Toward a Strategic Action Roadmap on Oceans and Climate: 2016 to 2021

Central Role of Oceans in Climate

Mitigation

Adaptation

Displacement

Financing

Capacity Development

Policy Recommendations on Oceans and Climate for Consideration at UNFCCC COP 22 and Beyond

Prepared with the support of:

Global Ocean Forum

Part of the Global Strategic Action Initiative on Oceans and Climate

Prepared with the support of:

Global Ocean Forum; Intergovernmental Oceanographic Commission of UNESCO; UN Environment Programme; Ocean Policy Research Institute, Sasakawa Peace Foundation, Japan; Oceano Azul Foundation, Portugal; Oceanário de Lisboa, Portugal; University of Delaware; Plymouth Marine Laboratory, UK; Duke University; Scripps Institution of Oceanography; Deep Ocean Stewardship Initiative; The Blue Network (Grenada, Netherlands, FAO); The Pacific Community; Secretariat of the Pacific Regional Environmental Programme; Partnership for Climate, Fisheries, and Aquaculture; Coastal and Marine Union EUCC; The Nature Conservancy; Ocean Recovery Alliance, Hong Kong; Center for Coastal Studies, US; Turkish Marine Research Foundation; World Ocean Network; World Ocean Observatory.

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Please note that this effort represents work in progress and is open to all interested participants from governments, international organizations, NGOs, and private sector wishing to contribute to advancing the issues related to oceans and climate, both within and outside the UNFCCC, in the next five years.

Comments on the policy recommendations contained in this document are kindly invited as are offers of collaboration to develop and implement the strategic actions identified in this document, please send these to Dr. Biliana Cicin-Sain, President, Global Ocean Forum, bilianacicinsain@ globaloceans.org and to Mr. Julian Barbiere, Intergovernmental Oceanographic Commission (IOC) of UNESCO, j.barbiere@unesco.org.

Toward a Strategic Action Roadmap on Oceans and Climate: 2016 to 2021

October 2016

Part of the Global Strategic Action Initiative on Oceans and Climate

Prepared by the International Expert Working Group on Oceans and Climate*

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**The International Expert Working Group first mobilized in the run-up to the Oceans Day at COP 21, presented initial recommendations at COP 21 in Paris, and then subsequently expanded and refined the analyses and recommendations to produce this Strategic Action Roadmap on Oceans and Climate. The analyses contained in the report represent the perspectives of the co-authors, not necessarily of their organizations.*

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Main organizers: The Global Ocean Forum, IOC/UNESCO, UNEP, Sasakawa Peace Foundation, Japan, Ocean and Climate Platform, and the University of Delaware Gerard J. Mangone Center for Marine Policy
Co-organizers:
Governments of Grenada, Indonesia, Portugal, Seychelles, South Africa, and Sweden
Intergovernmental/International Organizations: GEF, CBD, FAO, GEF/UNDP/UNEP African Large Marine Ecosystems Project, the International Atomic Energy Agency, the Pacific Islands Forum, The Pacific Community, the Secretariat of the Pacific Regional Environmental Programme, the World Bank, the World Meteorological Organization
Non-governmental Organizations: the EUCC, Forum do Mar of Brazil, Global Island Partnership, the Institute for Sustainable Development and International Relations (IDDRI), the Institute Oceanographique of Monaco, IUCN, the Partnership for Climate, Fisheries, and Aquaculture, the Prince Albert II of Monaco Foundation, the Nature Conservancy, the World Ocean Network, the World Ocean Observatory, the WWF, and Nausicaa
Academic/Scientific Institutions: Center for Coastal Studies of Massachusetts, Centre National de la Recherche Scientifique of France, Duke University's Nicholas Institute for Environmental Policy Solutions, the Global Change Institute of Queensland, the Instituto Politecnico Nacional of Mexico, Monmouth University, Oceanario de Lisboa, Scripps Institution of Oceanography, Plymouth Marine Laboratory, Turkish Marine Research Foundation, and Tara Expeditions

Biliana Cicin-Sain

Dr. Biliana Cicin-Sain
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Foreword

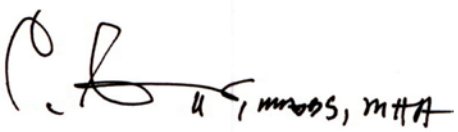
The ambitious Paris Agreement comes at a key moment in time for Small Island Developing States (SIDS). We are the people who live closest to the oceans; we are its beneficiaries and its stewards. We are seeing our life support system begin to fail as the effects of climate change lead to the disappearance of our islands and depletion of our food sources. For decades, SIDS nations have come together to raise global awareness of the unique threats that our people are already facing as a result of anthropogenic climate change, the importance of managing and protecting ocean ecosystems, and the drastic circumstances that may arise if stringent mitigation is not carried out. At the same time, we are also the people who have led the world in providing innovative measures to move toward a low-carbon Blue Economy in our island nations and around the world.

The Paris Agreement represents a victory for island and coastal nations. We have used the phrase "1.5 to stay alive" as a way to emphasize that the target warming limit of 2.0C is simply too high to ensure our very existence as low-lying island nations. It is a landmark achievement that the Paris Agreement calls for mitigation efforts for nations to pursue "efforts to limit the temperature increase to 1.5C." In addition to acknowledging this more appropriate warming limit, the Paris Agreement is also notable as the first major UNFCCC agreement to include a mention of the importance of ocean health within the context of mitigating and adapting to climate change.

However, these lofty goals and words must necessarily be supported by concrete and ambitious actions. The successful implementation of the Paris Agreement will be crucial, and strong pre-2020 action is absolutely essential to ensuring the integrity of ocean ecosystems and the very survival of SIDS and coastal populations and their ability to implement Blue Economy approaches for sustainable economic and social development, as called for in Sustainable Development Goal 14 on Oceans and Seas. These actions must not be postponed. For SIDS communities, delay could mean significant loss of land, life, and livelihoods.

This document, *Toward a Strategic Action Roadmap on Oceans and Climate*, represents a comprehensive set of policy recommendations which can help us to meet the goals of the Paris Agreement. The urgency that runs through the language of the Paris Agreement, and through this Roadmap, must be given sufficient momentum and resources for the implementation of strong policies to take shape and force in the next five years. The types of actions laid out in this Roadmap should receive appropriate consideration by UNFCCC parties and civil society alike so that we may safely protect island and coastal peoples everywhere and ensure their economic and social sustainable development for present and future generations.

H.E. Ambassador Ronald Jumeau
Ambassador for Climate Change and Small Island Developing State Issues
Permanent Representative of the Republic of Seychelles to the United Nations



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Executive Summary

This proposed **Strategic Action Roadmap on Oceans and Climate: 2016 to 2021** is intended to provide a vision for action regarding oceans and climate in the next five years—with a sense of urgency in the spirit of the landmark Paris Agreement. The Roadmap addresses six ocean and climate issue areas: The central role of oceans in regulating climate, mitigation, adaptation, displacement, financing, and capacity development. Each section presents the scientific and policy groundwork for a set of policy recommendations relevant to the particular issue. Draft policy recommendations were first discussed at the Oceans Day at COP 21--a high-level event at UNFCCC COP 21 in Paris that brought together over 400 participants to highlight the central importance of oceans as an essential component of human wellbeing, especially in the 183 coastal and island nations around the world--and then were refined in the months following COP21.

The Strategic Action Roadmap was prepared by the International Expert Working Group on Oceans and Climate, composed of 37 experts from the 46 partner organizations of the Oceans Day at COP 21, and coordinated by the Global Ocean Forum; IOC/UNESCO; UNEP; Sasakawa Peace Foundation, Japan; and the University of Delaware. For each of the major issues within the Strategic Action Roadmap on Oceans and Climate, members of the International Expert Working Group were asked to present: 1) the current status of the issue (and, as relevant, the science related to the issue); 2) the current state of play of the issue within the UNFCCC; 3) the opportunities and pathways that may be available within the UNFCCC to advance the issue in the next five years, 4) the opportunities and pathways that may be available outside of the UNFCCC to advance the issue; 5) financial considerations regarding each issue.

Following the production of this Strategic Action Roadmap report, the **Global Strategic Action Initiative on Oceans and Climate** (involving Parties, IGOs, NGOs, academic institutions, private sector groups, and local authorities) will be launched at COP 22 in Marrakesh, Morocco (November 7 to 18, 2016) to begin implementation of the recommendations contained within this Roadmap. The Initiative will, inter alia: further operationalize the major components, including development of specific targets, indicators, and timetables; mobilize resources; implement specific actions in each of the major areas on oceans and climate jointly with national and local level leaders and other partners; develop a knowledge management and reporting mechanism to report to the COP yearly.

Implementing the policy commendations contained within the Roadmap begins with a strong oceans presence at COP 22, where the partner organizations involved with this Initiative are working closely with the Government of Morocco and other organizers in the coordination of the Oceans Action Day at COP 22, part of the UNFCCC Global Climate Action Agenda. At COP 22 and beyond, the Initiative will organize various meetings to create "alliances of the willing" to implement the recommendations contained in this report and to bring these results into the policy processes associated with the implementation of the Paris Agreement.

Readers of the Strategic Action Roadmap on Oceans and Climate should know that this represents an open work in progress, and all UNFCCC Parties, IGOs, NGOs, and academic or private sector institutions are welcome to comment on and contribute to the advancement of oceans and climate issues over the next five years.

Summary of Policy Recommendations on Oceans and Climate

1. Recognize the central role of oceans in climate and the need to implement stringent reductions in greenhouse gas emissions to avoid disastrous consequences on coastal and island communities, marine ecosystems, and ocean chemistry.

2. Mitigation

Further develop and apply mitigation measures using the oceans, such as implementing "Blue carbon" policies, reducing CO_2 emissions from ships, developing ocean-based renewable energy, and considering (long-term/no-harm) ocean-based carbon capture and storage.

Encourage all nations to reduce CO_2 emissions so that the Paris Agreement to limit emissions to well below 2oC can be achieved.

--Sustainably conserve and enhance coastal ecosystems as major carbon sinks and integrate the management of the coastal carbon ecosystems ("Blue Carbon") into the policy and financing processes of the UNFCCC, and account for these ecosystems in the national reports to the UNFCCC, the INDCs (Intended Nationally Determined Contributions).

--Further accelerate progress in addressing air emissions from ships

--Sustainably develop ocean-based renewable energy (such as offshore wind power, wave energy, tidal power, and aquatic biofuels); and accelerate efforts to implement these approaches through integrated marine planning and enhanced regulatory frameworks

--Consider the potential for ocean-based carbon capture and storage, and, if appropriate, further develop regulatory systems for ocean-based sequestration and marine engineering

3. Adaptation

Implement ecosystem-based adaptation (EbA) strategies through integrated coastal and ocean management institutions at national, regional, and local levels to reduce vulnerability of coastal/ocean ecosystems and of human settlements, and to build the management capacity, preparedness, resilience, and adaptive capacities of coastal and island communities.

--Carry out adaptation measures through the integrated coastal and ocean management institutions created at national and local levels in all regions of the world since the 1992 Earth Summit, in close cooperation with disaster risk agencies and affected sectors and communities

--Apply ecosystem-based approaches to adaptation, especially regarding green infrastructure to provide natural system protection for defense against sea level rise, saltwater intrusion, storms, and flooding

--Establish and effectively manage coherent networks of marine protected areas in national and international waters to protect marine biodiversity and to enhance resilience of marine ecosystems to climate change, achieving the Convention on Biological Diversity's Aichi Biodiversity Target of conserving at least 10% of marine and coastal areas by 2020

--Promote and apply Blue Economy approaches with emphasis on low-carbon solutions and economic benefits to developing countries and SIDS (following SDG target 14.7)

4. Displacement

Develop and support measures to address the issues associated with the displacement of coastal and island populations as a result of climate change, which will necessitate improvement of international law, in terms of clarity of definitions, rights, and procedures for climate-induced refugees and migrants, including the development and implementation of appropriate financing measures.

The International Organization for Migrants (IOM) projects 200 million people will be displaced by 2050 due to overall environmental changes; a proactive strategy must be taken to reduce humanitarian, financial and other losses.

5. Financing

Adaptation and mitigation efforts in coastal and SIDS countries/communities should receive sufficient funding, through: 1) directing a significant portion of the current climate funds to coastal and SIDS

issues, and 2) developing supplementary financing to support adaptation and mitigation methods through innovative approaches and partnerships, entailing:

--Thorough examination of assessments of costs of adaptation, mitigation, and displacement

--Development of a financial tracking mechanism to report on financial flows to support climate change efforts related to oceans and coasts

--Earmarked funds in global public finance mechanisms to support adaptation and mitigation in coastal areas and SIDS

--Earmarked 10% of public and private investments in coastal infrastructure for coastal restoration

6. Capacity Development

Provide technical and financial assistance to SIDS, developing countries, and economies in transition to build capacity in the form of knowledge, tools, and scientific and political expertise to empower people to implement mitigation and adaptation measures, develop adaptive management capacity, early warning systems, and disaster risk reduction, and develop knowledge management mechanisms to share knowledge among all countries within and outside the UNFCCC frameworks.

--Promote the further enhancement of marine policy centers in developing countries and SIDS to build capacity in management and policy related to oceans and climate

--Strengthen the advancement of global marine observations, research, and related capacity development within the UNFCCC processes and beyond

--Support the preparation of the IPCC report on oceans and the cryosphere--to integrate and update the assessment of AR5 using scientific findings on the central role of oceans and climate and likely scenarios and consequences

--Include sustained ocean observation as part of national commitments, particularly within the framework of the UNFCCC and Agenda 2030/SDG 14 (target 14.a), in response to the call to increase knowledge to manage marine ecosystems sustainably, and understand the impacts of climate change and ocean acidification

--Enhance technical capacity development of vulnerable countries through the establishment of regional oceanographic centers to increase cooperation among States on ocean-climate research and multi-disciplinary observation (in accordance with SAMOA Pathway decision 58.f)

--Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels and the continued development of the Global Ocean Acidification Observing Network (SDG 14.3)

--Expand public outreach and education efforts, following the Lima Declaration on Education and Awareness-raising (COP 20, 2014), to enhance individual capacity and public understanding of the ocean's role in planetary survival and in global and national well-being, of the risks posed to SIDS and coastal communities by climate change, and to catalyse public support for mitigation and adaptation responses

Introduction

The purposes of this proposed **Strategic Action Roadmap on Oceans and Climate 2016 to 2021** are: 1) to suggest priority action items in each of six ocean and climate issue areas—central role of oceans in climate, mitigation, adaptation, displacement, financing, and capacity development (including scientific assessment and public education), and 2) to convey this information and policy priorities to decision-makers and multiple stakeholders at global levels, especially within the UN Framework on Climate Change (UNFCCC) and other relevant international processes, and to national governments as they are the main agents for policy implementation.

The draft Action Roadmap presents an analysis and a set of policy recommendations emerging from the work of the International Expert Working Group on Oceans and Climate, composed of 37 experts from the 46 partner organizations of the Oceans Day at COP 21 (held at the UNFCCC Conference of the Parties 21 (COP 21), Paris, on December 4, 2015), and coordinated by the Global Ocean Forum; IOC/UNESCO; UNEP; Sasakawa Peace Foundation, Japan; and the University of Delaware Gerard J. Mangone Center for Marine Policy, together with other co-organizers.

For each of the major issues related to oceans and climate members of the International Working Group were asked to analyze: 1) the current status of the issue (and, as relevant, the science related to the issue); 2) the current state of play of the issue within the UNFCCC; 3) the opportunities and pathways that may be available within the UNFCCC to advance the issue in the next five years, 4) the opportunities and pathways that may be available outside of the UNFCCC to advance the issue; 5) financial considerations regarding each issue. The draft policy recommendations were showcased at the Oceans Day at COP 21, and then further refined in the months following the COP 21.

A summary of the policy recommendations and suggested strategic actions may be found in the Executive Summary as well as in Box I.3, on pages 9-10; the recommendations are discussed in detail in the relevant report sections of the report.

The Global Strategic Action Initiative on Oceans and Climate (involving Parties, international agencies, NGOs, scientific institutions, private sector, and local authorities) will be launched at COP 22 to begin implementation of the Roadmap including, through, inter alia: further operationalization of the major components, including development of specific targets, indicators, and timetables; mobilization of resources; implementtation of specific actions in each of the major areas on oceans and climate jointly with national and local level leaders and other partners; development of a knowledge management and reporting mechanism to report to the COP yearly.

The reader should note that this effort represents work in progress and is open to all interested UNFCCC Parties, international organizations, NGOs, and private sector wishing to contribute to advancing the issues related to oceans and climate in the next five years.

The Central Role of Oceans in Planetary Survival and in Human Economic and Social Well-being

Oceans are essential to supporting life on Earth, and are of great economic, social, and cultural significance to all countries, including 183 coastal countries and island states.

Oceans are the life support system of the planet, producing half of the oxygen that we breathe. Since industrialization began, they have absorbed nearly 28% of carbon dioxide in the atmosphere, 93% of the heat added to the global system (between 1971 and 2010), and nearly all the water from melting ice, resulting in ocean warming, ocean acidification, and sea level rise.[1] However, anthropogenic climate change is threatening the critical role of oceans and seas in climate regulation, marine biodiversity and marine ecosystem integrity, food security, livelihoods, human well-being, and the global economy.

Ocean and coastal areas provide critical social, economic, and nutritional benefits and are essential to the well-being of global and national economies. It is estimated that the ocean provides an estimated

US$3-6 trillion to the global economy,[2] supports 90% of global trade through shipping; and fisheries nourish around 4.2 billion people with more than 15% of the animal protein they consume. [3]

However, coastal and island populations, who rely most on the services provided by the sea, are some of the most vulnerable populations to climate change impacts. Oceans, seas, and coastal areas experience an increased frequency and intensity of climate extremes, including stronger hurricanes, typhoons, and cyclones. They are also subject to ocean warming, acidification and deoxygenation, sea level rise, and fluctuations in ocean circulation and salinity—due to increased CO_2 emissions to the atmosphere, mainly due to burning fossil fuels. By 2050, it is estimated that 50 million to 200 million people worldwide will be displaced due to the negative impacts of climate change, threatening food security, livelihoods, and peace.[4]

It is imperative that climate change impacts on oceans and coastal and SIDS populations be considered both within and outside the UNFCCC, both for our planetary survival and for human well-being.

International Recognition of the Role of Oceans in Planetary Survival and in Human Economic and Social Well-being

Peoples and governments around the world understand and appreciate the central role of oceans in planetary survival and human well-being. Oceans have been prominently featured in the 1992 Earth Summit (Chapter 17, the longest chapter of Agenda 21), in the specific targets and timetables developed at the 2002 World Summit on Sustainable Development, and in the 2012 Rio+20 Conference (in particular in the outcome document, *The Future We Want*).[5] These summits have also underlined the important role of the 1982 UN Law of the Sea Convention for sustainable development, which sets out the legal framework within which all activities in the oceans and seas must be carried out. Most recently, in 2014-2015, oceans and seas have been recognized as one of the 17 Sustainable Development Goals to be included in the UN 2030 development agenda.[6] Goal 14 reads "Conserve and sustainably use the oceans, seas, and marine resources for sustainable development," and its inclusion as a balanced, stand-alone goal appropriately underscores the importance of ocean issues.[7] It is broken into practical, ambitious sub-goals, including targets such as the conservation of "at least 10 per cent of coastal and marine areas," the expansion of "economic benefits to SIDS and LDCs from the sustainable use of marine resources," and the prevention of "marine pollution of all kinds."[8] As well, the UN General Assembly has emphasized the "critical role of oceans and seas for climate regulation, food security, livelihoods, human well-being, and more generally for the global economy."[9]

Since 2006, the United Nations General Assembly (UNGA) has addressed issues related to climate change and oceans in its resolutions on oceans and the law of the sea.[10] In particular, for several years, the UNGA has reiterated its serious concern at the current and projected adverse effects of climate change, ocean deoxygenation, and ocean acidification on the marine environment and marine biodiversity, and emphasized the urgency of addressing these issues. The UNGA has encouraged scientific activity to better understand the effects of climate change on the marine environment and marine biodiversity, the oceans-atmosphere interface and to develop ways and means of adaptation, taking into account, as appropriate, the precautionary approach and ecosystem approaches. In this context, the Assembly underlined the importance of ensuring that assessments, such as those prepared under the Intergovernmental Panel on Climate Change, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services and the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socio-economic Aspects (the Regular Process), support one another and avoid unnecessary duplication. The UNGA called upon the international community to enhance its efforts to address sea-level rise and coastal erosion and addressed the vulnerabilities of specific ecosystems, such as the need to improve efforts to address coral bleaching; and the vulnerability of the environment and the fragile ecosystems of the polar regions, including the Arctic Ocean and the Arctic ice cap.[11]

Following the publication of the IPCC Fifth Assessment Report, the General Assembly has recognized the importance of raising awareness of the adverse impact of climate change on the marine environment and marine biodiversity, including in the context of the United Nations Framework Convention on Climate Change (UNFCCC) and noted the role of "Oceans Day at the twenty-first session of the Conference of the Parties to the United Nations Framework Convention on Climate Change."[12]

In its resolutions on sustainable fisheries, the General Assembly has expressed concern over the current and projected adverse effects of climate change on food security and the sustainability of fisheries and urged States, either directly or through appropriate subregional, regional or global organizations or arrangements, to intensify efforts to assess and address the impacts of global climate change and ocean acidification on the sustainability of fish stocks and the habitats that support them, in particular the most affected ones.[13]

In the context of UNFCCC, however, until COP 21 (November/December 2015 in Paris, France), the ocean and climate issues had figured only in a limited way in the formal UNFCCC deliberations. In the original formulation of the Convention in 1992, oceans and coasts are referred in two places.[14] With the advent of Oceans Days at the COPs (Oceans Days have been held at Copenhagen in 2009, Cancun in 2010, Durban in 2011,[15] and in Paris in 2015), and through the enhanced participation by many civil society, academic, and observer groups starting especially at the 2009 Copenhagen COP, there has been enhanced awareness and understanding in the UNFCCC processes of some of the oceans and climate issues, especially regarding the impacts of sea level rise, ocean deoxygenation, and of ocean acidification, and of the role of "Blue Carbon" in carbon sequestration and storage.

Experts and actors in the ocean community have called for oceans to play a more central role in the UNFCCC context, since they understand that the oceans plays a central role in climate and that it is the largest carbon sink. The ocean is the primary regulator of Earth's climate and weather, produces 50% of the oxygen in the atmosphere and fixes 50% of global primary production. The ocean is also an important recycler of waste and an enormous store of carbon, substantially greater than the land biosphere or in the atmosphere. It plays a key role in the global water and carbon cycles. It especially influences the climate through the regulation of the amount of CO_2 and heat in the atmosphere. Coastal ecosystems, such as mangroves, salt marshes, seagrass, and kelp beds take up, lay down, and store great amounts of carbon while also protecting shorelines from storms. Many of these planetary roles are literally priceless and are performed by a series of biogeochemical processes regulated by marine organisms as well as the important physical processes of ocean mixing, tides, currents, and air–sea exchange.

It is important to recall, however, that the UNFCCC is an international agreement about reducing and controlling emissions of greenhouse gases, and that promotion of the oceans agenda within the UNFCCC must conform to the mandate, language, and processes of the UNFCCC, and to its central missions of setting global targets on greenhouse emissions reductions, monitoring systems, and providing guidance and assistance to all nations and actors to implement these successfully at global, national, and subnational levels. This proposed Action Roadmap aims to put the oceans and climate issues in the context of the UNFCCC mandate, language, and processes, as an essential step in the process of achieving the desired policy results regarding the impacts of climate change on oceans and on island and coastal communities around the world.

Mobilization of the Ocean Community at COP 21

COP 21 in Paris saw unprecedented mobilization of the oceans community from around the world to articulate the central importance of oceans in the climate system and to underscore that coastal populations and SIDS will need enhanced capacity and financial resources to address the adverse impacts of climate change. Over 150 parties and organizations were mobilized (including governments, international organizations, IGOs, NGOs, academia and science groups, and private sector), and over 40 ocean events were held to highlight the oceans and climate issues.

The Oceans Day at COP 21

The high-level Oceans Day at COP 21 (held on December 4, 2015 in Paris) brought together over 400 participants from all regions and lent political support to the adoption of the ambitious Paris Agreement, and put forth an agenda for action for the next five years on oceans and climate. It stressed the need for recognizing the central role of the oceans in regulating climate, and the fact that the ocean will not be able to perform these functions in the future if GHG emissions and global warming continue unabated.[16]

The Oceans Day at COP 21:

- Highlighted the major climate and oceans issues, with emphasis on the impacts on the most vulnerable peoples and ecosystems, suggesting next steps, both within and outside the UNFCCC framework

- Engaged political leaders to move forward on the major climate and oceans issues and solutions
- Mobilized collaboration in the development of a five-year strategic plan on oceans and climate to guide policy and action

The Oceans Day at COP 21 was organized by 46 entities, from governments, international agencies, IGOs, NGOs, and academic and scientific institutions, representing a broad alliance of interests and perspectives related to oceans and climate, noted in Box I.1.

Oceans Day at COP 21 involved high-level speakers from governments, leaders of IGOs and NGOs, and technical experts, as highlighted in Box I.2. For each of the major issues discussed (Central role of oceans in climate, Mitigation, Adaptation, Displacement, Financing, and Capacity Development), members of the International Expert Working Group on Oceans and Climate presented stage-setting papers presenting on the status of the issue, its importance, and strategic steps that could be taken to advance the issue in the next five years, both within and outside of the UNFCCC.

The Oceans Day at COP 21 stressed the need for concluding an ambitious legally-binding agreement with stringent reductions in greenhouse gas emissions as essential to avoid disastrous consequences for the ocean and for coastal and island peoples. An important start was achieved with the landmark Paris Agreement. The Paris Agreement and the associated UNFCCC decisions offer significant opportunities for pursuing the policy recommendations and strategic actions detailed in this report. The Conclusion of this report elaborates on the progress made by the Paris Agreement and the opportunities for action that it created.

Box I.1 Organization of Oceans Day at COP 21

Main organizers: The Global Ocean Forum, IOC/UNESCO, UNEP, Sasakawa Peace Foundation, Japan, Ocean and Climate Platform, and the University of Delaware Gerard J. Mangone Center for Marine Policy

Co-organizers:
Governments of Grenada, Indonesia, Portugal, Seychelles, South Africa, and Sweden

Intergovernmental/International Organizations: GEF, CBD, FAO, GEF/UNDP/UNEP African Large Marine Ecosystems Project, the International Atomic Energy Agency, the Pacific Islands Forum,
The Pacific Community, the Secretariat of the Pacific Regional Environmental Programme, the World Bank, the World Meteorological Organization

Non-governmental Organizations: the EUCC, Forum do Mar of Brazil, Global Island Partnership, the Institute for Sustainable Development and International Relations (IDDRI), the Institute Oceanographique of Monaco, IUCN, the Partnership for Climate, Fisheries, and Aquaculture, the Prince Albert II of Monaco Foundation, the Nature Conservancy, the World Ocean Network, the World Ocean Observatory, the WWF, the Deep-Ocean Stewardship Initiative (DOSI), and Nausicaa

Academic/Scientific/Public Outreach Institutions: Center for Coastal Studies of Massachusetts, Centre National de la Recherche Scientifique of France, Duke University's Nicholas Institute for Environmental Policy Solutions, the Global Change Institute of Queensland, the Instituto Politecnico Nacional of Mexico, Monmouth University, Oceanario de Lisboa, Scripps Institution of Oceanography, Plymouth Marine Laboratory, Turkish Marine Research Foundation, and Tara Expeditions.

Box I.2 Oceans Day at COP 21 Major Speakers

Governments: H.S.H Prince Albert II of Monaco, H.E. Mr. Tommy E. Remengasau, Jr. President of Palau, H.E. Minister Mme Ségolène Royal, Minister of Ecology, Sustainable Development and Energy, France, H.E. Mr. Ronald Jumeau, Ambassador for Climate Change and Small Island Developing States, Seychelles, H.E. Greg Hunt, Minister of the Environment, Australia, H.E. Mr. Manuel Pulgar-Vidal, Minister of State for Environment, Peru, H.E. Dr. Angus Friday, Ambassador to the United States, Grenada, Dr. Hans Hoogeveen, Vice-Minister for Agriculture The Netherlands, Mr. Luke Daunivalu, Fiji, H.E. Mr. Karmenu Vella, EU Commissioner, H.E. Minister John Pundari, Papua New Guinea, H.E. Dr. Lisa Svensson, Sweden, Ms. Catherine Novelli, US Department of State, H.E. Yuriko Koike, Japan, Sir David King, United Kingdom, Dr. Monde Mayekiso, South Africa, H.E. Mr. Heremoana Mamaatuaiahutapu, French Polynesia, H.E. Ms. Ambassador Ngedikes Olai Uludong, Palau; Mr. Samuel Kame Domguia, African Union, Dr. Ir. Achmad Poernomo, the Republic of Indonesia

Intergovernmental/International Organizations: Dr. Irina Bokova, United Nations Educational, Scientific and Cultural Organization, Ms. Naoko Ishii, Global Environment Facility, Mr. Michel Jarraud, World Meteorological Organization, Dr. Braulio Ferreira de Souza Dias, Convention on Biological Diversity Secretariat, Dr. Vladimir Ryabinin, Intergovernmental Oceanographic Commission of UNESCO, Dr. Ibrahim Thiaw, United Nations Environment Programme, Dr. Helena Semedo, Food and Agriculture Organization of the United Nations, Ms. Paula Caballero, World Bank, Prof. Hans Pörtner, Intergovernmental Panel on Climate Change (IPCC), Dr. Edmund Hughes, International Maritime Organization (IMO), Dame Meg Taylor, Pacific Islands Forum Secretariat, and Pacific Ocean Commissioner, Dr. Raphaël Billé, Secretariat of the Pacific Community, Mr. Rawleston Moore, GEF, Dr. Hashali Hamukuaya, Benguela Current Commission, GEF/UNDP/UNEP African Large Marine Ecosystem Projects

Civil Society: Ms Mary Robinson, Mary Robinson Foundation–Climate Justice, Ms. Inger Andersen, IUCN, , Dr. Biliana Cicin-Sain, Global Ocean Forum and Univ. of Delaware, Mr. Francis Vallat, European Network of Maritime Clusters, Ms. Maria Damanaki, The Nature Conservancy, Ms. Dorothée Herr, IUCN, Mr. Romain Troublé, Tara Expeditions and Ocean and Climate Platform, Mr. Hiroshi Terashima, Ocean Policy Research Institute, Sasakawa Peace Foundation, Japan, Mr. John Tanzer, WWF International, Ms. Catherine Chabaud, Innovation Bleues and Ocean and Climate Platform, Mr. Langston James "Kimo" Goree, Earth Negotiations Bulletin, Mr. Philippe Vallette, Nausicaá National Sea Center, France, and the World Ocean Network, José Soares dos Santos, Sociedade Francisco Manuel dos Santos, Portugal, Prof. Carol Turley, Plymouth Marine Laboratory, UK, Dr. Brian Murray, Environmental Economics Program, Duke University, Mr. Angus Garrett, Seafish, UK.

Other Related Efforts to Advance Oceans at COP21 the Ocean and Climate Platform

There were many efforts to raise the profile of ocean and climate at COP 21; two are highlighted here.

The Ocean and Climate Platform, a main co-organizer of the Oceans Day at COP 21, brings together over 70 organizations (especially non-governmental organizations and research institutes), to focus on oceans and climate interactions, bringing the perspectives of the scientific community and of the general public into the UNFCCC deliberations. At COP 21, the Platform organized the Forum on Oceans and Climate, focused on disseminating the results of scientific research and at mobilizing public interest in the oceans and climate issues, and relayed the results of the Forum to Oceans Day at COP 21.

The **"Because the Ocean" Declaration** was presented at a side event organized by the Chilean Foreign Affairs Ministry, the French Ministry of Ecology, the Prince Albert II of Monaco Foundation, the Global Ocean Commission, the Institute on Sustainable Development and International Relations, and Tara Expeditions. It presented three objectives, which align closely with the recommendations in this action roadmap: work toward 1) a special report on the ocean by the Intergovernmental Panel on Climate Change (IPCC); 2) development of an ocean action plan under the UN Framework Convention on Climate Change (UNFCCC); and 3) the UN Ocean Sustainable Development Goal 14 Conference in in June 2017, which is expected to establish a regular review of SDG 14 on oceans and marine resources.

An Agenda for Oceans and Climate 2016-2021

The major policy recommendations on oceans and climate emanating from the Oceans Day at COP 21 to pursue within and outside the UNFCCC in the next five years, in the context of the implementation of the Paris Agreement, are summarized in **Box I.3.** These

recommendations are discussed in detail in the following sections of this report.

Box I.3. Summary of Policy Recommendations on Oceans and Climate

1. ***Recognize the central role of oceans in climate and the need to implement stringent reductions in greenhouse gas emissions to avoid disastrous consequences on coastal and island communities, marine ecosystems, and ocean chemistry.***

2. Mitigation

Further develop and apply mitigation measures using the oceans, such as implementing "Blue carbon" policies, reducing CO_2 emissions from ships, developing ocean-based renewable energy, and considering (long-term/no-harm) ocean-based carbon capture and storage.

Encourage all nations to reduce CO_2 emissions so that the Paris Agreement to limit emissions to well below 2°C can be achieved.

- Sustainably conserve and enhance coastal ecosystems as major carbon sinks and integrate the management of the coastal carbon ecosystems ("Blue Carbon") into the policy and financing processes of the UNFCCC, and account for these ecosystems in the national reports to the UNFCCC, the INDCs (Intended Nationally Determined Contributions)
- Further accelerate progress in addressing air emissions from ships
- Sustainably develop ocean-based renewable energy (such as offshore wind power, wave energy, tidal power, and aquatic biofuels); and accelerate efforts to implement these approaches through integrated marine planning and enhanced regulatory frameworks
- Consider the potential for ocean-based carbon capture and storage, and, if appropriate, further develop regulatory systems for ocean-based sequestration and marine engineering

3. Adaptation

Implement ecosystem-based adaptation (EbA) strategies through integrated coastal and ocean management institutions at national, regional, and local levels to reduce vulnerability of coastal/ocean ecosystems and of human settlements, and to build the management capacity, preparedness, resilience, and adaptive capacities of coastal and island communities.

- Carry out adaptation measures through the integrated coastal and ocean management institutions created at national and local levels in all regions of the world since the 1992 Earth Summit, in close cooperation with disaster risk agencies and affected sectors and communities
- Apply ecosystem-based approaches to adaptation, especially regarding green infrastructure to provide natural system protection for defense against sea level rise, saltwater intrusion, storms, and flooding
- Establish and effectively manage coherent networks of marine protected areas in national and international waters to protect marine biodiversity and to enhance resilience of marine ecosystems to climate change, achieving the Convention on Biological Diversity's Aichi Biodiversity Target of conserving at least 10% of marine and coastal areas by 2020
- Promote and apply Blue Economy approaches with emphasis on low-carbon solutions and economic benefits to developing countries and SIDS (following SDG target 14.7)

4. Displacement

Develop and support measures to address the issues associated with the displacement of coastal and island populations as a result of climate change, which will necessitate improvement of international law, in terms of clarity of definitions, rights, and procedures for climate-induced refugees and migrants, including the development and implementation of appropriate financing measures.

The International Organization for Migrants (IOM) projects 200 million people will be displaced by 2050 due to overall environmental changes; a proactive strategy must be taken to reduce humanitarian, financial and other losses.

5. Financing

Adaptation and mitigation efforts in coastal and SIDS countries/communities should receive sufficient funding, through: 1) directing a significant portion of the current climate funds to coastal and SIDS issues, and 2) developing supplementary financing to support adaptation and mitigation methods through innovative approaches and partnerships, entailing:

- Thorough examination of assessments of costs of adaptation, mitigation, and displacement
- Development of a financial tracking mechanism to report on financial flows to support climate change efforts related to oceans and coasts
- Earmarked funds in global public finance mechanisms to support adaptation and mitigation in coastal areas and SIDS
- Earmarked 10% of public and private investments in coastal infrastructure for coastal restoration

6. Capacity Development

Provide technical and financial assistance to SIDS, developing countries, and economies in transition to build capacity in the form of knowledge, tools, and scientific and political expertise to empower people to implement mitigation and adaptation measures, develop adaptive management capacity, early warning systems, and disaster risk reduction, and develop knowledge management mechanisms to share knowledge among all countries within and outside the UNFCCC frameworks.

- Promote the further enhancement of marine policy centers in developing countries and SIDS to build capacity in management and policy related to oceans and climate
- Strengthen the advancement of global marine observations, research, and related capacity development within the UNFCCC processes and beyond
- Support the preparation of the IPCC report on oceans and the cryosphere--to integrate and update the assessment of AR5 using scientific findings on the central role of oceans and climate and likely scenarios and consequences
- Include sustained ocean observation as part of national commitments, particularly within the framework of the UNFCCC and Agenda 2030/SDG 14 (target 14.a), in response to the call to increase knowledge to manage marine ecosystems sustainably, and understand the impacts of climate change and ocean acidification
- Enhance technical capacity development of vulnerable countries through the establishment of regional oceanographic centers to increase cooperation among States on ocean-climate research and multi-disciplinary observation (in accordance with SAMOA Pathway decision 58.f)
- Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels and the continued development of the Global Ocean Acidification Observing Network (SDG 14.3)
- Expand public outreach and education efforts, following the Lima Declaration on Education and Awareness-raising (COP 20, 2014), to enhance individual capacity and public understanding of the ocean's role in planetary survival and in global and national well-being, of the risks posed to SIDS and coastal communities by climate change, and to catalyse public support for mitigation and adaptation responses

The Landmark Paris Agreement Reached at COP 21

The Paris Climate Change Conference, bringing together the 21st session of the Conference of the Parties (COP 21) to the UN Framework Convention on Climate Change (UNFCCC) and the 11th session of the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (CMP 11) convened from 29 November to 13 December 2015, in Paris, France, and brought together over 36,000 participants, including nearly 23,100 government officials, 9,400 international organizations and civil society, and 3,700 members of the media.[17]

President Francois Hollande of France set the tone for the conference by noting that "We are in a fight for our lives." At the outset, there was great skepticism that the consensus on the Paris

Agreement could be achieved. Deep divisions existed among nations especially around the following issues:

--the global target of keeping temperature rise to less than 2°C or 1.5°C (the 2°C target had been established in Copenhagen in 2009, but the 1.5°C goal had long been advocated by the 44 small island developing States, "1.5 to stay alive," referring to the threats of sea level rise, increased floods and storms which could obliterate their homes and nations)

--the extent to which developing countries should have equal or differentiated responsibilities in responding to climate change

--the extent to which developed nations should provide financing for adaptation and mitigation, as well as for "loss and damage" incurred by developing nations and SIDS

--the extent to which there should be regular, monitored, and transparent reviews of countries' climate pledges

Nonetheless, at the end of COP 21, the historic universal and legally-binding Paris Agreement was agreed to by 195 nations on December 12, 2015. Conclusion of the Paris Agreement represented a landmark achievement, marking a common political will to stem the rise of global warming and shift from fossil fuels and giving hope to the world that the disastrous consequences associated with climate change could be averted. Some of the concluding comments by delegations at the adoption of the agreement provide a flavor of the perceived significance of the adoption of the Agreement:[18] "This is a transformational agreement, a triumph of multilateralism" (Morocco); "This marks a new path for our planet… we have reached an agreement that will help the world transition to a global low-carbon economy" (US); "We have reached a fair, flexible, and ambitious agreement that will lead to a carbon-neutral world" (Switzerland); "This is a marvelous action, balancing world interests with national interests" (China); "… the Agreement represents a new chapter of hope… as Ghandi had noted, 'We should care for the world we will not see'" (India); "… for the first time, the interests of the small island developing States (SIDS) were taken into account… and the goal of 1.5 C will keep us alive…" (St. Lucia, on behalf of the Caribbean states).

Country delegates unanimously welcomed the leadership role of France in its management of the negotiations and the central role in building consensus of France's Foreign Minister Laurent Fabius. As well, reportedly a pivotal role in the achieving of consensus was played by the "high ambition coalition"[19] informally led by Tony de Brum, Foreign Minister of the Marshall Islands, one of the countries most affected by climate change, and including other SIDS countries, the EU, US, and other countries from Africa, Asia, Europe and Latin America.

Looking Ahead

The experts and stakeholders involved in the preparation of this Strategic Action Roadmap on Oceans and Climate and the Oceans Day at COP 21 have identified a set of important steps which could further ocean and climate issues in the next five years. The Paris Agreement offers a receptive environment for stakeholder initiatives; the Agreement "welcomes the efforts of all non-Party stakeholders to address and respond to climate change, including those of civil society, the private sector, financial institutions, cities and other subnational authorities."

Next steps will begin with the partners involved in this effort and others to identify of what needs to be done on each major recommendation outlined in this Strategic Action Roadmap on Oceans and Climate within and outside of UNFCCC, with a 5-year time frame, and identifying priority actions for the first year. This Initiative will invite a High-Level Leaders Group to guide the effort, involving key actors in the UNFCCC process and other ocean leaders.

The Initiative will plan for a strong oceans presence at COP 22 in Marrakech, Morocco (November 7 to 18, 2016) working closely with the Government of Morocco and other organizers in the organization of the Oceans Action Day at COP 22, part of the UNFCCC Global Climate Action Agenda. At COP 22 and beyond, the Initiative will organize various meetings to create "alliances of the willing" to implement the recommendations contained in this report and to bring these results into the policy processes associated with the implementation of the Paris Agreement.

Initial implementation of items on the agenda on oceans and climate will be ongoing but must begin

as soon as possible. Some major opportunities for the first year are noted below.

1) Comment on, help shape, and support the planned IPCC reports on oceans and the cryosphere and on the impacts of global warming of 1.5C above pre-industrial levels (discussed in more detail in the Conclusion section).

2) Review of the Intended Nationally Determined Contributions (INDCs) Submitted by Nations and Their Oceans-Related Content. Review the INDCs submitted by SIDS nations and other nations that have included oceans and coasts in their INDCs to determine how these can be supported and realized, with the intention of developing a guide for nations on the inclusion and consideration of oceans and coasts in their national reports.

3) Financial Tracking Mechanism. Develop a Financial Tracking mechanism to examine and report on financial flows to support climate change responses in coastal and SIDS countries and communities. This work will place a special emphasis on Blue Economy approaches, especially by showing successful examples of Blue Economy strategies at COP 22. Given the estimated costs of SDG 14 and ocean adaptation to developing nations and SIDS, significant public and private capital will be needed over the coming decades.

4) Capacity Development and Public and Decision-maker Awareness on Oceans and Climate. Support capacity development among coastal and SIDS populations, bringing the ocean, coastal, and SIDS recommendations contained in this Strategic Action Roadmap on Oceans and Climate into the process of the newly established UNFCCC Committee on Capacity Building. As well, further work must be mobilized conveying information to the public and to decision-makers on the impacts of and responses to climate change impacts on coastal and SIDS nations around the world.

The Paris Agreement offers us hope for averting the worst impacts of climate change. It represents several landmarks steps in recognizing ocean and climate issues, particularly by acknowledging ocean ecosystems in its preamble and by marking the ambitious goal of limiting warming to 1.5C. The latter is especially significant to coastal and SIDS populations, for whom the goal of 2.0C is not sufficient to protect their survival, livelihoods, and the health of the oceans on which their economies depend.

The High-Level Climate Champions, H.E. Dr. Hakima El Haité, Minister Delegate to the Minister of Energy, Mines, Water, and the Environment, Morocco, and H.E. Ambassador Laurence Tubiana, France, released their Road Map for Global Climate Action in June 2016 as a follow-up to the Paris Agreement. Echoing the sense of urgency that was pervasive at COP 21 and that drove the creation of the Paris Agreement, the Champions noted that "there is a need to quick-start implementation with a sense of urgency and ambition; create an interface with the real world and solutions, particularly the involvement of non-Party stakeholders; and maintain the political momentum."

The emphasis on urgency and the participation of non-Party stakeholders, who have been active in representing ocean and climate issues, represents an important sea change in the international discussion around climate and ocean. We must take advantage of the momentum from Paris and influence every aspect of the implementation of the Paris Agreement in order to steadfastly advance the oceans and climate agenda within the UNFCCC and beyond.

1. The Central Role of Oceans in Planetary Survival and in Human Economic and Social Well-being: Choices for Decision-makers

The central tenet of this proposed Strategic Action Roadmap is that it is imperative that climate change impacts on oceans and coastal and SIDS populations be considered both within and outside the UNFCCC, both for our planetary survival and for human well-being.

Findings/Recommendation on the Central Role of Oceans in Climate

1.0 Recognize the central role of oceans in climate and the need to implement stringent reductions in greenhouse gas emissions to avoid disastrous consequences on coastal and island communities, marine ecosystems, and ocean chemistry.

Main Findings Regarding the Role of Oceans:

- The ocean and coasts provide critical ecosystem services, including biogeochemical and physical processes, making the ocean critical for planetary survival. Oceans and seas cycle over 28% of carbon dioxide emitted to the atmosphere from burning fossil fuels since 1750, produce 50% of the oxygen on Earth, store 50% of all naturally sequestered carbon, and absorbed 30% of the heat added to the global system since the 1970s.[20]

- Fisheries and aquaculture provide food for over 4 billion people and at least 50% of animal protein to 400 million people in the poorest countries. Fisheries and aquaculture alone support the livelihoods of 10-12% of the global population, including many vulnerable fishing and fish-farming communities.[21] Disruption of ocean processes could impact food security as well as livelihoods, such as those that are supported by coastal tourism.

- Oceans, seas, and coastal areas are experiencing an increased frequency and intensity of climate extremes, including stronger hurricanes, typhoons, and cyclones. Changes in ocean chemistry and temperature are causing ocean acidification, ocean deoxygenation, sea level rise, and fluctuations in ocean circulation and salinity. [22]

- As the concentration of greenhouse gasses increase, options to overcome or limit the risks on ocean ecosystems and on coastal and island populations will become fewer and less effective.

- Further scientific work is needed to understand the extent of climate change impacts between mean global temperature increases of 1.5 and 2.0^{o}C and thus help in decision-making.

- While emphasis must be placed on reducing CO_2 emissions in the future we know that impacts are already happening, so we must also consider adaptation strategies and corresponding financing measures for island and coastal populations.

- Two thirds of the ocean is within areas beyond national jurisdiction (ABNJ), and these areas play a key role in the processes discussed in this section. Therefore, successful policies must necessarily consider the preservation and sustainable management of ABNJ.

The Role of the Ocean in Planetary Survival and in Human Well-being

The ocean is the primary regulator of Earth's climate and weather, produces 50% of the oxygen in the atmosphere and fixes 50% of global primary production. The ocean is also an important recycler of waste and an enormous store of carbon, substantially greater than on land or in the atmosphere. It plays a key role in the global water and carbon cycles. It especially influences the climate through the regulation of the amount of CO_2 and heat in the atmosphere.[23] Currently, the ocean has taken up over 93% of the heat generated by warming of the Earth system over recent decades and all the water from melting ice.[24] Coastal ecosystems, such as man-groves, salt marshes, seagrass, and kelp beds take up, lay down, and store great amounts of carbon while also protecting shorelines from storms. Many of these planetary roles are literally priceless and are performed by a series of biogeochemical processes regulated by marine organisms as well as

the important physical processes of ocean mixing, tides, currents, and air–sea exchange.

Socio-Economic Effects of Climate Change on Oceans

The ocean provides enormous and diverse resources. It covers 70% of the planet, contributes ~96% of the living space on Earth, providing diverse habitats for 25% of eukaryotic organisms.[25] The ocean is of great economic, social, and cultural significance to all countries, including 183 coastal countries and island states. The substantial alteration in ocean physics and basic chemistry, and subsequent ocean warming, acidification, deoxygenation, storm frequency and intensity, and sea level rise—all emanating from climate change—are likely to have wide implications for life in the ocean with far-reaching socio-economic consequences.[26] Warming-induced deoxygenation will also lead to a significant reduction in the size of fishes and overall production.[27] Even countries or regions far from the coast will still experience the ocean's influence. For example, most of the rain that falls on land originates in tropical oceans.

Ocean and coastal areas are estimated to contribute US$3-6 trillion to the global economy.[28] For example, 90% of all goods (by volume) are transported via marine shipping, reinforcing the importance of the ocean and coasts to the global economy. Tropical coral reef ecosystems alone provide food, income, and coastal protection for around 500 million people throughout tropical coastal areas.[29] Healthy marine ecosystems also attract income from recreation, leisure and tourism, provide important aesthetic and spiritual experience and inspiration for culture, art and design as well as education and research. Ocean ecosystems are increasingly being explored for pharmaceutical and genetic products, as well as rare and precious metals.[30] Losing coral reefs could cost the tourism industry USD $1.9-12 billion per year.[31]

Fisheries and aquaculture provide essential proteins and nutrients to over 4 billion around the global, an especially important source in countries with low animal protein intake and livelihoods for hundreds of millions of people.[32] Aquaculture of both finfish and shellfish is increasingly important to world food security and the provision of both captured and cultured seafood results from a combination of primary and secondary production, biogeochemical cycling, and food web dynamics. The changing physics and chemistry of the ocean will disrupt these processes and create impacts throughout the supply chain, increasing risk for food and livelihood insecurity.[33] An overall reduction in marine diversity and abundances is expected to occur in a high CO_2 ocean;[34] nevertheless, not all species will be negatively affected. Some marine species that may be favoured also provide societal benefits, e.g. sea-grasses,[35] but some "nuisance" species, such as jellyfish, seem generally tolerant of ocean acidification and could increase in occurrence.[36]

World fisheries already face multiple challenges but some are now further subject to the combined global scale stressors of ocean acidification, warming, and deoxygenation.[37] As these increase with increased CO_2 emissions, so will the risk to fisheries and aqua-culture. For example, increasing water temperatures as well as deoxygenation will likely result in changes in distributions of marine species;[38] with most marine species ranges being driven toward the higher latitudes and habitat compression; leaving serious deficits in tropical countries where marine fish availability is predicted to decrease by as much as 40%.[39] This will have cascading effects on economic growth and jobs created through fisheries. For example, one model has projected a 21% drop in annual landed value, a 50% decline in fisheries-related jobs and an annual loss of US$311 million in 14 West African economies.[40]

Fisheries are not the only valuable resources in the oceans. Raw materials such as aggregates, oil, gas, minerals and water are extracted from the ocean and increasingly we harvest energy from ocean tides, waves and winds. Ocean ecosystems are increasingly being explored for pharmaceutical and genetic products. For example, patent claims on the genetic material of marine organisms grow an average of 12% per year.[41]

However, coastal and island populations are some of the most vulnerable populations to climate change impacts.[42] Oceans, seas, and coastal areas experience an increased frequency and intensity of climate extremes, including stronger hurricanes, typhoons, and cyclones. They are also subject to ocean warming, acidification and deoxygenation, sea level rise, and fluctuations in ocean circulation and salinity. Due to warming conditions, outbreaks of some water-borne diseases and infections, such as cholera, *Vibrio* and Ciguatera, may become more

common as species' ranges shift.[43] By 2050, it is estimated that 50-200 million people worldwide will be displaced due to the negative impacts of climate change, threatening food security, livelihoods, and peace.[44]

The effects of climate change are numerous. The effects vary globally and are all related. Whilst recognizing there are many important aspects, here we highlight four central issues: sea level rise and Pacific islands and coastal cities, changes to fisheries and aquaculture and attendant threats to global food security, ocean acidification, and ocean deoxygenation. These issues are summarized below and detailed in Boxes 1.1-1.5.

Sea Level Rise

Although the Pacific island and other small island developing states (SIDS) contributed little to climate change, sea level rise poses a threat to their survival and security—it has the potential to change coastlines, displace millions, and inundate coastal areas with sea water, ruining water supplies and crops (see Box 1.1). For 136 large coastal cities, the threat of sea level rise could necessitate the need to upgrade coastal defences, and could lead to retreat or abandonment of the city (see Box 1.2).

Fisheries and Aquaculture and Food Security

Climate change will have significant impacts on the four dimensions of food security through fisheries and aquaculture: varying the availability of aquatic foods, varying the stability of the fish supply, altering livelihoods due to altered access to aquatic foods and direct risks to safety at sea and fisheries and aquaculture infrastructure, and affecting the use of aquatic products and nutritional benefits from those products (see Box 1.3).

Ocean Acidification

While the socio-economic impacts of ocean acidification will vary locally, fisheries, coral reefs, and molluscs will be impacted, as well as sensitive areas such as the Arctic. The impact of ocean acidification on entire food chains and complex ecosystems remains poorly understood. Similarly, substantial additional research is required to understand how ocean acidification will compound other marine stressors, such as over fishing, pollution, rising temperatures and stratification. Action to understand, monitor, and respond to ocean acidification needs to be prioritized to reduce the effects on the economy and food security (see Box 1.4).

Ocean Deoxygenation

There are several anthropogenic factors which are contributing to increasing ocean deoxygenation. Although the activity most commonly associated with this phenomenon is eutrophication due to manufactured fertilizers, ocean warming has a significant impact on the solubility of oxygen in the ocean. The impacts of deoxygenation on aquatic ecosystems is dramatic, and has widespread consequences for several nutrient cycles. Further research is urgently needed to understand and monitor the causes, impacts, and potential solutions associated with deoxygenation (see Box 1.5).

Box 1.1 Sea Level Rise and the Pacific Islands Region: Threats to Survival and National Security

For the Pacific Islands region, anthropogenic climate change and its impacts are a matter of survival and national security. The Pacific Islands region is vast—containing about 10% of the global ocean—and has more than 33,000 islands. The Pacific Islands is home to a diverse range of peoples whose lifestyles have adapted to their environment over millennia. The ocean regulates weather and climate but this has been drastically affected by climate change. Sea level rise in particular represents an existential risk. Within the Pacific islands are four of the six lowest countries on Earth –-the atoll countries of Tuvalu, Kiribati, Republic of the Marshall Islands, and Tokelau. On average, the highest point in each country is between 3 to 4 metres. Additionally, some of the low lying outer islands of many Pacific Island countries are equally vulnerable. The IPCC predicts a sea level rise of up to one metre by 2100 under RCP 8.5, and by 2300 the projection is for a rise of 3 metres. If a business as usual scenario is allowed to continue, what is the world saying to these low-lying island countries?

This region contributes less than 0.03% of the world's total green-house gas emissions, yet it is amongst the most vulnerable to its impacts and the first to feel the impacts of climate change—the Pacific islands are on the frontline. The Pacific way of life is changing; sea level rise has ruined homes, gardens, water sources, buildings and infrastructure across the island region. Food security is threatened by salt water inundation, over-topping by waves, and by droughts. As each cyclone season app-roaches, the threat of extreme weather events causes widespread angst and trepidation.

Recent research has demonstrated that sea level rise is neither simple nor predictable, nor is the rise uniform across the region. Some islands actually appear to be increasing in horizontal size, due to the complicated processes of accretion and siltation, while others are rising or falling due to tectonic forces unrelated to sea level rise. Increasing in size doesn't necessarily mean increasing in height. The image of islands disappearing is thus overly simplistic, and does not reflect the overall range of climate change impacts. Long before islands disappear under the waves, how-ever, they will be uninhabitable, due to saltwater contamination of scarce groundwater supplies which provide the main potable water for atoll communities, which will make it impossible to grow food crops.

Apart from low-lying atolls, even the high volcanic islands of the Pacific will be impacted by sea level rise as most populations live along narrow vulnerable coastal zones sur-rounding steep interiors. Faced with inexorable rising waters, many Pacific islanders have resorted to building sea walls to keep out the hungry tides, but this is rarely successful, as the sand and sediment is scoured away by wave action. President Anote Tong of Kiribati has promoted the concept of an early 'migration with dignity,' and his government has purchased land in Fiji to resettle climate refugees.

The small-islands chapter[45] of the IPCC's fifth assessment report in 2014 found that rising seas present "severe sea flood and erosion risks for low-lying coastal areas and atoll islands." It highlighted one projection that a 50-centimetre rise in sea level could displace 1.2 million people from low-lying islands in the Caribbean Sea and the Indian and Pacific oceans; that number almost doubles if the sea level rises by 2 metres.

As islanders watch their homes being battered by waves, possessions washed out to sea, suffer the health effects of diminishing potable water, or witness their root crops dying from salt water inundation, we often hear: "we didn't cause this problem but we are suffering from the effects–we are being punished for what others have done." While much is un-certain, it is highly unlikely that the children growing up in the atolls of the Pacific islands will grow old there.

Box 1.2 Sea Level Rise and Coastal Cities

The risk of sea level rise for coastal cities is immediate and long term. Climate mitigation can stabilize the rate of sea level rise, which makes adaptation more feasible. However, even if the global temperature is stabilized, sea level will continue to rise for many centuries as the deep ocean slowly warms and the large ice sheets reach a new equilibrium: this has been termed the commitment to sea level rise. For coastal areas and cities, mitigation and adaptation must be considered together as sea level rise necessitates an adaptation response.[46]

Adaptation limits of coastal cities are not easily predictable. The rise in mean sea level raises the likelihood of catastrophic floods and extreme events which damage and trigger a possible response: abandonment, defense upgrading or another response entirely. Limits to adaptation can be grouped into physical and engineering limits, economic and financial limits, and socio-political limits.[47]

In 2005, there were 136 large coastal cities with a population exceeding one million people and a collective population of 400 million people. All these coastal cities are threatened by flooding from the sea and these risks are increasing due to growing exposure (people and assets), rising sea levels due to climate change, and in some cities, significant coastal subsidence due to human agency (drainage and groundwater withdrawals from susceptible soils). Flood risks grow with sea-level rise as it raises the likelihood of extreme sea levels.[48]

In those 136 large coastal cities over the next 50 years, damages could rise from US$6 billion/year to US$52 billion/year solely due to increase in population, property and its value. With additional climate change and subsidence, global losses could approach US$1 trillion or more per year if flood defenses are not upgraded. Even if protection levels are maintained (i.e. flood probability is kept the same thanks to upgraded defenses), annual losses will grow as individual floods become more severe due to flood depths increasing with relative sea level rise.[49]

To maintain present levels of flood risk (average losses per year), protection will need to be upgraded to reduce flood probabilities below present values. Even with upgraded protection, the magnitude of losses when flood events do occur would increase for the reasons stated above. Beyond a 50 year time frame, sea levels will continue to rise and protection will have to be progressively upgraded into the future with uncertain consequences. If protection limits are reached, some cities may have to be abandoned. Other cities would have to retreat by reconfiguring the city to the new land-water interface.[50]

Few cities have been subject to studies that quantify the sea level rise threshold at which cities will be abandoned. One exception is London and the Thames estuary. Though a less extensive sea level rise is projected to 2100, for London and the Thames estuary, the key adaptation threshold is 5 meters of mean sea-level rise. For higher sea level rise, due to limits of sea walls and tidal barriers, the River Thames would need to be diverted or pumped to the sea.[51]

In the Netherlands, the Delta Programme considered sea level rise of 4 meters by 2200, and concluded that continuation of dyke-raising and beach and dune nourishment with sand could still be effective.[52]

New York City has also considered risks of sea level rise in its adaptation strategies. Sea level rise combined with storm surges is likely to give rise to greater flooding of low-lying neighborhoods and infrastructure, increased structural damage, and impaired city operations. The extent and location of changes is being mapped out, allowing the development of adaptation res-ponses and increasing the city's resilience to sea level rise.[53]

London's Thames Estuary 2100 (TE2100) plan, the Dutch Delta Programme and New York City have defined adaptive pathways into the future, which include a portfolio of adaptation measures which can be progressively and flexibility applied to manage flood and other risks as sea level rises, and promote urban resilience. This is a best practice proactive approach and could be applied widely to the coastal cities global as they identify adaptation and resilience approaches.

Box 1.3. Climate Change Impacts on Fisheries and Aquaculture and Peoples' Livelihoods: Growing Threats to Global Food Security

Over 800 million people depend, directly or indirectly, on fisheries and aquaculture for their livelihoods. Fish products are among the most widely-traded foods, with more than 37% by volume of world production traded internationally. In addition, fish provide essential nutrition for 4 billion people and at least 50% of animal protein and essential minerals to 400 million people in the poorest countries.[54] But climate change is bringing an ocean of change to the world's fisheries, which are already in crisis from over-fishing and poor management.

Dimensions and Scales of Likely Impacts on Fisheries and Aquaculture including Livelihoods of Fishing Communities

Climate variability and change are compounding threats to the sustain-ability of capture fisheries and aquaculture development. Impacts occur as a result of both gradual warming and associated physical changes as well as from frequency, intensity and location of extreme events, and take place in the context of other global socio-economic pressures on natural resources. Urgent adaptation measures are required in response to opportunities and threats to food and livelihood provision due to climatic variations.

Ecosystem Impacts

In a warmed world, aquatic eco-system productivity is likely to be reduced in most tropical and subtropical oceans, seas and lakes and increased in high latitudes. Increased temperatures will affect fish physiological processes resulting in both positive and negative effects on fisheries and aquaculture systems. Coral reef systems, housing one out of four marine species, will be at increased risk of coral bleaching.

Climate change is already affecting the seasonality of particular biological processes, radically altering marine and freshwater food webs, with unpredictable consequences for fish production. Increased risks of species invasions and spreading of vector-borne diseases provide additional concerns.

Differential warming between land and oceans and between polar and tropical regions may affect the intensity, frequency and seasonality of climate patterns (e.g. El Niño) and extreme events (e.g. floods, droughts, storms) affecting the stability of marine and fresh-water resources adapted to or affected by these. Rising sea levels displace brackish and fresh waters in river deltas, wiping out some aquaculture practices and destroying wetlands.

Sea level rise, glacier melting, ocean acidification and changes in precipitation, groundwater and river flows will significantly affect coral reefs, wetlands, rivers, lakes and estuaries, requiring adapting measures to exploit opportunities and minimize impacts on fisheries and aquaculture systems.

Impacts on Livelihoods

Changes in distribution, species composition, productivity, risks and habitats will require changes in fishing practices and aquaculture operations, as well as in the location of fish landing, farming and processing facilities. Extreme events will impact infrastructure, ranging from landing and farming sites to processing facilities and transport routes. They will also affect safety at sea and settlements, with communities living in low-lying areas at particular risk. Water stress and competition for water resources will affect aqua-culture operations and in-land fisheries production, and are likely to increase conflicts among water-dependent activities. Livelihood strategies will have to be modified for instance with changes in fishers migration patterns due to changes in timing of fishing activities.

Reduced livelihood options, especially in the coastal regions, inside and outside the fishery sector will force occupational changes and may increase social pressures. Livelihood diversification is an established means of risk transfer and reduction in the face of shocks, but reduced options for diversification will negatively affect livelihood outcomes. There are particular gender dimensions to impacts and vulnerabilities to these impacts, including competition for resource access, risk from extreme events and occupational change in areas such as markets, distribution and processing, in which women currently play a significant role.

Box 1.4. Ocean Acidification: The Other CO_2 Problem[55]

What Is It: Ocean acidification, sometimes called "the other CO_2 problem," describes a series of chemical changes caused when excess atmospheric CO_2 is absorbed by seawater.[56] Since the 1850s, mean surface seawater pH has decreased by 0.1 units, equivalent to a 26% increase in acidity. While ocean acidification events have occurred before, the ocean is currently acidifying faster than it has in the past 300 million years.[57]

The Science: As seawater pH decreases, carbonate ion (CO_3^{2-}) concentration decreases as well, making it harder to form minerals such as calcium carbonate ($CaCO_3$). Furthermore, if concentrations become low enough, it can cause these minerals to dissolve. Calcifying organisms such as corals, pteropods, molluscs, and some species of phytoplankton form their shells and skeletons out of calcium carbonate, and are there-fore particularly sensitive to changes in seawater carbonate chemistry.[58] Moreover, experimental, field and modelling studies have shown a wide variety of possible impacts, both positive and negative, on survival, reproduction, growth, abundance, behaviour, photosynthesis and other processes.[59]

Models project that ocean acidification will continue into the future under most emissions scenarios of the Intergovernmental Panel on Climate Change (IPCC). Projections show a decline in global-mean surface pH of 0.41-0.43 units or a100-150% increase in acidity by 2100 based the business as usual scenario (RCP8.5).[60]

Impacts: While the impacts of ocean acidification on marine ecosystems are not fully under-stood, there will undoubtedly be significant social and economic impacts.

Coral reefs are marine biodiversity hotspots providing habitat for numerous species and fisheries, coastal protection, and are the basis of an important tourism industry in many countries. Coral reefs provide food, revenue and protection for almost 500 million people[61] and their annual value has been evaluated to be 30 billion US dollars.[62] Coral reefs and their associated services are among the most sensitive ecosystems to ocean acidification.[63] Brander et al. (2012) estimated that damages due to ocean acidification could reach 870 billion US dollars in 2100.[64] This is exacerbated by the fact that coral reefs and their associated services are already threatened by numerous stressors such as ocean warming, pollution, tourism and overfishing.

Fisheries are directly or indirectly affected by ocean acidification through effects on habitats or food webs (impacts on prey or predators of species of commercial interest). High-latitude pteropods, an important food source for many commercial species such as salmon, seem to be particularly vulnerable to ocean acidification.[65]

Some bivalve molluscs also appear to be particularly sensitive to ocean acidification. Oyster hatcheries in the States of Washington and Oregon in the United States, which represent a 270 million US dollars industry and employ 3200 people, suddenly faced increased mortality rates of juvenile oysters in 2008. The decline was linked to corrosive conditions of the surrounding seawater.[66] In this area, upwelling events bring deep water, naturally rich in CO_2, to the surface, and ocean acidification causes these waters to become increasingly corrosive.

The Arctic Ocean is especially vulnerable to ocean acidification.[67] Due to large freshwater inputs from rivers and melting ice, the Arctic Ocean is less effective at chemically neutralizing acidification. Freshwater in the Arctic increases with global warming, while decreasing sea ice means more open water, allowing for greater absorption of carbon dioxide. Furthermore, the Arctic Ocean is cold, which increases the absorption of carbon dioxide. The Arctic food web is short, and key marine species may be disadvantaged to extinction.[68]

While socio-economic impacts of ocean acidification will depend on local vulnerabilities, adaptation capacity and mitigation strategies, communities that are already heavily impacted by climate change and have few possibilities to adapt, such as the Small Island Developing States (SIDS), might be particularly sensitive. Across the Pacific region, small-scale fisheries provide vital income for around 50% of coastal households and also comprise 50-90% of dietary protein.[69] Unabated ocean acidification has the potential to severely impact the region's coral reefs in the near future, and thus will have significant negative impacts on the region's economy and food security.

The Bottom Line: The threat of ocean acidification needs to be highlighted and action needs to be prioritized. Ocean acidification will add to the stress already caused by increased ocean warming as well as other ocean stressors such as deoxygenation, pollution and overfishing, together increasing the risk to ecosystems and society. There is an urgent need for increased ocean acidification monitoring and research on impacts on commercial

Box 1.4. Continued

species, as well as efforts to assess the costs and effectiveness of adaptation measures, reduce local stress factors, and mainstream ocean acidification into global, regional and national policies and investment strategies. Without immediate and significant reductions in CO2 emissions, adaptation efforts will be at best short-term, as continued warming and acidification of the marine environment will exceed the conditions where vulnerable species can provide ecosystem services we have come to depend on.

Looking Ahead: In the next 5 years:
Establish and maintain long-term global ocean acidification monitoring networks, including the Global Ocean Acidification Observation Network (GOA-ON).

Carry out comprehensive baseline studies and vulnerability assessments at the regional, national, and local levels especially in SIDS regions.

Prioritize local action to a) include ocean acidification in local marine management policy, b) increase ecosystem resilience to ocean acidification through the removal of other stressors such as pollution and overfishing, c) consider and research potential pros and cons of adaptation strategies including use of ecosystem based adaptation, culture of more resilient strains of seafood and the control of seawater chemistry in aquaculture

Box 1.5. Ocean Warming and Deoxygenation: The Ocean is Losing its Breath

What is Deoxygenation? Oxygen is fundamental to most life on earth, including life in the oceans. Oxygen governs most biological and biogeochemical processes. When oxygen is lost from the open and coastal ocean we call this ocean deoxygenation. [70] It is a major result of ocean warming and can have deleterious impacts on marine organisms and ecosystems. Although there are areas of the ocean that are naturally low in oxygen, these areas are expanding and new areas are appearing as the ocean warms. [71]

How does it happen? The ocean is warming, throughout the water column, including in deep water. A warmer ocean holds less oxygen due to declining solubility of oxygen with increasing temperature. A warmer ocean also has reduced ventilation (transport of oxygen from the mixed layer to the ocean interior). Warming also increases the oxygen requirements of most organisms and reduces their tolerance to low oxygen concentrations.[72] The combination of lower solubility, reduced ventilation and increased respiration act to cause ocean deoxygenation. Other contributors to oxygen loss in the ocean are atmospheric iron and nitrogen fertilization of the open ocean, along with warming-induced dissociation of gas hydrates and climate-induced intensification of upwelling winds on continental margins. Other human activities (e.g. nutrient input from agriculture) can increase the rate, extent, and severity of ocean deoxygenation, particularly in coastal and estuarine water. The areas affected by ocean deoxygenation are vast. Since the 1960s over 4.5 million km^2 of the ocean has become deprived of oxygen (hypoxic) at 200 m water depth, over broad swaths of the tropical and subtropical oceans and NE Pacific. [73] Simultaneously, ocean warming increases vulnerability of coastal and estuarine areas to hypoxia (oxygen loss) from nutrient inputs. [74] However, more science is needed to discover the feedbacks associated with oxygen loss.

What are the Consequences? When oxygen levels become stressful, oxygen influences metabolic, physiological, reproductive, behavioral, and ecological processes. This ultimately shapes the composition, diversity, abundance and distribution of marine life and reduces the resilience of coastal populations to further climate change. Deoxygenation reduces the quality and quantity of habitat that wild fisheries species use and that is available for aquaculture production. Chronic exposure to insufficient oxygen also increases disease susceptibility, [75] interferes with reproduction, [76] and reduces growth rates.

Predicted future declines in oxygenation will move ecosystems across biodiversity tipping points in some regions, including in coastal waters and at intermediate (100-1000 m) depths. [77] Fish and invertebrates are sensitive to water temperature and oxygen level for their survival and each organism has a range of ocean conditions that they can tolerate. Marine species are becoming increasingly exposed to conditions beyond their tolerance level. Some organisms show decreased growth and body size and compromised reproductive output. At the species level, some exhibit changes in distribution by moving to areas with more favorable conditions. Under a business-as-usual scenario, by 2050 relative to now, the maximum body size of fish communities is expected to decrease by 14-24%

Box 1.5. Continued.

globally. The distribution of fishes and invertebrates will shift poleward by 10s-100s km per decade or into deeper waters, resulting in local extinctions in tropical waters.[78] Loss of some species and expansion of species highly tolerant of low oxygen, from chemosynthetic bacteria to jellyfish and giant (Humboldt) squid often will alter food web interactions and change energy pathways in the ocean. From a human perspective, deoxygenation can reduce the abundance and mix of species that are important to food security and local economies.

Climate feedbacks. The oxygen content of the ocean and coastal waters also exerts an important influence on the biogeochemical cycles of nitrogen (N) phosphorus (P) and carbon (C) in the water column and sediments directly and through its effect on the types of benthic organisms that occur in an area. These changes in the sediment and water column can then alter the air-sea exchange of climatically important greenhouse gases (CO_2, N_2O, CH_4) and, as a result, may influence the climate on both long and short-term scales. With the expansion and intensification of the open ocean oxygen minimum zones, and the increasing emergence of low-oxygen sites in the coastal areas, it is most likely that deoxygenation will significantly increase oceanic emissions of N_2O in future, which in turn further warming the planet. Another potential consequence of deoxygenation is nitrogen loss through denitrification (and a similar process called anammox), leading to a potential reduction in nitrogen available for primary production in the open ocean. A less productive ocean is projected to have a lower capacity to sequester anthropogenic CO_2 from the atmosphere, hence the regulating role of the world's ocean will decrease. Warming may also dissociate large amounts gas hydrates, methane buried on continental margins, releasing a potent greenhouse gas into the ocean.

Are there Solutions? There is an urgent need to better understand the causes and consequences of ocean deoxygenation and to adapt and manage accordingly. Key actions to halt the loss of oxygen in the ocean are to:

(a) reduce the greenhouse gas and particulate (black carbon) emissions that cause atmospheric and ocean warming
(b) reduce nutrient inputs to the ocean that exacerbate oxygen loss,
(c) alleviate direct anthropogenic stressors (e.g. pollution, overfishing, invasive species, habitat loss, trawling or mining disturbance) that threaten resilience and increase vulnerability of marine ecosystems to deoxygenation
(d) adopt spatial planning and fisheries management strategies that identify deoxygenation vulnerabilities and protect species and habitats.
(e) expand ocean oxygen observations to improve mechanistic understanding and provide early warning systems, especially in countries where changes threaten fisheries, aquaculture and livelihoods,
(f) promote global awareness and the exchange of information about ocean deoxygenation, for example through the IOC's Global Ocean Oxygen Network (GO_2NE) and
(g) recognize ocean deoxygenation as one of multiple climate stressors and work to unify research across (i) coasts and the open ocean (ii) biology, geochemistry and physics, (iii) on warming, acidification and deoxygenation and (iv) across academic, industry, government and regulatory sectors.

Estimating the Risks of Climate Change on Oceans and on Coastal and Island Populations

A recent report (King et al., 2015) presents a need for a climate change risk assessment that aims to be holistic.[79] It emphasises that the risks of climate change are non-linear, for example, while average conditions may change gradually, the risks can increase rapidly. It also highlights that risks of climate change are amplified by feedbacks: e.g. rising temperatures melt ice; sea without ice absorbs more heat; and the temperatures rise faster. It also warns that the most significant risks may arise if thresholds are crossed beyond which certain kinds of adaptation are no longer possible. Although the Earth's climate has changed dramatically in the past, human civilization has seen few of those changes as the Earth's climate has been unusually stable during this period with little variation in global temperature and sea levels. We have taken advantage of this period of stability to grow crops, build cities, and develop a global economy. Greatest risks may arise from the interaction of the climate with complex human systems such as global food markets, governance arrangements within states, and international security. The risks to human interests will also depend on how successfully we can limit emissions and how we can adapt to these changes.

The original text of the UNFCCC adopted a long-term goal of keeping global average warming to "safe levels," which was specified as below 2°C above pre-industrial levels by the Copenhagen

Accord.[80] The choice of this policy target is a subjective policy informed by estimates of future climate impacts and relative difficulty of adaptation, and the judgment that there is a sufficiently high chance of being able to limit warming to this level. However, even the lowest emissions scenario (RCP2.6) has a more than a 33% chance of exceeding 2°C.

An assessment by Gattuso *et al.* (2015) of the risk of impacts of high and low CO_2 emissions scenarios on key ocean ecosystems and the goods and services they provide[81] took a holistic approach for the ocean by combining the risk of impact from the ocean warming, acidification, deoxygenation and sea-level rise. The authors called on the findings of the IPCC 5th Assessment report[82] and research published since then and also produced a policy brief.[83] Their assessment made it clear that this integrated risk was high or very high under high emissions (RCP 8.5, the current trajectory of business-as-usual CO_2 emissions) for key ecosystems or links in the food chain such as coral reefs, sea grass beds, bivalve shellfish, fin fish, krill and sea butterflies. Worryingly, the risk assessment found that even under the stringent emissions scenario (RCP2.6, the 2°C warming target), warm-water corals and mid latitude bivalves will be at high risk by 2100.

Impacts to the ocean's ecosystem services follow a parallel trajectory. Services such as coastal protection and capture fisheries are already affected by ocean warming and acidification. The risks of impacts to these services increase with continued emissions: They are predicted to remain moderate for the next 85 years for most services under stringent emission reductions, but the business as-usual scenario (RCP8.5) would put all ecosystem services considered at high or very high risk over the same time frame. These impacts will be cumulative or synergistic with other human impacts, such as overexploitation of living resources, habitat destruction, and pollution. The authors found that the management options to address ocean impacts become fewer and less effective. They conclude that the ocean provides compelling arguments for rapid reductions in CO_2 emissions and eventually atmospheric CO_2 drawdown and that any new global climate agreement that does not minimize the impacts on the ocean will be inadequate.[84]

Choices for Decision-makers

Evidence and scientific predictions show that climate change will cause adverse impacts on major social, economic, and environmental sectors in coastal countries and SIDS such as water resources, biological diversity, fisheries and aquaculture, agriculture, energy access, health, economy, tourism, and even human settlement and infrastructure. Most of these impacts have negative effects on GDP and reduce funds available for adaptation and development of capacities to face climate change impacts.[85]

The King et al. (2015) report underlines that the risks of climate change are both immediate and long-term, therefore, we must act both immediately and with a long-term view. A risk that grows over time will not be managed successfully if our horizons are short-term. Ultimately, the risks of climate change will only be under control when we have reduced further buildup of CO_2 in the atmosphere. So while we must do all in our power to reduce emissions now, we must also follow a path that increases our power to do more in the future.

The authors underline, as well, that climate change represents both national and global security risks and must be addressed and managed at the highest levels of authority—at the highest levels in national governments and at the global level, in institutions where heads of state meet to make decisions.

With regard to the impacts of climate change on the ocean and on coastal and island populations, as noted by many scientists and policy specialists,[86] and supported by the authors of this Strategic Action Roadmap:

- It is imperative that immediate and substantial reductions of CO_2 emissions take place starting in 2016 for the ocean to continue to perform its central role in planetary survival.

- As the concentration of greenhouse gasses increase, options to overcome or limit the risks on oceans and on coastal and island populations will become fewer and less effective, as risks are non-linear and small changes in emission concentrations could mean disproportionate risks to humans and the environment.

- Further scientific work is needed to understand the extent of climate change impacts between

mean global temperature increases of 1.5 and 2.0°C and thus help in decision-making.

This is the challenge to the decision-makers. Money spent now to reduce emissions and mitigate the risks of climate change could save money on adaptation later. Risks of climate change are near term and long term, and delayed response means options for limiting impacts are reduced. Careful planning and fast action are both needed to ensure risks are minimized. The authors of the King et al., 2015 report conclude:

"It is clear to us that the risks posed by climate change to these objectives are very great. We are deeply concerned about what this means for the future of our families, our countries, and our civilization, all of which we care about. At present, our exposure to these risks is far higher than we would wish to tolerate. We do not believe the situation is hopeless. On the contrary, there is much that we can do. The risks of climate change cannot be entirely eliminated, but they can certainly be reduced."

"To win this battle, we must deploy equally powerful forces in favor of change: the power of human ingenuity, the power of technology, and the power of leadership. We must match the laws of physics with a will and a determination that is equally unyielding. The greatest risks of climate change arise when thresholds are crossed: what had been gradual becomes sudden; what had been inconvenient becomes intolerable. The greatest reductions in risk will be won in the same way. Gradual, incremental measures will not be enough: we must seek out non-linear, discontinuous, transformational change."

In this Strategic Action Roadmap, we address specific pathways, which can be pursued within and outside of the UNFCCC, to mitigate whenever/however possible the effects of climate change on oceans and coastal and island communities, to adapt to a changing climate, as well as mobilizing the requisite financing, and the essential capacity development, scientific monitoring, and public outreach.

2. Mitigation

The IPCC defines mitigation as "a human intervention to reduce the sources or enhance the sinks of greenhouse gases."[87] Mitigation, including reducing greenhouse gas (GHG) emissions and investing in low-carbon energy supplies, is necessa to limit temperature increases and decrease CO2 concentrations. Even though mitigation strategies have grown in recent years, GHG emissions continue to increase, meaning additional efforts to reduce GHG emissions are necessary.[88] Key to achieving these emissions reductions are commitments made by countries as part of their intended nationally determined contributions (INDCs),[89] a roadmap for how each country plans to reduce emissions post-2020. There are other benefits to mitigation as well, including influencing societal goals such as human health, food security, biodiversity, and sustainable develop-ment.[90] For oceans in particular, mitigation strategies include implementing blue carbon policies, reducing CO2 emissions from ships, developing ocean-based renewable energy, and considering carbon capture and storage following appropriate research and under regulatory frameworks.

Main Recommendations

2.0 Further develop and apply mitigation measures using the oceans, including implementing "blue carbon" policies, reducing CO2 emissions from ships, developing ocean-based renewable energy, and considering (long-term/no-harm) ocean-based carbon capture and storage. Encourage all nations to reduce CO_2 emissions so that the Paris Agreement to limit emissions to well below 2°C can be achieved.

2.1 Sustainably conserve and enhance coastal ecosystems as major carbon sinks and integrate the management of the coastal carbon ecosystems ("Blue Carbon") into the policy and financing processes of the UNFCCC, and account for these ecosystems in the national reports to the UNFCCC, the INDCs (Intended Nationally Determined Contributions).

Account for the contribution of coastal ecosystems as GHG emissions and removals in the Intended Nationally Determined Contributions

2.2 Further accelerate progress in addressing air emissions from ships

2.3 Sustainably develop ocean-based renewable energy (such as offshore wind power, wave energy, tidal power, and aquatic biofuels); and accelerate efforts to implement these approaches through integrated marine planning and enhanced regulatory frameworks

2.4 Consider the potential for ocean-based carbon capture and storage, and, if appropriate, further develop regulatory systems for ocean-based sequestration and marine engineering

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Current Status of the Issue

Many natural environments contain large stores of carbon deposited by vegetation and various natural processes over centuries. The ability of these vegetated ecosystems to remove carbon dioxide (CO_2) from the atmosphere make them significant net carbon sinks. If the ecosystems are however degraded or damaged directly or indirectly by human activities, their carbon sink capacity is lost or adversely affected, and the carbon stored in the soil is released resulting in emissions of CO_2 that contribute to climate change.

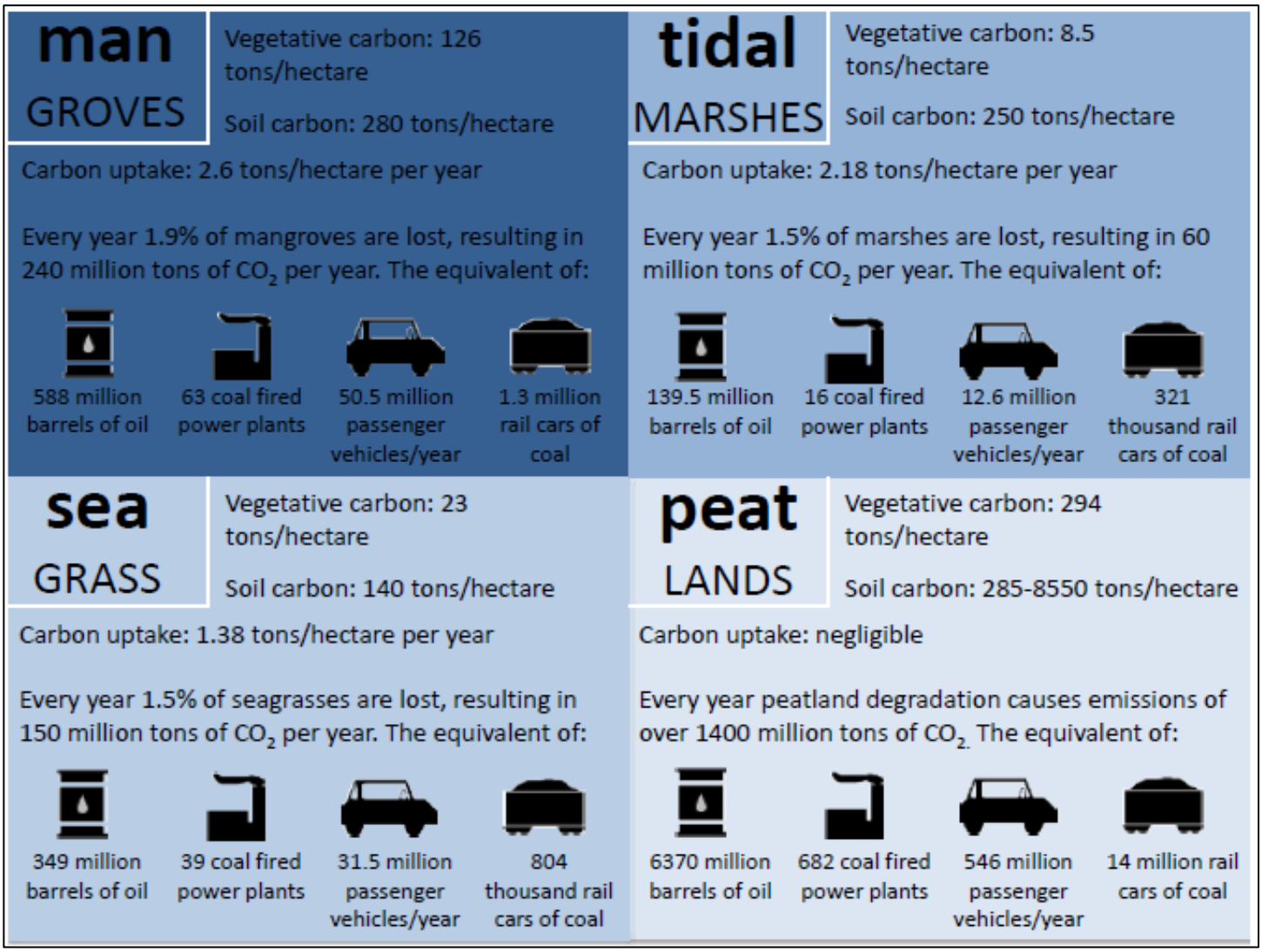

Figure 2.1. Blue Carbon sinks. Source: Herr, D. et al. 2014

The coastal ecosystems of mangroves, tidal marshes, and seagrass meadows provide numerous benefits and services that are essential for climate change adaptation along coasts globally, including coastal protection and food security for many coastal communities (Figure 2.1). Additionally, these eco-systems sequester and store more carbon per unit area than some terrestrial forests and are now being recognized for their role in mitigating climate change.

Despite their multiple benefits, coastal carbon ecosystems are some of the most threatened ecosystems on Earth, with an estimated 340,000 to 980,000 ha being destroyed each year. Although the historical extent of coastal carbon ecosystems is difficult to determine due to dramatic losses occurring before we could accurately measure these habitats, scientists have estimated that up to 67% of historical global mangrove range has been lost, and at least a 35% and 29% loss of global coverage for tidal marshes and seagrass meadows respectively.[91]

Current State of Play of the Issue within the UNFCCC

Conserving and restoring terrestrial forests, and more recently peatlands, has been recognized as an important component of climate change mitigation. Several countries are developing policies and programs in support of sustainable development through initiatives that reduce the carbon footprint associated with the growth of their economies, including actions to conserve and sustainably manage natural systems relevant to the UNFCCC, including through the Reducing Emissions from Deforestation and Forest Degradation (REDD+) mechanism.

These approaches are expanding to manage other natural systems, including marine and coastal

systems, that contain rich carbon reservoirs and to reduce the potentially significant emissions from the conversion and degradation.

UNFCCC Article 4(d) calls for Parties to "promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases not controlled by the Montreal Protocol, including […] oceans as well as […] other coastal and marine ecosystems."

Strategic Goals and Actions to Address the Issues

Coastal carbon ecosystems need to be mapped, conserved and restored as globally significant carbon sinks. Despite their small extent relative to other ecosystems, they sequester and store globally significant amounts of carbon in their soil, sequestering an estimated 44.6 million tonnes per year.[92] Besides the loss of biodiversity, the ongoing destruction and loss of these systems also contributes to additional human induced GHGs. Alongside tropical forests and peatlands, coastal ecosystems demonstrate how nature can be used to enhance climate change mitigation strategies and therefore offer opportunities for countries to achieve their INDCs and to include the emissions and removals related to coastal ecosystems as part of their national GHG accounting.

Dedicated conservation efforts can ensure that **coastal ecosystems** continue to play their role as long-term carbon sinks by helping to ensure that no new emissions arise from their loss and degradation whilst stimulating new carbon sequestration through the restoration of previously carbon-rich coastal habitats.

Opportunities and Pathways that may be Available within the UNFCCC to Advance the Issue in the Next Five Years

On an implementation level, mangroves, saltmarshes and seagrasses can be included in national GHG accounting, now that the new 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement) has been issued. Mangroves can also be included in REDD+, and all three ecosystems can be incorporated into NAMAs.[93] Some technical elements need to be fully integrated into these mechanisms to value the full coastal carbon potential, e.g. accounting for soil carbon. An expansion of the implementation of programmes and projects aimed at reducing the ongoing loss of these systems is still needed to reduce the resulting emissions.

Opportunities and Pathways that may be Available outside of the UNFCCC to Advance the Issue

Currently the management of **marine ecosystems** is not recognized as a climate mitigation option under the UNFCCC. Further debate and dialogues are now needed to analyse the usefulness and opportunities to develop an incentive mechanism for the open ocean under the Climate Convention.

An ecologically degraded ocean loses its capacity to support the carbon cycle and act broadly as a carbon sink; the pathways for this degradation are discussed in Section 2 of this brief. There may be opportunities for a UNFCCC oceans emissions work program to complement activities under other processes (e.g. UNCLOS,[94] CBD,[95] RFMOs)[96] which are concerned about the sustainable management of diverse marine resources and their services. MPAs[97] and other area-based management efforts are opportunities for no-regret climate change tools and are now needed more than ever for sustaining a functioning ocean, which continues to serve as a carbon sink.

Many countries have started to include **coastal ecosystem** management into their national climate change mitigation activities, including under REDD+, NAMAs and other mechanisms. These experiences show opportunities for further enhancement (e.g. on a technical level the accounting for soil carbon as part of REDD+ needs to be further advanced) as well as replication and expansion in other countries. More efforts now also try to link the mitigation and adaptation benefits of these systems (including through NAPs),[98] and to direct the appropriate management and policy responses through their national development goals as well as coastal planning efforts. Coastal ecosystem management for mitigation and adaptation may also be advanced under the Poznan Strategic Program on Technology Transfer and the through the work and services of the Technology Mechanism.

The role and implications of the importance of healthy **marine ecosystems** for a functioning ocean carbon cycle ought to be better incorporated into sectoral regulation and management regimes (e.g. fisheries, deep sea mining).[99]

The scientific understanding of the role of marine flora and fauna for climate change mitigation is increasing steadily and this needs to be further supported. However, a thoughtful debate is needed to determine if/how these elements should be addressed in future climate change strategies.

Financing Considerations

Coastal carbon projects and programs can be financed through a variety of mechanisms.[100] A schematic overview is shown in Fig. 2.2 below. Possibilities exist through funds that are directly linked to a convention, for example the UNFCCC, Convention for Biological Diversity (CBD) or Ramsar, and managed via a dedicated institution, e.g. the GEF.

Other possibilities include national funds as well as funds from multilateral development banks. Both climate change and biodiversity related finance mechanisms can be accessed for coastal carbon activities. Other non-market mechanisms—the more traditional grant type funding—include phil-anthropic donors as well as debt-relief agreements. Additional to these non-market mechanisms, carbon offset crediting schemes or Payment for Ecosystems Services (PES) mechanisms that use a direct market to receive payments for specific activities, can be explored.

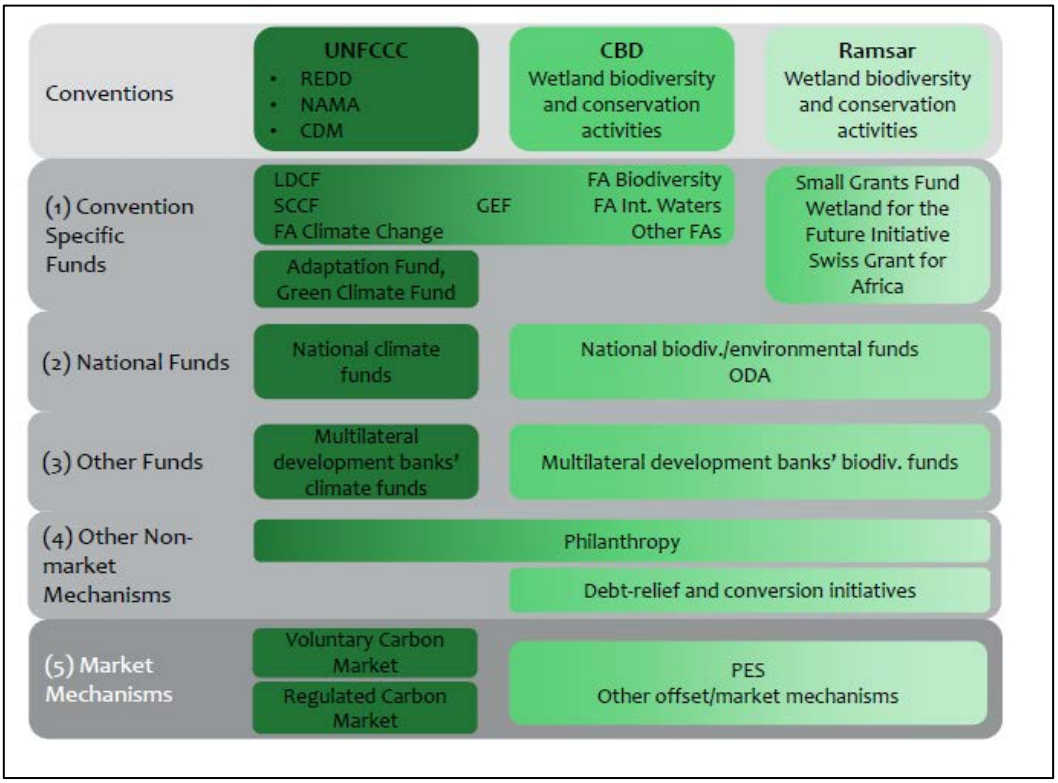

Figure 2.2. Overview of the main climate (dark green) and biodiversity-related (lighter-green) finance mechanisms relevant for wetland carbon projects and programs. Source: Herr, D. et al. 2014

2.2 Further accelerate progress in addressing air emissions from ships

Current Status of the Issue

On 26 September 1997, the Conference of Parties to MARPOL 73/78 (the Air Pollution Conference) adopted a new Annex VI—Regulations for the Prevention of Air Pollution from Ships—and invited the International Maritime Organization (IMO) to undertake a study of CO_2 emissions from ships and to consider what reduction strategies may be feasible. The IMO has since commissioned three studies of GHGs from ships, with the most recent

published in 2014, and adopted in a number of technical and operational measures to increase ship energy efficiency and reduce emissions from international shipping.

Estimates for GHG emissions from international shipping accounted for 796 million tonnes of CO_2 in 2012, which accounts about 2.2% of the total CO_2 emission volume for that year (Third IMO GHG Study 2014, approved by the sixty-seventh session of the IMO's Marine Environment Protection Committee (MEPC 67, October 2014)).[101] By contrast, in 2007, before the global economic downturn, international shipping is estimated to have emitted 885 million tonnes of CO_2, which represented 2.8% of the global emissions of CO_2 for that year. These percentages are all the more significant when considering that shipping is the principal carrier of world trade, carrying as much as 90% of all goods by volume and therefore providing a vital service to global economic development and prosperity.

Although international shipping is the most energy efficient mode of mass transportation, a global approach to further improve its energy efficiency and effective emission control is needed as, depending on future economic and energy developments, projections forecast a growth in CO_2 emissions for international maritime transport of 50% to 250% in the period up to 2050.

The IMO is the global standard-setting authority for the safety, security and environmental performance of international shipping. IMO's regulatory framework covers all aspects of technical matters pertaining to the safety of ships and of life at sea, efficiency of navigation, and the prevention and control of marine and air pollution from ships. The original focus of IMO's environmental work was on the prevention of marine pollution by oil, resulting in the adoption of the first ever comprehensive anti-pollution convention, the International Convention for the Prevention of Pollution from Ships (MARPOL) in 1973. This has changed over the last few decades to include a much wider range of measures to prevent marine pollution, and the original MARPOL Convention was amended many times to also include requirements addressing pollution from chemicals, other harmful substances, garbage, sewage and, under an Annex VI adopted in 1997, air pollution and emissions from ships.

Emissions are not the only aspect of shipping which may affect ocean environments. The use of High Density Fuel Oil (HFO) by shipping in or near the Arctic poses a further threat to the polar environment. HFO use as fuel produces harmful and significantly higher emissions of sulphur and nitrogen oxides and black carbon than other fuels. Black carbon is transported according to regional meteorological conditions and strongly absorbs visible light. When it falls on light-coloured surfaces, such as Arctic snow and ice, the amount of sunlight reflected back into space is reduced and thus contributes to accelerated snow and ice melt. Phasing out of the use of HFO in the Arctic will help slow down the melting of Arctic Ice.[102]

Current State of Play of the Issue within the UNFCCC

As already acknowledged by the Kyoto Protocol, CO_2 emissions from international shipping cannot be attributed to any particular national economy due to its global activities and complex operation. Article 2.2 of the Kyoto Protocol therefore states that the Parties included in Annex I shall pursue limitation or reduction of emissions of greenhouse gas emissions not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organization (ICAO) and IMO, respectively.

IMO's Assembly Resolution A.963(23) on "IMO Policies and Practices Related to the Reduction of Greenhouse Gas Emissions from ships" adopted in December 2003 sets out that the Organization should take the lead in developing GHG limitation and reduction strategies and mechanisms for international shipping and that, in doing so, it should co-operate with the Conference of the Parties to the UNFCCC.

No reference to the IMO nor the International Civil Aviation Organization (ICAO) is made in either the articles of the Paris Climate Change Agreement or the decisions to implement the agreement including on the pre-2020 ambition (the period between the Kyoto Protocol commitment period ending on 31 December 2020 and the new agreement entering into effect on 1 January 2020). The forty-third session of the Subsidiary Body for Scientific and Technological Advice (SBSTA), held during COP 21, took note of

the information received from and progress reported by the secretariats of the ICAO and the IMO on their ongoing work on addressing emissions from fuel used for international aviation and maritime transport, and invited the secretariats to continue to report, at future sessions of the SBSTA, on relevant work on this issue.

Strategic Goals and Actions to Address the Issues

In July 2011, IMO adopted mandatory measures to improve the energy efficiency of international shipping, representing the first ever mandatory global energy efficiency standard for an international industry sector, and the first legally binding instrument to be adopted since the Kyoto Protocol that addresses greenhouse gas emissions.

The adopted measures add to Annex VI of the MARPOL Convention a new Chapter 4 entitled "Regulations on energy efficiency for ships." This package of technical and operational requirements, that apply to ships over 400 gross tonnage, requires new ships to be constructed to a mandatory design index, the Energy Efficiency Design Index (EEDI), which sets a minimum energy-efficiency level for the work undertaken (e.g. CO_2 emissions per tonne-mile) for different ship types and sizes.

The EEDI requirement aims to increase the energy efficiency of new ships over time. It is a non-prescriptive standard that leaves the choice of which technologies to use in a ship design to the stakeholders, as long as the required energy-efficiency level is attained, enabling the most cost-efficient solutions to be used. It is therefore intended to stimulate innovation in, and continued development of, the technical elements influencing the energy efficiency of a ship. Reduction factors are set until 2025 to the extent that ships constructed in 2025 will be required to be at least 30% more energy efficient than those constructed in 2014. The EEDI has been developed for the largest and most energy-intensive segments of the world merchant fleet and, following the inclusion of additional ship types, will embrace approximately 85% of emissions from international shipping.

The new regulations also make mandatory the Ship Energy Efficiency Management Plan (SEEMP) for all ships over 400 gross tonnage. The SEEMP is an operational measure that establishes a mechanism to improve the energy efficiency of a ship against business-as-usual, in a cost-effective manner and also provides an approach for monitoring ship and fleet efficiency performance over time, using, for example, the IMO's Energy Efficiency Operational Indicator (EEOI) as a monitoring and/or benchmarking tool.

Studies by IMO indicate that uptake of SEEMP measures will have significant effect in the short to medium term, while EEDI measures should have a greater impact in the longer term, as fleet renewal takes place and new technologies are adopted. Estimates (in a study by Lloyd's Register and DNV reported in October 2011) suggest that successful implementation of this energy-efficiency framework by 2050 could reduce shipping CO_2 emissions by up to 1.3 gigatonnes per year against the business-as-usual scenario (to put this in context, the Third IMO GHG Study 2014 estimated global CO_2 emissions to be 35.64 gigatonnes in 2012).

These mandatory energy efficiency requirements for international shipping have now been in force for almost three years. Data presented to MEPC 68 (May 2015) clearly identifies the improvements made, significant in many cases, in the energy efficiency of ships being designed and delivered today. This success story once again demonstrates the IMO's important role as the global standard setter for international shipping. For further information visit the IMO web-site:
http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Default.aspx

In addition to the energy efficiency requirements, the IMO has engaged in two partnership projects to further technical co-operation and technology transfer: Global Maritime Energy Efficiency Partnerships Project (GloMEEP) and the establishment of regional Maritime Technology Cooperation Centres (MTCCs).

The Global Maritime Energy Efficiency Partnerships Project (GloMEEP), an initiative of the Global Environment Facility (GEF), United Nations Development Programme (UNDP) and IMO, will focus in particular on building capacity to implement technical and operational measures in developing countries, where shipping is increasingly concentrated. The aim is to promote a low-carbon maritime sector, in order to minimize the adverse

impacts of shipping emissions on climate change, ocean acidification and local air quality. IMO will execute the project, which marks the beginning of a new blueprint for creating global, regional and national partnerships to build the capacity to address maritime energy efficiency and for countries to mainstream this issue within their own development policies, programmes and dialogues.

Ten IMO Member States have signed up to the two-year GloMEEP project as lead pilot countries: Argentina, China, Georgia, India, Jamaica, Malaysia, Morocco, Panama, Philippines and South Africa. The lead pilot countries will be supported in taking a fast-track approach to pursuing relevant legal, policy and institutional reforms, driving national and regional government action and industry innovation to support the effective implementation of IMO's energy efficiency requirements.

The Maritime Technology Cooperation Centres (MTCCs) aim to become a global network of regional centres of excellence to promote the uptake of low-carbon technologies and operations in maritime transport. The five target regions - Africa, Asia, the Caribbean, Latin America and the Pacific - have been selected for their significant number of Least Developed Countries (LDCs) and Small Island Developing States (SIDSs).

This four-year project, administered by the IMO with €10 million in funding from the European Commission, is designed to help beneficiary countries limit and reduce GHG emissions from their shipping sectors through technical assistance and capacity building, while encouraging the uptake of innovative energy-efficiency technologies among a large number of users through the widespread dissemination of technical information and know-how. This will heighten the impact of technology transfer.

Opportunities and Pathways that May be Available within the UNFCCC to Advance the Issue in the Next Five Years

As requested by the IMO's Assembly Resolution A.963(23) on "IMO Policies and Practices Related to the Reduction of Greenhouse Gas Emissions from ships", and reiterated by IMO's Marine Environment Protection Committee (MEPC 68/21, paragraph 5.4), the IMO Secretariat should continue to report to the UNFCCC on IMO's work to address GHG emissions from international shipping.

The IMO Secretariat will continue reporting to the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) under the agenda item on "Emissions from fuel used for international aviation and maritime transport", and participate in UN system activities including side events and other activities held parallel to COP meetings.

Opportunities and Pathways that May be Available outside of the UNFCCC to Advance the Issue

IMO's Data Collection System

IMO continues to consider further technical and operational measures to enhance the energy efficiency of ships. The complexity of optimizing the energy efficiency of existing ships requires that any future action is taken following the analysis of robust data.

IMO is therefore focusing on the development of a data collection system for ships and agreed that it should follow a three step approach: data collection, data analysis, followed by decision-making on what further measures, if any, are required. MEPC 68 (May 2015) also noted that one purpose of the data collection system was to analyze energy efficiency and that for this analysis to be effective some transport work data needs to be included. Therefore, work at MEPC 68 primarily focused on the development of the full language for a data collection system for fuel consumption, which can be readily used for voluntary or mandatory application of the system, and consideration was given to transport work and/or other proxies for inclusion in such a system.

Contribution of the Shipping Sector

This year is a crucial year in the IMO's efforts to address emissions from international shipping. The agreement reached in the IMO in April on a mandatory global data collection system on shipping emissions (the actual collection starting in 2019) is an important milestone. Having said that, based on earlier discussions in MEPC, it is clear that data collection on its own is not enough and further measures are needed.

The discussions started in the IMO in April on the contribution of the sector to the international efforts to address greenhouse gas emissions will continue in MEPC 70 (Marine Environment Protection Committee) in October. A working group should be set in MEPC 70 for the start of a process to define the contribution of the sector to the international emission reduction efforts and for adoption of a workplan and timetable for this process.[103]

IMO's Technical Cooperation Program

In order to support countries which lack the requisite resources, experience or skills to implement IMO treaties, the Organization has developed an Integrated Technical Co-operation Programme (ITCP) which is designed to assist Governments by helping them build the necessary capacity. Through technical co-operation and capacity building activities, IMO helps to transfer know-how to those countries that need it, thereby promoting wider and more effective implementation of IMO measures.

Chapter 4 to MARPOL Annex VI on Regulations on energy efficiency for ships recognized this need with a specific regulation on "Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships". This regulation requires the relevant national Administrations, in co-operation with IMO and other international bodies, to promote and provide support to States, especially developing States, that request technical assistance. The regulation also requires the Administration of a Party to co-operate actively with other Parties, subject to its national laws, regulations and policies, to promote the development and transfer of technology and exchange of information to States, which request technical assistance, particularly developing States, in respect of the implementation of measures to fulfill the requirements of Chapter 4.

Further to this, in May 2013, IMO's Marine Environment Protection Committee (MEPC) adopted resolution MEPC.229(65) on "Promotion of Technical Co-operation and Transfer of Technology relating to the Improvement of Energy Efficiency of Ships" which, among other things, requests the Organization, through its various programmes, to provide technical assistance to Member States to enable cooperation in the transfer of energy-efficiency technologies to developing countries in particular; and further assist in the sourcing of funding for capacity building and support to States, in particular developing States, which have requested technology transfer. Examples include the cooperation agreement between KOICA and IMO on "Building Capacities in East Asia countries to address Greenhouse Gas Emissions from Ships" and the recently initiated UNDP-GEF-IMO Global Maritime Energy Efficiency Partnerships (Glo-MEEP) project.

In accordance with this resolution, MEPC 66 (April 2014) established the Ad Hoc Expert Working Group on Facilitation of Transfer of Technology for Ships (TT-EG) which reported to MEPC 69 on the following activities: 1) assess the potential implications and impacts of the implementation of the energy efficiency regulations in chapter 4 of MARPOL Annex VI, in particular on developing States, as a means to identify their technology transfer and financial needs; 2) identify and create an inventory of energy efficiency technologies for ships; 3) identify barriers to transfer of technology, in particular to developing States, including associated costs, and possible sources of funding; and 4) make recommendations, including the development of a model agreement enabling the transfer of financial and technological resources and capacity building between Parties, for the implementation of the energy efficiency regulations.

2.3 Sustainably develop ocean-based renewable energy (such as offshore wind power, wave energy, tidal power, and aquatic biofuels); and accelerate efforts to implement these approaches through integrated marine planning and enhanced regulatory frameworks

Current Status of the Issue

The pressing need to develop renewable sources of energy has intersected with the trend for ocean industrialization, driving interest in marine renewable energy (MRE) technologies. MRE is a term encompassing all of the renewable energy resources found in the oceans, including offshore wind and ocean energy technologies. Offshore wind is an extension of onshore wind technologies to the marine environment, while ocean energy technologies use the waves, tides, currents, heat or salinity of the ocean to generate electricity.[104] While offshore wind technology has standardized, ocean energy currently encompasses a wide range of

technologies, with the current frontrunners being tidal stream and wave energy.

Offshore Wind

Over 90% of the world's offshore wind power is installed in northern Europe, with much of the remaining capacity installed in two demonstration projects off China's east coast.[105] Capacity is expected to reach 75 GW worldwide by 2020, with significant additions in China and the United States.[106]

Ocean Energy

Tidal

There are two main approaches to tidal energy conversion: tidal barrages and tidal stream (hydrokinetic) technologies. A tidal barrage is a dam-like structure used to capture the potential energy created by the difference in sea level between high and low tides, while tidal stream technologies seek to exploit the kinetic energy from flow of tidal currents. The former are large-scale engineering projects more akin to traditional hydropower projects, while the latter will involve deployment of arrays of individual turbines.

The Rance Tidal Power Station in France (240MW)[107] and Sihwa Lake Tidal Power Station in South Korea (254MW)[108] account for almost all of installed capacity of tidal power, while a further 1,320MW installation is under construction in South Korea.[109] A lack of suitable locations and the intensive nature of such projects limit their future potential. Most tidal stream deployments have taken place at designated test centers, with no commercial projects currently operational. Many projects are under development, especially in the UK's where the Crown Estate has leased seabed with a potential capacity of almost 1.5GW.[110]

Wave

Wave Energy Converters (WECs) transform energy from the kinetic and potential energy of ocean surface waves. Extraction of wave energy at useful scales and costs has proven challenging and it is only recently that developers have started to produce full-scale prototypes. Similar to tidal stream, the most wave energy deployments have been prototype devices deployed at designated test centers.

Thermal and Geothermal

The natural temperature gradient that exists between the depths of the ocean and surface has to potential to be harnessed for power generation.[111] The process, frequently called ocean thermal energy conversion (OTEC), works best in tropical coastal areas and OTEC plants have existed since the 1930s.[112] These plants are not very widespread yet, but OTEC researchers believe that once the initial investment required to build a plant becomes cost-competitive, OTEC can be deployed with very few negative environmental impacts across hundreds of sites in the tropics.[113]

Challenges

Technical

Ensuring reliability and survivability is difficult in the harsh marine environment, and devices face high impacts from the energy sources they seek to exploit. Offshore wind has largely overcome its most pressing technical difficulties. Today the major challenge is to reduce costs as a move to deeper waters further offshore, with challenging bottom conditions and higher waves, has driven costs up faster than improvements in technology have reduced them.[114] Ocean energy still faces considerable hurdles. Optimism by device developers and pressure on the industry to attract the attention of policymakers and investors has caused overstatement of technology readiness, while challenging economic circumstances in leading European countries has led to reduced risk appetite amongst investors.[115] To date there is limited experience with arrays of ocean energy devices, raising questions as to how commercial-scale projects will function in practice.

Environmental

The environmental interactions of offshore wind are now quite well understood,[116] and a range of potential environmental interactions of ocean energy devices has been identified.[117] Nonetheless, considerable knowledge gaps and uncertainties remain as the size of deployments grows. There are also likely to be some positive environmental interactions, though these are not yet well understood. For example MRE devices may act as fish-aggregation devices, arti-ficial reefs, or *de facto* marine-protected areas.[118] Detailed resource mapping is typically not available for MRE resources, restricting efforts to identify and develop projects.[119]

Regulatory and Legal

Regulatory processes have not been adapted to better support emerging MRE technologies. Environmental Impact Assessment (EIA) frameworks are not standardized[120] and MRE has attracted a much higher level of scrutiny from regulators than established marine industries.[121] Consenting processes for MRE projects have also proven problematic: considerable regulatory uncertainty remains in many jurisdictions and information regarding the relevant process is often very difficult to obtain.[122] The problematic elements of the consenting process include: the number of authorities involved and communication between them; lack of a consenting process tailored to the needs of ocean energy; integration of offshore and ancillary onshore structures; and the time taken to obtain consents.[123]

Strategic Goals and Actions to Address the Issues

Resource-Mapping

Policy makers should consider supporting resource-mapping exercises in order to understand the nature of MRE resources and which technologies are appropriate. Understanding the resource enables basic cost of energy modeling, sensitive siting of devices, and longer-term infrastructural planning and development.

Funding

Long-term revenue support should be given to offshore wind to encourage growth in the industry. For ocean energy, given the high technical risk and substantial capital requirements of prototype deployment and the development of the first arrays, funding is needed to support R&D activities. Initially funding should be in the form of capital grant funding for research and demonstration, while longer-term revenue support is needed as commercial deployment takes place.

Integrated Marine Spatial Planning

There is an established need, and a desire, for a planled and integrated approach, and Marine Spatial Planning (MSP) has emerged as the frontrunner concept for meeting this need.[124] MSP is intended to help reconcile potential conflicts between different uses of ocean space, while achieving sustainability. In doing so, MSP has the potential to ensure that MRE technologies are sustainably developed and integrated into a strategic plan for rational use of the marine environment.

Enhanced Regulatory Frameworks

Consenting processes must be adaptive and risk-based, and should reflect the scale of development and the level of risk posed. In particular this involves allowing for more permissive procedures for small scale, time-limited deployments in areas of low environmental sensitivity. Options include adaptive management and the "deploy and monitor" approach,[125] while Strategic Environmental Assessment could help identify the scope of potential impacts and information needs.[126] Countries should also transition towards integration of the various competent regulatory bodies in consenting processes.[127]

Test Centers

The European Marine Energy Centre (EMEC) has been at the center of technology development, while newer test centers in North America and Asia are starting to provide benefits. Demonstration at test centers can help to address many of the innovation needs of ocean energy technologies and so should be supported where possible.

Sharing of Good Practices and Lessons Learnt

Technology development can be accelerated by ensuring that best practice is shared on a global, regional and national level.[128] Policy makers can assist by joining and promoting relevant organizations and processes:[129]

- Globally: participate in the International Energy Agency's (IEA) Ocean Energy Systems (OES) programme.
- Regionally: participate in regional bodies such as the European Ocean Energy Association and the South East Asian collaboration for Ocean Renewable Energy
- Nationally: ensure that funding is contingent upon recipients meeting specified knowledge-sharing protocols ensuring that these are carefully framed to protect device developers' intellectual property rights.

Opportunities and Pathways that May be Available Outside of the UNFCCC to Advance the Issue

MRE remains a small and emerging industry. As such, it has not been directly addressed within the UNFCCC. The UN Open-ended Informal Consultative Process on Oceans and the Law of the Sea (ICP) dedicated a session to these technologies, noting that MRE technologies:[130]

"could foster increased energy security, generate employment and play a role in mitigating the impacts of climate change. At the same time, the importance of assessing and studying the impacts of [MRE], including on the marine environment, was stressed by several delegations [to the ICP]."

Outside of these processes, there may be some useful pathways through which MRE can be advanced at the regional and international levels. As mentioned above, the IEA-OES has been one of the primary drivers of international cooperation, while the International Renewable Energy Agency (IRENA) has recently increased its engagement with MRE, for example by issuing a report on the status of the ocean energy industry.[131] In Europe the EU has invested heavily in offshore wind,[132] and has more recently developed an action plan to support the ocean energy sector, convening an Ocean Energy Forum with potential for the development of a European Industrial Initiative.[133]

2.4 Consider the potential for ocean-based carbon capture and storage, and, if appropriate, further develop regulatory systems for ocean-based sequestration and marine engineering

Current Status of the Issue

Summary of CO_2 Capture and Storage under the London Protocol[134]

Carbon Capture and Storage (CCS) is seen as one of the short term technological options for reducing net CO_2 emissions to the atmosphere by the Intergovernmental Panel on Climate Change (IPCC) (refer to IPCC Working Group III and 24 Session of the IPCC in Montreal, 26 Sep. 2005).[135] CCS, as well as other geoengineering methods, need to be conducted in a comprehensive regulatory framework, based on a risk assessment and management approach.[136] To that end, work by the Contracting Parties to the London Protocol has established a global regulatory mechanism for both CCS and marine geoengineering activities.

CS-SSGF technologies can reduce emissions to the atmosphere from power plants and factories to almost zero. The possibility of mitigating these impacts through CO_2 sequestration in sub-seabed geological formations is being investigated by a number of countries around the world. Within Europe for example, capacity for storing CO_2 in geological formations could be around 200 GtC, mostly under the North Sea and mainly in the Norwegian sector and the United Kingdom continental shelf. About 95% of this potential is in deep saline aquifers and about 5% in depleted oil and gas fields. In practical terms, there is significant potential for geological storage in formations beneath the oceans. Depleted oil and gas reservoirs and saline aquifers are expected to have the largest potential to accommodate safe, long-term storage. The aim is to retain CO_2 permanently. Because of the various trapping mechanisms, storage may, in some cases, become more secure over time.

Contracting Parties to the London Protocol started their discussions on CO_2 sequestration in earnest in 2005, as they were concerned about the implications for the marine environment of climate change and ocean acidification due to elevated concentrations of CO_2 in the atmosphere. In their view, CO_2 sequestration in sub-seabed geological formations is one of a portfolio of options to reduce the levels of atmospheric CO_2 and represents an important interim solution, while every effort should be made to further develop low-carbon forms of energy. The starting point of their discussion was—at that time—that the London Protocol prohibited CO_2 sequestration which is viewed as a dumping activity.

Since 2005, the following regulatory framework has been established:

1. Contracting Parties to the London Protocol adopted, on 2 November 2006, amendments to Annex 1[137] to the London Protocol to regulate CO_2 sequestration in sub-seabed geological formations. These amendments entered into force on 10 February 2007 for all Parties to the Protocol. The rules state that carbon dioxide streams may only be considered for dumping, if: (1) disposal is into a sub-seabed geological formation; (2) they consist overwhelmingly of carbon dioxide (they may contain incidental associated substances derived from the source material and the capture and sequestration

processes used); and (3) no waste is added for the purpose of its disposal. In other words, these rules do not permit CO_2 sequestration in the deep oceans themselves;

2. Contracting Parties to the London Protocol also endorsed, in the 2006 Meeting of Contracting Parties, the "Risk Assessment and Management Framework for CO_2 Sequestration in Sub-Seabed Geological Structures." This Framework was developed: (1) to ensure compatibility with Annex 2 to the London Protocol; (2) identify relevant gaps in knowledge; and (3) reach a view on the implications of this practice for the marine environment;

3. As sub-seabed geological sequestration of CO_2 is now subject to licensing under the Protocol, Contracting Parties furthermore adopted, on 9 November 2007, "Specific Guidelines for Assessment of Carbon Dioxide Streams for Disposal into Sub-seabed Geological Formations." These Guidelines advise Parties on how to capture and sequester CO_2 in a manner that meets all the requirements of the Protocol and is safe for the marine environment, over both the short and long terms;

4. A specific CO_2 sequestration reporting format was adopted in October 2008, as it is necessary to archive documentation so that future generations would be informed of the existence of the CO_2 sequestration reservoirs, as well as its history and the assessment process leading to their establishment. In 2011, a revised reporting format for all classes of wastes was adopted, where the 2008 format was incorporated and expanded;

5. In order to ensure that CS-SSGF translated into the effective, invaluable climate mitigation tool it was intended to be, Contracting Parties adopted, on 30 October 2009, an amendment to Article 6[138] of the London Protocol, conditionally enabling the export of carbon dioxide streams for the purpose of sequestration in sub-seabed geological formations. The amendment will enter into force for those Parties which have accepted it, on the 60th day after two-thirds of the Parties have deposited their instruments of acceptance with IMO; and

6. With a view to better guiding the transboundary issues (transboundary geo-logical formations, transboundary movement after injection, and export for sub-seabed sequestration), the Contracting Parties revised the "Specific Guidelines for Assessment of Carbon Dioxide Streams for Disposal into Sub-seabed Geological Formations" in 2012, and adopted the "Guidance on the implementation of article 6.2 on the export of carbon dioxide streams for disposal in sub-seabed geological formations for the purpose of sequestration," in 2013.

The 2006 and 2009 amendments to the London Protocol have created a legal basis in international environmental law to regulate CS-SSGF for permanent isolation of CO_2 waste streams as part of a suite of measures to tackle the challenge of climate change and ocean acidification, including, first and foremost, the need to further develop low carbon forms of energy. This practice would typically apply to large point sources of CO_2 emissions, including power plants and cement works. Note that the use of CO_2 waste streams for enhanced oil recovery is not regulated by the London Protocol because article 1.4.3 of the Protocol states that "the disposal or storage of wastes or other matter directly arising from, or related to the exploration, exploitation and associated offshore processing of seabed mineral resources is not covered by the provisions of this Protocol".

The guidance developed under the London Protocol advise Parties on how to capture, sequester and export CO_2 in a manner that meets requirements of the London Protocol and is safe for the marine environment, both for the short- and long-term.

Summary of Developments to Regulate Marine Geoengineering under the London Protocol

In June 2007, the Scientific Groups, established under the London Convention and Protocol, considered several submissions relating to large scale iron fertilization of the oceans to sequester CO2. This practice is aimed at drawing down an additional amount of surplus CO2 from the atmosphere in the oceans for sequestration purposes. In November 2007, the Contracting Parties endorsed the view that the scope of work of the London Convention and Protocol included ocean fertilization, as well as iron fertilization, and that these agreements were competent to address this

issue due to their general objective to protect and preserve the marine environment from all sources. Recognizing that it was within the purview of each State to consider proposals on a case-by-case basis in accordance with the London Convention and Protocol, urged States to use the utmost caution when considering proposals for large-scale ocean fertilization operations.

In October 2008 the Contracting Parties developed and adopted the (non-binding) resolution on the regulation of ocean fertilization. By this resolution Parties have declared, inter alia, that, “given the present state of knowledge, ocean fertilization activities other than legitimate scientific research should not be allowed.” In addition, it was agreed to further consider a potential legally binding resolution or an amendment to the London Protocol on ocean fertilization in the future. Furthermore, the governing bodies commenced the preparation of a document, for the information of all Contracting Parties, summarizing the current state of knowledge on ocean fertilization, relevant to assessing impacts on the marine environment, taking into account the work done on this issue in other fora.

In 2010 they adopted resolution LC-LP.2(2010) on the “Assessment Framework for Scientific Research Involving Ocean Fertilization,” the development of which was required under the 2008 resolution prohibiting ocean fertilization activities for purposes other than legitimate scientific research. The Assessment Framework guides Parties on how to assess proposals they receive for ocean fertilization research and provides criteria for an initial assessment of such proposals, including detailed steps for completion of an environmental assessment, which encompasses risk management and monitoring.

In 2013, the Contracting Parties to the London Protocol adopted resolution LP.4(8) on the Amendment to the London Protocol to regulate the placement of matter for ocean fertilization and other marine geoengineering activities. The amendment adds a new article 6bis which states that "Contracting Parties shall not allow the placement of matter into the sea from vessels, aircraft, platforms or other man-made structures at sea for marine geoengineering activities listed in Annex 4, unless the listing provides that the activity or the sub-category of an activity may be authorized under a permit."

Here marine geoengineering means “a deliberate intervention in the marine environment to manipulate natural processes, including to counteract anthropogenic climate change and/or its impacts, and that has the potential to result in deleterious effects, especially where those effects may be widespread, long lasting or severe.”

A new Annex 4 on "Marine geoengineering" lists "Ocean fertilization," defined as "any activity undertaken by humans with the principal intention of stimulating primary productivity in the oceans. Ocean fertilization does not include conventional aquaculture, or mariculture, or the creation of artificial reefs. The Annex provides that all ocean fertilization activities other than those referred to above shall not be permitted. An ocean fertilization activity may only be considered for a permit if it is assessed as constituting legitimate scientific research taking into account any specific placement assessment framework.

A new Annex 5 adds the Assessment Framework for matter that may be considered for placement under Annex 4. The Assessment framework provides that Contracting Parties should consider any advice on proposals for activities listed from independent international experts or an independent international advisory group of experts. To date, no Parties have accepted the amendment.

GESAMP A Working Group under GESAMP[139] has been established on Marine Geoengineering, which aims to assist LP Parties to identify those marine geoengineering techniques that they may wish to consider for listing in the new annex 4 of the Protocol. The working group will conduct a study aimed at providing a better understanding of the potential ecological and social impacts of different marine geoengineering approaches. The working group, led by IMO, gained the support of the Intergovernmental Oceanographic Commission (IOC) of UNESCO and the World Meteorological Organization (WMO).

Recent developments and related information can also be obtained at the London Protocol website: http://londonprotocol.imo.org .

Current State of Play of the Issue Within the UNFCCC

UNFCCC has recognized the value of CCS in SBSTA as part of the Clean Development Mechanism (CDM) and a resolution has been adopted to this effect. It is envisaged that further discussion will take place to encourage the use of CCS (terrestrial or sub-sea) at a future date. In order to meet the targets for the agreed temperature ceiling, CCS will need to be accelerated in the short term.

As far as we are aware, issues surrounding marine geoengineering has not been addressed by UNFCCC. IPCC has identified a range of possible marine geoengineering mechanisms.

Opportunities and Pathways that May be Available Outside of the UNFCCC to Advance the Issue

To increase the use of CCS, the remaining transboundary amendment must be come into force. The export amendment adopted in 2009 to allow export of CO_2 for geological storage requires two thirds of Parties to ratify before it comes into force. This currently means 29 countries need to ratify it. To date just three have done so (Norway, the Netherlands and the United Kingdom).

3. Adaptation

Main Recommendations

3.0. Implement ecosystem-based adaptation (EbA) strategies through integrated coastal and ocean management institutions at national, regional, and local levels to reduce vulnerability of coastal/ocean ecosystems and of human settlements, and build the management capacity, preparedness, resilience, and adaptive capacities of coastal and island communities.

3.1 Carry out adaptation measures through the integrated coastal and ocean management institutions created at national and local levels in all regions of the world since the 1992 Earth Summit, in close cooperation with disaster risk agencies and affected sectors and communities

3.2. Apply ecosystem-based approaches to adaptation, especially regarding green infrastructure to provide natural system protection for defense against sea level rise, storms, and flooding

3.3 Establish and effectively manage coherent networks of marine protected areas in national and international waters to protect marine biodiversity and to enhance resilience of marine ecosystems to climate change, achieving the Convention on Biological Diversity's Aichi Biodiversity Target of conserving at least 10% of marine and coastal areas by 2020

3.4 Promote and apply Blue Economy approaches with emphasis on low-carbon solutions and economic benefits to developing countries and SIDS (following SDG target 14.7)

Brief History and State of Play Regarding Adaptation in Coastal and Island Areas

Adaptation to climate change progressively emerged as a topic of research, action and negotiation in the 1980s. It was already central to IPCC's first assessment report[140] which underlined that "limitation [of greenhouse gases emissions] and adaptation strategies must be considered as an integrated package and should complement each other to minimize net costs. Strategies that limit greenhouse gas emissions also make it easier to adapt to climate change." Attention then grew from the beginning of the 1990s, reaching a high peak from the mid-2000s.

Adaptation Negotiations under the UNFCCC

As noted by Garnaud (2009), from the outset, the Convention stressed the importance of both mitigation and adaptation[141]. However, adaptation was actually played down initially in the work undertaken under UNFCCC auspices. The Convention does not define adaptation clearly, which made debates on the subject more theoretical than those on mitigation. At the same time, reducing GHG emissions was seen as a matter of urgency, and there was an implicit belief that this would be sufficient to avoid most of the consequences.

Only in the 2000s did the international community fully realize on the one hand that mitigation efforts would not be sufficient to avoid all significant consequences of climate change and, on the other hand, that adaptation needed to be supported, in particular because of the speed of unavoidable changes. On the international negotiation scene, this resulted in pressure from developing countries– generally considered to be the most at risk from the consequences of climate change–and civil society for adaptation to be fully part of the agenda. Starting with the seventh Conference of the Parties (COP 7) in Marrakesh in 2001, three adaptation funds were created and since Bali COP 13 (2007) adaptation and mitigation have been increasingly on an equal footing. In Cancun (COP 16, 2010) Parties adopted the Cancun Adaptation Framework.[142] They reaffirmed that adaptation must be addressed with the same level of priority as mitigation.

Throughout these two decades of international talks on adaptation, the focus has largely been on financial considerations, especially the assessment of adaptation costs and identification of funding sources, which have typically involving bargaining discussions between developing and developed countries on the scope and support of adaptation activities.

At present activities on adaptation under the UNFCCC are multiple and include[143] (see Table 3.1):

- Activities of the Least Developed Countries Expert Group[144] established in 2001 and the Adaptation Committee[145] established under the Cancun Adaptation Framework;
- Approaches to address loss and damage associated with climate change in developing countries that are particularly vulnerable to the adverse effects of climate change,[146] also as part of the Cancun Adaptation Framework and the subsequent Warsaw International Mechanism for Loss and Damage (COP 19, 2013);
- The Cancun Adaptation Framework, including five clusters: implementation, support, institutions, principles and stakeholder engagement;
- Implementing adaptation action through national adaptation plans (NAPs) established under the Cancun Adaptation Framework, and national adaptation programmes of action (NAPA);
- The Nairobi Work Programme[147] on impacts, vulnerability and adaptation to climate change;
- The development and transfer of technologies, research and systematic observation;
- Supporting adaptation through finance, technology and capacity-building.

Workstreams		**Groups and Committees**		
Loss and Damage	Nairobi Work Programme	Adaptation Committee	LDC Expert Group	Loss and Damage Executive Committee
National Adaptation Plans	National Adaptation Programmes of Action			

Table 3.1. Adaptation workstreams, groups and committees under the UNFCCC
(Source: http://unfccc.int/adaptation/items/4159.php)

Adaptation Practices at National and Local Levels

The international attention to adaptation under the UNFCCC soon translated into the development of adaptation policies, plans and projects at national and local levels. This was initiated in developed countries but expanded to the developing world, often with the support and under the impetus of international development cooperation. In many cases, extreme events such as cyclones or floods have also been important adaptation stimuli, but proactive adaptation is the most commonly reported adaptive response, particularly in developed countries.[148]

Adaptation efforts often take the form of either spatial or sectoral adaptation plans and strategies (e.g. adaptation plans for the agriculture or tourism sector), with National Adaptation Plans (NAPs) in all countries, and National Adaptation Programmes of Action (NAPAs) being prepared in Least Developed Countries. Many applied forms of adaptation have also been tested at the policy/strategy levels as well as through tools and practices to build resilience throughout the sectors and ecosystems. Coastal areas have consistently been among the top priorities for adaptation efforts—as the early effects of climate change and/or the extreme events associated with future changes—are often more visible and tangible in coastal areas (e.g., erosion, saltwater intrusion, floods, storms, coral bleaching etc.).

A key challenge is to assess the extent to which action taken leads to actual adaptation. As Berrang-Ford et al. (2011) find, understanding of the magnitude of the adaptation challenge at a global scale is incomplete, constrained by a limited understanding of whether and how adaptation is taking place. The authors underline that "considerable research on adaptation has been conducted yet the majority of studies report on vulnerability assessments and natural systems (or intentions to act), not adaptation actions."

3.1 Carry out adaptation measures through the integrated coastal and ocean management institutions created at national and local levels in all regions of the world since the 1992 Earth Summit, in close cooperation with disaster risk agencies and affected sectors and communities

Adaptation plans and strategies are being developed at various scales and for the most vulnerable sectors (fisheries, tourism, infrastructures etc.). These need to be implemented urgently and need to converge

with integrated coastal[149] and ocean management (ICM) approaches and be carried out through the integrated coastal and ocean management institutions created at national and local levels in all regions of the world since the 1992 Earth Summit, in close cooperation with disaster risk agencies and affected sectors and coastal communities.

ICM and adaptation to climate change share the same general sustainable development objective—the sustainability of human activities and their underlying ecosystems. Moreover, ICM and adaptation share similar principles: institutional coordination, public participation in decision-making, strong science-policy interfaces, etc. ICM and adaptation are defined as continuous, dynamic and adaptive processes of decision-making and implementation. Neither imply reaching a stable, final and utopian condition: the management of a coastal zone is never totally integrated just like a coastal system can never be totally adapted to climate change.

These shared objectives and principles mean that in practice ICM and adaptation policies, plans and projects typically employ similar tools and instruments. For instance, by contributing to the prevention of coastal erosion and the protection of biodiversity, regulations on the extraction of sand and river sediment contribute to adaptation and to ICM implementation. Land-use, urban development and regional/island plans are fundamental tools for both.

Overall, ICM is key to effective adaptation, and adaptation must be accounted for in ICM planning processes and implementation. There is a need to implement integrated adaptation approaches which focus on reducing community and ecosystem vulnerabilities and enhancing their resilience to the multiple pressures they face, including those related to development and to climate variability, extremes and change. In practice they usually cannot and should not, be disentangled.

As well, ICM institutions should work on adaptation efforts in close coordination with relevant disaster risk and emergency preparedness and response agencies at national, regional, and local levels. An excellent example of such joint action is the recent coming together of efforts on climate change adaptation with efforts on disaster risk reductions in the Pacific Islands region.

Current State of Play of the Issue within the UNFCCC

The push for true integration—that is, ICM—traditionally focused on coral reef, mangrove, estuaries, and beaches—linked systematically to MSP—focused on offshore environments and activities. UNFCCC can help guide countries to do these two types of planning in tandem so as to maximize both adaptation potential, and also to maximize mitigation potential. This also links to conservation finance because innovative financing mechanisms can be identified and then spatial planning (ocean zoning or MPAs) can be established to keep funds flowing from buyers (beneficiaries of ecosystem services) to sellers (communities, NGOs, or government agencies that can protect or manage the habitat providing the ecosystem services). For instance, a marine spatial plan can identify mangrove areas that generate funds from carbon credits (mitigation) and also generate funds from fisheries interests that see benefit in preserving the mangrove as fish nursery habitat, while at the same time protected mangrove can help with shoreline stabilization. When not just coastal areas but also offshore ones are considered in the mix, the mitigation and adaptation potential can be realized, and all the opportunities for generating conservation finance.

3.2. Apply ecosystem-based approaches to adaptation, especially regarding green infrastructure to provide natural system protection for defense against sea level rise, storms, and flooding

Ecosystem-based Adaptation (EbA) can be defined as follows:[150]

- EbA is the sustainable management, conserveation, and restoration of ecosystems to assure the continued provision of vital services that help people adapt to the adverse effects of climate change;
- EbA increases ecosystem resilience to reduce human vulnerability in the face of climate change and can be applied to coastal and marine ecosystems to ensure that they are able to continue to provide vital services (e.g. storm protection);
- EbA strategies can be more cost-effective than physical infrastructures and engineering projects and are often more accessible to the rural poor.

How Ecosystem-based Adaptation Can and Should be Applied in Coastal and Marine Areas

Coastal flooding, erosion, inundation, and extreme weather events affect hundreds of millions of vulnerable people, important infrastructure, tourism, and trade, causing significant human suffering and losses to national economies. In 2011, insured losses from natural disasters reached an all-time high and impacts are predicted to worsen with climate change and population growth. The proportion of the world's gross domestic product (GDP) annually exposed to tropical cyclones has increased from 3.6 percent in the 1970s to 4.3 percent in the first decade of the 2000s.[151] Insurers have paid out more than $300 billion just for coastal damages from storms in the past 10 years, which often goes toward rebuilding similar coastal infrastructure that is still vulnerable to coastal storms and flooding.

Coastal and marine habitats, particularly coral reefs and mangroves, can substantially reduce exposure and vulnerability, providing natural protection from risk. Yet the value of these systems as "green infrastructure" is still not fully recognized, and they continue to be lost and degraded. The Global Assessment Report on Disaster Risk Reduction highlights that economic loss risk resulting from tropical cyclones and floods is growing as exposure of economic assets increases and the status of ecosystem services degrades,[81] and that societies are excessively discounting risk in development choices, particularly in coastal areas.[152] In terms of habitat loss statistics, 30 to 50 percent of wetlands have already been lost,[153] 19 percent of mangroves were lost from 1980–2005,[154] and 75 percent of the world's coral reefs are now rated as threatened.[155]

The trends in habitat loss and the concomitant loss of coastal adaptation services will continue unless the values of these habitats are accounted for in policy and decisions. The importance of mainstreaming the coastal protection value of mangroves and reefs is great, as there are substantial opportunities and risks that will affect the ecosystems and the communities that rely on their services during the next 5 to 10 years. 60% of the world population is expected to live in urban areas by 2030, with a greater concentration in coastal areas. As coastal development increases, there will be heavy investments in coastal infrastructure and the potential loss of more coastal habitats and their services.

Billions of dollars are being dedicated to reduce risks from disasters and climate change, creating both threats and opportunities for natural systems. Total Fast Start Finance commitments under the United Nations Framework Convention on Climate Change (UNFCCC) through 2012 include roughly $3 billion for climate protection assistance. In the United States, the Federal Emergency Management Agency (FEMA) spends $500 million per year to reduce flooding hazards. Middle-income countries—such as Brazil, China, and Colombia—are making multi-billion dollar investments to address the risks of flooding and other disasters exacerbated by climate change. Most of these funds are destined for the creation and maintenance of "grey infrastructure," such as seawalls, which will further degrade coastal ecosystems, and may not be cost effective for risk reduction when compared to more natural and hybrid alternatives (hybrid approaches combine natural features with built infrastructure to enhance coastal resilience).

Following the 2004 Indian Ocean tsunami and Hurricane Katrina in 2005, there has been substantial scientific focus on recognizing and quantifying the benefits from mangroves and coral reefs. There has also been an increasing focus on identifying the policies needed to encourage ecosystem adaptation and restoration specifically for hazard mitigation and risk reduction.

In many locations, some of the most cost-effective solutions for coastal adaptation will be to reduce threats through improved management of existing mangroves and coral reefs.

McLeod (2015) identifies a number of measures to apply ecosystem-based adaptation for coastal and island adaptation, focusing especially on the central roles of coral reefs and mangrove forests as a major ways to defend the coast. As offshore breakwaters, the basic engineering models of how reefs provide coastal adaptation are well known. Engineering models and field demonstrations of the role of mangroves in flood and erosion reduction have been developed over the past several decades and clearly demonstrate effectiveness.

McLeod (2015) puts forward a set of recommendations for consideration within both the UNFCCC process and outside the UNFCCC:

- *Develop national coastal risk maps*. This is a critical first step for overall risk reduction and coastal adaptation. Many countries are moving toward developing these maps, creating opportunities to include natural adaptation benefits in planning. These national risk maps should identify where and how much risk reduction value is currently provided by reefs and mangroves, and then prioritize where coastal habitat adaptation and restoration offer the greatest risk reduction.

- *Develop guidelines or best practices for restoration of mangroves and reefs for coastal adaptation*. There is a growing body of guidance on mangrove restoration, which, while very good, can still be enhanced. There is little-to-no guidance on best practices for reef restoration for coastal adaptation.

- *Develop large scale commitments to conserve and to restore degraded mangroves and coral reefs*. In Vietnam, for example, the amount (hectares) of mangrove conservation and restoration has been at the same scale as the past loss of these habitats. Few other countries have made such commitments.

- *Include coral reefs and mangroves in national adaptation plans (NAPs). Include coral reefs and mangroves in support programs for adaptation and risk reduction.*

- *Identify sustainable financing options for mapping coastal ecosystems, large scale reef and wetland restoration and development of strategic plans for the related systems that support natural infrastructure investment* (specific possibilities are noted in Section 5).

3.3 Establish and effectively manage networks of marine protected areas in national and international waters to protect marine biodiversity and to enhance resilience of marine ecosystems to climate change, achieving the Convention on Biological Diversity's Aichi Biodiversity Target of conserving at least 10% of marine and coastal areas by 2020

Marine protected areas (MPAs), along with strictly protected zones within marine spatial plans have been shown to boost productivity, safeguard vulnerable biodiversity, and enhance the values that humans derive from the marine and coastal environment. While networks of MPAs cannot halt climate change, they are key components of climate change and resilience and can ultimately help maintain the ocean's biodiversity and ecosystem services.

Despite several thousand MPA designations that now exist the world over, MPAs have not been used to their full potential to mitigate climate change, facilitate adaptation, or heighten the resilience of natural systems–and the human communities that depend on them–in the wake of inevitable climate change.

When MPAs are embedded in a wider and more holistic marine spatial planning (MSP) regime, the investments made in protection can be safeguarded as environmental conditions deteriorate, or as uses of the marine environment intensify.

The process of developing an integrated management system for coastal and offshore areas and establishing MPAs, has been impeded by a number of factors—i.e., limited knowledge of how our oceans will function in a rapidly changing climate; the challenges of competing political and socio-economic interests; the need to act at different levels (national, regional and global); and the need to work with communities and sectors who both benefit from but also impact the coastal and ocean ecosystems. These trends have had serious consequences on the investments devoted to the development of MPAs.

MPAs are most effective when planned within the broader context of marine planning for the blue economy. This way, protected areas can help meet biodiversity targets and maintain nature's values, while other places are provided for expanding ocean use and maritime revenues. Countries would do well to commit to systematic planning within their jurisdictions, as well as working cooperatively to ensure that shared waters/resources are effectively managed. MPAs and marine management outside MPAs (including ICM) should be done in a coordinated manner at a variety of levels: local or community-based, regional, national, and trans-boundary or international. UNFCCC should work

with UNEP Regional Seas to achieve both standardization of management approaches and monitoring, and to ensure that the expanding blue economies within any ocean basin or region do not lead to biodiversity loss or conflict.

Benefits of and Priorities for MPAs

MPAs provide many benefits, not the least of which is raising public awareness about the global ocean, and the special marine places that still exist, and the opportunities we have to safeguard the seas. Protected areas can enhance fisheries production, protect habitat from degradation, and help reduce risks to property and livelihoods. MPAs also serve an important function as sentinel places, providing control sites for scientific study that enhances our understanding of marine ecology and marine management. Effectively placed MPAs can not only protect coastal communities, livelihoods, and national economies, but also improve resilience to impending climate changes such as sea level rise, ocean warming, changes to ocean circulation, and ocean acidification. MPAs, when encompassing carbon-sequestering habitats such as mangroves, seagrasses, and salt marshes, can not only mitigate against climate change–they can do so while delivering a host of other valuable ecosystem services as well.

The priority for MPAs should be protecting Key Biodiversity Areas (KBAs) and supporting the resilience of biodiversity and ecosystem services, especially vulnerable marine habitats with high societal value such as coral reefs, mangroves, estuaries, and deep-sea habitats, such as canyons, and seamounts, which contribute to climate change mitigation.

Ecosystem services are the natural by-products of healthy, well-functioning environments and in all environments include provisioning for food and water resources, as well as regulating and supporting.

Networks of MPAs can be seen as and relied upon as part of conservation strategies for poverty reduction and environmental sustainability, particularly with respect to climate change. Networks of MPAs respond better to climate change and other stressors when effectively managed; MPA management effectiveness should be enhanced. In order to effectively adapt to climate change, zonation schemes and adaptive management should be flexible. The response to climate change by networks of MPAs is enhanced if other stressors and the cumulative impacts of stressors are reduced.

Management effectiveness can be enhanced through governance schemes that incorporate design, access and benefit-sharing by local communities; education and training; inter-sectoral coordination; continued communication; and transparency. Gaps in the distribution of current networks of MPAs do exist and tend to be mostly coastal. Networks of MPAs must be representative and distributed consistently to be effective.

The Usefulness of Marine Spatial Planning

Marine Spatial Planning (MSP) can be used to promote sustainable use of ocean space and resources, while at the same time meeting social and conservation objectives. In some scenarios, MSP is used primarily to reduce conflict between big, industrial users. However, effective MSP can do much more: it can link to coastal planning to create truly effective ecosystem-based management, in which degradation of important ecosystems is prevented by focusing management on drivers of degradation (even if those drivers do not trace back to ocean use but rather have their base in land and freshwater use).

This sort of holistic planning also creates opportunities for transboundary collaboration to effectively manage shared resources. MSP and related ocean zoning can ensure that ecologically important areas are fully represented in a mosaic of use and protection. Finally, the planning process can ensure that the needs of local communities, and the safeguarding of values that extend beyond those captured by large maritime industries, are considered in decisions on how to allocate space and resources in an equitable way, while promoting economic growth.

UNFCCC

The UNFCCC is perfectly poised to assist countries in utilizing these valuable tools to their full potential. Countries that are already committed to establishing MPAs, as for example those that have signed and ratified the Convention on Biological Diversity and support the Aichi Targets, can and should do more

than establishing protected and managed areas in least-used areas in order to fulfill their international commitments. Instead, protected areas, as well as zones of highly regulated use within a matrix of ocean zones derived from marine spatial planning, should be established in ecologically important areas that are under the most threat from human activity. By directing the use of the MPA tool toward the most valuable areas, and by designing the management regime to address the real and present threats that these ecosystems face, MPAs will prove to enhance resilience so that ocean uses can continue, and ocean values will not diminish.

Bottom Line

Ultimately the role of networks of MPAs is to ensure biological and ecological connectivity and enhance resilience of marine ecosystems to climate change and thus maintaining ecosystem services. There is the opportunity to use them as sentinel (research) sites to help track the effects of climate change but as well at the same time as key component of any climate change strategy.

We have the opportunity to re-assess existing conservation and sector management strategies at national, regional and international levels by using the best knowledge at hand to protect the ecosystems that provide critical ecosystem services through the creation of large, coherent and resilient networks of MPAs.

Recommendations

- *MPAs should (1) be based on an ecosystem approach, including human well-being; (2) be able to identify systems of governance for sustainable MSP processes; (3) boast a new agenda for scientific research; and (4) take into account existing relevant processes including the development of criteria for identification and selection of new MPAs*

- *Provide technical assistance for countries to perform and use ecosystem services assessments to determine where protected and managed areas and zones should be implemented.*

- *Innovative and appropriate financial mechanisms, including the use of carbon credits/offset (as a way to pay for ecosystem services) and fiduciary trusts or debt/nature exchanges. The Green Climate Fund (GCF) is an opportunity for developing countries to receive support for mitigation and adaptation efforts, including support for MPA networks.*

- *Global networks and coordinated efforts to monitor the role and performance of networks of MPAs to achieve greater climate resilience are needed such as the International Marine Protected Areas Agenda of the IUCN Global Marine and Polar Programme, the Sustainable Ocean Initiative (SOI) of the Convention on Biological Diversity (CBD).*

3.4 Promote and apply Blue Economy approaches with emphasis on low-carbon solutions and economic benefits to developing countries and SIDS (following SDG target 14.7)

The ocean currently provides food, livelihoods, and economic opportunities for a large portion of the world's population, yet recent projections suggest that demand may grow much faster in the coming decades as this population climbs to 9.6 billion, with greater purchasing power and need for additional supplies of food and energy. [156] As this new phase of growth begins, more and more the term 'industrialization' is being used to describe the scale of economic activity in and around the ocean.[157] However, as countries increasingly look to the ocean for new sources of growth, the ecosystems upon which it depends are changing at an unprecedented rate.[158] In June 2015 the G7 Science Academies issued a statement of scientific consensus that human activities are leading to changes in the ocean that will significantly impact societies and well-being.[159]

As consensus grows that human activities are significantly changing ocean ecosystems, and at the same time projections suggest that many of these activities will rapidly accelerate in the coming decades, the concept of a '**blue economy**' has emerged in policy conversations around the globe. The conversation began in Rio+20 in 2012, as countries articulated the concept of a 'green economy' to align their development aspirations to environmental health.[160] From that discussion, the focus shifted seaward to the 'blue economy' and 'blue growth', as illustrated in the recent formation of FAO's 'Blue Growth network'[161] and the June 2015 World Ocean Summit focused on the blue economy, convened in Lisbon by the Economist.

With the adoption by the UN General Assembly of a **Sustainable Development Goal (14)** to conserve and sustainbly use the ocean—and notably to increase the economic benefits to small island developing states and least developed countries from sustainable use of ocean resources—the concept is being adopted as policy by a growing number of countries. For example, coastal governments with large ocean economies such as China, the E.U. Portugal, South Africa, and Indonesia have already started to put in place policy frameworks to achieve blue growth, as have small island states such as Grenada, Mauritius, and Seychelles.

The Baseline: The Ocean Economy

Despite the importance and unique role that the ocean plays in providing food, livelihoods, and economic growth, this contribution often remains undervalued and poorly measured. Indeed, Park and Kildow (2014)[162] note that 14 countries have 14 different definitions, but suggest the following definition: The ocean economy is the economic activities that take place in the ocean, receive outputs from the ocean, and provide [inputs] to the ocean.

Box 3.1 Defining the Blue Economy: A Working Definition

From the Economist (June, 2015):
"What is the difference between the ocean economy and the blue or sustainable ocean economy? Is it simply that a sustainable ocean economy is one where the environmental risks of, and ecological damage from, economic activity are mitigated, or significantly reduced? Is it enough that future economic activity minimizes harm to the ocean, or rather, should the aim be to restore its health?

The following is an adapted working definition: A sustainable ocean economy emerges when economic activity is in balance with the long-term capacity of ocean ecosystems to support this activity and remain resilient and healthy."

Source: Economist Intelligence Unit, 2015

Because the ocean is a unique environment, understanding and measuring the economic activity related to it, and dependent upon it, is essential for growing coastal economies—or the ocean economy. Measuring the ocean economy is challenging, due in part to: (i) the number of non-market goods and services produced by the ocean (such as the role of natural habitats in sequestering carbon to help mitigate for climate change or in protecting coastal towns and communities, i.e. 'green infrastructure'—see Figure 3.1 below, discussed in Part 4. Adaptation), (ii) the inability of national processes to account for depletion of natural resources supporting economic activity, and (iii) the difficulty in drawing the line between coastal and ocean economic activity (see Table 3.2 below). At the same time, even where efforts have been made to measure the ocean economy, information on its carbon intensity or footprint is often not available.

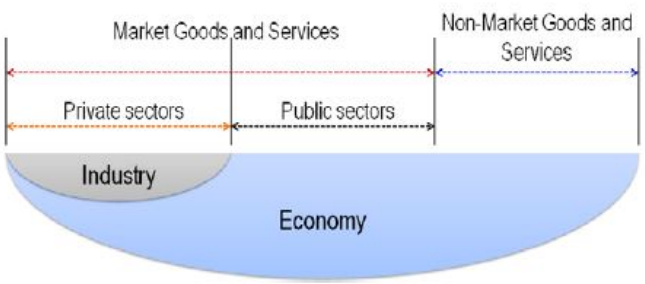

Figure 3.1. Measuring economic benefits from the ocean, with and without markets.
Source: Park and Kildow (2014)

Table 3.2. Components of the ocean economy Source: Economist Intelligence Unit, 2015

Type of Activity	Ocean Service	Economic Sector/Industry
Harvesting of living resources	Seafood	Fisheries
		Aquaculture
	Marine biotechnology	Pharmaceuticals, chemicals
Extraction of non-living resources, generation of new resources	Minerals	Seabed mining
	Energy	Oil and gas
		Renewables
	Freshwater	Desalination
Commerce, tourism and trade	Transport and trade	Shipping
		Port infrastructure and services
	Tourism and recreation	Tourism (including eco-tourism)
		Coastal development
Responses to ocean health challenges	Ocean monitoring and surveillance	Technology and R&D
	Carbon sequestration	Blue carbon (i.e. coastal vegetated habitats)
	Coastal protection	Habitat protection, restoration
	Waste disposal for land-based industry	Assimilation of nutrients, solid waste

Transitioning to a Blue Economy

The global ocean economy is growing, while at the same time global indicators of the status of the ocean environment, e.g. "ocean health," show significant changes from human activities. For this reason, the sustainable use and conservation of the ocean and coasts was articulated specifically among the global SDGs. To achieve SDG 14 and increase the benefits from sustainable ocean use for developing coastal and island states (indicator 14.7), policies will be needed to decouple economic growth from environmental degradation in the ocean, and achieve a low-carbon, sustainable "blue economy." It is important to note that the health of the oceans and its resources supports the successful achievement of many of the SDGs in addition to SDG 14, such as SDGs 1, 2, 3, 6, 7, and 8.

There are few guides to defining such policies in the ocean space, however much of the work on 'the green economy' is instructive. The OECD developed a global green growth strategy that defines the concept as a policy agenda to "*foster economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies*."[163] The strategy provided guidelines for policies to achieve a green economy, including those that demonstrate measurable progress in:

- Enhancing efficiency in the use of resources and natural assets, and reducing waste;
- Spurring innovation to simultaneously create value and help solve environmental problems;
- Creating new markets by stimulating demand for green technologies, goods and services; and
- Boosting investor confidence through greater predictability and continuity in addressing environmental issues.

Similarly, FAO has defined the growth of a blue economy, or blue growth, as a coherent approach for the sustainable and integrated management of oceans and wetlands that is appropriate for the specific social context.[164] Investments in blue growth would focus on the sustainable management of aquatic resources and the adoption of approaches to ensure continued and improved contributions to food and livelihood security and economic growth from the aquatic systems. FAO emphasizes that a blue economy recognizes and addresses the rights of those dependent on fisheries and aquaculture for their livelihoods—some 12% of the world's population.

The action and leadership taken by African nations in implementing Blue Economy strategies must be recognized. The UN Economic Commission for Africa (ECA) created a Blue Economy Policy Handbook for Africa, a comprehensive and practical document which is already being effectively utilized. African leaders have seen Blue Economy policies as

a particularly useful method of integrating climate adaptation and mitigation within their development goals.[165] The growing sustainable management and utilization of fisheries and aquaculture has been a transformational strategy for many African economies.

Applying these types of policies to the ocean economy would essentially define the 'rules of the game' for a low-carbon blue economy. While no two situations are the same, there are some important tools that countries might use to develop policies for the transition to a blue economy, such as:

- *Better accounting for the ocean's natural capital, particularly given that some of the goods and services are not exchanged in the marketplace;*
- *Utilizing some form of coastal and marine spatial planning to help assess competing uses in the same space and provide clearer 'rules of the game;' and*
- *Developing metrics to measure the transition to a blue economy and specifically the benefits to coastal and island communities and economies, as well as carbon intensity and sequestration.*

4. Displacement

4.0 Develop and support measures to address the issues associated with the displacement of coastal and island populations as a result of climate change, which will necessitate improvement of international law in terms of definitions, rights and procedures for climate-induced refugees and migrants, including the development and implementation of appropriate financing measures.

Definitional Issues of Climate-Induced Displacement

The legal status, and thus the human rights to which people displaced due to impacts of a changing climate may be entitled, hinges on evolving definitional issues. Displacement is defined by the UN as "The forced movement of people from their locality or environment and occupational activities."[166] There are two types of population displacement; the direct form is actual displacement of people from their locations, while indirect displacement leads to a loss of livelihood. A refugee is defined as "any person who is outside their country of origin and unable or unwilling to return there or to avail themselves of its protection, on account of a well-founded fear of persecution for reasons of race, religion, nationality, membership of a particular group, or political opinion," while an environmental refugee is defined as "a person displaced owing to environmental causes, notably land loss and degradation, and natural disaster."

Estimating the numbers of people who are or will be migrating due to climate change requires means to distinguish them from those who move for other reasons, in addition to ascertaining whether displacement is undertaken willingly or not.

Given that the 2014 IPCC report finds the most vulnerable members of the population are often most impacted by the effects of climate change,[167] defining their status is important. The International Federation of Red Cross and Red Crescent Societies (IFRC) finds displaced populations leave their homes in groups, usually due to a sudden impact such as a storm, flood, threat or conflict–and there is usually an intention to return home. Thus operationally, migration and displacement are interlinked, but must be distinguished. Displaced populations–either across borders such as refugee influxes, or within a country because of disasters (or conflict)–usually need relief operations combined with efforts aiming at collective and lasting solutions. Migration, on the other hand, usually involves more individual social assistance, legal protection and personal support. The displacement of populations often leads people to move further and to become migrants. [168]

Migrants are people who leave or flee their home to go to a new place–usually abroad–to seek better or safer surroundings. Migration can be voluntary or forced, but generally a combination of choices and constraints are involved, as well as the intent to live abroad for an extended period. Many migrants succeed in establishing themselves in their new communities, but others face difficulties and it is these people who are of primary concern to the IFRC. With their traditional support systems removed, they are often unable to access basic health and welfare services. They may lose links with their families and communities, and be subject to people smuggling and trafficking, or be exploited in informal labour arrangements. As part of the migration process, they may be detained and deprived of their freedom. There are often challenges such as cultural and language barriers, discrimination, exclusion, or even violence to overcome. Women and children are particularly at risk. The IFRC is committed to addressing the needs and vulnerability of migrants in order to provide protection and assistance.[169]

The humanitarian sector acknowledges that climate change is here to stay, will accelerate, and although a global issue with impacts all over the world, those people with the least resources have the least capacity to adapt and are therefore the most vulnerable. While developing countries and more particularly their poorest inhabitants, lack the means to fend off floods and other natural disasters; to make matters worse, their economies tend to be based on climate/weather-sensitive sectors such as agriculture and fisheries, which makes them all the more vulnerable.[170] Going forward, as climate-induced displacement becomes more frequent and involves more and more people in all parts of the word, in order to develop appropriate criteria for determining

rights and protections these definitional issues will have to be further discussed and agreed upon.

What Does Climate-Induced Displacement Look Like?

Walter Kälin, former representative of the UN Secretary-General on the human rights of internally displaced persons, identified five scenarios qualifying as climate-induced displacement arising from environmental issues: "sudden onset disaster, slow onset environmental degradation, sinking small island states, high risk zones designated by governments, and unrest that disturbs public order."[171]

Those displaced by flooding and sea level rise are perhaps the easiest to define as climate refugees because there is less likely to be an element of choice and these drivers of movement are readily attributable to climate change. As sea levels continue to rise, states will continue to lose land, resulting in millions of climate change refugees.[172] For some nations, this will eventually lead to total submersion, resulting in a loss of sovereignty. For other countries, there will be a shift in maritime baselines and the boundaries set in the UN Law of the Sea may need to be revisited.

Climate-induced displacement is an issue of particular importance to coastal and SIDS populations. For these populations, climate change and sea level rise are direct threats to their economies, culture, and lifestyle. Mitigation is crucial to protecting these populations from displacement. Because a 2.0C limit is widely considered insufficient to protect many coastal and island populations, the temperature limit target supported by SIDS countries is "1.5C to stay alive."

Current and Projected Scope of Climate-induced Displacement

Estimates from various organizations of the number of refugees that could be displaced within the century range from 50 million to 1 billion. The International Organization for Migrants (IOM), an intergovernmental organization of the UN system acts with its partners in the international community to assist in meeting the operational challenges of migration. It is mandated to advance understanding of migration issues, encourage social and economic development through migration and uphold the human dignity and well-being of migrants. It is committed to the principle that humane and orderly migration benefits migrants and society and defines environmental refugees as: persons or groups of persons who, for compelling reasons of sudden or progressive change in the environment that adversely affects their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad.

The IOM projects 200 million will be displaced by 2050 due to overall environmental changes.[173] Reflecting on the ground-breaking integration of displacement in the newly adopted Sendai Framework on Disaster Risk Reduction 2015-2030, Walter Kälin cites only a few of the growing statistical evidence that disaster risk reduction is highly relevant for displaced persons: between 2008 and 2013, sudden-onset disasters including cyclones and floods displaced an estimated 164 million people. Most of them became internally displaced persons, such as the more than four million displaced survivors of Typhoon Haiyan/Yolanda in 2013.[174] The IFRC notes that global sea level rise of several cm per decade, which will affect coastal flooding, water supplies, tourism, fisheries etc. Tens of millions of people will be forced to move inland.[175]

Taking into account the combined effects of population growth, changing settlement patterns and more extreme sea levels, Vafeidis et al (2011)[176] estimate that by 2030 the number of people exposed to coastal flooding in Asia will increase by 50% over 2000 levels. Changes in the spatial distribution of some extreme events due to a changing climate may result in new areas being exposed to extremes, potentially leading to previously unseen impacts. In Vietnam, 1 million people could be displaced by 2050, and 60% of the Mekong delta (which produces over 50% of the world's rice), could be flooded nearly year-round.[177] In Bangladesh, 3 million people could be displaced by 2050. Higher sea level projections foresee a 25% overall loss of land area by 2100.[178]

Examples of populations that are already vulnerable include Kiribati, where at least two islands have already disappeared, and the government is actively pursuing negotiations to secure means for migration with dignity.[179] The World Bank estimates that by 2050, Kiribati will need to spend 13-27% of its GDP on climate damages.[180] In the Maldives, according to

mid-range sea level rise (SLR) projections, 77% of the land could be gone by 2100.[181] The Maldives has already spent $100 million to make a "safe" island, though millions more will be necessary to shore up enough space for the entire population.[182]

A 2013 World Bank study on climate-driven risk finds that developing-country cities move up the most vulnerable list when flood costs are measured as a percentage of municipal GDP, and cites the 10 most vulnerable cities to flood risk as: 1) Guangzhou; 2) New Orleans; 3) Guayaquil; 4) Ho Chi Minh City; 5) Abidjan; 6) Zhanjing; 7) Mumbai; 8) Khulna; 9) Palembang; and 10) Shenzen. Rapid urbanization also tends to push the poor into the most vulnerable neighborhoods, which are often in low-lying areas and along waterways prone to flooding.[183]

It is important to note that saltwater intrusion and actual land loss are only some of the more direct drivers of climate induced-displacement. Although arguably the easiest direct causes to predict, they may not be the largest. The impacts of climate change, such as instability in food and water supplies, are likely to fuel shortages and conflicts which in turn trigger migration.[184] Complex climate-induced drivers are likely to be more difficult to define, as the links between migration and climate change will not always be clear.

Climate-related extreme disasters have risen by 44% over a 1994-2000 average, and while it remains challenging to assign specific attributions in cases of events like hurricanes and hundred-year floods,[185] progress is being made in the scientific basis for establishing direct causality. The 2016 report of the US National Academies of Sciences, Engineering and Medicine committee on extreme weather events and climate change attribution notes that the past decade has seen a remarkable increase in interest and activity in the extreme event attribution field. Since the 2004 publication of the first attempt at attributing an extreme weather event to climate change--analyzing the 2003 European summer heat wave that killed tens of thousands of people--the American Meteorological Society Bulletin has inaugurated a special annual issue dedicated to articles on extreme weather events, and from 2012 to 2015, the number of research groups submitting studies to this issue grew by more than a factor of five.[186]

State of Play Within the UNFCCC

The climate change refugee is a new concept, and there is still no international law which addresses environmental displacement. Since 2009, states convening under UNFCCC have recognized the importance of addressing displaced environmental refugees. There have been workshops, panels, and reports which address this concern, notably the Global Forum on Migration and Development and a focus in chapter 13 of the IPCC's Fifth Assessment Report. However, stronger action in the form of specific policy is required.[187] Seeking a UN General Assembly resolution to better define refugee status qualifications could produce the necessary definitional progress.

Climate-induced displacement falls within a "protection gap" between the definition of a migrant and a refugee/stateless person. The 1951 UN Convention Relating to the Status of Refugees distinguishes migrants from refugees.[188] Migrants are those who voluntarily leave their country to take up residence elsewhere. Migrants are not guaranteed the rights of refugees, who are defined as unable or unwilling to return to their countries. The UN High Commissioner for Refugees (UNHCR) has responsibilities to provide international protection to refugees. UNHCR is also mandated to promote the conclusion and ratification of international conventions for the protection of refugees, and is responsible for proposing amendments thereto, which offers a way forward in defining the legal status, criteria for and rights pertaining to climate-induced refugees.

A further complicating issue is the lack of an agreed definition of loss and damage under the UNFCCC. Loss and damage must be formally addressed, according to the IPCC's Fourth Assessment Report, in those circumstances where mitigation and adaptation would not be enough to avoid major consequences, including population displacement for many countries. A proposed working definition of loss and damage as it pertains to climate change is "the negative effects of climate variability and climate change that people have not been able to cope with or adapt to."[189] Loss and damage can be divided into three categories; avoided, unavoided, and unavoidable.[190] Unavoided loss and damage is defined as those situations that could have been avoided by preemptive mitigation or adaptation but

were not, and these are likely to be the situations where international insurance or social safety nets may be appropriate in relevant circumstances.

A certain amount of climate-induced displacement is now considered unavoidable; whether progress on loss and damage will ultimately yield a mechanism for providing designated safety nets remains to be seen. Loss and damage as a result of the impacts of climate change can be economic, cultural, or social; the consequences of displacement also intersect these categories. The Warsaw Loss and Damage Mechanism is the UNFCCC's attempt to address the loss and damage associated with the impacts of climate change, which include both extreme and slow-onset events. In the future, dealing with the costs of climate-induced displacement may be possible through this mechanism if such displacement is categorized under loss and damage. Both funding and loss and damage are further discussed in Part 5 of this report.

Opportunities and Pathways to Advance this Issue

The non-binding but highly authoritative Sendai Framework offers a wealth of opportunities to further engage and establish closer ties with the disaster risk reduction community to strengthen the protection of internally displaced people (IDPs) worldwide. Its Preamble specifically acknowledges the large number of displaced persons in recent years as one of the devastating effects of disasters and one of seven targets of the Framework is to "substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared to 2005-2015." In light of the yearly average of 27.5 million newly displaced persons in the past six years as reported by the Internal Displacement Monitoring Center, Kälin underlines that this target is clearly not ambitious enough. Nevertheless, it provides an important basis for improving the protection of disaster displaced persons. To effectively mainstream displacement into regional, national, and local disaster risk reduction strategies, investment in capacity building is required at all levels. [191]

Climate-induced displacement should also be considered in the UN Secretary-General's Anticipate, Absorb, Reshape (A2R) climate resilience initiative which aims to mobilise action and investment in the context of the Sustainable Development Goals. A2R aims specifically to help address the needs of the nearly 634 million people, or a tenth of the global population who live in at-risk coastal areas just a few meters above existing sea levels, as well as those living in areas at risk of droughts and floods. It brings together 13 UN entities—FAO, UNEP, UNFCCC, UN-Habitat, UNICEF, UNESCO, UNFPA, UNOPS, UNISDR, WFP, OCHA, WHO, and WMO—to strengthen the ability of countries to anticipate hazards, absorb shocks, and reshape development to reduce climate risks.[192] Anticipating hazards through investments in early warning systems should specifically identify risks that could lead to displacement and trigger actions to reduce these risks. Absorbing shocks should include measures to smooth impacts that could result in people becoming climate refugees. Resilient development cannot be achieved unless and until criteria are defined and measures are designed to reduce the risk of climate-induced displacement, to address the needs of the most vulnerable for those risks which cannot be avoided, and to make provisions for unavoidable impacts that result in climate-induced displacement.

According to the International Federation of Red Cross and Red Crescent societies, displacement is always traumatic: in addition to basic needs, the IFRC aims to provide psychological support to displaced persons. While the responsibility for refugees and all displaced populations primarily rests with the host government, it is the mandate of the United Nations High Commissioner for Refugees to protect and assist refugees. The World Food Programme has a mandate to provide emergency food relief, although it may require assistance with supplies and distribution. Red Cross Red Crescent operations respond to displaced populations who are vulnerable or in need, providing some or all of the following:

- material and social assistance
- protection against abuse, exploitation and the denial of rights
- advocacy for the rights of refugees and internally displaced people

The needs of the host population are also taken into account. In general, the immediate Red Cross Red Crescent response to a sudden population movement

prioritizes safe water and basic sanitation, emergency medical care and basic health services, temporary shelter, and distribution of food and other urgently needed items.

Clearly, disaster risk reduction is highly relevant for displaced persons. While the Sendai Framework underlines the need to prepare for "ensuring rapid and effective response to disasters and related displacement, including access to safe shelter, essential food and non-food relief supplies," building resilience through the reconstruction and recovery phase is also important. In this context, states are encouraged to adopt, at national and local levels, "policies and programs addressing disaster-induced human mobility to strengthen the resilience of affected people and that of host communities as per national laws and circumstances." Kälin notes that mention of host communities is significant as they too are affected by displacement.[193]

The conventional wisdom suggests that mitigation, preemptive disaster risk reduction, and adaptation can avoid and reduce human suffering and long-term costs of displacement. Pursuing a formalized definition for climate-induced displacement and refugee status through the UN Convention Relating to the Status of Refugees (1951) should serve as a foundation for moving forward. Any solution dealing with the coming refugee crisis from climate change will have to come to grips with the definitional issues related to refugees and migrants. Vulnerable populations give preference to a more liberal definition of refugee in order to protect coastal and SIDS populations.

Funding the mitigation and adaptation methods to deal with the impacts of climate change in the context of sustainable development is difficult and expensive. The Green Climate Fund, adopted in 2011, is one potential source of financial aid. An international insurance fund has been presented as an option by some advocates for SIDS and coastal populations. Regardless of the mechanism or level of participation, it is vital for funding methods to be proactive, reliable and mobilized for the areas with the highest need. Identification of the areas of greatest risk and need should be prioritized.[194]

The IFRC promotes bridging of climate change adaptation and disaster risk reduction through integrated social, economic and environmental resilience-building approaches to sustainable development. The Red Cross Red Crescent Climate Centre is a dedicated scientific reference centre which supports the "movement" (the world's largest humanitarian organization) through activities based on the "triple A" principle, which readily applies to advancing rights and protections for vulnerable people at risk of or subject to climate-induced displacement:

Awareness: Implementing information and education activities about climate change and extreme weather events within the Red Cross/Red Crescent Movement, including through its role as auxiliary to government and as a civil society organization, among the general public;

Action: Supporting the development of concrete climate adaptation activities within the existing context of disaster risk reduction and climate-resilient development programs;

Advocacy: Bringing concerns about the impacts of climate change on vulnerable people and experience with climate adaptation and disaster risk reduction programs to the places of policy development, both within the International Federation, as in other relevant international fora

In 2006 a "fourth A" was introduced:
Analyses: Analysing climate change risk reduction issues and building a body of evidence in the context of experiences to better inform policy, investment and practice.[195]

Going forward, it is difficult to prescribe, but important to learn from practical experience in developing the best methods for ensuring human security and providing the social, economic, environmental, and in some cases sovereign protections to the populations most likely to be affected by climate-induced displacement. Coastal and SIDS populations voiced their preferences in the run-up to COP 21. The Polynesian Leaders Group, for example, set forth a list of actions that they believe can help protect them against the repercussions of displacement.[196] These Leaders called for the UNFCCC to recognize that climate change represents an existential threat to their sovereignty, and in some cases, their existence as nations with physical land to occupy. They propose an inter-national protection regime for climate

displaced populations, including the fixing of EEZ areas defined in UNCLOS around threatened SIDS to protect economic livelihoods. In cases where entire islands may disappear, some SIDS fear the loss of their natural resources if areas formerly within their EEZ become part of the high seas.

The proposal put forth by SIDS leaders would theoretically provide a mechanism for identifying those who are at risk of being or have been displaced by climate change and have no choice but to leave their country. The proposal asserts that this categorization should be included in the UNHCR definition of refugee with all of the protections of refugee status. Delaying the development of universal climate refugee criteria and appropriate financial mechanisms will only allow the economic and humanitarian toll from climate-induced displacement to rise.

Recommendations

- *Proactively address the "protection gap" by determining criteria and definitions of refugee status within the UNHCR.* The international community requires criteria for classifying displacements as climate-induced in order to better prepare and assist displaced populations.[197]
- *Identify vulnerable populations with a high risk of displacement using best available science.* It is possible to preemptively identify and prepare vulnerable populations in the case of slow-onset impacts such as sea-level rise, for which case studies exist.[198]
- *Develop early warning indicators and risk reduction actions linked to these triggers for populations at risk of displacement.*
- *Build coherence and complementarity by leveraging linkages and synergies across the UNFCCC, Sendai Framework and SDG processes in criteria and targets related to vulnerable people at risk of or subject to climate-induced displacement.*
- *Consider proposals for financial mechanisms to address climate-induced displacement from various stakeholders.* It will ultimately be necessary to develop fair and balanced financial mechanisms before large displacement events occur. Such mechanisms can best be created with input from all relevant stakeholders.[199]

5. Financing

Major Recommendations:

5.0 Adaptation and mitigation efforts in coastal and SIDS countries /communities should receive sufficient funding, through:

5.1 Thorough examination of assessments of costs of adaptation, mitigation, and displacement (existing assessments are often inadequate, for example, do not account for ecosystem services)

5.2 Development of a financial tracking mechanism to report on financial flows to support climate change efforts related to oceans and coasts

5.3 Earmarked funds in global public finance mechanisms to support adaptation and mitigation in coastal areas and SIDS

5.4 Earmarked 10% of public and investments in coastal infrastructure for coastal habitat protection and restoration)

5.5 Develop a financial tracking mechanism to report on financial flows to support climate change efforts related to oceans and coasts and SIDS

5.6 Earmark funds in global public finance mechanisms to support adaptation and mitigation in coastal areas and SIDS

Financing Adaptation to a Changing Ocean

Previous sections have emphasized the central role of the ocean in human economic and social well-being, and the projected impacts on it as a result of climate-related drivers in various global scenarios for rising greenhouse gas emissions, including sea level rise and storm surge, and ocean warming and acidification, among others. In addition to these climate-related drivers of change, the ocean is already experiencing impacts from a number of other human-related drivers. The United Nations estimates that already as much as 40% of the global ocean is heavily affected by human activities,[200] and earlier in 2015 the G7 Science Academies issued a statement warning that these activities are leading to changes that will significantly affect human economic and social well-being.[201] These changes include:

- *Depletion of fish stocks* (29% of the world's assessed ocean fisheries are considered biologically overfished—up from 10% in 1970);[202]

- *Loss/conversion of coastal natural habitats* (the world has lost 20% of sea grass and mangrove habitats since the 1970s and 1980s respectively, and coral reefs have declined by 38% since 1980); and

- *Pollution* into ocean waters (some 80% of pollution entering the ocean comes in the form of excess nutrients from land-based sources such as agriculture and untreated sewage,[203] while an estimated 4.8 to 12.7 million tons of plastic entered the ocean in 2010, with an estimated total natural capital cost of US$13 billion/year).[204]

The cumulative impact of this combination of climate-related and other human-related drivers threatens the ability of the ocean to provide a range of services essential to the social and economic well-being of many communities and societies, notably those in developing coastal and island states. For example, some 3 billion people are estimated to depend on marine and coastal biodiversity for their livelihoods,[205] and seafood contributes over 16 percent of the animal protein consumed by the world's population—with 1 billion people in developing countries relying on this source of protein.[206] More broadly, a range of services are provided by the ocean– many of which are dependent upon the functioning of marine ecosystems–(See Box 3.1 in Part 3) leading to an annual 'gross marine product' of some $2.5 trillion according to WWF.[207] In many cases these services could be greater with reduced stressors on ecosystems, for example the ocean's commercial fisheries could generate an estimated $50 billion more in annual net economic benefits with reductions in fishing pressure.[208]

Given the importance of ocean ecosystems to human social and economic well-being, as well as the

impacts of both climate-driven and other human-driven changes to these systems, the description of adaptation costs and financing options in this section is organized as follows:

Coastal Populations: The costs of measures to help coastal populations and sectors adapt to climate-related impacts;

Ecosystems: The costs of measures to help ocean ecosystems adapt to climate-related impacts in order to continue to provide current services;

Ocean adaptation costs compared to global adaptation costs: Putting the known estimates for ocean adaptation costs into perspective of estimates for global adaptation costs; and

Financing mechanisms for ocean, SIDS and coastal adaptation: A brief summary of global public adaptation financing mechanisms that could help offset the costs of ocean adaptation, and emphasis on the potential gap that exists.

This division reflects the need to reduce the vulnerability of coastal populations to climate-related impacts, as well as the vulnerability of the ocean's ecosystems that support the global population. Ecosystem management—or reducing other human-related stressors on coastal and ocean ecosystems such as overfishing, loss/conversion of coastal natural habitats, pollution– is one of the key categories of approaches for reducing vulnerability and exposure and increasing adaptation to climate-related changes in the ocean.[209] As the IPCC states, climate-related impacts only add to the threats posed by overfishing and these other human-related stressors.[210] Essentially, reducing these stressors can both enhance adaptation and help achieve the Sustainable Development Goal 14 (SDG14): to conserve and sustainably use the oceans, seas and marine resources for sustainable development.[211] *As such, ocean adaptation—both of coastal populations and of ocean ecosystems—is tightly linked to meeting SDG14, and vice versa.*

Finally, these costs of adaptation should be considered in the context of the costs of climate mitigation. The latter are also difficult to measure and depend heavily on the costs associated with the baseline scenario. The most widely cited global mitigation cost estimate is the cumulative loss of 1% +/-3% of global GDP by 2050, or 0.05% average annual global GDP.[212] Due to the uncertainties involved in measuring global mitigation costs, experts caution about putting much emphasis on the actual dollar values.[213] There *is* a large cost associated with climate mitigation, and a healthy ocean can play a large role in climate mitigation by offsetting costs at least partially through blue carbon finance, biodiversity finance, other payments for ecosystem services, and other mechanisms.

The Costs of Measures to help Coastal Populations Adapt to a Changing Ocean

Types of investments needed. Without adaptation, hundreds of millions of people will be affected by coastal flooding and displaced by 2100.[214] Adapting to climate-driven increases in sea levels and storm surge will require various types of investments, classified in the IPCC's 5th Assessment Report as:

1. *Retreat:* allowing wetlands to migrate inland, shoreline setbacks, and managed realignment by, for example, breaching coastal defenses allowing the creation of an intertidal habitat;

2. *Accommodation:* increasing flexibility, flood proofing, flood-resistant agriculture, flood hazard mapping, the implementation of flood warning systems, or replacing armored with living shorelines; and

3. *Protection:* advancing or holding existing defense lines by means of different options such as land claim; beach and dune nourishment; the construction of artificial dunes and hard structures such as seawalls, sea dikes, and storm surge barriers; or removing invasive and restoring native species.[215]

Additionally, increasing attention has been given to community-based adaptation measures, and ecosystem-based adaptation, including protection and restoration of relevant coastal natural systems such as mangroves, oyster reefs, and salt marshes.[216] Finally, the above costs do not include the potentially significant costs to SIDS that could be associated with population displacement or even loss of territorial integrity and EEZ.[217]

Investments in reducing vulnerabilities in fisheries and aquaculture ecosystems and the communities

that depend on these will also be necessary. Targeted investments in understanding the vulnerability of food security to climate change and extreme weather events are needed to guide targeted adaptation actions ranging from climate proofing development and management plans to technical tools and processes to increase resilience throughout the food production supply chain.

Estimated costs. The full global cost of protection measures to help coastal populations adapt to sea level rise and storm surge have been estimated by various organizations, though with high levels of uncertainty.[218] These estimates have focused on protection of coastlines via dykes and beach nourishment, indicating annual investment and maintenance costs by 2100 on the order of:

1. US$12 to 31 billion per year under the stringent mitigation scenario (increase in global mean surface temperature of 0.3 and 1.7 °C) and
2. US$27 to 71 billion per year under the high emission scenario (increase in global mean surface temperature of 2.6 to 4.8 °C).[219]

Alternatively, coastal adaptation costs reported by IIED (2009) are approximately US$11 billion/year, of which US$4 billion are for developing countries.[220]

The Costs of Helping the Ocean Adapt to a Changing Climate *(Ocean Warming and Acidification)*

Types of investments needed. Reducing the vulnerability and preserving, restoring or increasing the resilience of ocean ecosystems is essential to sustaining the provision of many services upon which the global population depends. Because of ecological limits and in some cases low adaptive capacity, such natural systems are some of the most vulnerable "sectors" to climate-related impacts.[221] Marine ecosystems are no exception, given the projections for ocean warming and acidification, and the additional stresses on these systems—from overfishing, coastal habitat loss/degradation and pollution—only increase their vulnerability.

Coral reef ecosystems are the most vulnerable marine ecosystem, with little scope for adaptation.[222] Additionally, climate-related impacts on the distribution of marine species and biodiversity will challenge sustained provision of fisheries productivity by the mid-21st century, as well as other marine ecosystem services—with tropical regions particularly vulnerable.[223] Ocean acidification also poses substantial risks to ocean ecosystems, with potentially detrimental consequences for fisheries and livelihoods.[224] Acidification acts together with other climate-related changes (e.g. warming) and with local changes such as pollution and eutrophication, and will be higher in areas where eutrophication is an issue.[225]

Investment options to directly help ocean ecosystems adapt to the impacts of warming and acidification are limited. Hence, ecosystem-based management of ocean resources and areas, in order to reduce these additional human-related stressors, should be a priority for financing ocean adaptation.[226] Such investments would also contribute directly towards achieving SDG 14. These types of investments include, among others:

- *Fisheries governance reform* to reduce overcapacity and effort on overexploited stocks and maintain fully exploited stocks at levels capable of supporting the maximum sustainable yield;

- *Integrated coastal and ocean management* to restore and/or protect critical natural habitats, as well as investments to conserve at least 10% of coastal and marine areas (notably coastal systems such as coral reefs, mangroves and seagrass beds, that support high levels of biodiversity); and

- *Reduction of land-based sources of pollution*, including increased wastewater treatment capacity in the coastal zone, reduction of excess nutrient use and runoff in agriculture systems and enhanced collection/prevention of marine debris.

Estimated costs. UNEP reports that the costs of measures to help coastal populations adapt to sea level rise and storm surge have been relatively well studied, but the costs of adaptation for natural systems (i.e. ecosystems) and the services they provide have not. This is certainly the case for ocean ecosystems, and the costs of reducing the other human-related stressors and achieving SDG14. At present, only very initial attempts have been made to indicate rough orders of magnitude of the costs, including:

- *Rebuilding marine fisheries*: estimated on the order of $200 billion in present value;[227] and

- *Reducing land-based source of pollution to the ocean*: estimates on the order of US$579 billion in investment, and some $75 billion in annual expenditures.[228]

Ocean Adaptation Costs in Comparison to Global Adaptation Costs

The global costs of adaptation have been estimated by a number of organizations (*Figure 5.1*),[229] most recently by the IPCC at some US$70 to 100 billion annually by 2050. UNEP[230] found this estimate to be likely far too low, suggesting estimates on the order of US$300 billion annually by 2050. As mentioned previously, coastal protection costs alone have been estimated on a range of US$12 to 71 billion per year by 2100, with high levels of uncertainty. This does not include ecosystem-based adaptation, notably reduction of other human-related stressors on ocean ecosystems per SDG14, such as overfishing, loss/conversion of natural coastal habitats and pollution. Initial estimates of very rough orders of magnitude suggest that the up-front investment costs to reduce these stressors could be on the order of hundreds of billions. Essentially, the costs for both coastal populations and ocean ecosystems to maintain current services may be on the order of at least tens of billions annually by 2050.

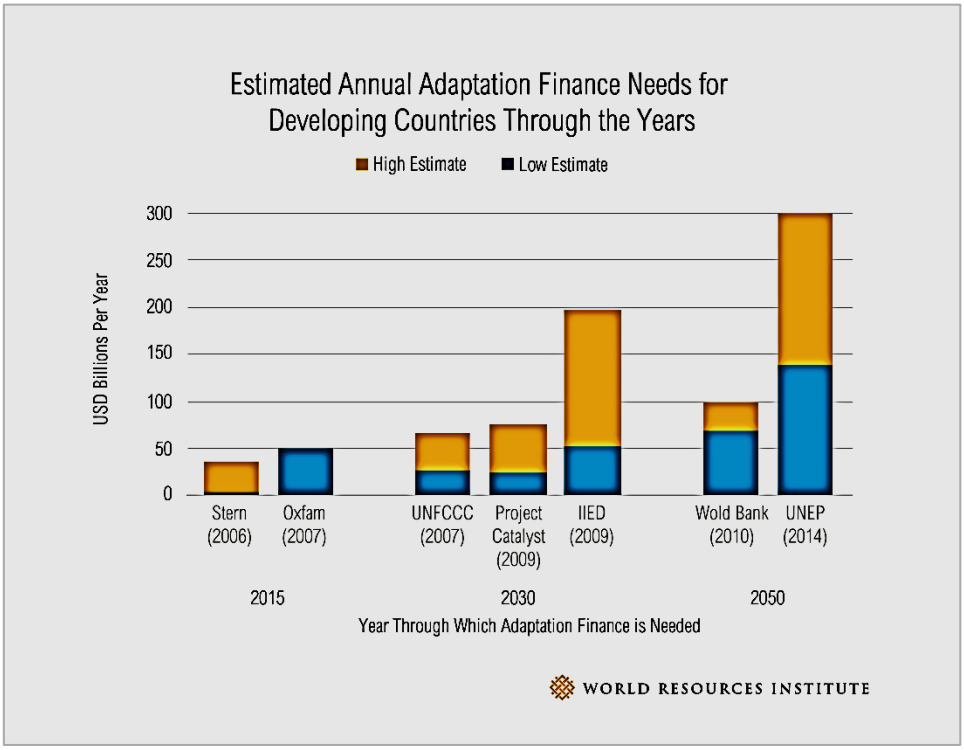

Figure 5.1. Global adaptation costs in the literature. Source: WRI (2015)[231]

Financing Mechanisms for Ocean Adaptation

Finance for adaptation includes both public and private sources, with the former classified by UNEP as:

A. Development finance institutions (including bi-lateral, multi-lateral and national institutions),
B. Governments (through bilateral official development assistance contributions), and
C. Climate Funds targeting adaptation.[232]

The various development finance mechanisms and climate funds that form available sources of public finance for the costs of adaptation have been described in the literature.[233] *Table 5.1* shows the most widely known and discussed climate finance mechanisms that can currently be drawn upon to fund adaptation, and in some cases mitigation, projects.

Table 5.1. Climate-Related Public Finance Mechanisms within the UNFCCC and Regional Development Banks

Name	**Description**	**Funds available or allocated**	**Eligible ocean-related activities (including mitigation)**
GEF Trust Fund	Finances adaptation projects under a specific Climate Change Focal Area (FA) for adaptation. The Strategic Priority on Adaptation (SPA), established in 2004 as a $50 million allocation inside of the GEF Trust Fund, designed to support pilot and demonstration adaptation projects that provide real benefits and can be integrated into national policies and sustainable development planning.[234] SPA funding was accessible to all countries eligible for GEF funding. The SPA portfolio is now complete with 26 projects and $649 million leveraged in co-financing.	Available (2014-18): $3 billion[235,236] with an expected US$30 billion being leveraged from other sources	Biodiversity, climate adaptation, chemical, international waters, land degradation, sustainable forest management / REDD+, Can also finance mitigation (e.g. blue carbon)
GEF Special Climate Change Fund	Finances programs relating to adaptation, (capacity-building, technology transfer, and economic diversification) for all countries. Within these categories, the SCCF has two active funding windows: the Adaptation window (SCCF-A) and Technology Transfer window (SCCF-B).	Available (Pledged amount): $227.5 million as of 2011[237]	Capacity-building, adaptation, technology transfer, coastal zone and disaster risk management, enhancing the resilience of water resources management.
GEF Least Developed Countries Fund	Activities supported under this GEF operated fund include preparing and implementing NAPAs to identify the immediate needs of LDCs to adapt to climate change. LDCF grants are awarded to adaptation projects that address high-priority areas identified in the approved, country-specific NAPA.	Available (Pledged amount): $420.8 million as of 2011[238]	Natural resources, coastal zone, and water resources management
Green Climate Fund	A mechanism to assist the developing countries in adaptation (and mitigation) practices to counter climate change. Supports projects, programs, policies and other activities in developing countries and will aim for a 50:50 balance between mitigation and adaptation over time.	Available (to date): $10.2 billion,[239] with $100 billion per year pledged by 2020 as the target.[240]	Increasing the resilience of ecosystems such as wetlands, and communities, scaling up the use of modernized climate information and early warning systems Can also finance mitigation (e.g. blue carbon)

Adaptation Fund	Finances practical adaptation projects and programs in developing countries and support capacity-building activities.	Available (allocated): $318 million[241]	Water resources and land management, agriculture, health, infrastructure development, fragile ecosystems; Supporting capacity building for preventive measures, planning, preparedness and management of disasters
African Development Bank (DB) climate change funds (CCF)	Helps with adaptation by providing funding for 'climate finance readiness' projects in individual countries.	Available (2012): $523 million[242]	Can also finance mitigation (e.g. blue carbon)
Asian Development Bank (DB) climate change funds (CCF)	Resources get pooled within the Bank to address climate change through technical assistance and grant components of investment projects.	Available (Allocated as of 2012): $50 million[243]	Can also finance mitigation (e.g. blue carbon)

Table 5.1 illustrates public finance mechanisms available for at least a portion of the types of investments discussed previously for ocean adaptation, with a current total available of just under US$10 billion (assuming only half of the current funding in the Green Climate Fund is available for adaptation), and an additional US$80 billion per year pledged to the Green Climate Fund by 2020. These funds are not limited to ocean adaptation, but all global adaptation financing needs in developing countries. According to UNEP, the global amount of public finance committed to activities with explicit adaptation objectives ranged between US$23 billion and $26 billion in 2012 – 2013, of which 90% was invested in developing countries and a small percentage was invested towards coastal adaptation (see *Figure 5.2* below).[244]

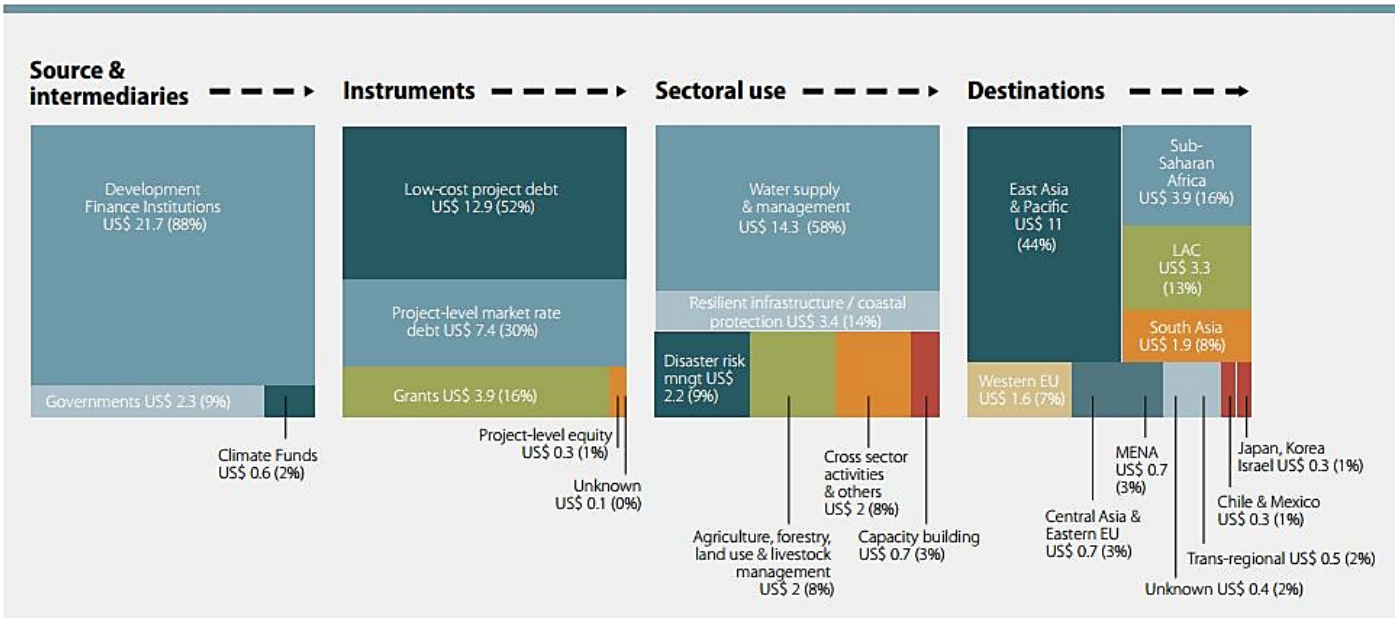

Figure 5.2. Breakdown of 2012/2013 Public Adaptation Finance Commitments in US$ billions at current prices and percentage of total
Source: UNEP (2014)

Some Options to Fill the Ocean Adaptation Finance Gap

Given the high up-front global investment costs to implement coastal and marine ecosystem-based adaptation measures and other investments to reduce additional human-related stressors on the ocean (e.g. overfishing, loss/conversation of natural coastal habitats, pollution) and improve ecosystem and human well-being to achieve the SDG14, a case could be made for a global public financing mechanism targeted towards this objective.

Currently there is no *global public financing mechanism* for the ocean. The Global Environment Facility has an International Waters Program that provides some US$450 million over a 4-year cycle to developing countries for the additional costs of measures that have global environmental benefits in either transboundary ocean waters and resources, or transboundary watersheds and lakes.[245] The World Bank has an active or cumulative portfolio of investments with potentially positive impacts on ocean ecosystems on the order of US$6.4 billion, including US$1 billion targeted to sustainable fisheries and aquaculture, and another US$5.4 billion for coastal wastewater treatment, watershed management and other activities that could help reduce pollution.[246] However, these levels of public finance are likely significantly below what would be needed to achieve SDG14 and ecosystem-based ocean adaptation.

Yet creating a new global financial mechanism, such as to finance ocean adaptation, is a labor-intensive process, generally requiring multi-lateral agreement on the objectives and governance of the fund, designation of a trustee, and robust procedures for disbursing, tracking and supporting the use of the funds according to internationally-agreed standards.

For this reason, it may be more feasible to ensure that some portion of existing mechanisms are available and dedicated to finance ocean adaptation, such as the Green Climate Fund. Additionally, The Nature

Conservancy has proposed a goal of shifting 10% of the estimated trillions in annual global coastal 'grey' infrastructure investment—US$10 billion by 2020—towards financing coastal ecosystem protection and restoration: "green" or "blue" infrastructure (see Box 3.1). States (and/or existing global financial mechanisms and development banks) undertaking this commitment would need not transfer funds to a separate entity, but rather make investments directly and 'tag' them for monitoring purposes.

Private Sector Involvement

In the absence of a global public finance mechanism for ocean ecosystems that could support both adaptation and achieving SDG14, *potential private sector initiatives* are being proposed. For example, the Ocean Recovery Alliance has proposed an '*Ocean Appreciation Toll*' as a voluntary mechanism for global importers/buyers who use the ocean to ship their products. The global shipping industry would be the channel for contributions, but the buyers/importers would make the payments to support ecosystem-based management.[247] The mechanism would function similar to a toll for the use of roads, set at a level intending to have negligible impact on shipping rates for buyers, but nonetheless generating significant total annual investment: US$2 for every 20-foot container or equivalent to be paid by the buyers and collected at the point of insurance payment or port reception. Given that in 2013 some 650 million 20-foot container shipments took place, the toll would generate funds on the order of over US$1 billion annually for enhancement or restoration of ocean ecosystem functions—towards both adaptation to climate-related drivers and achievement of SDG14.

A strong commitment to engaging and scaling up private investment into ocean adaptation and mitigation could be a significant boon, and there are already exemplary efforts being made in this area. The progress made by the Climate Bonds Initiative and the recent launch of the Coalition for Private Finance in Conservation both indicate that there is a serious interest in this type of funding which must be fully utilized. Public-private "blue finance" partnerships for coastal adaptation and related ocean infrastructure could be designed for multiple stakeholders to address climate challenges.

A new Ocean Sustainability Bank could then be funded from multiple sources, including the Green Climate Fund and private sources. It could function as a hub for knowledge, debt, equity, and grant finance and as a lead institution to structure projects. This creation of this type of organization has been endorsed by a number of relevant partners, and the rapid growth of both the European Bank for Reconstruction and Development (EBRD) and the Asian Infrastructure Investment Bank (AIIB) indicate that there is growing acknowledgment of the magnitude of financial effort needed to address climate challenges.[248]

Collection and deployment of funds could be managed as a global trusteeship and disbursed to developing coastal and island countries and high biodiversity/high vulnerability ocean ecosystems according to agreed criteria and subject to performance monitoring and audits. In the absence of global public finance mechanisms targeted specifically towards ecosystem-based management and conservation of the ocean, such initiatives may become more and more feasible as a means to fill the funding gap for the costs of transitioning to sustainable fisheries and aquaculture, coastal natural habitat loss/conversion, pollution and other ecosystem-based ocean adaptation measures. Successful ocean finance can be achieved through a collaborative combination of earmarked funds, strong project planning and coordination, and innovation within marine technology development and transfer.

Conclusion

The Estimated Costs of Ocean Adaptation

Coastal protection costs alone have been estimated on a range of US$12 to 71 billion per year by 2100, with high levels of uncertainty, and additionally a number of other ecosystem-based adaptation measures may be needed to reduce human-related stressors on ocean ecosystems and help meet SDG14 in the short term. Given the likely costs of adaptation for coastal populations and sectors, as well as the costs of reducing other human-related stressors on ocean ecosystems such as overfishing, habitat loss and pollution, the costs of ocean adaptation more broadly may be on the order of at least tens of billions annually by 2050.

Public Financing Mechanisms Available

There is currently just under US$10 billion estimated to be available (assuming only half of the current

funding in the Green Climate Fund is available for adaptation), and an additional US$80 billion per year pledged to the Green Climate Fund by 2020. According to UNEP, the global amount of public finance committed to activities with explicit adaptation objectives ranged between US$23 billion and $26 billion in 2012-2013, of which 90% was invested in developing countries and a small percentage was invested towards coastal adaptation.

Recommendations Going Forward:

- *Dedicated windows or earmarked funds from existing public finance*: Proposals have emerged to earmark some of the funds in global public finance mechanisms, or general coastal infrastructure funding, for investment in ocean adaptation—e.g. 10% of investment in 'grey' coastal infrastructure to be directed towards coastal habitat protection and restoration.
- *Private sector-led initiatives*. Similarly, private-sector initiatives are being proposed as voluntary mechanisms to generate funding for ocean adaptation, such as an 'ocean toll' on shipping.
- *Tracking investment in ocean adaptation within the UNFCCC*. In all cases, there is currently little monitoring or tracking infrastructure in place, by which to establish a baseline for public and private investment in ocean adaptation as defined here, nor to track incremental investments over time. Certainly in the case of the public finance mechanisms within the UNFCCC that are shown in Table 5.1, expenditures could be tagged for ocean/coastal adaptation to start to monitor the level of investment, particularly in developing coastal and island states. This could include for example, tracking National Adaptation Programs of Action (NAP) and Intended Nationally Determined Contributions (INDCs) on ocean adaptation projects and implementation.

6. Capacity Development

Major Recommendations:

6.0 Provide technical and financial assistance to SIDS, developing countries, and economies in transition to build capacity in the form of knowledge, tools, and scientific and political expertise to implement mitigation and adaptation measures, develop adaptive management capacity, early warning systems, and disaster risk reduction, and to develop knowledge management mechanisms to share knowledge among all countries within and outside the UNFCCC frame-works.

6.1 Promote the further enhancement of marine policy centers in developing countries and SIDS to build capacity in management and policy related to oceans and climate

6.2 Strengthen the advancement of global marine observations, research, and related capacity development within the UNFCCC processes and beyond

6.3 Support the preparation of the IPCC report on Oceans—to integrate and update the assessment of AR5 using scientific findings on the central role of oceans and climate and likely scenarios and consequences

6.4 Sustained ocean observation should be included as part of national commitments, particularly within the framework of the UNFCCC and Agenda 2030/ SDG 14 (target 14.a), in response to the call to increase knowledge to manage marine ecosystems sustainably, and understand the impacts of climate change and ocean acidification

6.5 Enhance technical capacity development of vulnerable countries through the establishment of regional oceanographic centers to increase cooperation among States on ocean-climate research and multi-disciplinary observation (in accordance with SAMOA Pathway decision 58.f)

6.6 Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels and the continued development of the Global Ocean Acidification Observing Network (SDG 14.3)

6.7 Expand public outreach and education efforts, following the Lima Declaration on Education and Awareness-raising (COP 20, 2014), to enhance individual capacity and public under-standing of the ocean's role in planetary survival and in global and national well-being, of the risks posed to SIDS and coastal communities by climate change, and to catalyze public support for mitigation and adaptation responses.

Current Status of the Issue

Capacity development is widely recognized within the ocean community as a crucial pillar of policy action. Multiple intergovernmental processes – the implementation of the Aichi Targets, the ongoing discussions on the development of an international legally binding instrument under UNCLOS on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, the 2030 Agenda and the SDG 14 on oceans and seas, and the UN Framework Convention on Climate Change—have all called for efforts from developed Member States, the UN System, and other stakeholders on the development of capacities of developing states and sub-national governments. Civil society has voiced similar calls. Among a host of other ocean-related platforms of civil society actors, the Global Ocean Forum has continuously called for investment in and activities around the development of participatory processes and capacities to enable national and local authorities to better manage their coastal and marine areas.

A changing climate has exacerbated the need for the development of ocean-based mitigation, adaptation and scientific monitoring capacities of developing states, in particular the most vulnerable SIDS and coastal Least Developed Countries. Capacity building for developing countries is essential to enable them to participate fully in, and to implement effectively their commitments under, the UNFCCC. Some institutional responses are emerging both within and outside of the UNFCCC and the climate

debate, but the implementation of political commitments remains diffuse and uneven across regions.

The UNFCCC adopted capacity-building frameworks for developing countries and countries with economies in transition in 2001 at COP 7[249] as well as the Nairobi Work Programme (NWP) in 2005 at COP 11, which was designed to "facilitate and catalyse the development and dissemination of information and knowledge that would inform and support adaptation policies and practices."[250] However, capacity development focused specifically on ocean issues and coastal adaptation has been limited to vulnerability assessment tools such as sea level fine resolution acoustic measuring equipment.

Beyond the UNFCCC, an array of capacity development initiatives related to ocean and climate have taken shape in various forms – at the individual, institutional and societal levels – and under multiple entities, including UN agencies and civil society. For example, the joint GEF-UNDP-IOC project on Adaptation to Climate Change on the Coasts of West Africa (ACCC) provided financial and technical assistance to Senegal, Mauritania, Cape Verde, Gambia and Guinea Bissau to develop coastal adaptation measures and to build their coastal adaptive capacity. From the NGO and the scientific communities, initiatives such as the Partnership for Observation of the Global Oceans (POGO)—a platform of 38 oceanographic institutes from 19 different countries—seek to bridge the capacity gap between developing and developed countries to create and implement an integrated global ocean observing strategy.

Despite the UNFCCC capacity-building frameworks, the NWP and POGO, it is increasingly clear that effective capacity development activities must be adapted to specific regional and local contexts. To that end, UNEP's PROVIA initiative moves the focus from capacity development delivery to investigating how different types of governance, collaborative frameworks and networks are effective at fostering partnerships and multi-stakeholder approaches in support of Vulnerabilities, Impacts and Adaptation (VIA). The Islands and Oceans Net (IO Net) was adopted at a side event at the Samoa SIDS summit in 2014, with the goal of creating and implementing joint policy recommendations for the better conservation and managements of islands and their surrounding ocean areas. A platform involving partners and multi-stakeholders both from islands and international society such as these can function as key regional information sharing and capacity building networks.

Finally, many intergovernmental and civil society-led assessments of capacity development needs have been undertaken across the years, from the GOF's regional assessments to the ongoing World Ocean Assessments and the Global Ocean Science Report. These global assessments could become key reference points for launching more concerted, context-specific action around capacity development for ocean and climate.

Current State of Play of the Issue within the UNFCCC

Articles 4.1, 4.3, 4.4, 4.5 and 4.7, in the context of Article 3, and Articles 5 and 6 of the Convention provide specific guidance on capacity-building on climate change. UNFCCC negotiations have traditionally recognized capacity development as a key element of the climate regime, and nearly every COP as well as each Kyoto Protocol Meeting (CMP) since COP 9 (2003) has featured specific decisions on "capacity-building".[251]

In 2001, the UNFCCC COP adopted two frameworks that address the capacity-building needs, conditions and priorities of developing countries and countries with economies in transition. These frameworks set out the scope of, and provided the basis for action, on capacity-building related to the implementation of the Convention, preparation for their participation in the Kyoto Protocol process, and in the case of developing countries, assist them in promoting sustainable development while meeting the objectives of the Convention. The frameworks also provided guidance on the financial and technical support to be addressed by the Global Environment Facility, bilateral and multilateral agencies, and other intergovernmental organizations and institutions.[252]

Through the SBI, the UNFCCC has already undertaken two comprehensive reviews of the implementation of the framework for capacity development in developing countries (begun in COP 10 and COP 17, respectively). A third comprehensive review is expected to be completed in time for COP 22. Reviews of the implementation of the capacity-

building framework in countries with economies in transition were carried out in 2004, 2007, and 2012. The goal of these comprehensive reviews is, broadly, to take stock of progress and assess effectiveness of the capacity development framework, examine gaps between decisions and implementation activities, identify lessons-learned and best practices, and review challenges in the implementation of priority areas. Among other review findings, Parties noted that the implementation of the framework for capacity-building under the Convention should be further improved at the systemic, institutional and individual levels.[253]

Significant capacity-building provisions were also made under the 2011 Cancun Agreements, which represented key steps to speed up the implementation of plans for sustainable greenhouse gas emissions reductions and help developing nations protect themselves from climate impacts.[254] The 2012 COP finalized the creation of the Durban Forum on Capacity Building, which was designed as a vehicle where representatives from Parties, UN organizations, intergovernmental and non-governmental organizations, research, academia and the private sector would share ideas, experiences, lessons learned and good practices on implementing capacity-building activities in developing countries.[255]

In the UNFCCC Report from Lima SBI 41, the Convention calls on Parties to promote and cooperate in systematic observation of the climate system, e.g. through support to existing international programmes and networks (Articles 4.1(g) and 5), referring to Global Observing System and the World Meteorological Organization as the major implementation agencies/organizations.

Advocating around and finding channels to participate in the frameworks review process and in the Durban Forum could be an effective way to highlight the need for greater focus on developing ocean-based capacities within the capacity development frameworks of UNFCCC. The priority areas of adaptation, research and systematic observations of both the capacity development framework and the Nairobi Work Programme offer useful entry points for integrating ocean into the more practical aspects of the climate regime.

Strategic Goals and Actions to Address the Issues

Action around ocean and climate capacity development should be framed along the following strategic goals:

1. Strengthen the overall visibility of ocean-based capacity development issues and solutions within the climate debate and in the official climate regime through UNFCCC processes;

2. Establish indicators within UNFCCC review processes to assess progress in capacity development for coastal and marine adaptation (i.e. integrated coastal area management), mitigation (i.e. management of carbon sinks), scientific research, and observing systems;

3. Integrate the ocean and climate perspective within the UNFCCC capacity development and technology transfer priorities under a consolidated framework of action (as illustrated by *IOC Criteria and Guidelines on the Transfer of Marine Technology*, which effectively covers both pure technology transfers and activities that would traditionally fall under capacity development, such as technical training and the sharing of knowledge).

One of the most important aspects of building the capacity of developing nations to address ocean and climate issues is the education of the public. Non-profit international organizations such as the World Ocean Network (WON) work to further this goal by engaging the public at the community level and helping them to identify the tools they need for sustainable use of the oceans. WON and other groups such as the Sea for Society Project emphasize the notion of a "Blue Society," which is aware of the importance of oceans in daily life and maintenance of a healthy planet.[256] Increased efforts from these and similar organizations can further the cause of building capacity by investing the general public of developing nations in the proper stewardship of oceans and coastal areas.

From a financing perspective, it is essential to advocate not only for a stronger recognition by the UNFCCC of oceans as a key element of the global climate mechanism, but also the inclusion of ocean-based solutions for a changing climate into the

priority areas for adaptation and mitigation financing, such as the Adaptation and the Green Climate Funds.

Opportunities and Pathways that may be Available within the UNFCCC to Advance the Issue in the Next Five Years

Ocean-based capacity development solutions for climate change are not high on the UNFCCC priority agenda compared to land-based approaches. Even as existing frameworks for capacity development within UNFCCC gain prominence and more financing, there is a risk that it will remain difficult to integrate ocean-based capacity development into processes such as the Nairobi Work Programme, the PCCB, and the UNFCCC capacity building frameworks. That said, the upcoming SBI Third Comprehensive Review of the implementation of the capacity development framework might offer a chance to highlight the positive role of ocean-based solutions to bridge some of the implementation gaps that exist, in particular in SIDS and coastal LDCs. The regular meetings and reports of the PCCB may also become important opportunities to advance the visibility of ocean issues.

The UNFCCC's SBSTA agenda item on "Sustained Observations and Research" provides for another way to address capacity development in the context of ocean and climate. Ocean observations and research, in particular through the Global Climate Observing System (GCOS) and its ocean component led by the Global Ocean Observing System (GOOS), have been linked to the COP negotiations for decades and remain alive and vigorous. An important argument can be put forward that capacity development initiatives should be focused on the technical and research capacities required to manage observing systems in developing countries.

In addition, it is possible to include ocean observations and research in the UNFCCC process via the Special IPCC Report on Oceans and the Cryosphere, to be published in 2019 (discussed in section 6. Ultimately, there is an opportunity to highlight the importance of ocean-based capacity development in the official process if champions can be found among the State Parties.

Opportunities and Pathways that may be Available Outside of the UNFCCC to Advance the Issue

Beyond the UNFCCC, the following intergovernmental processes have strong capacity development components: the implementation of the Aichi Targets, the Ad hoc Open-ended Informal Working Group on BBNJ, the SIDS Accelerated Modalities of Action (SAMOA) Pathway, and the implementation of the SDGs on climate (SDG13) and oceans (SDG14). Capacity development is fully incorporated through different platforms and financing mechanisms into each of these processes and they are natural home for ocean-based solutions around this issue.

For example, the SIDS Accelerated Modalities of Action (SAMOA) Pathway directly urges support for improving the adaptive capacity, addressing gaps to climate financing, and developing the technological capacity of SIDS through the establishment of oceanographic centers and the provision of technical assistance.[257] Also within UN-wide intergovernmental processes, the Sustainable Ocean Initiative emerged on the margins of COP10 of the UN Convention on Biodiversity, to provide a universal platform for partnerships and enhance capacity to achieve the marine and coastal Aichi Biodiversity Targets.

IOC-UNESCO has developed a wide host of activities around marine and coastal capacity development regarding international oceanographic data and information exchange, technical training, the development of sustained ocean and biodiversity monitoring and services, and integrated management of coastal zones. These activities assist and will continue to bolster Member States' abilities to achieve international commitments from the Aichi Targets to the SDGs. Capacity development priorities are also well built into UNEP, UNDP, FAO and other UN Agencies that carry-out ocean-related programmes.

Financing Considerations

Many ocean-based projects currently funded by the Global Environment Facility (GEF) already deploy specific capacity development components, but these components have limited scope. Financing full

capacity development projects is not a priority for the GEF.

That said, within the context of the UNFCCC, the GEF could become an important vehicle of financing for capacity development activities around ocean and climate. Its Strategic Plan prioritizes "capacity development for both public and private actors" as well as "identifying and addressing policy and operational gaps" in the implementation of the UNFCCC commitments and objectives.[258] Given the Fund's commitment to devote 25% of investments to SIDS, LDCs and African States, there are potential opportunities to tap into financing for supplying these countries' capacity development needs around ocean-based solutions to adaptation to a changing climate. As the parties to UNFCCC increase funding to 100 billion USD annually by 2020, it will be important to identify opportunities to utilize these funds for capacity development related to ocean issues.

Conclusions

The Oceans Day at COP 21 stressed the need for concluding an ambitious legally-binding agreement with stringent reductions in greenhouse gas emissions as essential to avoid disastrous consequences for the ocean and for coastal and island peoples. An important start was achieved with the landmark Paris Agreement. The Paris Agreement and the associated UNFCCC decisions offer significant opportunities for pursuing the policy recommendations and strategic actions detailed in this report.

Pursuing the Agenda on Oceans and Climate in the New Climate Regime

The Landmark Paris Agreement

The landmark Paris Agreement sets more ambitious global targets for reducing GHG emissions, binds all parties in taking action through a system of national reports, and develops a set of procedures for transparent reporting, accounting, verification, and stock-taking to insure progress.

A major provision in the Paris Agreement was the call to holding "the increase in the global average temperature to well below 2 °C above preindustrial levels and pursuing efforts to limit the temperature increase to 1.5 °C,"[259] recognizing that this would significantly reduce the risks and impacts of climate change. The previous global goal had been to hold the global average temperature increase to 2 °C above preindustrial levels. The 1.5 °C goal had long been advocated by the 44 small island developing States, "1.5 to stay alive," referring to the threats of sea level rise, increased floods and storms which could obliterate their homes and nations. The Paris Agreement acknowledged the significance of keeping warming below 1.5 °C by "emphasizing the enduring benefits of ambitious and early action, including major reductions in the cost of future mitigation and adaptation efforts."[260]

The Paris Agreement increased ambition by extending the agreement to address the vast majority of emissions, rather than focusing only on the emissions of developed countries (as was the case under the Kyoto Protocol). The Agreement states that "developed country Parties should continue taking the lead by undertaking economy-wide absolute emission reduction targets" and "developing country Parties should continue enhancing their mitigation efforts, and are encouraged to move over time towards economy-wide emission reduction or limitation targets in the light of different national circumstances."[261]

The Agreement supports this increased ambition and the principle of enhanced transparency by calling for the COP to "periodically take stock of the implementation of this Agreement to assess the collective progress towards achieving the purpose of this Agreement and its long-term goals (referred to as the 'global stocktake')."[262] It further details a system of national reports by all countries reporting on reductions to emissions and other matters every five years, and a transparent system of accounting and verification, with a first facilitative dialogue in 2018 and the first full global stocktake in 2023. As of May 15, 2016, 188 nations had put forward intended nationally determined contributions (INDCs) representing roughly 95% of global emissions, indeed an extraordinary achievement.[263]

Notwithstanding the important advances made by the Paris Agreement, however, the enormity of the challenges that lie ahead in moving the world toward a low carbon economy should not be underestimated. According to the Climate Tracker[264] full implementation of the INDCs submitted as of December 15, 2015 would put the world on a pathway to 2.4 to 2.7 degrees Celsius, far exceeding the new targets in the Paris Agreement. A recent Nature publication found that INDCs collectively still imply a median warming of 2.6-3.1 degrees Celsius by 2100.[265]

The Paris Agreement Notes the Importance of Oceans

The Paris Agreement acknowledged the role of oceans in a section of the Preamble. Most notably, a new provision in the Preamble to the Paris Agreement states "the importance of ensuring the integrity of all ecosystems, *including oceans*,[266] and the protection of biodiversity, recognized by some cultures as Mother Earth, and noting the importance for some of the concept of "climate justice," when taking action to address climate change."[267] The inclusion of this language reflects an emerging recognition of the importance of ensuring the integrity of ocean and coastal ecosystems.

Strong Emphasis on Adaptation

The Paris Agreement brings a new emphasis on the importance of adaptation, in addition to mitigation. The Agreement calls for adaptation which "does not threaten food production"[268] and "contributes to sustainable development;"[269] issues which are important to coastal and SIDS populations and their concerns about livelihoods which depend on healthy ocean and coastal ecosystems. The Agreement recognizes "the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change."[270] Fisheries and aquaculture can certainly be categorized as vulnerable food production systems, and their continued ability to provide for coastal and SIDS communities should be safeguarded.

COP 21 produced some concrete steps toward addressing and fulfilling adaptation needs, focused on the most vulnerable areas. Coastal and SIDS populations are undoubtedly included in this category. A significant portion of the Paris Decision falls under the sub-heading "enhanced action prior to 2020;" the length and content of this section represents the COP's recognition that in order to achieve many of its mitigation and adaptation goals, ambitious steps must be taken within the next five years. As part of this section, the COP decided to "launch, in the period 2016–2020, a technical examination process on adaptation"[271] with the aim to "identify concrete opportunities for strengthening resilience, reducing vulnerabilities and increasing the understanding and implementation of adaptation actions."[272]

The Paris Agreement calls for Parties to include adaptation in their national plans to address climate change, reflecting a stronger balance between mitigation and adaptation concerns. The Agreement provides the following guidance on the types of actions which could be included in adaptation plans: "(a) The implementation of adaptation actions, undertakings and/or efforts; (b) The process to formulate and implement national adaptation plans; (c) The assessment of climate change impacts and vulnerability, with a view to formulating nationally determined prioritized actions, taking into account vulnerable people, places and ecosystems; (d) Monitoring and evaluating and learning from adaptation plans, policies, programmes and actions; and (e) Building the resilience of socioeconomic and ecological systems, including through economic diversification and sustainable management of natural resources."[273]

The Decision also recognizes the problems of climate-induced displacement, by calling for the development of approaches to "avert, minimize and address displacement related to the adverse impacts of climate change."[274] There are, however, few details in this section. The Executive Committee of the Warsaw International Mechanism was charged with the creation of a task force to investigate and create recommendations on this important issue.

Much of the increased ambition with respect to adaptation found in the Paris Agreement is related to capacity development and financing. The Agreement recognized that ramped-up funding and capacity development efforts should be allocated appropriately, and increasingly, toward adaptation. These provisions are quoted later in this section. Article 7, Paragraph 2 of the Agreement summarizes the Parties' intentions regarding adaptation going forward: "Parties recognize that adaptation is a global challenge faced by all with local, subnational, national, regional and international dimensions, and that it is a key component of and makes a contribution to the long-term global response to climate change to protect people, livelihoods and ecosystems, taking into account the urgent and immediate needs of those developing country Parties that are particularly vulnerable to the adverse effects of climate change."[275]

Ramping Up Financing?

This Strategic Action Roadmap on Oceans and Climate and the Oceans Day at COP 21 stressed the need for targeting action and financing to address climate change impacts in coastal communities and island states—for adaptation programs, for capacity development, for mitigation efforts to preserve coastal and ocean ecosystems, and for addressing the problems of climate-induced population displacement with equity and justice. This is a work in progress which will continue in the next five years through, in part, the joint efforts of the Global Strategic Action Initiative in Oceans and Climate.

In this regard, COP 21 saw an increase in ambition with respect to financing, reflected in the Paris Decision to Give Effect to the Agreement. The Decision states that "developed countries intend to

continue their existing collective mobilization goal through 2025 in the context of meaningful mitigation actions and transparency on implementation; prior to 2025 the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement shall set a new collective quantified goal from a *floor*[276] of USD 100 billion per year, taking into account the needs and priorities of developing countries."[277] The Agreement aims to make "finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development."[278] It is notable that the Agreement mentions both mitigation and adaptation here; in the past, the majority of funding had been focused on mitigation alone. The Agreement further specifies that "financial resources provided to developing countries should enhance the implementation of their policies, strategies, reg-ulations and action plans and their climate change actions with respect to both mitigation and adaptation to contribute to the achievement of the purpose of the Agreement."[279]

Further details on the implementation of the financial goals are found in the Decision. The COP decided that "the Green Climate Fund and the Global Environment Facility, the entities entrusted with the operation of the Financial Mechanism of the Convention, as well as the Least Developed Countries Fund and the Special Climate Change Fund, administered by the Global Environment Facility, shall serve the Agreement"[280] and also decided that "the Standing Committee on Finance shall serve the Agreement in line with its functions and responsibilities established under the Conference of the Parties."[281] The Decision further urges these institutions to "enhance the coordination and delivery of resources to support country-driven strategies through simplified and efficient application and approval procedures, and through continued readiness support to developing country Parties, including the least developed countries and small island developing States, as appropriate."[282]

The Decision explicitly states that increased future financial resources should "aim to achieve a balance between adaptation and mitigation, taking into account country-driven strategies, and the priorities and needs of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change and have significant capacity constraints, such as the least developed countries and small island developing States, considering the need for public and grant-based resources for adaptation."[283]

It should be noted that the new specific commitments to financing are not found in the legally-binding Agreement; all of the passages referred to above are found in the Decision, which is not legally binding. Although the consensus of the international community is that the text of the Decision represents a scaling up of climate change finance because it specifically refers to a *floor* of USD 100 billion, others point out that Item 115 of the so-called "Paris Decision" actually refers back to the 2009 Copenhagen Accord (COP 15) text.[284] The promise of US$100 billion a year by 2020 was first formalized at COP 16 in Cancun in 2010: "[…] developed country Parties commit, in the context of meaningful mitigation actions and transparency on implementation, to a goal of mobilizing jointly US$100 billion per year by 2020 to address the needs of developing countries."[285] Some analysts also point out that the Decision lacks a clear language around the definition of "climate finance" and whence additional resources will be mobilized.

Boost to Capacity Development

As well, the Agreement ramps up ambition by further addressing capacity development issues, and establishing the "global goal on adaptation of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal."[286] By refocusing the goals of capacity development toward adaptation strategies, the Agreement implicitly recognizes the inevitability of negative impacts to coastal and SIDS communities.

The Agreement also maintains the COP's commitment to capacity building among developing nations by reaffirming "capacity-building under this Agreement should enhance the capacity and ability of developing country Parties, in particular countries with the least capacity, such as the least developed countries, and those that are particularly vulnerable to the adverse effects of climate change, such as small island developing States, to take effective climate change action, including, inter alia, to implement adaptation and mitigation actions, and should facilitate technology development, dissemination and deployment, access to climate finance,

relevant aspects of education, training and public awareness, and the transparent, timely and accurate communication of information."[287] It recognizes the necessity of individualized, constantly evolving efforts by stating "capacity-building should be country-driven, based on and responsive to national needs, and foster country ownership of Parties, in particular, for developing country Parties, including at the national, subnational and local levels. Capacity-building should be guided by lessons learned, including those from capacity-building activities under the Convention, and should be an effective, iterative process that is participatory, cross-cutting and gender-responsive."[288]

The Paris Decision also recognizes the urgency of ramping up capacity development measures by resolving to "enhance the provision of urgent and adequate finance, technology and capacity-building support by developed country Parties in order to enhance the level of ambition of pre-2020 action by Parties, and in this regard strongly urges developed country Parties to scale up their level of financial support, with a concrete roadmap to achieve the goal of jointly providing USD 100 billion annually by 2020 for mitigation and adaptation while significantly increasing adaptation finance from current levels and to further provide appropriate technology and capacity-building support."[289] Within the Agreement, Parties declared intentions to strengthen cooperation on adaptation with specific capacity-building steps.[290] The enhanced commitment to capacity building in the area of adaptation will be greatly beneficial to vulnerable coastal and SIDS Parties when carried out as intended.

The Agreement encourages more engagement from both Parties and non-Party stakeholders in the areas of technology development and transfer. It further reiterates that "Parties share a long-term vision on the importance of fully realizing technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions."[291] It continues to call upon developed Parties to take the lead and "cooperate to enhance the capacity of developing country Parties to implement this Agreement" and "enhance support for capacity-building actions in developing country Parties."[292]

Technology development and transfer is emphasized several times within the Agreement. It recognizes that "Accelerating, encouraging and enabling innovation is critical for an effective, long-term global response to climate change and promoting economic growth and sustainable development" and supports this potential innovation by "the Technology Mechanism and, through financial means, by the Financial Mechanism of the Convention, for collaborative approaches to research and development, and facilitating access to technology, in particular for early stages of the technology cycle, to developing country Parties."[293]

The Paris Committee on Capacity-Building (PCCB) was established within the Decision, with the aim to "address gaps and needs, both current and emerging, in implementing capacity-building in developing country Parties and further enhancing capacity-building efforts, including with regard to coherence and coordination in capacity-building activities under the Convention."[294] The establishment of this committee represents an important step in coordinating and promoting efforts in capacity building. Going forward, this committee will "annually focus on an area or theme related to enhanced technical exchange on capacity-building, with the purpose of maintaining up-to-date knowledge on the successes and challenges in building capacity effectively in a particular area."[295]

Through many of the provisions detailed above, the Paris Agreement and subsequent actions to implement it offer a number of important opportunities to advance the Oceans and Climate agenda in the next phase. An important step in carrying out the ambitious goals of the Paris Agreement will be the full participation of all stakeholders in working to "cooperate in taking measures, as appropriate, to enhance climate change education, training, public awareness, public participation and public access to information, recognizing the importance of these steps with respect to enhancing actions."[296] This Initiative represents one such effort, focused on carrying out these steps with respect to the oceans and climate agenda.

Next Steps

The experts and stakeholders involved in the preparation of this Strategic Action Roadmap on Oceans and Climate have worked to identify important steps which could further ocean and climate issues in the next five years. The Paris

Agreement offers a receptive environment for stakeholder initiatives; the Agree-ment "welcomes the efforts of all non-Party stakeholders to address and respond to climate change, including those of civil society, the private sector, financial institutions, cities and other subnational authorities."[297] This proposed Strategic Action Roadmap on Oceans and Climate follows the Paris Agreement's call to "scale up efforts and support actions to reduce emissions and/or to build resilience and decrease vulnerability to the adverse effects of climate change and demonstrate these efforts."[298]

Next steps will begin with the partners involved in this effort and others to identify of what needs to be done on each major recommendation outlined in this Strategic Action Roadmap on Oceans and Climate within and outside of UNFCCC, with a 5-year time frame, and identifying priority actions for the first year. This Initiative will invite a High-Level Leaders Group to guide the effort, involving key actors in the UNFCCC process and other ocean leaders.

Looking forward, the Initiative will plan for a strong oceans presence at COP 22 in Marrakech, Morocco (November 7 to 18, 2016) working closely with the Government of Morocco and other partners. At COP 22 and beyond, the Initiative will organize various meetings to create "alliances of the willing" to implement the recommendations contained in this report and to bring these results into the policy processes associated with the implementation of the Paris Agreement.

Some Initial Priority Actions

Initial implementation of items on the agenda on oceans and climate will be ongoing but must begin as soon as possible. Some major opportunities for the first year are noted below.[299]

1) Comment on, help shape, and support the planned IPCC reports on oceans and cryosphere and on the impacts of global warming of 1.5C above pre-industrial levels.

In the COP 21 Decision, the UNFCCC invited the IPCC to prepare the Special Report on the implications of the global target of pursuing efforts to limit the temperature increase to 1.5C at COP21,[300] and the IPCC accepted and began preparations for its release in 2018 at its 43rd session in April 2016. The decision to create a Special Report on Climate Change and the Oceans and Cryosphere was also made at this session, and it will be prepared "as soon as possible in the Sixth Assessment Cycle," likely 2017.[301] The topic was chosen by the Panel based on proposals submitted by various States and organizations. Many nations asked for a report on the effects of climate on oceans, including China, Monaco, South Africa, Spain, and the United States.[302] The arguments made by these nations and the decision by the Panel to choose oceans and the cryosphere represent growing recognition of significant knowledge gaps on these topics, as well as the unprecedented mobilization on oceans and climate which took place at COP 21. These reports will play a significant role in demonstrating the issues related to ocean ecosystems and to coastal and SIDS populations, which could not be achieved in the periodic IPCC reports with a broader scope.

2) Review of the INDCs Submitted by Nations and Their Oceans-Related Content

The Initiative will review the Intended Nationally Determined Contributions (INDCs) submitted by SIDS nations and other nations that have included oceans and coasts in their INDCs to determine how these can be supported and realized, with the intention of developing a guide for nations on the inclusion and consideration of oceans and coasts in their national climate plans. Natalya D. Gallo and co-authors at the Scripps Institution of Oceanography are conducting a holistic analysis of ocean-related content in the 161 INDCs submitted to the UNFCCC Secretariat by June 2016. The analysis finds that 70% of INDCs include oceans, marine, or coastal areas in some way. [303]

Marine ecosystems are most commonly included as adaptation contributions by Parties (92% of ocean-inclusive INDCs), and less frequently as mitigation contributions (40% of ocean-inclusive INDCs). Marine ecosystems are included as both adaptation and mitigation contributions by 36 Parties, signifying the importance of the ocean for climate change action for these countries. This analysis also looks at which factors influence Parties including marine ecosystems in their INDCs. A regional INDC analysis for the Mediterranean region is being conducted by Louise Ras of the Ocean and Climate Platform. These analyses have important policy implications as countries have the opportunity to modify their submitted INDCs until the ratification of the Paris Agreement, and also have the

opportunity to review and modify their INDCs during subsequent 5-year review cycles.

3) Financial Tracking Mechanism
With respect to financing, this Initiative intends to develop a Financial Tracking mechanism to examine and report on financial flows to support climate change responses in coastal and SIDS countries and communities. This work will place a special emphasis on Blue Economy approaches, especially by showing successful examples of Blue Economy strategies at COP 22. Given the estimated costs of SDG 14 and ocean adaptation to developing nations and SIDS, significant public and private capital will be needed over the coming decades. To mobilize these resources, clear and transparent information will be needed for decision makers to track current financing levels from mechanisms such as the Green Climate Fund, the Global Environment Facility, the World Bank, and multilateral and regional development banks, compared to needs, and aim to fill the remaining gaps. As well, this Initiative will strive to develop supplementary financing to support coastal adaptation and mitigation efforts through innovative public and private partnerships.

4) Capacity Development and Public and Decision-maker Awareness on Oceans and Climate
This Initiative intends to support capacity development among coastal and SIDS populations, bringing the ocean, coastal, and SIDS recommendations contained in this Strategic Action Roadmap on Oceans and Climate into the process of the newly established UNFCCC Committee on Capacity Building.

As well, efforts to support the growth of public and political awareness of ocean and climate issues must continue. Further work must be mobilized conveying information to the public and to decision-makers on the impacts of and responses to ocean warming and of ocean acidification, e.g., coral bleaching, extreme events, impacts of ocean acidification on food security.

In Conclusion

The Paris Agreement offers us hope for averting the worst impacts of climate change. It represents several landmarks steps in recognizing ocean and climate issues, particularly by acknowledging ocean ecosystems in its preamble and by marking the ambitious goal of limiting warming to 1.5C. The latter move is especially significant to coastal and SIDS populations, for whom the goal of 2.0C is not sufficient to protect their survival, livelihoods, and the health of the oceans on which their economies depend.

The High-Level Climate Champions, H.E. Dr. Hakima El Haite, Minister Delegate to the Minister of Energy, Mines, Water, and the Environment, Morocco, and H.E. Ambassador Laurence Tubiana, France, released their Road Map for Global Climate Action as a follow-up to the Paris Agreement.[304] They echoed the sense of urgency that was pervasive at COP 21 and drove the creation of the Paris Agreement, stating that "there is a need to quick-start implementation with a sense of urgency and ambition; create an interface with the real world and solutions, particularly the involvement of non-Party stakeholders; and maintain the political momentum."

The emphasis on urgency and the participation of non-Party stakeholders, who have been active in representing ocean and climate issues, represents an important sea change in the international discussion around climate and ocean. We must take advantage of the momentum from Paris and influence every aspect of the implementation of the Paris Agreement in order to steadfastly promote the oceans and climate agenda within the UNFCCC and beyond.

Endnotes

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[271] FCCC/CP/2015/L.9/Rev.1. Decision, Paragraph 125. Details regarding the technical examination are found in Paragraph 128: "the process referred to in paragraph 125 above will be pursued by: (a) Facilitating the sharing of good practices, experiences and lessons learned; (b) Identifying actions that could significantly enhance the implementation of adaptation actions, including actions that could enhance economic diversification and have mitigation co-benefits; (c) Promoting cooperative action on adaptation; (d) Identifying opportunities to strengthen enabling environments and enhance the provision of support for adaptation in the context of specific policies, practices and actions."
[272] FCCC/CP/2015/L.9/Rev.1. Decision, Paragraph 127
[273] FCCC/CP/2015/L.9/Rev.1. Article 7, Paragraph 9
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[277] FCCC/CP/2015/L.9/Rev.1. Decision, Paragraph 54
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[279] FCCC/CP/2015/L.9/Rev.1. Article 53
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[283] FCCC/CP/2015/L.9/Rev.1. Article 9, Paragraph 4
[284] FCCC/CP/2009/L.7. Paragraph 8. Full text: "[…] developed countries commit to a goal of mobilizing jointly US$100 billion dollars a year by 2020 to address the needs of developing countries. This funding will come from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources of finance. New multilateral funding for adaptation will be

delivered through effective and efficient fund arrangements, with a governance structure providing for equal representation of developed and developing countries."

[285] FCCC/CP/2010/7/Add.1. Paragraph 98.

[286] FCCC/CP/2015/L.9/Rev.1. Article 7, Paragraph 1

[287] FCCC/CP/2015/L.9/Rev.1. Article 11, Paragraph 1

[288] FCCC/CP/2015/L.9/Rev.1. Article 11, Paragraph 2

[289] FCCC/CP/2015/L.9/Rev.1. Decision, Paragraph 115

[290] FCCC/CP/2015/L.9/Rev.1. Article 7, Paragraph 7. Full text: "Parties should strengthen their cooperation on enhancing action on adaptation, taking into account the Cancun Adaptation Framework, including with regard to: (a) Sharing information, good practices, experiences and lessons learned, including, as appropriate, as these relate to science, planning, policies and implementation in relation to adaptation actions; (b) Strengthening institutional arrangements, including those under the Convention that serve this Agreement, to support the synthesis of relevant information and knowledge, and the provision of technical support and guidance to Parties; (c) Strengthening scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision making; (d) Assisting developing country Parties in identifying effective adaptation practices, adaptation needs, priorities, support provided and received for adaptation actions and efforts, and challenges and gaps, in a manner consistent with encouraging good practices; (e) Improving the effectiveness and durability of adaptation actions."

[291] FCCC/CP/2015/L.9/Rev.1. Article 10, Paragraph 1

[292] FCCC/CP/2015/L.9/Rev.1. Article 11, Paragraph 3

[293] FCCC/CP/2015/L.9/Rev.1. Article 10, Paragraph 5

[294] FCCC/CP/2015/L.9/Rev.1. Decision, Paragraph 72

[295] FCCC/CP/2015/L.9/Rev.1. Decision, Paragraph 75

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[299] These priority actions were first developed at several stakeholder meetings organized by the Global Ocean Forum: UN Side Event, UN Headquarters, April 5, 2016, organized by the Government of the Kingdom of the Netherlands, The Government of Seychelles, and the Global Ocean Forum on behalf of the 46 co-organizers of the Oceans Day at COP 21, co-chaired by H.E. Mr. Karel J.G. van Oosterom, Ambassador and Permanent Representative of the Kingdom of the Netherlands to the United Nations and H.E. Mr. Ronald Jumeau, Ambassador for Climate Change and Small Island Developing State Issues, Seychelles
Meeting on Oceans and Climate, Washington DC, April 18, 2016, organized by the Global Ocean Forum on behalf of the 46 co-organizers of the Oceans Day at COP 21 and hosted by H.E. Ambassador Dr. Angus Friday, Grenada's Ambassador to the United States, Mexico, and to the Organization of American States at the Organization of American States

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[304] H.E. Ambassador Laurence Tubiana and H.E. Minister Delegate Hakima El Haite. Road Map for Global Climate Action, 2016.

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