Executive Summaries and Recommendations

Seminar 1
Oceans at Risk: Protecting the oceans and marine resources

Nouméa, New Caledonia, November 22-24, 2011

The Pacific Economic Cooperation Council (PECC) commenced its two-year international project by holding the first of a series of three seminars on the protection of marine resources in Nouméa, New Caledonia, on November 22-24, 2011. The seminar brought together academics, scientists, policy-makers, and business executives to discuss and examine the consequences of climate change on oceans; exploitative versus responsible usage of marine resources including food, energy, and goods; treatment of solid and liquid waste in coastal areas; and ways to achieve sustainable biodiversity in and around the oceans. Best practices, empirical studies, and innovative approaches were put forward and discussed at the seminar.

The seminar addressed three main issues:

- What are the consequences of climate change on the economic development of the Pacific Rim region? Perceived and real impacts;
- Protection of the marine environment for sustainable economic development; and
- Mitigating urban and industrial impact on the quality of marine resources and protecting the ocean from pollutions.

Discussions and recommendations presented during the two-day seminar are summarized as follows:

1. Recognize the vulnerabilities exposed by man-made and natural climate changes

At present, as much as 40% of world population lives within 100km from coastlines. Those living closer to the coastline will find themselves in situations more vulnerable to climatic changes and rising sea levels than others. In addition, with the continued trend of urbanization along the coastlines coupled with our growing dependence on resources from the sea, it is evident that there are significant social, political and economic challenges that need to be tackled. In the Pacific Island Countries and Territories (PICTs), for example, increasing populations will put great strains on livelihoods and food security, not to mention habitat degradation occurring due to destructive fishing practices and land-based sources of pollution. Weak governance including subsidies, policies lagging behind science and technology, lack of sustained research and inadequate data pose as main challenges to the situation.[1] Far too often, such challenges are not made obvious from the local levels and by same token, high-level initiatives or policies are often criticized for not fully taking into consideration the local communities' sovereignty or indigenous lifestyle. The European Union works in partnership with local governments and communities within the framework of the EU Global

[1] From "The Role of Regional and Multilateral Regulators in the Management of Shared Fish Stocks," Andrew Wright, Executive Secretary, Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR).

Climate Change Alliance initiative. Approximately 130 Euros have been allocated as a joint initiative for the six-year period of 2008-2013 to address a wide range of climate change impacts.[2]

Climate changes such as rising sea levels, rising water temperature, and ocean acidification have had significant impact on the fish stock and the local economies of the Pacific islands. And while effective adaptation needs to be based on sound understanding of such vulnerabilities, climate change is not the only challenge faced by vulnerable populations; other social, human factors and conditions should not be overlooked. For example, the black pearl industry in the French Polynesia has also been suffering from climate changes and steep losses in productivity since the pearl prices peaked in the mid 1990s.[3] Many of these PICTs need to increase local access to tuna, and develop small-pond aquaculture, put in place integrated coastal zone management, set limits to the harvest of coastal fish stocks, in order to secure adequate food and income in the future.[4]

Although climate change ultimately poses a grave risk to coastal resources, there are many other drivers that threaten the sustainable use of these valuable assets in the shorter term. For Pacific Island countries and other coastal areas, the main driver is population growth, with its attendant problems of degradation of coastal habitats and overfishing of coastal stocks. Integrated coastal zone management, limits to the harvest of coastal fish stocks, increased access to tuna, and development of pond aquaculture for tilapia are needed to provide food security. Adaptations are required that address the pressures from other drivers in the short term, and build resilience to climate change in the long term.

Recommendations

Effective adaptation of economies and communities to climate change needs to be based on a sound understanding of their vulnerability. This understanding can only come from: 1) improved models of the responses of the ocean, and the natural living resources it supports, to global warming and increased carbon dioxide emissions; 2) long-term monitoring to inform and validate these models; and 3) comprehensive vulnerability assessments. To ensure that the billions of dollars committed to assist developing economies adapt to climate change are used effectively, adequate funds are also needed for the necessary modeling, monitoring and vulnerability assessments. Because developing economies do not have the capacities to do this work themselves, it must be done on their behalf by advance scientific institutions and international/ regional organizations.

Meeting the climate change challenges mentioned above requires mitigation and adaptation efforts at an unprecedented level by all communities at all scales. Developing the commitment to do what is necessary will require information and understanding. Developing necessary information flows from community to policy makers and expert advisors and back is a central requirement. Community priorities need to be understood in order to determine what technical information is required, and communities need to understand the outcomes of climate science which are relevant to these priorities.

PECC should alert the senior policy-makers at high political levels, in particular those of APEC, of the short and medium challenges arising from the various man-made and natural climate change with the aim of securing increased political support leading to increased funding for: 1) predictive modeling so that scenarios can be discussed with improved confidence that they represent plausible

[2] From "The European Union Action on Climate Change in the Pacific," Abdoul Aziz M'Baye, Head of Delegation of the European Union to the Pacific.

[3] From "The Tahitian Black Pearl Industry and Climate Change; Impacts and prospects of adaptation," Bran Quinquis, PhD Candidate, University of French Polynesia.

[4] From "Implications of Climate Change for Contributions by Fisheries and Aquaculture to Economies and Communities in the Tropical Pacific," Johann Bell, Principal Fisheries Scientist, Secretariat of the Pacific Community.

outcomes; and 2) improved mitigation and adaptation initiatives for vulnerable populations in exposed environments such as the Pacific Islands region.

PECC should contribute to worldwide efforts to manage climate changes by reinforcing the message that global warming is an imminent threat to the international security and well-being.5

2. Strengthen the solidarity for collective action and regional cooperation

Economies and communities with Pacific coastlines are all connected through the ocean waters and through shared marine ecosystems. Ocean acidification and rising sea levels are shared concerns. Rapid deteriorations in the marine and coastal environment can be mitigated only through collective action and by including multiple stakeholders. Scientists and researchers at the seminar voiced that PECC should try to remain inclusive and involve as many sectors and communities as possible. They also emphasized that more solidarity among the Pacific economies would be needed to achieve regionally autonomous models of cooperation.

Recommendations

- On topics relating to the protection of marine resources in the Pacific, PECC should involve participation of local communities and notably the Pacific Islands Forum (PIF) which is a full member of PECC; their involvement would help to ensure compatibility with local development goals and sovereignty.
- As a hybrid network with access to high-level policy-making process, PECC could further provide input to regional and global decision-making processes and fora on matters relating to climate change and management of marine resources (e.g. APEC, MDGs, Rio+20). As the only non-governmental official observer of APEC, PECC must strive to better connect to the APEC process on issues relating to maritime and fishery affairs. The best added value of PECC is its wide network and potential to reach out even further.
- Strengthen the regional cooperation and promote capacity building while respecting local sovereignty and culture. From an operational point of view, the challenge is to translate the results of scientific research into relevant and efficient management practices. We must find ways to facilitate sharing of best practices across industries and across borders, and strengthen communications between the relevant industries to the policy-makers.
- With the general aim of achieving a better understanding of marine ecosystems in the Pacific Rim, we should enhance our regional network of marine observatories. This would entail sharing coordination, linking and unlinking the existing marine alliances, and monitoring health indicators.

3. Knowledge-sharing and innovation

Global warming is real and international efforts still fall far short of what is needed to mitigate the adverse effects of climate changes on our ecosystem. Greenhouse gas emissions are rising rapidly and not enough commitments have been made to reduce the emissions level with aims to curb the global temperature from rising two degrees, or even as high as four degree by the end of the century. The ocean acidification is becoming more evident and this may have devastating impacts on the marine ecosystem while the global demand for food from fisheries and their prices continue to rise.

[5] Michel Rocard, Chair of France Pacific Territories committee for PECC and former prime minister of France.

International efforts to manage the challenges mentioned above should include the Pacific Islands and their local communities. A knowledge-action methodology developed by the Association of Pacific Rim Universities World Initiative – Climate Mitigation and Adaptation (CMAS) research program is an effort to centrally tackle the multifaceted challenges by facilitating the two-way information flows from community to policy makers and expert advisors. The initiative consists of an international collaboration of researchers working together around an integrated model that combines both the social and technical dimension dynamics of a community in interaction with a water system.[6]

NET-BIOME is funded by the European Commission to support a biodiversity research initiative of local authorities of the Outermost Regions of France, Portugal, Spain, and Overseas Territories of the UK and the Netherlands. The project aims to coordinate research activities specific to the tropical and subtropical regions and territories which have direct effects on the local economies consisting of agriculture, fisheries, tourism, biotechnologies, etc.[7]

PACE-Net is another example of international cooperation and capacity-building effort financed by the European Union. It is scheduled to last three years starting May 2013 and aims to strengthen dialogue between the EU and the Pacific islands while providing platform for knowledge-sharing of science and technology in respect to the priorities of the Pacific region.[8]

Recommendations

- Enhance public education and involve the local communities. The first step to transferring diagnosis into action is education. Public education and campaigns will help to raise awareness on the sustainable and responsible use of marine resources among local communities. It was also noted that equipping women with knowledge and thereby empowering them would be an effective and necessary approach.
- Research-funding is needed on a long-term basis. Scientists and academics should also look for ways to facilitate information-sharing to encourage joint research projects, and widen the access to information regarding the available funds. Participants at the seminar stressed that in order for studies to be more reliable and useful, it was important that research funding and investments on data-gathering be secured on a long-term basis.
- With the general aim of achieving a better understanding of marine ecosystems in the Pacific Rim, regional network of marine observatories should be enhanced. It was proposed that an international network of actors involved in management of pacific marine resources be established to collectively commit to: sharing of data collection tools, methodologies and know-how for comprehensive monitoring and management of marine ecosystems. For example, different stakeholders could share naval means used for data acquisition, establish linkage between existing marine environment observatories such as the French Grand Observatoire du Pacifique Sud (GOPS), the Australian Integrated Marine Observation System (IMOS), and the Global Ocean Observing System. There could also be a better harmonization of marine environment health indicators.[9]

[6] From "Confronting climate change in the Pacific: Knowledge-action approaches and the APRU World Institute CMAS Program," Jim Falk, Climate Mitigation and Adaptation Research Director, APRU World Initiative.
[7] From "NET-BIOME: NETworking Tropical and Subtropical Biodiversity Research in the Outermost Regions and Territories of Europe in Support of Sustainable Development," Josiane Irissin-Mangata, Research Project Officer, Regional Council of Reunion Island and Coordinator for NET-BIOME project.
[8] From "Regional Networks in the Pacific – PACENET," Claude Payri and Fadhila Le Meur, IRD (Institute of Research for Development), France
[9] Remarks from Jean-Yves Perrot, CEO, IFREMER.

4. Development of new local economic models

Most economic activities are concentrated in cities and most cities are located in coastal areas. The World Bank states that by 2025, 6 billion people, or 75% of the world population will live within 60km from coast. It is imperative that cities find new models to break the link between income generation on the one hand and consumption of natural resources and emission of environmental pollution on the other.[10] New economic models will succeed where there is cost reduction from becoming more eco-friendly and where the economic models are local models, blending local resources with local uses.

We have to change the existing natural resource and space-hungry growth into a thriftier form of growth. This implies a three-pronged approach to our economy: de-carbonating it, de-materializing it, and dehydrating it. Several options could be implemented for public local services such as water, waste management or energy:

- Instituting performance-based remuneration partially disconnected from volumes sold. In this economic system, there is no point in selling more cubic meters of water or kWh if an operator wants to boost its revenues; rather, the aim is to meet the objectives set by the client;
- Shifting from a volume-based economy to one based on "non-volumes" that remunerates natural resources saved (such as energy performance contracts which remunerate "negawatts"); and
- Changing raw materials and energy sources, rather than the method of remuneration. Renewable energy is inexhaustible, so when we use it to produce electricity, we leave problems of scarcity and its constraints behind. Using recycled waste or recycled wastewater separates volumes sold from volumes drawn from earth and sea.

It is also crucial that we enhance business-to-business connections – e.g. industrial by-products should be put to better usage with optimized recycling technologies and innovation. One example is the nickel slag which can provide solution to economies needing to diversify sources of materials for building or sea embankment constructions. Logistics, cost, environmental and political concerns pose as various considerations but there is considerable potential for nickel slag to turn into commercial by-product in the near future with the development of environmentally-friendly and cost-effective recycling methods.[11]

New Caledonia produces 3 to 5 tons of fish waste per day which are simply buried in controlled landfills. There is potentially significant gain to be reaped by innovating ways to treat and turn the daily fish waste produced by the local fishing companies into rich liquid fish fertilizer for agriculture and aquaculture as well as mining re-vegetation, and pet food.[12]

Another potentially valuable source of income for the local communities of the PICTs and other developing economies in the Pacific Rim is in aquaculture: in addition to freshwater fish such as tilapia, pearls, seaweed, microalgae, shrimps, and marine ornamentals are also possible commodities.

[10] From "New Economic Models to Preserve Natural Resources and to Limit Pollutants Discharged into the Oceans," Nicolas Renard, Veolia Environnement.
[11] From "An Example of an Efficient Management of Industrial Waste for Coastal Preservation in the PIC: Use of nickel slag," Pierre Kolb (A2EP), Dominique Chu Van (Societé Le Nickel), and Michel Allenbach (University of New Caledonia).
[12] From "Fish Waste Valorisation in New Caledonia: A sustainable development approach towards the management of industrial waste," Manuel Ducrocq (ZoNéCo, ADECAL, New Caledonia).

In particular, microalgae, which use solar energy to convert CO_2 and nutrients into carbohydrates and other molecules, can play a major role in the future for aquaculture as useful animal feed.[13] Microalgae biotechnology research became commercialized with large-scale culture started in the early 1960s in Japan with the cultivation of Chlorella. It has diversified and grown significantly in volume since then. Microalgae can play a major role in meeting the future demands for terrestrial and aquatic animal feed as aquaculture continues to grow in many part of the world. Currently, more than 40 species of microalgae are used for the purpose depending on the specific requirements of local seafood production. Other potential applications and products from microalgae are biofuel, biological sequestration of CO_2, wastewater treatment, food additive and human health, cosmetics, etc.

Continuous innovation and creative thinking to optimize the available resources will allow us to generate economic wealth while preserving the nature and its resources; moreover, for them to become mutually reinforcing.

Recommendations

- For operators: Institute performance-based remuneration partially disconnected from volume of water, energy, or waste services sold
- Switch from limited and exhaustible fossil energies and raw materials to renewable and inexhaustible resources
- Reap additional commercial benefit by treating wastes from fishery, mining, and other forms of conventional industrial activities and transforming them into reusable products
- Innovate new economic activities such as microalgae culture to meet the growing demands for animal feed or aquaculture

5. Establish new forms of governance and better manage the maritime areas

A crucial challenge is to translate the results of scientific research into relevant and efficient management practices. We must find ways to facilitate sharing of best practices across industries and across borders, while strengthening communications between the relevant industries and policy-makers. Such forms of governance for conservation and management should be integrated, based on ecosystem, and based on scientific research; they should include addressing land and offshore sources of pollution and debris, use of spatial planning and continued establishment of marine protected areas (MPAs).[14]

5.1. Management of conflicting interests

Areas near water are often subject to conflict of interests over usage and exploitation. The key is to attain a stable balance between biodiversity conservation and socio-economic benefits from the use of ecosystem products and services (e.g. exploitation of biological resources, tourism, industrial development, and shipping).[15] An integrated coastal management approach at the local level and regional cooperation through multilateral agreements must take place side by side.

[13] From "Potential for Microalgae R&D in New Caledonia," Jean-Paul Cadoret (IFREMER, Nantes, France), Liet Chim (IFREMER, New Caledonia), Adrien Rivaton (ADECAL, New Caledonia), and Fabrice Colin (ADECAL, New Caledonia).
[14] From "Food Security and Vulnerable Populations: Perspectives on fish and the sustainable use of marine resources," Gillian Bowser (Office of Marine Conservation, US Department of State).
[15] Jean-Yves Perrot, CEO, IFREMER

Marine protection areas must be reinforced in certain areas; effective marine education and implementation of coastal management are key factors that must improve as seen through Chinese Taipei's Turtle Island Marine Spatial Planning example.[16]

However, government efforts to establish and manage marine protected areas through regulations are often challenging. In the case of Japan, the costs of conservation are shared by the local fishers' group and the government licensing scheme to secure the rights-based management of fishing allowing fishers' group to reap benefits from the conservation activities in the future.[17] Challenges lie ahead as the Japanese fishing industry becomes weaker and the Japanese economy continues to stagnate.

5.2. Food security

According to the 2010 statistics from Food and Agriculture Organization (FAO) of the United Nations, 925 million people are estimated to be undernourished. Micronutrient deficiencies affect about two billion people. According to the same FAO report, global food production must double in order to feed a world population of 9.2 billion in 2050. In this light, sustainable fisheries are critical to global food security.[18] Food insecurity, which may exacerbate given the increasing climate uncertainties, can become a significant debilitating factor for global peace if not addressed in a timely fashion. At the sustainable development summit of Rio in 2012, the US Government will be underscoring the importance of promoting sustainable fisheries, small-scale aquaculture and education of women as key strategies towards global food security. Specific actions include control over illegal fishing, addressing marine pollution, promotion of global data collection, development of sustainable aquaculture and fisheries, as well as continued establishment of marine protected areas.

In the Pacific Islands and Territories, where the level of demand for fish far exceeds harvests available from coastal fishes, tuna is needed to fill the gap. Due to several climate change factors impacting the Pacific, tuna are seen to be migrating eastward. The islands on the Western Pacific are expected to experience declines in tuna abundance while the overall demand for food to be met largely by fish is expected to increase. Hence, we need to improve the redistribution of tuna for the populations in the Pacific while ensuring that there is responsible fishing practice based on constant monitoring of the stock of fish in different areas of the Pacific. Meeting the demand through tuna will be the primary option while other options such as aquaculture and freshwater fishing or farming are to be pursued.

5.3. Clean water

Proper treatment of water after industrial use to be put back into the sea is an extremely important element of environmental protection. Wastewater treatment operator such as Caledonienne Des Eaux applies BioReactor Membrane (BRM) technology which is a process that combines biological treatment and clarification using membranes with microscopic pore size to create a physical barrier against almost all kinds of suspended solids, bacteria, and some virus.[19]

Public opinions on the pros and cons over desalination remain divided and controversial. However, tremendous technological advancement has been made in the field of desalination over the recent

[16] From "Critical Indicators on Marine Spatial Planning and Community Renaissance around Turtle Island, Chinese Taipei," Ching-Ta Chuang, Professor and Director, Institute of Marine Affairs and Resource Management, National Taiwan Ocean University.
[17] From "Coastal Conservation Practices (Satoumi) and Marine Protected Areas in Japan: Institutional approach," Nobuyuki Yagi, Associate Professor, University of Tokyo.
[18] From "Food Security and Vulnerable Populations: Perspectives on fish and the sustainable use of marine resources," Gillian Bowser (Office of Marine Conservation, US Department of State).
[19] From "The Development of Environmental Services to Mitigate Urban and Industrial Impact on the Quality of Marine Resources," Fabrice Polizzi, Caledonienne Des Eaux (CDE), New Caledonia.

years. There remain two key concerns with desalination: high cost of energy required for the process and the discharge of brine and chemicals into the environment. Brine discharge is a fluid waste from a desalination plant containing a high concentration of salt and other minerals. It can potentially kill certain marine organisms, disrupt the natural reproduction, and have other types of undesirable effects on the survival of marine species at various stages of life. Such concerns require a long-term monitoring and would necessitate the implementation of a thorough environmental management plan.[20]

Recommendations

- On marine protection areas (MPAs): There are fundamental benefits from MPAs on the aspects of conservation of marine patrimony and the sustainable development of their economic resources. Marine protection areas must be reinforced in certain areas; effective marine education and implementation of coastal management are key factors that must improve. It is recommended that an international network of actors involved in MPAs be set up to define, implement, manage, and help to define payment of economic services from the resources and territories around the Pacific Ocean. Such network could facilitate sharing practical experiences in the various types of MPAs (coastal and open seas) that the Pacific region can offer in order to harmonize the tools and methodologies regarding the implementation of MPAs.
- On fishery and food security: Work to dispel an "illusion of abundance" which poses as a barrier to establishing good and responsible fishing practices among the local communities. Reef fishes, in particular, are becoming increasingly endangered with the degradation of coral reefs and overfishing.[21] They are obviously easier to catch compared to tuna or other deep sea species and the primary step towards mitigating the impact of overexploitation would be enhancing awareness through public education and putting in place sound local governance supported by reliable monitoring system. It was also recommended that education and training particularly for women be included in global efforts to achieve sustainable fishing practices.
- On desalination: The effects of salinity, temperature and total alkalinity fluctuations, as a consequence of the brine discharge of the desalination plant, should be clarified. Modelling the plume of the brine discharge will be desirable in order to illustrate the diffusion area. Long-term monitoring is recommended. The implementation of a plan of environmental management of effluents is needed for the best prevention of impacts, and their minimization to an acceptable level. A preliminary analysis of the existing situation and of the sensitivity of the ecosystem downstream of the effluents is required for large-scale projects. For projects with potentially significant impacts, the implementation of an environmental management plan is necessary.

[20] From "Desalination: Chemical Impact on Oceans," Henri Boyé, French Ministry of Sustainable Development (MEDDTL).
[21] From "Management of Reef Fish Spawning Aggregations," Henri Boyé, MEDDTL, in collaboration with Yvonne Sadovy (University of Hong Kong) and Eric Clua (Secretariat of the Pacific Community).

Summary of Discussions and Recommendations

Seminar 2
Oceans as a Source of Renewable Energy

Hawaii, USA, March 26-28, 2012

The second seminar of the PECC international project on marine resources, "**Oceans as a Source of Renewable Energy**," held in Hawaii in March 2012, covered four key areas:

1) Development of new technologies for the efficient use of marine energy;
2) New energy sources of the sea including: the operation of ocean thermal energy conversion (mainly in the Pacific), wave energy, tidal energy, hydraulic energy;
3) Means to increase the use of marine energy through technical and financial support from the public and private sectors; and
4) Role of marine energy in future cities and adaptation requirements of urban infrastructures.

Experts highlighted the various benefits and constraints to new forms of ocean energy. For example, the use of ocean thermal technology is useful for dense urban centers, with proximity to deep seas to benefit from differences in temperature between warm surface water and cold water at significant depth. Seawater air conditioning technology is simple and reliable for cooling buildings, an example of which was given from French Polynesia (Bora Bora), and operational in many other cities around the world. Wind turbines are more efficient on the sea than onshore as wind is more regular and consistent offshore. Current energy is deemed more predictable and consistent than wave energy. In general, however, environmental conditions at sea are harsher and more aggressive than on land due to faster corrosion, problems of anchoring, and accelerated aging. Technologies are available but the biggest challenge is the commercialization of these innovations in the marketplace, and developing the economies of scale to make them viable requires sizable companies to buy into, and invest in the new technologies.

The expected benefits of marine energy are significant:

- Less dependence on oil;
- Lower power consumption;
- Reducing greenhouse gas emissions (and even zero emissions as seen in the case of Brando's atoll in Polynesia);
- Minimal or no refuse; and
- Reduced industrial usage of water.

The development of these new sources of energy requires a change in interconnections as existing networks are not compatible with renewable energy. It is therefore necessary to revisit the entire chain of production and distribution if we wish to develop renewable energy. The challenge facing public policy makers is how to connect and plug the many production centers offshore at low cost, into the overall production network at high capacity. To harness the benefits of marine energy requires a rethink of how different aspects of urban services are integrated with each other. This

would involve consultation and agreement with stakeholders and the development of public-private partnerships. However, this requires rethinking the integration of urban services in developing better governance, by seeking the agreement of stakeholders and developing public-private partnerships.

While experts see enormous potential for marine energies, they also believe that the market by itself will not be enough to facilitate their further development; it would require all stakeholders to undertake concerted efforts. At this stage there is little likelihood of adoption without cooperation and without public financial support. The development of these new sources of energy require support from the political centers of decision that unfortunately are not always near coastal areas, as noted by an American expert who explained that from Washington DC, one feels little or no concern with marine energy. The development of marine energy calls for strong political will that also needs to be approved by the taxpayers.

The development of "clusters" (example of “Synergie” in New Caledonia) receiving state support as a form of “startup” in financial, technical, and legal aspects, was perceived desirable, as well as the backing of SMEs by major corporations as seen by an Australian firm specializing in wave energy that has signed partnerships with EDF (Electricity of France) and DCNS (French shipbuilding and energy company). Many examples of efforts led by France (e.g. EMACOP, AMI-ADEME, and IEED projects) and the European Union were presented during the seminar:

- EMACOP refers to a French national research project set up this year to study the potential and feasibility for generating renewable energies from marine, coastal, and port areas.
- AMI-ADEME refers to ‘Invitation for Expression of Interest by the French Agency for Environment and Energy Management,’ in which several joint projects involving marine current turbines (e.g. ORCA,SABELLA), floating wind turbines (e.g. WINFLO, VERTIWIND), and wave energy (e.g. S3) are receiving government funding.
- IEED stands for ‘Institute of Excellence in Carbon-free Energy’ which offers scientific and technological facilities to promote industrial development of marine resource energies, particularly through public-private partnerships.

The example of NELHA (National Energy Laboratory of Hawaii Authority), which helped establish a business incubator dedicated to marine energy, was notably interesting. A field visit of the 870-acre facility of NELHA was organized by the East West Center including presentation by the following companies and start-ups associated with the project: OTEC heat exchanger test facility of Makai Ocean Engineering, microalgae farm of Cellana, aquaculture facility Big Island Abalone Corporation, and Keahole solar power facility run by Sopogy. NELHA is an industrial park that offers research support facilities for development of marine renewable energy and aquaculture by providing continuous supply of cold deep seawater at 4 degrees Celsius as well as warm surface water which allows for various tests to take place with views to reap economic potentials from the dual temperature seawater delivery system. Tenants of NELHA work at the pre-commercial, commercial, research and educational levels.

Another issue highlighted by the experts was the unpredictability of when energy from marine sources can be made available. For example, with tidal power, offshore wind or wave energy, their contributions to the total electricity capacity will vary with the weather in terms of timing and amount.

There are currently hundreds of patents that exist on marine energy technology but there is a relative lack of transparency. It is important to ensure that the technologies that are adopted by the market also address issues of environmental protection of the oceans.

According to a speaker from China, marine technologies are not yet mature enough and should be considered to be in the incipient stages of their development. They are perceived as technologies of luxury that developing economies cannot yet fully afford to grasp. As most marine renewable energies are yet in pre-industrial stages, the question is who will set the norms and standards to be recognized globally. The market is far from being structured, and its structuring will depend on forces that will facilitate its organization, the constraints as well as limits to its development.

Lessons should be learned from tests in situ in order to improve performance, quality of materials, design, reliability, and to lower the maintenance costs. A thorough and well-thought out policy framework is required to develop a solid industry. In addition, various socio-economic as well as technical barriers should not be neglected: the need to collect more reliable data for sound decision making, development of new digital tools, addressing problems connecting to the sector, risks related to operations at sea, evolution and compatibility of norms must also be tackled. This is a multidisciplinary field where technologies are not yet stabilized. Some experts urge caution, they said it would be cheaper and more appropriate to encourage lower energy consumption than developing new technologies, and similarly, terrestrial technologies (e.g. solar and wind) are less difficult to implement than marine technologies.

A key issue related to smart grids that are expected to efficiently manage the delivery of energy between peak and off-peak hours, consists of finding the optimal balance between collective systems and area-specific solutions. It requires finding the most efficient ways of integrating the energy generated from many different sources into the power grid without destabilizing the latter. New business models are expected to make networks more intelligent by connecting offices, stores, hotels, treatment stations for marine renewable energy where available. This process would be assisted by economic models which are based not on more production but on energy savings.

New research and new investments will be required as we push the boundaries of innovation in the ways we produce, consume, and manage energy and their sources. Some sources of marine energy are more likely than others to develop and become viable; the transition from experimentation to exploitation will then define internationally recognized standards. Network reconfigurations will become necessary for public service providers and require finance to develop the sector through public-private partnership. This raises the question of energy security in small islands which are vulnerable to difficulties with remote distance and high costs of service equipment.

Summary of Discussions and Recommendations

Seminar 3
Management of Deep Sea Marine Resources and Oceans as a Means of Communication

Auckland, New Zealand, December 4-5, 2012

It is now more obvious that despite the strong potential of marine resources, market by itself will not be enough to facilitate their further development; it would require all stakeholders to contribute concerted efforts and financial support. The development of marine resources calls for strong political will in support of the research and development efforts conducted by the private sector. A thorough and well-thought out industrial policy is required to develop a solid industry. In addition, various socio-economic as well as technical and environmental barriers should not be neglected: the need to collect more reliable data for sound decision-making, development of new digital tools, risks related to operations at sea, evolution and compatibility of norms must also be tackled. This is a multidisciplinary field where technologies are not yet stabilized or sufficiently protected.

Four sessions were organized to discuss the following issues:

Session 1 *Identified solutions to reconcile the development of deep sea exploration and environmental protection and to provide a sound surveillance of oceans*

Session 2 *Focused on the ways to protect the resources from non-authorized users, identified available technology, international agreements to protect their own resources. It also presented technical, legal and environmental cooperation efforts being made among neighbors to monitor and protect shared waters.*

Session 3 *Looked at ways to maintain the level and quality of existing resources and ways to guarantee the protection of exclusive zones*

Session 4 *Looked at oceans as a means of communication and development for local communities. Sea is a crucial means for transportation and communication for Pacific economies and particularly for Pacific islands. Well established sea lines as well as submarine infrastructure allow for the essential passage of goods and services across the seas and help these island economies enhance competitiveness and prevent economic isolation despite the obvious challenges brought by geographic constraints.*

A New Social Contract for the Blue Planet: A better management of the oceans

Although immense, the sea is a finite universe. Following the wake-up call that happened during the latter half of the 20th century which made us switch from the perception of our marine world being infinite to the consciousness of its fast exhaustion by human activities, the beginning of the 21st century offers us another paradox. Resources from the Blue Planet are likely to become extinct or destroyed by human activities if not wisely managed. Fish resources are depleted, many species are disappearing, and coral reefs are affected by incurable diseases. In addition, new offshore activities, such as deep sea oil and mineral exploitation, wind and underwater turbines, underwater plants, collective housing, may create conflicts of use of the maritime space.

The overall surface area of the ocean's deep waters explored so far is more or less equal to the size of a large global city. We know very little of it; most is still to be discovered with regards to its biodiversity, species and molecules. The deep sea mining resources not yet identified are immense and we have limited knowledge to capture the unlimited energy of the solar cells that the oceans are capable of providing.

Economic activities linked to oceans represent a huge economic value well beyond all other human activities, except perhaps agriculture. Some striking figures were highlighted[22]:

- Extraction of ores and transformation of sea water represent already US$50 billion.
- Fishing, transformation, aquaculture generate a value of US$160 billion.
- Exploration and extraction of oil and gas represent wealth of more than US$900 billion.
- Sea transport and services at sea sum up to US$500 billion.

New considerations should be taken aboard: technical and environmental constraints in regards to the depth of oceans; the ecosystems to be evaluated not at the local but at the global level; the cost of preventing and fighting pollution which is likely to spread throughout the different oceans; the appropriation of marine resources to be discovered and exploited in marine areas outside the national jurisdictions; as well as ethical and social dimensions and responsibilities vis-à-vis the future generations.

The threats on the oceans are real; we have to act as shareholders of the oceans and not as simple stakeholders. Our responsibility is much broader, ampler, and deeper:

- We can use this common good under the condition that we are able to protecting it and sharing fairly the profits.
- Preserving the resources is not adequate in itself; we have the mandate to implement policies to render value while protecting them.
- States cannot be left claiming ownership and privileges without limits without risking the generation of severe conflicts. We have to proactively master the place given to human activities in the development of resources from the oceans.
- Using while protecting, valorizing while preserving, this apparent conflict needs also to be managed.

In Search for New Sources of Energy – Exploring Deep Seabed Minerals

There is rapidly growing interest and quest for offshore minerals in the Pacific waters. Recent deep seabed mineral activities in the Pacific Islands region largely consist of research and exploration as well as preparing economies to put in place the necessary legal instruments for effective

[22] Bertrand Aubriot, DCNS, Paris, France

administration and governance of deep sea mineral resources.[23] Active commercial exploration within the national jurisdiction of Papua New Guinea in recent years as well as the issuance of a mining lease to Nautilus Minerals in 2011 have led to many other companies to follow suit by applying for and being granted exploration licenses in other places such as the Solomon Islands, Tonga, and Fiji.

The regional SPC-EU EDF10 (European Development Fund 10) Deep Sea Minerals Project is being implemented in 15 Pacific economies and Tonga has become the first economy to be assisted by the project in drafting of its national seabed minerals bill and regulations in consultation. Others will follow suit and the economies are strongly encouraged to use relevant international law provisions including the precautionary principles in drafting their respective deep sea minerals policies, legislation and regulations. Other types of capacity building initiatives have been implemented by the DSM project with the aim of enabling Pacific economies effectively participate in and regulate the new industry.

There is rapidly growing interest in offshore minerals exploration in New Zealand waters. Legislation is still under development with the two equally important aims of facilitating development of potential mining operations while ensuring g that environmental sustainability is not compromised. Such legislation is still under development and scientific research plays a critical role in these efforts by providing support such as much needed baseline information, a robust monitoring program, and precautionary conservation measures. A strong collaborative approach in the early stages of exploration is taking place between New Zealand minerals companies and researchers which in the long run will provide a solid foundation for subsequent environmental management.

As an example, a four-year research project funded by the NZ Ministry of Business, Innovation and Employment (MBIE) and executed by the National Institute of Water and Atmospheric Research (NIWA) of New Zealand aims to help enable management of offshore hydrocarbon and mineral operations through improved understanding of environmental impacts.[24] The objective of the program is to provide guidelines for consistent, appropriate and robust assessment of environmental impacts across the range of marine activities. The guidelines will be based on both Environmental Risk Assessment (ERA) and Environmental Impact Assessment (EIA) processes. The program, consisting of collaboration among various players from industry, research and government organizations, will support the development of guidelines for monitoring the impacts of marine industry operation, techniques to determine key parameters of spatial management, and improve our understanding of the impact in the broader ecosystem context.

In the case of New Zealand, a number of factors led to pushing up the need for environmental legislation higher up the priority list of policy-makers including: increased awareness of mineral resources, increased global demand for mineral resources, government's economic development agenda and increasing public interest in environmental projects and potentials.[25] According to the Centre for Advanced Engineering, seafloor mineral deposits within New Zealand's Exclusive Economic Zone could be worth up to $500 billion. In the past, legislation was largely industry-specific, piecemeal, and there was heavy reliance on self-regulation in regards to minerals. As of September 2012, a comprehensive legal framework has been enacted to manage the environmental effects of certain activities including minerals exploration and mining, called the 'Exclusive Economic Zone and Continental Shelf Act (Environmental Effects) 2012'. Consent decisions for exploration or

[23] Akuila Tawake, Team Leader of SPC-EU Deep Sea Minerals Project, SOPAC Division, Secretariat of the Pacific Community (SPC), Suva, Fiji
[24] Geoffroy Lamarche, Principal Scientist, National Institute of Water and Atmospheric Research (NIWA), Wellington, New Zealand
[25] Dave Trueman, Partner, Simpson Grierson, Wellington, New Zealand

other activities will be considered and managed by an independent regulatory body called EPA with the aim of finding a balance between economic development and environmental protection.

Some of the current activities taking place on the ocean continental shelf (areas beyond 200 nautical miles) include: marine scientific research (MSR), fishing, mining for seabed minerals, hydrocarbon extractions, and bio-prospecting.[26] Other such activities are sure to follow as we take increasing interest in the vast potential resources harbored in the marine ecosystem. These activities face unique issues such as interactions with various users in the high seas, different rules regarding MSR, possible risks of transboundary damages or harm to the global commons. When regulating such activities, one cannot assume 'business as usual.' There are legal or regulatory differences from one state to another and such differences should be reflected in the regulatory framework as much as possible.

In sum, marine resources can provide enormous potential for economic growth and development for all economies bordering the Pacific. However, ensuring sustainable exploration and exploitation through reliable data acquisition, careful considerations of other factors such as preservation of natural and cultural heritages should not be ignored.

Surveillance of Oceans

There are clear benefits of strengthening international cooperation in shared waters by improving the governance and responsible management of the marine resources and environment. These include areas such as illegal fishing, illegal immigration, human and drugs trafficking across waters, and pollution. Cooperation, effected through various multilateral, regional, and bilateral agreements at the political level, is essential for the long-term protection of the resources, including cooperation in maritime surveillance. Further, policy coherence and harmonization of approaches can enhance the benefits of collaborative action. That necessitates a combination of good frameworks, practices, and networks.[27] Solid legal frameworks were regarded as essential for the joint maritime surveillance efforts in the Pacific Ocean. The Declaration on Maritime Surveillance signed by New Zealand, Australia, France and the US at the 2012 Forum, the Niue Treaty, and the WCPFC high seas boarding and inspection regime, all provided the framework for surveillance cooperation in the Pacific.

In the maritime surveillance area there was good cooperation among the QUADs (Quadrilateral Defense Coordination Group involving Australia, New Zealand, France, and the United States), which had a positive deterrent value on illegal fishing. There was room, however, to broaden the cooperative frameworks in the future to include Asian nations. This would also help to deal with future threats in the region.[28]

In the case of New Caledonia, political support among the indigenous populations was seen as crucial in the development of the Coral Sea Marine Protected Area. The MPA was used as an example to highlight the value which scientific research could add in the development of policy options to address the protection of the oceans.[29]

[26] Joanna Mossop, Senior Lecturer, School of Law, Victoria University of Wellington, New Zealand
[27] Francis Etienne, Embassy of France, Wellington, New Zealand
[28] Bruno Jeannerod, Commanding Officer, French Armed Forces in the Pacific, Noumea, New Caledonia
[29] Yves Lafoy, Embassy of France, Wellington, New Zealand

Partnerships needed to be strengthened among key organizations in the Asia-Pacific region so that a more coherent approach to the protection of the oceans could result. Benefits from scientific collaboration and value of networks in providing the necessary framework for collaboration apply not only to scientific research endeavors but also more generally to marine policy development and governance.

Marine Pollution

In contrast to the above, it was in part the lack of international legal frameworks and common standards to deal with land-based sources of pollution which had contributed to the significant problem of marine debris in the global oceans.[30] The ocean was more too often treated in past centuries as a convenient dump site. And preventing or managing pollution that is spilling over into or affecting other states require going beyond national jurisdictions.

Marine plastic debris is one of the most problematic of pollutions. Plastic is commonly non-biodegradable, thus remaining in the marine system for a very long time. Ocean surface currents move the debris from its sources into areas of current convergences which become reservoirs of floating litter. It is challenging to quantify and to collect reliable data on this complex problem. A SCUD (a diagnostic model of the ocean surface currents) model has been developed using satellite data and trajectories of drifting buoys. This SCUB model is being used as a tool to investigate the pathways, along which marine debris is transported in the marine system. Needless to say, the sources and impact of marine pollution are global and thus international effort is crucial in order to mitigate the problems. In 2011, the NOAA Marine Debris Program took a lead in the initiative to promote international and interdisciplinary cooperation in the field of marine debris leading to "Honolulu Strategy".

As much as 80% of wastewater being discharged into the ocean today is untreated and according to Veolia Environment, half of water treatment technologies which will be used in the next 15 years have not even been invented.[31] Hence, continuous research and development (R&D) efforts are needed as well as ensuring appropriate technology transfer and intensive training in order to fight mitigate the environmental pollution in the sea. Public-private partnership (PPP) is crucial in this collective effort by encouraging both sectors to raise the standards and the technologies needed to ensure sustainable management of the sea and its environment. Such form of collaboration is aimed to facilitate and serve as a catalyst to the much needed innovation in the waste management field. While continued efforts to explore and responsibly exploit minerals and particular rare minerals are important, it is equally important to continue to conserve and find ways of recycling raw materials to reduce the demand wherever possible.

Maintaining the Quality of Existing Resources vs. Protection of Exclusive Zones

In view of the world economy's increasing dependence on rare earth elements for industrial use, it is particularly worth noting that 97% of the rare earth and yttrium (REY) production comes from mainland China today. These 17 identified elements are crucial for novel electronic equipment (e.g. flat-screen TV, hard-disk drives, and smartphones), green-energy technologies (e.g. fuel cells, wind

[30] Jan Hafner, Scientific Computer Programmer, International Pacific Research Center, University of Hawaii, USA
[31] Nicolas Renard, Advisor to the Chairman and CEO, Veolia Environnement, Paris, France

turbines, LED bulbs, hybrid vehicles), and space development industry.[32] However, the principal uses of REY lie in advanced military technology such as missile guidance and control system, laser targeting system, and radar surveillance system.

Now this near-monopoly held by China may be challenged in the near future by the discovery of massive deposits in the mud on the Pacific floor by Japanese geologists who estimate that there are about a 100 billion tons of rare elements in the mud. The research team led by Professor Yasuhiro Kato, professor of earth science at the University of Tokyo, found the minerals in 78 locations around the Pacific. While the rare earth elements (REE) found on land are often scattered and in thin deposits, those found in the sea mud are in much thicker concentrations so the finding offers a promising prospect for more efficient exploitation of REEs in the near future.

With the objective of diversifying sources of supply for REEs for which we have become increasingly dependent, and the advancement in technology which enables it, there is noticeable rise in interest to and intentions to further the scientific exploration of the mud on the seafloor that contain the REEs. One particular challenge is that some of the REEs are highly endemic based on small amounts of deep sea samples. Other challenges include scientific, technical, economic versus environmental, legal (e.g. demarcation of EEZ and inland seas), and geopolitical concerns (e.g. diversification of supply sources).[33] While recognizing the important need to explore and exploit the REEs, there is evidently a need to strike a fine balance between exploitation and conservation of marine resources, in light of sustainable and responsible development.

In New Zealand, interest in offshore petroleum and minerals exploration is growing rapidly as investors assess the potential economic returns from their rich marine resources.[34] The main challenge of scientists and the relevant management agencies is about how to facilitate the development of this natural wealth while ensuring environmental sustainability is not compromised. The EEZ and Legal Continental Shelf in the case of New Zealand cover 5.7 million km2 of ocean which means 20 times the land area. It has a complex seabed, a diverse range of habitats, is influenced by major ocean currents, and supports a globally unique and diverse biota, including mobile species that transcend lines or zones that we identify on maps. There are much more complex sets of factors and circumstances for offshore mining operations in comparison on onshore yet much less is known about the potential environmental impact of the former.

Large deposits of geological resources, including oil and gas, hydrates, minerals, sand and aggregates, phosphates, gold, polymetallic nodules and volcanic massive sulfides, have been recognized or inferred at and beneath the seafloor. Between 1997 and 2002, the marine mineral economy alone is said to have increased by 26%. A conservative valuation of this vast mineral estate is estimated at NZ$500 billion.

In sum:

- There is a consensus that seafloor resources are exploitable and would provide substantial economic benefit to ocean economies.
- However, rigorous, quantitative research is still required to make estimate and model that would convince the industry.
- There is need for much more conservation science to provide sound environmental management and balance between extraction and conservation

[32] Yasuhiro Kato, Professor, Frontier Research Center for Energy and Resources, Graduate School of Engineering, University of Tokyo, Japan
[33] Martin Patriat, French Research Institute for the Exploration of the Sea (IFREMER), France
[34] Geoffroy Lamarche, NIWA

Communications and Transport across the Oceans

As much as an alternative source for precious minerals and other resources, the seabed is being explored further and used to meet the growing demand of laying submarine communication cables. A 2009 World Bank report on Pacific Islands states: "Distance is not just a physical concept, but also an economic one. It is the ease or difficulty of which goods, services, labor, capital, information and ideas move between places. […] The correlation between access to markets and economic growth is strong."[35] Transporting goods and services throughout the Pacific Ocean, using some of these Pacific Islands as en-route ports for cargo ships and as hub points for submarine optical cables have significant implications for these island economies which would otherwise risk economic isolation. Companies like New Zealand Steel, owned by Bluescope Steel, formerly a business group of BHP Billiton, exports steel products to various destinations in the Pacific. Optimized shipping and logistics are of utmost concern for such companies doing business across the seas.[36]

As much as 90% of world's communication flows are carried via submarine cables and the internet annual growth is as high as 60% per annum, observed between 2010 and 2016. Without doubt, laying more submarine cables and thus increasing the open access to high-speed and cost-effective broadband connectivity lead to accelerated social and economic development. However, the majority of Pacific island economies remain under-connected and they are still dependent on satellite networks which are now inadequate to meet their growing needs. Financing for the infrastructure remain the key concern that is preventing some of major projects from going ahead to alleviate this problem. Governments have crucial roles to play along with regional or global financial institutions and other private financing platforms.[37] Public-private partnership models take shape in rolling out submarine cable projects which allows for mixed ownership – in the forms of joint funding and joint operations or maintenance. One such example is one undertaken by Alcatel-Lucent between Tonga and Suva as part of the regional connectivity project to eventually connect all Pacific Islands with fiber optic cable. The 837km link was financed by the World Bank, the Asian Development Bank and Tongan government, and it gives access to the Southern Cross Cable in Suva, Fiji which serves as the main trans-Pacific link between Australia, New Zealand and the United States. "Gondwana-1" is another regional submarine project stretching 2,100km between Sydney and Nouméa, New Caledonia. The success of submarine cable projects depend on an optimal mix of technical expertise, long-term financial commitments, and mutual confidence shared among neighboring economies for a collective regional approach in quickly achieving an economy of scale.

However, building such submarine infrastructure involved extensive research, and careful planning. For example, shortest route was not always the least expensive and shortcuts were not an option in consideration of certain seabed conditions and environmental concerns. Sometimes the sheath of the cables had to be reinforced in shallow waters, subject to substantial maritime activities. There is also a need to diversify routes to reduce the risk of failure as any disruption in submarine cables wreaks havoc and financial losses. In particular, the services trade would be most likely impacted than agricultural or manufacturing trades. Governments need to continue to analyze and assess the

[35] The World Bank Report 2009: Pacific Islands Development in 3D
[36] Blandina Diamond, Logistic Manager, New Zealand Steel, Auckland, New Zealand
[37] Emmanuel Delanoue, Head of APAC Sales & Marketing, Alcatel-Lucent Submarine Networks, Singapore

potential risk factors by studying various scenarios which will ultimately help decision-making on how much to invest in costly infrastructure projects such as submarine cables.[38]

Conclusion

In view of the growing global demand for more minerals, it is inevitable that governments, industries, and scientists look into the possibilities of diversifying the sources of such mineral by exploring the deep seas and seabed. In view of growing demands for faster connectivity and wider open access to internet, laying more fiber optical cables on the seabed become inevitable. Human dependence on the sea goes far beyond fishing and maritime leisure activities on the surface of the ocean.

The discussions have emphasized that resources from the oceans available in most of the Pacific island territories are potentially ready for commercial exploitation; nevertheless with a view to develop a sustainable exploitation of the resource it was felt that more scientific data should be collected and made available with a view to better identify the amount and quality of the resources available, namely for the REE, as well as the environmental risks derived from. Given the growing world demand for new mineral resources from the Oceans all legal aspects related to access, environmental protection, preservation are to be put up front to allow Pacific economies to allow for the commercial use of the resource.

A sustainable exploitation of the natural resources from the Oceans calls for a strong political will to complement the R&D efforts by the private sector. Several obstacles - technical, environmental, as well as socio-cultural - are still present. Responsible exploration and exploitation of the sea are taking on new dimensions and considerations. We would need to enhance regulations and legal frameworks that can adequately cover the intricacies and complexities surrounding the protection and sustainable development of marine resources.

Long-term sustainability of the world's marine resources, given the risks, both technical and financial linked to the deep sea exploitation of resources, would require:

1) strong political will on the part of governments;
2) regional and international cooperation;
3) new technologies and innovation;
4) shared accountability and ownership between the private and public sectors through PPPs; and
5) better surveillance of the oceans through close cooperation among the owner economies of the resources.

[38] John Ballingall, Deputy Chief Executive, New Zealand Institute of Economic Research, Wellington, NZ