Programme Specialist Ocean Carbon bei Intergovernmental Oceanographic Commission of UNESCO***

Ocean acidification occurs when CO2 from the atmosphere dissolves into seawater, altering its chemistry by lowering pH and reducing carbonate ion levels. As CO2 levels rise, this process causes ocean water to become more acidic, with current acidity increasing by 30% since pre-industrial times. Projections for 2100 suggest a further 100-150% increase in acidity, leading to a 50% reduction in carbonate ions. These chemical changes have significant impacts on marine ecosystems, including coral reef erosion, shifts in biodiversity, and harmful algal blooms.

The Global Ocean Acidification Observing Network (GOA-ON) was established to address these challenges by improving our understanding of ocean acidification's global and local effects. The network aims to enhance data collection, predict future acidification impacts, and develop mitigation strategies. With over 900 scientists in 105 countries, GOA-ON focuses on regional and global observations to inform policy and improve resilience against ocean acidification. Future efforts will involve expanding partnerships, securing long-term support, and integrating scientific findings into effective policies and practices.

***Rear Admiral Nick Lambert, Founder, NLAI***

The speaker tackled the urgent need to address ocean health and highlighted the importance of local actions in mitigating global issues such as ocean acidification. Long-term, sustainable programs are critical to tackle these issues effectively.

The potential of the blue economy should be integrated with sustainable practices across marine industries to generate socioeconomic benefits while preserving ocean ecosystems. It was stressed that technological advancements, such as satellite data and modern GIS, have improved our understanding of ocean health but also highlighted the need for better data collection and policy implementation. He emphasized the importance of creating regenerative business models to replace unsustainable practices and advocate for a holistic approach to marine resource management.

The speaker discussed various aspects of the blue economy, including the value of marine resources, the potential for economic growth in ocean-based industries, and the need for investment in environmentally sound technologies. He described initiatives like the MARES project, which aims to combine renewable energy with marine aquaculture and other sustainable practices. The importance of long-term planning, starting with zero-carbon electricity and expanding to broader economic and environmental goals, was underscored. The speaker concluded by highlighting ongoing efforts and the need for continued investment and strategic implementation to ensure the sustainability of ocean resources.

***Agostinho Miguel Garcia, Consultant from the Pacific Floating Solar***

The presentation discussed that leveraging floating solar photovoltaics (FPV) is not only for generating electricity but also for socio-economic development in the Pacific Island countries. These islands face significant challenges such as rising sea levels and reef vulnerability, which impact their ecosystems and economic activities. The proposed approach aims to integrate FPV with other sectors like aquaculture and aquaponics, potentially reducing water loss and enhancing food production, while supporting energy needs for desalination and circular economies.

The presentation highlighted several benefits of FPV, including its potential to power desalination plants, contribute to circular economies, and facilitate green hydrogen production. It also explored the use of FPV for mobility solutions, such as e-bikes and e-boats, which could support local transport needs. Overall, the plan is to create sustainable, local economic opportunities and improve resilience against environmental challenges by incorporating FPV into various aspects of life and industry in the Pacific Island nations.

**Panel discussion**

- The focus was on the advancement and financing of marine energy projects, particularly the challenges and opportunities associated with new technologies. Alix Burrell, ADB highlighted the need for affordable, long-term financing to make these projects viable. She explained that while banks are cautious about financing new technologies due to perceived risks and high costs, the ADB is actively working on pilot projects and using credit enhancement tools to mitigate these risks. An example provided was ADB's Pacific Renewable Energy Program, which supports small projects by backing off-take payment obligations and attracting other lenders.
- Cindy Cisneros-Tiangco, ADB emphasized the importance of addressing the Pacific region's climate vulnerabilities through integrated, nature-based solutions. She outlined how the ADB is focusing on cross-sectoral approaches that combine green technologies with established methods to tackle climate, energy, and infrastructure challenges. Cindy highlighted the potential of integrating productive uses of energy, such as aquaculture and vertical farming, with floating solar PV structures. This approach aims to make projects more attractive to private investors by creating additional revenue streams.
- Gary Krishnan, ADB noted the progress being made at both regional and national levels, mentioning specific initiatives like Thailand and Malaysia's guidelines for converting decommissioned rigs into reefs and Malaysia's green city action plans. He expressed optimism about the growing adoption of circular economy principles and green infrastructure. Gary also pointed out that even generic technical assistance (TA) projects are showing promising developments, contributing to a broader shift towards sustainable practices.
- The conversation shifted to the potential of marine energy to meet global electricity demands and the challenges of scaling up pilot projects. Alix stressed that successful pilot projects can attract further investment, creating a cascading effect that encourages more

banks to participate. Cindy and Gary echoed the need for collaboration, agility, and integrated solutions to address complex environmental and financial issues.

- Finally, the discussion addressed specific questions on floating solar technology, including its environmental impact and scalability. Agostinho explained that while operational and maintenance costs for floating solar PV are relatively low, the main challenge lies in training and capacity building for local communities. He also provided insights into the scale of floating PV projects planned for different countries and addressed concerns about the environmental impact of shadowing on marine ecosystems, emphasizing that floating PV structures are designed to minimize such impacts.

**Speakers**

- Alix Burrell, Principal Investment Specialist, PSIF2, ADB
- Gary Krishnan, Senior Country Specialist, Regional Cooperation and Cooperation Integration Unit (SERC)
- Agostinho Miguel Garcia, Consultant from the Pacific Floating Solar
- Kirsten Iseensee, Programme Specialist Ocean Carbon bei Intergovernmental Oceanographic Commission, UNESCO
- Stephen Peters, Senior Energy Specialist (Waste to Energy), Energy Sector Advisory Group, Sustainable Development and Climate Change Department, ADB
- Cindy Cisneros-Tiangco, Principal Energy Specialist, Pacific Energy Division, ADB