



# EAS CONGRESS 2018

THE EAST ASIAN SEAS CONGRESS

# 25 Years of Partnerships for Healthy Oceans, People and Economies

Moving as One with the Global Ocean Agenda

**27-30 November 2018** • **Iloilo Convention Center, Philippines**



**TRACK 6: OCEAN INDUSTRY AND FINANCE**

## SESSION 6.4

# Ocean Energy - The Future of Blue Economy

**CONVENERS:**



Korea Institute of Ocean  
Science and Technology



Partnerships in Environmental  
Management for the Seas of  
East Asia

**COLLABORATOR:**



First Institute of  
Oceanography of China



# Table of Contents

INTRODUCTION ..... 1

PROGRAM ..... 2

KEYNOTE MESSAGE..... 3

CONGRATULATORY REMARKS ..... 4

SUMMARY OF THE WORKSHOP..... 5

**I. INTRODUCTION** ..... 5

**II. KEYNOTE MESSAGES** ..... 5

**III. PRESENTATIONS** ..... 6

**IV. PANEL DISCUSSION** ..... 9

**V. OPEN FORUM**..... 10

**VI. CONCLUSIONS AND RECOMMENDATIONS**..... 11

## **INTRODUCTION**

Ocean is the biggest carbon sink of the earth system which sequester more than 2 billion metric ton per year or one third of anthropogenic carbon generation. Ocean possesses not only the sequestering potential but also the power to produce renewable energies which ultimately contribute to the reduction of fossil fuel consumption. Owing to its enormous potent energy through tide, wave, heat and others, the oceans provide numerous opportunities for energy sources which fuel necessary economic development in the era of climate change afflicted global community.

The status of ocean energy development is in its nascent stage. Research efforts have been devoted to the development of key technological components with certain degree of successes. However, there are myriad of works need to be done before ocean energy can be mainstreamed into the power sector. Barriers such as non-supportive government policies and resistance to clean and renewable energy sources by the Business As Usual (BAU) energy sectors make ocean energy development sluggish.

In this workshop, the success stories of the ocean energy development as well as up to date government policies will be presented in support of the ocean energy development around the globe. The case studies in the East Asian Seas region will be highlighted. The roles and contributions of ocean energy in the Blue Economy will also be delved into.

### **Objectives:**

- Sharing the research efforts on the development of ocean energy of the countries
- Laws, policies and programs on ocean energy in the EAS region
- Discuss on possible incentives to foster the development of the ocean energy as one of the sectors of the Blue Economy.

### **Co-convenors:**

- Korea Institute of Ocean Science and Technology (KIOST), RO Korea
- PEMSEA

### **Collaborator:**

- First Institute of Oceanography (FIO), China

### **Desired Outcome:**

- Joint research efforts and policy reform on ocean energy in the EAS region

## PROGRAM

Chair: Prof. Raphael P.M. Lotilla, University of the Philippines

<b>Time</b>	<b>Agenda</b>
13:30-13:40	Opening <ul style="list-style-type: none"><li>- Keynote Message, Dr. Kim Woong Seo, President, KIOST</li><li>- Congratulatory Remarks, Ms. Aimee Gonzales, Executive Director, PEMSEA</li></ul>
13:40-13:55	Past, Present and the Future of Ocean Energy as one of the promising sector of Blue Economy <ul style="list-style-type: none"><li>- Dr. Lee Kwang-Soo, KIOST, RO Korea</li></ul>
13:55-14:10	State of the Art Development of Ocean Energy in China <ul style="list-style-type: none"><li>- Dr. Liu Weimin, First Institute of Oceanography, China</li></ul>
14:10-14:25	Development of Ocean Energy in the Philippines <ul style="list-style-type: none"><li>- Dr. Michael Lochinvar Abundo, Ocean Pixel Philippines</li></ul>
14:25-14:40	Indonesian Road Map to Marine Energy: status and prospective <ul style="list-style-type: none"><li>- Dr. Erwandi, Agency for the Assessment and Application of Technology, Indonesia</li></ul>
14:40-14:55	'KRISO's plan for ocean energy utilization to achieve SDGs in Pacific/Asian coastal areas <ul style="list-style-type: none"><li>- Dr. Kim Hyeon-Ju, KRISO, KIOST, RO Korea</li></ul>
14:55-15:25	Panel Discussion Topics: <ul style="list-style-type: none"><li>- Recent success stories in ocean energy development</li><li>- Contribution of ocean energy in carbon sequestration</li><li>- Policy reform for fostering ocean energy development</li></ul> Moderator: Dr. Won-Tae Shin, PEMSEA  Panelist: <ul style="list-style-type: none"><li>- Dr. Keita Furukawa, OPRI, Japan</li><li>- Mr. Raphael Dorilag, Ocean Pixel, Philippines</li></ul>
15:25-15:30	Wrap-up and Closing <ul style="list-style-type: none"><li>- Prof. Raphael PM Lotilla, University of the Philippines</li></ul>

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## **KEYNOTE MESSAGE**

**By President Dr. Kim Woong-Seo, KIOST**

Honorable Ms. Aimee Gonzales, PEMSEA Executive Director, Mr. Raphael PM Lotilla, former PEMSEA Executive Director, and Distinguished guests and participants today, good afternoon.

My name is Woongseo Kim. It is my privilege and pleasure to welcome you here in the “Partnership Hub KIOST Ocean Energy Session” on behalf of KIOST. We are delighted to be able to welcome you as part of the EAS Congress 2018 held here in Iloilo, Philippines. Thank you all for coming and joining us here today.

The theme of this year’s EAS Congress is “25 Years of Partnerships for Healthy Oceans, People and Economies: Moving as One with the Global Ocean Agenda.” We hope that the Ocean Energy Session we have prepared will provide an opportunity for redoubling the solidarity of the East Asian region in line with this theme.

Among components of the earth’s system, oceans play the most important role in climate regulation through carbon cycle adjustment. Oceans are also closely linked to human society, with over three billion people depending on oceans for their livelihoods. Keenly aware of this importance of oceans, humans have endeavored to derive economic benefit from oceans in a sustainable way, going beyond just consuming marine resources.

The focus of this session is on sharing national-level ocean-related laws, policies, and programs besides relevant research findings. So we have invited experts in these fields from Korea, Japan, China, Indonesia, and the Philippines. The experts’ presentations will be followed by discussions about the benefits of ocean energy development as part of Blue Economy.

It is our earnest hope that the presentations and discussions in today’s session will be reflected in future ocean energy policies towards sustainable Blue Economy, ultimately contributing to the sustainable use and development of oceans on a global scale.

Thank you!

## **CONGRATULATORY REMARKS**

**By Ms. Aimee Gonzales, Executive Director, PEMSEA**

Dr. Kim Woong Seo, President of the Korea Institute of Ocean Science and Technology, Prof. Raphael Lotilla, former Secretary of the Department of Energy and the former Executive Director of PEMSEA, speakers and panelists, ladies and gentlemen, good morning.

First and foremost, I would like to congratulate KIOST for convening this important workshop through inviting many renowned experts from EAS (East Asian Seas) region and beyond.

As you may realize, climate change is affecting our daily lives. And the global community is searching for various options and solutions to avoid the worst-case scenarios of climate change. It seems that chances are quite slim to prevent the likely course of the severe impacts. We will need to soon come up with innovative and alternative solutions for mitigating emissions of the global green house gases in order to minimize its imminent adverse impacts.

To me, developing ocean energy is one huge solution for the battle against climate change. Our ocean is not only regulating global climate system, but also sequestering more than 70% of carbon in the atmosphere. As we may hear during this workshop, we see huge potential of reducing global emission by sourcing our energy needs from the oceans. For example, Philippines is already demonstrating electricity production through ocean current. As an archipelago country, we see a big potential of ocean current energy development in the Philippines.

However, ocean energy sector is in its nascent state. There should be significant research and development efforts as well as investment devoted for Ocean Energy to take into reality. In this sense, this workshop on Ocean Energy is timely and important. As a leading institute for ocean energy development, KIOST is a proper PEMSEA non-country partner to lead the discussion under the framework of SDS-SEA. Taking the opportunity of this workshop, I hope PEMSEA partners will continue to dialogue to develop ocean energy solutions in support of the global fight against climate change.

I wish to convey our sincere appreciation to the organizer, KIOST, and collaborating agency, FIO, for their funding support for the workshop and wish to have fruitful and constructive discussions throughout the workshop. And don't forget to enjoy and explore the wonderful and beautiful city of Iloilo. I hope your pleasant stay in the Philippines during the EAS Congress 2018.

Thank you very much.

## **SUMMARY OF WORKSHOP**

### **TRACK 6: OCEAN INDUSTRY AND FINANCE**

#### **SESSION 6.4: OCEAN ENERGY - THE FUTURE OF BLUE ECONOMY**

Chair : Prof. Raphael P.M. Lotilla, University of the Philippines

Moderator : Dr. Won-Tae Shin, PEMSEA

#### **I. INTRODUCTION**

The session was chaired by former Secretary of Energy of the Philippines and former Executive Director of PEMSEA, Prof. Raphael P.M. Lotilla. He stated that the session would be a venue for exchange of data and information and to share progress in relation to ocean energy development. He introduced that from 2000 to 2016, the global community has seen an increase in the access of population to electricity from 78 to 87 per cent. However, the renewable energy has been limited only 17.5% of the total energy supply in 2015. In this sense, he stated that significant opportunities exist for ocean renewable energy to play role in the energy sector. The session is expected to indicate the next steps to be taken in order to address the needs of Asia and the world specifically for Sustainable Development Goal 7: Affordable and Clean Energy.

#### **II. KEYNOTE MESSAGES**

The President of Korea Institute of Ocean Science and Technology (KIOST), Dr. Kim Woong Seo gladly welcomes all the participants for the session. He introduced the main goal of the session as recognizing the important role of ocean as a new source of renewable energy aside from climate regulation and carbon cycle. He suggested that about 3 billion people rely on ocean for livelihood aside from its economic benefit and that ocean is also a suitable source of energy development. He hoped that the session would serve as a venue for sharing information related to laws, policies, programs and research findings for future ocean energy policies towards sustainable blue economy and ultimately for a sustainable use and development ocean in a global scale.

Ms. Aimee Gonzales, Executive Director of PEMSEA, gave the congratulatory remarks. She highlighted the ceaseless impact of climate change to the environment and to the lives of people around the world. She said that ocean energy is one possible solution in order to combat

climate change as ocean does not only regulate global climate system but is also sequestering 70% of the carbon from the atmosphere. However, she added that more research and development programs are needed to have fully understand the effects and balance between technological aspects and adaptation to socio-cultural needs of ocean energy. There is a need for significant investment to explore and harness the ocean energy sources. Ms. Gonzales emphasized that the session would be a great opportunity for PEMSEA partners to deepen the dialogue in developing ocean energy solutions and sharing experiences and best practices in support in the global fight against climate change beyond the Congress.

### **III. PRESENTATIONS**

#### **Past, Present and the Future of Ocean Energy as one of the promising sector of Blue Economy**

By Dr. Lee Kwang-Soo, KIOST, RO Korea

Dr. Lee Kwang-Soo, KIOST, RO Korea, presented his research outputs entitled “Past, Present and the Future of Ocean Energy as one of the promising sectors of Blue Economy”. He introduced the energy supply situation of RO Korea to which renewable energy covers about 6% of total energy supply and ocean energy only covers only 1.6% of total renewable energy. Dr. Lee showed that to strengthen the renewable energy supply by 2030, the RO Korean government has set out a strategic plan “2030 Plan for Renewable Energy” under the Moon administration which envisions covering 20% of total energy supply (about 76 gigawatts (GW) through renewable energy sources among which ocean energy would cover 1.5 GW by 2030. The plan was designed to produce 1.5GW from ocean energy, mainly from tidal wave (254 megawatts (MW), tidal wind (220MW), hybrid (wave and wind, 300MW), and tidal current (700MW). It may seem as an ambitious plan for Korea but in order to achieve this goal, Dr. Lee said that RO Korea will need to carry out pilot and feasibility studies that are both economically and environmentally sound.

Dr. Lee then introduced the use of tidal power and highlighted as one of their best and active technology, the Shihwa lake Tidal Power Plant which was built in 2011 and one of the world’s largest tidal power installations. He indicated that the project has been beneficial to some extent in terms of improved ecology and reduced environmental impacts such as improved water quality, increase in species diversity index and reduced CO2 emission. Dr. Lee then moved onto the “Tidal Energy” generation which has significant potential along the Korean waters and ready to be a commercialized technology. He demonstrated the 10MW tidal energy pilot array with economic feasibility study results and comparison with other technologies. Dr. Lee concluded that the tidal current energy would be feasible by 2025 and that ocean energy development policies should be enhanced in order to expedite the development of the ocean



energy technologies. He added that further research efforts should be continued in addition to the development of guidelines for environmental monitoring and impact assessment.

### **State of the Art Development of Ocean Energy in China**

By Dr. Liu Weimin, First Institute of Oceanography, China

Dr. Liu Weimin, First Institute of Oceanography, introduced the recent development of the ocean energy technologies in China in two aspects: i) policies and ii) standards. In terms of ocean energy policies, Dr. Liu mentioned that China has established the renewable energy law in 2010 and special funds for renewable energy is available. He introduced the 13<sup>th</sup> Five-year Plan on Marine Renewable Energy Development (2016) which has 4 specific targets including the installation of one 10MW tidal power station and two demonstration bases in Zhoushan and Wanshan. He stated that public funding opportunities for marine renewable energy are available from the Ministry of Finance, the State Oceanic Administration (SOA) and the Ministry of Science and Technology (MOST) where more than 110 projects were funded with US\$200M investment during 2010 to 2018. He added that market incentives are also available but no specific funds for ocean energy has yet been developed. Dr. Liu then moved on to introduction of the three demonstration sites of ocean energy, namely: wave and tidal current site, a full scale tidal current and full scale wave energy site.

The other aspect of the ocean energy development in China was the standard system design. Dr. Liu showed that 9 national standards and 9 industrial standards have been approved by 2018 with more standards are under development. He expected that future development of ocean energy in China will be a four-pronged approach: i) demonstration in large scale; ii) advanced technology development; iii) development of ocean energy policies and incentives; and iv) optimization for industrialization of the technologies. These future directions are under testing at the Wanshan Wave Energy demonstration base and the Zhoushan Tidal Current Energy demonstration base.

### **Development of Ocean Energy in the Philippines**

By Dr. Michael Lochinvar Abundo, OceanPixel Pte Ltd, Singapore

Dr. Michael Lochinvar Abundo, Managing Director from OceanPixel, presented the topic on Marine Renewable Energy: Enabling Green Marine and Maritime Ecosystems towards a Sustainable Blue Economy. He introduced his company, OceanPixel as a start up company from the spun off from the Nanyang Technological University, for developing and implementing Marine Renewable Energy (MRE) projects in Singapore, Indonesia and the Philippines. He showed that the level of maturity in marine renewable energy technology is of the following order: i) tidal range being the most mature, ii) followed by tidal stream, iii) wave energy

converters, iv) ocean thermal energy conversion (OTEC), v) deep ocean current and salinity gradient being the least developed. He added that marine floating solar and offshore wind energy sources are also matured.

Dr. Abundo then showed some examples of actual application of marine renewable energy plants around the globe including Indonesia and Philippines. He elaborated some considerations of the MRE technology applications including configuration options, site selections and hybridization of technologies. Dr. Abundo concluded that MRE is fast developing with several potential benefits aside from the generated electricity and that market supports may accelerate the progress. He added that MRE options need to be carefully selected depending on the pilot studies and site-specific designs and that MRE can be the lower hanging fruits with various applications such as transportation, aquaculture, food and water. He mentioned that progressive development approach toward a blue economy needs to be taken considering capability development, pilot projects implementation, hybrid system application and leveraging marine/maritime ecosystem of the countries.

### **Indonesian Road Map to Marine Energy: status and prospective**

By Dr. Erwandi, Agency for the Assessment and Application of Technology, Indonesia

Dr. Erwandi stated that Indonesia, being the largest archipelago country in the world, has the policy that islands should utilize the local energy sources including the ocean energy sources since the cost of connecting national energy grid to the remote islands are becoming the main problem in supplying energy. He introduced some of the major works of his institute the Badan Pengkajian dan Penerapan Teknologi/Agency for the Assessment and Application of Technology (BPPT) in ocean energy development at various locations in the country. He stated that marine current energy is the main source of hydro-kinetic energy in Indonesia and BPPT has been developing Marine Current and Wave (ORE) energy technology. He showed that BPPT has identified two ORE sites in Baron, Yogyakarta (wave rider buoy) and Larantuka (tidal gauge system) where the two sites have been tested for actual application of the developed technologies and produced significant outputs through the research conducted. Dr. Erwandi showed that these two sites also have tested the prototype pilot plants with valuable data and experience achieved.

Dr. Erwandi then showed the case study results conducted through the support of UNIDO in 2008, the project entitled “ENERMAR” which employed the concept of tidal bridge in East Rombok Island. He mentioned that the project output has become the “monument” since the power generation unit has not been deployed to the site due to the lack of transportation means. Through the experience, Dr. Erwandi recommended that development of ocean energy

should consider long term goals which take into consideration the maritime cluster industries around the project site and short term goals which take into consideration the available means relevant to the project such as transport, erection as well as maintenance requirements.

### **'KRISO's plan for ocean energy utilization to achieve SDGs in Pacific/Asian coastal areas**

By Dr. Kim Hyeon-Ju, KRISO, KIOST, RO Korea

Dr. Kim Hyeon-Ju presented the current research efforts and future direction of ocean energy within the KRISO, a subsidiary research Institute of KIOST. He showed that KRISO's main research efforts on ocean energy include four areas: i) wave energy converter; ii) OTEC; iii) tidal current energy converter; and iv) floating offshore wind turbines (FOWT) and hybrid system. Dr. Kim showed various applications of the ocean energy sources to real life utilization including food through aquaponics, water through desalination and electricity. Among them, he focused on the development of OTEC and its applications at pilot sites in RO Korea where 1MW production unit has been installed.

Dr. Kim mentioned that KRISO's research efforts have generated government's attention and culminated in some international collaboration projects within the country. He showed results of capacity building and activities conducted in Kiribati during 2016 and 2018 for OTEC development. He stressed that ocean energy and seawater utilization can be an effective means of achieving SDG in the Pacific and Asian countries. He requested research communities to expedite the development process and applications of ocean energy in East Asian countries and urged collaboration of researchers for sharing of research outputs.

#### **IV. PANEL DISCUSSION**

A panel discussion was moderated by Dr. Won-Tae Shin, PEMSEA, with the following panelists: Dr. Keita Furukawa, OPRI, Japan and Mr. Raphael Dorilag, OceanPixel, Philippines. Dr. Shin stated that the application of ocean energy in real life has been a challenge in the East Asian countries and requested the panelists to elaborate their views on that aspect.

Dr. Keita Furukawa showed various benefits of ocean energy development for achieving sustainable development goals in respect to the blue economy. He stated that Ocean Thermal Energy Conversion (OTEC) has been already utilized in aquaculture in Okinawa for shrimp culture. He added that Okinawa example demonstrates clear application of ocean energy to Blue Economy through infrastructure development, industrial application, service sector and sustainable society. He concluded that OTEC has a sure potential which should be pursued further.

In the context of a developing country like the Philippines, Mr. Raphael Dorilag, OceanPixel, Philippines, said that ocean thermal energy is one of the options being considered and that the country is now ready to install and invest in such technology to produce renewable energy source. The Philippines has great potential for ocean thermal energy conversion given that it has high ocean surface temperature and up to thousand meters deep ocean trenches. In the global context, however, Mr. Dorilag said that it has not gone really into the commercial scheme as a result of the delay in the progress and that there is very little development and support for ocean energy technology. He mentioned that although OTEC can generate electricity on a large scale, but there is not enough market support for this kind of technology due to lack of economic setup to compensate the cost. He suggested that this bottleneck should be addressed in order to get the ocean energy technology be applicable in potential sites.

Mr. Dorilag mentioned that the ocean energy development should not be on a large scale at this point in time. He reasoned that the regulators do not have enough basis for the computation of costs for large scale ocean energy development and that there is still a need to do piloting and demonstration in this kind of technology that would work in the local settings in the South East Asian Region.

## **V. OPEN FORUM**

The floor was opened for questions and comments from the participants. The Session Chair, Prof. Lotilla requested the presenters and the panelists to share their thoughts as to where all the efforts and initiatives can be converged so that everyone can comprehend ocean energy issues and development in the East Asian context.

Dr. Lee of KIOST answered that as far as the tidal energy is concerned, although we could get some benefits from the ocean energy in some economical point of view, it is largely ambiguous to start up in a large-scale tidal energy plant. He suggested that Indonesian ocean engineers could start up with small scale or small tidal range generations where it could be more advantageous for some small islands as an energy supply system. He added that it is also necessary to consider the economical-social conditions in order to figure out the best energy combination for each site.

Mr. Dorilag responded that at this moment we still cannot compete with fossil fuel energy due to lack of economic scale, innovations and reliability in the technology. He added that it is important to provide market opportunities for ocean energy technologies which are struggling to enter into the grid connected renewables.

Dr. Abundo shared his experience in the last symposium that he attended in Australia wherein they have established an Australian Ocean Energy Marine Energy Task Force which acts as a body and coordinating hub that can build a triple helix approach of academe, government and industry working together. He said that it can be replicated in an East Asian setting so that we do not have scattered efforts but rather a collective effort in order to come up with a very strategic or coordinated plan.

Dr. Erwandi added that it would be a good opportunity especially for PEMSEA to strengthen the development of ocean renewable energy. He proposed that PEMSEA could become a “coordinator” for the development of ocean energy technology in the region. As for the Indonesia’s context, he said that he will give a strong recommendation to the government to support ocean energy for infrastructure and supporting facilities to enable the full potential of ocean energy in the country especially in the eastern part of Indonesia.

Dr. Angelica Baylon from Academy of Asia in the Pacific, stated that there are 6 sources of energy sources in the Philippines with an acronym BiG SHOW, which stands for Bi - biomass, G - geothermal, S - solar, H - hydrothermal, O - ocean and W - wind. She added that ocean energy is rather costly now but through project partners encouraging foreign investors to invest in the Philippines considering the geographical location of the country, she sees ocean energy sector as promising, but she expressed her disappointment of having very few projects on ocean energy. She suggested that there is a great potential for sources of energy in ocean, in particular in the developing country like the Philippines.

## **VI. CONCLUSIONS AND RECOMMENDATIONS**

Prof. Lotilla summarized the workshop presentations, panel discussions and questions and answers from the open forum to come up with the following conclusions and recommendations which were presented to the Ministers of the PEMSEA countries during the Closing Ceremony:

### **Conclusions**

1. Global community demands more energy from various sources to support the ever growing economy.
2. EAS countries are currently developing ocean energy sources such as tidal, current, wave, ocean thermal gradient, salinity gradient and others, as an alternative energy sources to meet the energy demand.

3. Since ocean energy sector is still in the development stage, more efforts should be devoted to commercialize the technologies.
4. Consideration of local setting and scales of development (large and small) should be optimized in order to make ocean energy marketable.
5. Collaboration between countries in developing ocean energy technologies is important.

## **Recommendations**

1. Countries should expedite the development of ocean energy sources in order to combat climate change through strong policy and legal foundation as well as efficient coordinating mechanism in place within the country.
2. Developed countries are requested to share the experiences and technologies with developing countries where resources and capacity for developing ocean energy sources are limited.
3. Inter-ministerial collaboration and integration within a country is necessary to remove hurdles and expedite the development of ocean energy.
4. PEMSEA should play key role in brokering the collaboration on ocean energy technology development between partner countries.

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