Post-COVID-19 Economic Recovery and Building Resilience for the OECS

Harnessing the Sustainable Blue Economy

Julian Roberts

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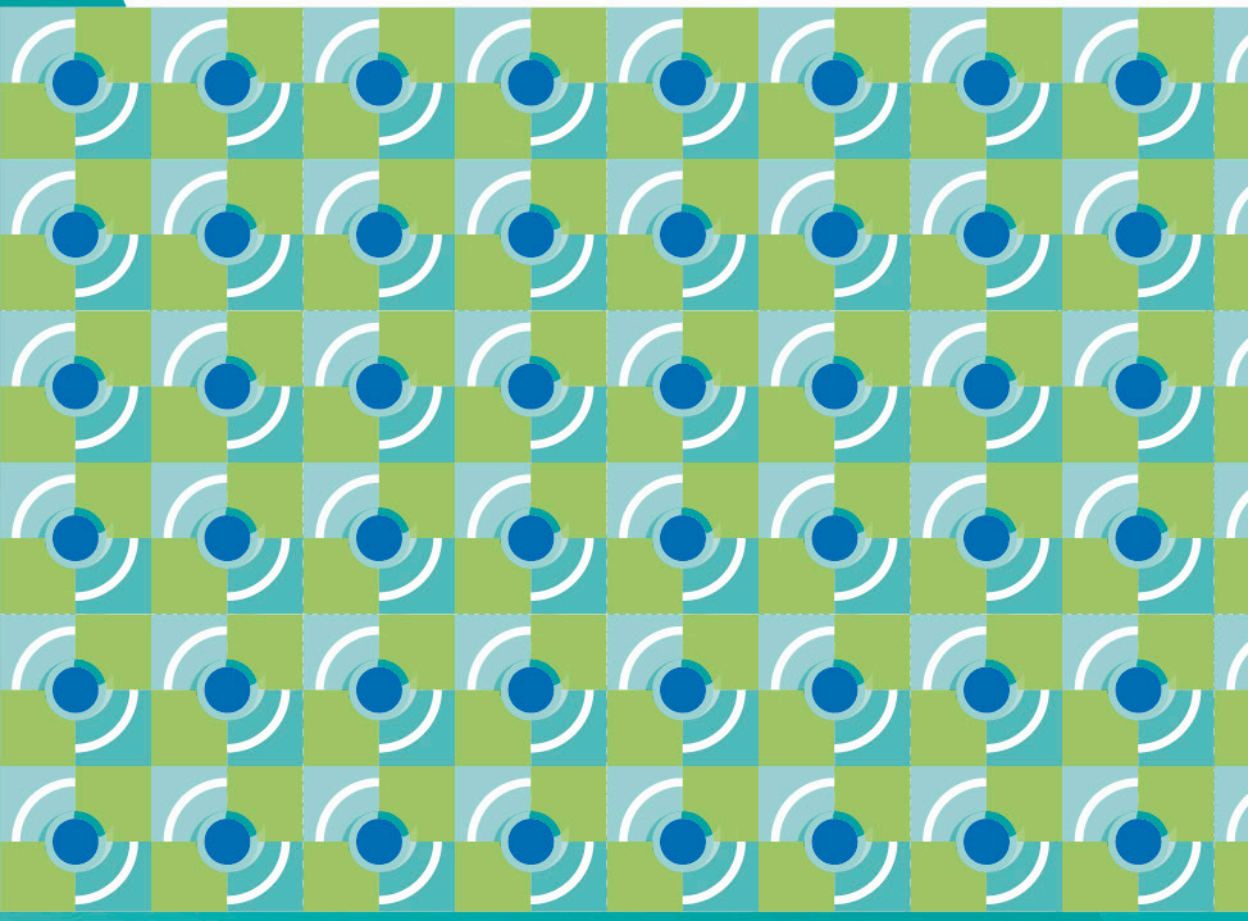

The Commonwealth

Post-COVID-19 Economic Recovery and Building Resilience for the OECS

Harnessing the Sustainable Blue Economy

Economic Paper Series

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The Commonwealth

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Acronyms and Abbreviations

AI	artificial intelligence
BVI	British Virgin Islands
CARICOM	Caribbean Community
CBC	Commonwealth Blue Charter
CCPF	Compete Caribbean Partnership Facility
CDB	Caribbean Development Bank
CROP	Caribbean Regional Oceanscape Project (World Bank)
CSF	Caribbean Sustainable Fisheries
ECROP	Eastern Caribbean Regional Ocean Policy
EEZ	exclusive economic zone
FAO	Food and Agriculture Organization
GDP	gross domestic product
GEF	Global Environment Facility
ICT	information and communication technology
IDB	Inter-American Development Bank
IUU	illegal, unregulated and unreported (fishing)
MPA	marine protected area
MRE	marine renewable energy
NGO	non-governmental organisation
ODS	OECS Development Strategy
OECD	Organisation for Economic Co-operation and Development
OECS	Organisation of Eastern Caribbean States
SDG	Sustainable Development Goal
SGD	St Georges Declaration of Principles for Environmental Sustainability in the OECS
SIDS	small island developing states

(M)SME	(micro) small and medium-sized enterprise
UNDP	United Nations Development Programme
UBEEC	Unleashing the Blue Economy of the Eastern Caribbean Project (World Bank)
UNCTAD	United Nations Conference on Trade and Development

Executive Summary

Context

The sustained supply of ocean-derived goods and services will be critical to the future well-being and prosperity of many small island developing states (SIDS), particularly those, such as member countries of the Organisation of Eastern Caribbean States (OECS), that benefit from the conferral of extensive areas of ocean space. To this end, the emerging concept of the 'blue economy' has been embraced by OECS countries as a mechanism to realise sustainable economic development, with governments increasingly looking to their maritime waters to both diversify and bolster economic growth. That said, the concept of the blue economy is not new to OECS countries, which have benefitted from their ocean resources for much of their history, through the development of fisheries, their reliance on shipping to support trade, and their global tourism industry.

Against this backdrop, the impact of the COVID-19 pandemic on Caribbean economies has been significant. Development of a sustainable blue economy is, therefore, viewed by OECS governments as one component of a broader sustainable development framework that can contribute to a post-COVID-19 economic recovery for the OECS region.

Towards this goal, the OECS Commission has embarked on a number of initiatives aimed at strengthening the enabling environment needed to support the transition to a sustainable blue economy. While it is recognised that several systemic challenges persist, it is clear that the OECS Commission and its partners are striving to establish a comprehensive enabling environment to support sustainable economic (including blue) growth in the OECS. In addition, with the support of various development partners, a broad portfolio of initiatives is currently underway across the wider Caribbean region, which can contribute to the strengthening of this enabling environment. So, while acknowledging that many challenges and barriers persist, with the support of international and regional development partners, the OECS Commission continues to strengthen the enabling framework required to support blue growth.

Purpose and scope of the paper

Against this context, this report seeks to explore the potential ocean-based development opportunities that OECS and its member countries could pursue to build more inclusive, sustainable and resilient economies, provided the right conditions are created to support those opportunities. Building on existing literature and policy initiatives, the purpose of this paper is to identify gaps and actions, related to development of sustainable blue economies, and to make recommendations on the

types of resources and actions that will be required, both at the regional and national levels, to advance the blue economy across the OECS.

It is beyond the scope of this analysis to address all the development needs in detail. Instead, and recognising the broad support already being provided by development partners, this report has sought to highlight some specific perceived gaps that, not only will be required to support a blue economy agenda, but are also critical from the perspective of the broader regional development framework being implemented by the OECS Commission. The broad premise put forward by this analysis is that translating new opportunities into productive sectors will require significant investment in research and development, building technical capacity and creating the right environment to attract and retain outside investment.

As such, this analysis focuses on three key themes that are considered to require greater attention than has been the case to date, and which are broadly identified as priorities in the OECS' regional sustainable development framework.

First, it is recognised that the OECS and member countries lack a robust framework to guide, manage and disperse the levels of finance required to restore and protect coastal ecosystems, support growth and innovation in economic sectors, and attract the levels of private sector investment necessary to sustainably grow the blue economy.

Second, despite an understanding of the economic potential of the blue economy and the desire to diversify and strengthen the economies of OECS member countries, little substantive progress has been made towards developing new sectors of the blue economy. Meanwhile, the existing mature sectors require substantial investment and innovation to make them both more sustainable and profitable. Progress on this aspect will require mobilisation of the private sector and, in particular, support to catalyse the development of small and medium size enterprises (SMEs), which are considered to offer the most significant potential to grow the blue economy in the Eastern Caribbean region.

In this regard, while it is acknowledged that broad investment is required across the full range of blue economy sectors, the OECS, through its Blue Investment Portfolio, has expressed a specific interest in the development of the following blue economy areas:

- Fish processing and added value (including aquaculture development)
- Blue biotechnology
- Ocean energy
- Waste management

Third, many of these future opportunities have an essential technological component that will, in some cases, require substantial capital investment. Technology will also play a significant part in addressing some of the barriers to developing a sustainable blue economy.

As such, this paper focuses on three critical areas that will require considerable attention if the blue economy is going to become an economic reality:

- the design and deployment of sustainable finance instruments to support the blue economy transition;
- the development of existing and emerging business opportunities to grow the blue economy – with a specific focus on capture fisheries, aquaculture, biotechnology and marine energy; and
- the application of science and technology to address key ocean sustainability challenges facing the blue economy – including the improvement of maritime surveillance and enforcement.

Based on this brief and high-level analysis, this paper therefore makes ten recommendations, for the consideration of the OECS Commission and its member countries.

Recommendations

1. The concept of the blue economy should not be seen as a development strategy in and of itself, but rather, viewed more broadly in the context of the OECS' sustainable development framework. Strategies to support development of existing and emerging blue economy sectors should be embedded not only under sector-specific management agencies, but also in the portfolios of those government agencies responsible for fiscal policy, economic planning, business development and tourism development.

   Support for blue economy development should therefore take place in parallel with support for the development of SMEs, information technology (IT) and technology innovation, and trade reforms.

2. Addressing institutional capacity gap requires strong public leadership, backed up by a coherent top-to-bottom planning and management regime. OECS countries, the OECS Commission and development partners supporting this process must work collectively to devise new ways of working that force greater capacity from current systems, making change happen through, for example, increased regional co-operation, sharing of costs and public/private partnerships. Addressing three practical issues can help support the development of institutional and human capacity to act:

   - by sharing and creating joint capacity;
   - through **increased co-operation and co-ordination** on ocean issues of common concern; and
   - by conducting an **OECS cross-sectoral skills gap analysis for the blue economy**, which can be followed by a strategy to address the revealed skills gaps.

3. As part of a broader programme to develop regional capacity, it is recommended that OECS countries participate more widely in the various Action Groups under

the Commonwealth Blue Charter initiative, either individually or collectively through the OECS Commission.

4. For OECS countries to fully support the transition to a sustainable blue economy, it is necessary to have in place a sustainable financing mechanism that will provide long-term and reliable funding to support blue economy activities. These activities include:

   - conservation, restoration and sustainable management initiatives for marine and coastal resources;
   - investments to make existing sectors more sustainable and profitable, including fishery improvement projects, efforts to recognise the true economic value of marine ecosystem services, and projects that link coastal and marine ecosystems to climate change adaptation; and
   - investment to support the development of emerging sectors (such as ocean-based renewable energy and 'blue biotechnology') by reducing the up-front risk for companies investing in these sectors.

   Taking action to address these needs would support sufficiently 'de-risking' the business environment to an extent that entrepreneurs and investors perceive more certainty. They would then have the confidence that there were solid opportunities to achieve the necessary scale and competitiveness to make new innovative blue economy business models financially viable and sustainable.

5. While opportunities to leverage domestic resources by blending different types of finance with private equity are promising, there is currently a critical lack of investable projects that can attract such finance. Key to developing these sectors in the OECS is the recognition of the important role of SMEs. These businesses can bring innovative niche products to market and play an important role in value chains, as they touch many cross-cutting areas in society.

   Building on the work undertaken for the OECS Blue Economy Investors' Roundtable and Partnership Forum, to develop the Blue Investment Portfolio, the OECS Commission and individual governments need to work with the business sector to identify and develop investment opportunities. This collaboration would focus on resolving the major challenges facing micro, small and medium-sized enterprises (MSMEs) in the blue economy, namely: marketing, product development, operational management and finance.

6. In parallel, OECS governments should examine the mechanisms available to encourage start-up MSMEs (such as tax incentives, training or seed infrastructure investment), and to assist with capacity and technology development and to define the pathway to an effective blue economy investment promotion strategy. In addition to the Unleashing the Blue Economy of the Eastern Caribbean (UBEEC) Project (of the World Bank), the OECS Commission should engage more closely with the UN Development Programme's (UNDP's) programme to support MSMEs' economic transformation.

Leveraging the existing initiatives being implemented by UNDP and the World Bank, the OECS Commission and individual governments must increasingly work with the business sector to identify and develop investment opportunities and to support the development of a robust pipeline of investment opportunities. A key focus should be on how to support pioneer investors through fiscal incentives and de-risking. In this regard, it is critical that the OECS Commission maintains and builds upon the momentum of the OECS Blue Economy Round Table initiative.

7. Moving forward, government leaders, civil society organisations, funders and other blue economy stakeholders will benefit from the clear definition of regionally grounded opportunity areas to narrow the field of potential blue economy initiatives to those that contribute to larger systems change and are most likely to succeed given present conditions.

8. Considering the ongoing work being undertaken by the OECS through the Caribbean Regional Oceanscape Project (CROP) (of the World Bank) and the UBEEC project, attention should be given to establishing one or more OECS-wide 'Blue Economy Clusters' that could focus on both core and emerging blue economy sectors. The initial focus for such clusters should be to:

    - build a shared competitive advantage for OECS members by developing and commercialising technologies, and positioning the entity as a regional ecosystem for technology and capability development;
    - position firms, in particular SMEs, to scale and integrate into regional and global value chains, transition to high-value activities, and become regional market leaders;
    - foster a critical mass of growth-oriented firms and strengthen connections and collaborations between private, public and academic organisations; and
    - transform the OECS into a Caribbean hub for ocean innovation and collaboration.

9. To support the establishment of such clusters, options should be explored to create partnership arrangements between local and foreign companies and training/research institutes. These would utilise expatriate expertise at the outset, but would rapidly develop local capacity to sustain the future of the sector. Access to technology can also be improved in the short term by establishing demand-led and responsive relationships/structures (for example, technology extension services delivery structures) that facilitate faster adoption of already-available technology (which is more often the challenge, as opposed to research to generate virgin technology).

10. In addition to a focus on the development of individual sectors, the OECS Commission and member countries should focus on developing strategies that strengthen the linkages both within and between different sectors. As an initial step, it is suggested that a small number of pilot initiatives be trialed with key economic sectors to test the approach and adapt it as necessary to local conditions.

Chapter 1

Introduction

1.1 Background and purpose

The 'blue economy' is an evolving development approach centred around sustainable utilisation of the ocean for its full socio-economic potential. It seeks to promote economic growth, social inclusion, and the preservation or improvement of livelihoods, while at the same time ensuring environmental sustainability of ocean and coastal areas (World Bank and UNDESA 2017). Perhaps nowhere is the blue economy more relevant than in the Caribbean, where it directly supports the economies of 37 coastal and small island countries and territories.

Member countries of the Organisation of Eastern Caribbean States (OECS) have jurisdiction over maritime areas that are significantly larger than their respective land areas (Table 2.1) and are, therefore, increasingly looking to their maritime waters to both diversify and bolster economic growth by exploring new opportunities for investment, employment and to support local livelihoods. Not only do opportunities exist for growth and innovation in traditional sectors, such as fisheries, marine transport and marine-based tourism, but also to expand into higher-value emerging sectors such as sustainable aquaculture, marine biotechnology and marine renewable energy. While these opportunities do exist, however, the full potential of the ocean is not being realised. Barriers to ocean sustainability need to be addressed, and for OECS countries to fully optimise the benefits of the blue economy, regional, state and non-state actors need to work together to implement a robust enabling environment that will benefit the region as a whole.

The impact of the COVID-19 pandemic on Caribbean economies has been significant. All blue economic sectors and activities were affected, with the most vulnerable groups, such as coastal communities and informal workers, suffering the most (Northrop et al. 2020). This notwithstanding, policy-makers across the OECS region are focusing on the post-coronavirus recovery and how to set the economy on a sustainable footing.

The strategic investment of post-COVID-19 recovery and stimulus funds offers opportunities to accelerate the sustainable and equitable growth of blue economy sectors, thereby securing the long-term health and resilience of the ocean and blue economy (Northrop et al. 2020). Nevertheless, compared to other economic sectors, only a limited number of investments are currently directed towards blue economic development. According to a recent analysis prepared by the World Resources Institute (McCauley et al. 2020):

> *despite its central importance to the global economy and the people's livelihoods, the ocean economy was overlooked in the over $10 trillion in COVID-19 stimulus*

packages announced by governments to date. This is a missed opportunity, both in terms of supporting ocean workers and communities that have been deeply impacted as well as the potential return on investment from sustainable ocean solutions.

In exploring trade-related policy options to drive a post-COVID-19 recovery and support long-term economic growth and resilience, OECS countries have sought analysis on possible responses to the opportunities and challenges related to the blue economy, the digital economy and micro, small and medium sized enterprises (MSMEs). This report seeks to explore the potential ocean-based development opportunities that OECS and its member countries could pursue to build more inclusive, sustainable and resilient economies, provided the right conditions are created to support those opportunities. Building on existing literature and policy initiatives, the purpose of this paper is to identify gaps and actions, related to development of sustainable blue economies, and to make recommendations on the types of resources and actions that will be required both at the regional and national levels, to advance the blue economy across the OECS.

1.2 Scope and structure

It should be stated at the outset that this analytical paper has been prepared at a time when the OECS Commission is executing numerous initiatives aimed at defining future development scenarios, including the sustainable utilisation of natural resources and the future implementation of a comprehensive Green-Blue Economy development framework. To this end, several policies, strategy documents and action plans have already been, or are currently being, prepared. Furthermore, in the context of the blue economy, several donor-funded initiatives are underway, or planned, that will provide implementation support to strengthen ocean governance arrangements across the OECS, most notably with respect to implementation of the recently revised *Eastern Caribbean Regional Ocean Policy* (ECROP).

While every attempt has been made to identify the most pressing needs for advancing the blue economy in the OECS, it would neither be helpful nor efficient to simply reinforce the various strategies and actions that have been agreed under those initiatives. Moreover, given the limited timeframe within which this project has been executed, it is beyond the scope of this brief paper to address all the reforms necessary to enable the transition to a sustainable blue economy.

Instead, this report focuses in more detail on three key themes that, not only will be required to support a blue economy agenda, but are also critical from the perspective of the broader regional development framework being implemented by the OECS Commission. The themes are:

- the design and deployment of sustainable finance instruments to support the blue economy transition;
- the development of existing and emerging business opportunities to grow the blue economy – with a specific focus on capture fisheries, aquaculture, biotechnology and marine energy; and

- the application of science and technology to address key ocean sustainability challenges facing the blue economy – including to improve maritime surveillance and enforcement.

Throughout this paper, case study examples are used to illustrate how countries have responded to these three themes, highlighting the opportunities that may provide a blueprint for broader OECS action.

This report is divided into six main sections, as set out below:

1. Following this introduction, Section 2 provides a broad overview of the blue economy context within the OECS region, a broad characterisation of the nature of blue economy sectors in OECS countries and the broader sustainable development policy context, within which the blue economy is being developed. In particular, this section provides an overview of the enabling conditions that will be required to support the blue economy transition, including an assessment of the extent to which these are currently in place across the OECS region.
2. Section 3 provides a specific analysis on the future needs and opportunities relating to the development of a framework to mobilise sustainable finance to support blue growth in the OECS region. In this regard, this section specifically discusses the potential opportunities to mobilise domestic resources to support the blue economy transition.
3. Section 4 provides an overview of the potential opportunities that may be realised through the development of those sectors that have been identified as a priority by the OECS and provides some practical examples of how these sectors may be developed in the context of the OECS region. As one possible mechanism to facilitate this, this section provides a brief overview of the potential application of the concept of 'ocean clusters' as a tool to engage the private sector more broadly in the blue economy.
4. Finally, Section 5 provides a brief assessment of the range of emerging technologies that are increasingly being deployed to address the challenges facing sustainable utilisation of the ocean, along with the potential application of new and emerging technologies to support development of the blue economy.
5. To conclude the analysis, Section 6 presents broad conclusions from the analysis and offers recommendations for further research or action that should be considered by the Commonwealth Secretariat and the OECS Commission.

Chapter 2

OECS and the Blue Economy

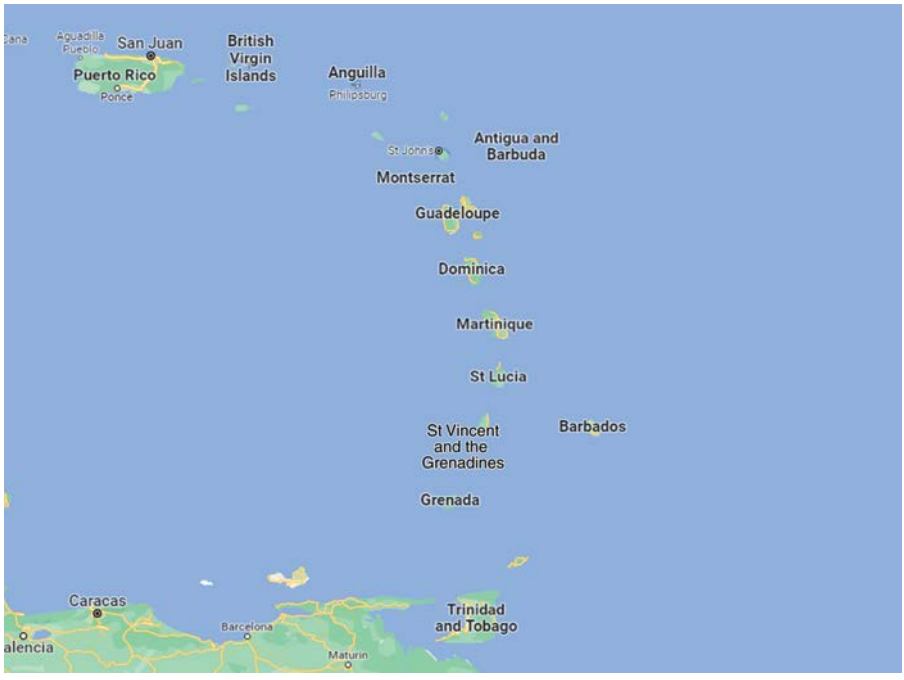
2.1 Geographic context

Bordered by the Atlantic Ocean to the east and the Caribbean Sea to the west, island nations of the Eastern Caribbean form a long, partly volcanic island chain in the Caribbean Sea, including eight sovereign states and 14 dependencies of the UK, Netherlands, France and the US respectively. For the purposes of this report, the 'Eastern Caribbean region' refers to these islands and the marine waters surrounding them (Figure 2.1).

Of these 22 states and territories, 11 are either full or associate members of the Organisation of Eastern Caribbean States (OECS):

- full members: Antigua and Barbuda, Dominica, Grenada, St Kitts and Nevis, Saint Lucia, and St Vincent and the Grenadines; and non-independent Montserrat; and
- associated members: Anguilla, Guadeloupe, Martinique and the British Virgin Islands.

Figure 2.1 Geography of the Eastern Caribbean region



Source: Google Maps (2021)

Table 2.1 Key geographic characteristics of OECS countries

	Land area (sq. km)	Coastline (km)	EEZ area (sq. km)	Shelf area (sq. km)	OHI ranking
Anguilla*	91	16	92,178	N/A	123/121
Antigua and Barbuda	442.6	153	110,071	3,886	27/121
British Virgin Islands (BVI)*	151.4	80	80,117	3,093	110/221
Dominica	750	148	28,593	356	201/221
Grenada	348.5	121	26,133	2,709	134/221
Guadeloupe*	1,628	306	90,570	2,150	71/221
Martinique*	1,128	350	47,372	1,230	71/221
Montserrat	102	40	7,582	168	74/121
St Kitts and Nevis	261	161	10,209	855	86/121
Saint Lucia	617	158	15,472	593	139/221
St Vincent and the Grenadines	389	N/A	36,304	2,223	166/221

Note: *Associate members; EEZ – exclusive economic zone; OHI – Ocean Health Index. The OHI is the comprehensive framework used to measure ocean health from global to local scales. See: http://www.oceanhealthindex.org/

This smaller 'OECS region' covers a land area of some 3,500 square kilometres (sq.km) and is home to over 1.5 million people. OECS regional waters cover an area well in excess of 500,000 sq.km, almost 150 times the land area (Table 2.1). Hence, the marine waters of the OECS region and the marine resources therein offer OECS countries significant opportunities for future economic development.

2.1.1 Marine environment

The maritime waters of the wider Caribbean support a high diversity of associated flora and fauna. This rich biodiversity, due partly to isolation within the Caribbean Sea, has resulted in high rates of national and regional endemism and the greatest concentration of rare and endemic marine species in the Western Hemisphere. The Caribbean is among the top global biodiversity hot spots in the world (CANARI 2019). The region's coastal zones constitute rich and unique habitats, which include coral reefs, sea grass beds, mangroves and salt ponds. The coastal and marine biodiversity includes a rich diversity of reef and pelagic fish, lobsters, conch, turtles, algae, and resident and migratory birds. Offshore waters are home to numerous species of marine mammal and turtles, as well as pelagic fish species. These coastal resources provide the basis for a range of economic and social activities, including the tourism and fishing industries.

While these ecosystems are essential to the overall economy of the OECS region, they are also overexploited and under-protected. The range of threats facing the region's maritime waters include: unsustainable exploitation of fish and other living resources; pollution from marine and land-based sources; invasive species; and habitat damage. Climate change has added to these pressures and may also lead to an increase in the cumulative impacts of these factors. Moreover, the interconnected nature of ocean

and coastal environments means that exploitation of one type of marine resource has the capacity to impact on other marine resources and the wider marine environment.

Given that the health of the oceans is inextricably linked to the sustainability of economic livelihoods for coastal communities and the economy generally, a fundamental requirement for the blue economy is that ocean ecosystems and resources are healthy and productive. For the Caribbean, in particular, the health of coral reefs and associated biodiversity are of critical importance both from an environmental perspective and as an economic one. Thus, effective management of the marine environment and the maintenance and restoration of ecosystem health and integrity is fundamental to ecologically sustainable development.

2.2 Economic context

Despite economic contractions caused by the 2008 financial crisis and several severe hurricane events during 2017, OECS economies have generally maintained positive growth rates in recent years, averaging 4.1 per cent in 2019.[1] Prior to the pandemic, public debt ratios had continued to fall across most of the Caribbean. That notwithstanding, economic diversification remains limited throughout the OECS region and existing trade relies on a narrow range of products. This lack of diversification makes OECS countries extremely vulnerable to external shocks (such as hurricanes, the 2008 financial crisis and the COVID-19 pandemic). The services sector dominates economic activity, contributing close to 75 per cent of gross domestic product (GDP) in some countries. Moreover, OECS countries are heavily reliant on tourism, which for some contributes as much as 50 per cent of GDP and provides jobs for up to 50 per cent of labour forces. As the main buyers in the tourist market, hotels, restaurants and cruise ships were affected by the pandemic. Knock-on effects were also felt throughout the supply chain, impacting the agriculture, fisheries and non-tourism sectors. Overdependence on the tourism sector therefore made it a key vulnerability during the health crisis. Many OECS countries are also net food and energy importers and highly vulnerable to sharp price swings.

Their size, limited resource bases and remoteness constrain development and the ability to build resilience. Regional integration still has some way to go and, in the absence of a strong business enabling environment,[2] investment and innovation are likely to take time to develop. These inherent structural problems have prevented the Caribbean from reaching its true economic potential (reliefweb/OCHA 2020). The lack of resilience and economic diversification makes the OECS region highly vulnerable to a wide range of threats (including from economic, social and environmental factors). The frequency of natural disasters in this region means that recovery can take years, as witnessed by the economic, social and physical impacts caused by Hurricanes Maria and Irma during 2017 and the social and economic impacts caused by the COVID-19 pandemic. When they occur simultaneously, these

1 Despite these growth rates, five economies (Anguilla, Antigua and Barbuda, Grenada, Montserrat, and St Kitts and Nevis) did experience declines in their GDP growth rates in 2019.

2 The Eastern Caribbean is ranked above 100 for 'Ease of Doing Business' (190=worst).

Table 2.2 Key economic indicators for OECS countries (unless otherwise stated, all values are for 2019)

	Population	GDP (US$ billion)	GDP growth (%)	Pre-COVID unemployment (%)	Gross national income (GNI) per capita (US$)	Gross public sector debt (% of GDP)
Anguilla	18,090[a]	0.313	10.9	13	21,068	49.9
Antigua and Barbuda	97,118	1.662	6.5	8.7	16,600	84.47
British Virgin Islands	30,030	1.297	DNA	3	39,414	11.5
Dominica	71,808	0.582	4.9	23	7,920	85.72
Grenada	112,003	1.211	4.0	29	9,840	59.08
Guadeloupe	400,214[a]	9.740	DNA	17	DNA	DNA
Martinique	375,265[a]	9.363[b]	DNA	DNA	DNA	DNA
Montserrat	4,992	0.067	1.5	7	13,562	6.1[c]
St Kitts and Nevis	52,834	1.053	3.5	DNA	19,290	56.22
Saint Lucia	182,790	2.122	3.2	21	11,020	59.98[c]
St Vincent and the Grenadines	110,589	0.825	2.4	20	7,460	75.2

[a]2020 data
[b]2015 data
[c]2018 data
DNA = data not available
Source: Economic Commission for Latin America and the Caribbean (ECLAC)

external shocks can multiply the impacts across affected states, as can be witnessed with the recent eruption of the La Soufrière volcano on Saint Vincent.

2.2.1 Impact of COVID-19 on OECS economies

Prior to the pandemic, the overall growth outlook for the Caribbean had been positive for 2020 (Alleyne et al. 2020). Instead, during 2020 hotel stays plummeted by 70 per cent and cruise ship travel completely halted throughout the Caribbean. While most Caribbean countries managed to contain the virus' spread initially, and reopened to international travellers in the second half of 2020, subsequent waves of infections and travel restrictions in the countries from where most visitors normally come (the US, UK and Canada) stalled any hopes of a short-term recovery (Srinivasan et al. 2021). In the context of the Eastern Caribbean, the International Monetary Fund (IMF) estimated that real GDP contracted by up to 16 per cent in 2020 – significantly more than the global average – with negative inflation and stagnant credit growth. With sizable revenue losses and spending pressures, aimed at limiting the socioeconomic impact of the pandemic, fiscal positions have deteriorated significantly, raising public

debt sharply. As a result, the current account deficit is estimated to have widened sharply due to the decline in tourism exports (IMF 2021). GDP growth rebounded sharply in 2021 and 2022. Despite the anticipated global slowdown in the coming years, the OECS countries are forecast to experience strong growth (above 4 per cent) in 2023 and 2024 (IMF 2022).

Women's employment is generally concentrated in less cyclical sectors than that of men, like healthcare and education. While during 'standard' downturns (that is, the 2008 financial crisis) this shields women from being heavily affected, it means that women have suffered greater consequences in the COVID-19 recession. Women also tend to be more heavily represented in services occupations, like restaurants and hospitality. The women working in this sector were likely to be out of work for a potentially long time, especially for occupations that rely on tourism.

2.3 Importance of blue economy sectors across the OECS

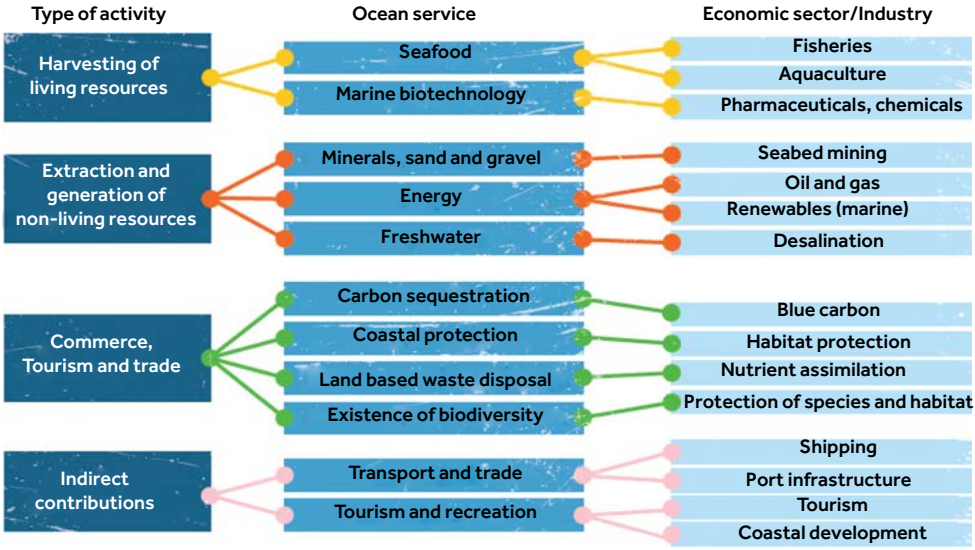
While projections are scarce, prior to the pandemic, indications suggested that blue economies would continue to grow faster than overall rates of economic growth in the coming decades (Patil et al. 2016). The sustainable scenario of the Organisation for Economic Co-operation and Development (OECD) indicated that Caribbean ocean-based economies could employ 8.6 million people in 2030 and could generate a value of US$640 billion (OECD 2016). This forecast is, however, likely to have altered significantly.

The blue economy is not a uniform theme, but rather a concept that embraces multiple sectors with different investment opportunities. The list of sectors relevant from a maritime perspective is broad and different approaches have been adopted to categorise and classify the key sectors and subsectors that fall within the purview of the blue economy. According to the OECS (2020), while the mix of oceanic activities varies in each OECS nation, depending on their unique national circumstances and their vision for a blue economy, tourism, fisheries and maritime transport are the predominant sectors operating throughout the region. The coastal area is also a source of construction materials in many OECS countries. Several small-scale examples of aquaculture and biotechnology are also identifiable in specific countries (Figure 2.2). Annex A provides a summary of the future trends and sector drivers for those sectors that are relevant to the OECS region.

Tourism

- Tourism is the main pillar of the economy in most OECS countries, accounting for 75 per cent of the collective GDP, and is a substantial source of employment. It is also a major source of foreign exchange and has, since the 1990s, helped to offset a decline in agricultural exports. This over-reliance on tourism caused a large part of the region to become disproportionately affected by the pandemic during 2020.
- The Caribbean has also been the world's premier cruise tourism destination, commanding more than 60 per cent of the world cruise market.

Figure 2.2 Blue economy sectors of the OECS region



Source: OECS (2020)

- Tourism is heavily reliant on the marine environment to support the various subsectors (such as scuba diving, yachting and sport fishing). Environmental degradation could therefore have a significant impact on the value of this sector, depending on how tourists perceive the quality of the marine environment and the tourism experience.

Fishing

- Fisheries is an important subset of the blue economy for OECS countries and represents a significant source of nutrition, employment and foreign exchange, as well as contributing to social and economic stability. Further, the region provides global markets with important fishery-based products (including shrimp, red snapper and emblematic species such as spiny lobster and queen conch).
- According to figures published by the Caribbean Regional Fisheries Mechanism (CRFM), in 2018, the value of marine capture fishery production reported across OECS countries[3] was approximately US$66.4 million (Masters 2018). The value of aquaculture production was almost US$183,000.
- In 2018, almost 11,000 people were reported to work directly in commercial capture fisheries, with a total fleet of almost 5,000 fishing vessels operating in this area. In addition, a further 138 are reported to work in the aquaculture sector. According to the Food and Agriculture Organization (FAO), for every one person

3 Data is reported for: Anguilla, Antigua and Barbuda, Dominica, Grenada, Montserrat, St Kitts and Nevis, Saint Lucia, St Vincent and the Grenadines.

working directly in capture fisheries or aquaculture, a further three people are employed in secondary but dependent activities, meaning that well over 40,000 people are employed in activities relating to fisheries across the OECS.

- According to figures published by the CRFM, the total value of fish and fish products imported to OECS countries in 2018 was approximately US$37 million while the value of exported fish and fish products for the same year was approximately US$8.1 million, with some countries (for example, Saint Lucia and Antigua and Barbuda) being most reliant on imported fish (Masters 2018).

Maritime transport

- It is estimated that more than 90 per cent of global trade is seaborne with most, if not all, agriculture products exported by sea.
- Caribbean island nations, in particular, are almost entirely reliant on shipping to support their economies. Thus, shipping and the supporting infrastructure such as ports and harbours are vital to the economic growth of the islands.
- The Caribbean Sea is also a major global shipping hub due to the large number of vessels converging on and departing from the Panama Canal. The recent doubling of the capacity of the Panama Canal, effective in 2016, can now accommodate 96 per cent of containerships currently in service. Plans also exist for a second inter-oceanic canal in Nicaragua, although limited progress has been made to date.

2.4 Trade profile of selected blue economy sectors

2.4.1 Measuring the blue economy

Only a few regional and international initiatives have attempted to map and measure the ocean economy, with modest international funds devoted to the development of ocean economy and trade strategies (UNCTAD 2021). To date, Jamaica is the only Caribbean country that has preliminary estimates for the blue economy (Ram et al. 2019). Based on the traditional elements of the blue economy (visitor accommodation, fishing, tourism and recreation services, and maritime transport), Ram et al. (2019) obtained a '*measurable and direct impact of 6.9 % of GDP in 2017 and an average contribution of 6.7 % for the period 2012 to 2017*'. There is no comparable data for OECS countries to measure the overall contribution of the blue economic sectors to the economy.

However, given the specification of the activities undertaken within the blue economy, there are estimates for some indicators of blue economy activities that can be discerned from available data and these can provide a sense of the current size of the blue economy for OECS countries (Table 2.3). More formally, the blue economy should be measured through the adoption of satellite accounts within the overall system of national accounts, designed to measure special features of a particular sector or set of activities.

Table 2.3 Selected indicators of blue economy activity

	FISHERIES		PORTS and SHIPPING	TOURISM	
	Capture fisheries production (US$)	Aquaculture production (US$)[b]	Container port throughput (TEU)[C]	Visitor expenditure GDP (%)[d]	Total cruise tourism expenditure (US$ million)[e]
Anguilla	10,040,000	0	6,229	37.9	DNA
Antigua and Barbuda	14,767,071	131,852	27,656.88	40.5	77.74
British Virgin Islands	DNA	DNA	45,956	26.6	12.63
Dominica	4,638,860	0	8,083	21.6	50.81
Grenada	13,809,151[a]	0	26,290	20.1	19.25
Guadeloupe	DNA	DNA	DNA	DNA	52.94
Martinique	DNA	DNA	DNA	DNA	38.22
Montserrat	203,053	0	2,238	14.4	DNA
St Kitts and Nevis	5,531,147	0	14,258	20.7	149.28
Saint Lucia	10,278,458	50,789	31,875	70.1	59.42
St Vincent and the Grenadines	7,084,487	0	18,650	13.9	16.43

[a]2017 estimated
[b]As reported by CRFM (Masters 2018)
[c]TEU = Twenty-foot Unit Equivalent. 2019 data. Source: World Bank Data Indicators (https://data.worldbank.org/indicator)
[d]2018 data. Source: Ram et al. (2019).
[e]2017/1018 cruise season. Source: Business Research and Economic Advisers (2018).
DNA = data not available

2.5 The blue economy in the broader context of OECS sustainable development

A recent analysis of the role of trade policy in the Caribbean Community (CARICOM) region's COVID-19 economic recovery concluded that the Caribbean's future development should hinge on five core areas, namely: (i) innovation and industrial policy; (ii) agricultural development and food security; (iii) e-commerce; (iv) MSME development and export activity; and (v) investment facilitation for development (Braithwaite et al. 2020).

While it is tempting view the blue economy in isolation, it should not be seen as a development strategy in and of itself, but rather, conceived in the context of a broader sustainable development framework, particularly in terms of how it can contribute to the broader post-COVID-19 economic recovery. It is worth noting that the OECS Commission is in the process of revising its overall development framework, taking

Figure 2.3 ODS goals and objectives

into account future environmental, social and economic development needs. To this end, the OECS Commission has prepared several new and updated development strategies that, when considered together, provide a context for future development of the blue economy.

2.5.1 OECS Development Strategy 2019–2028

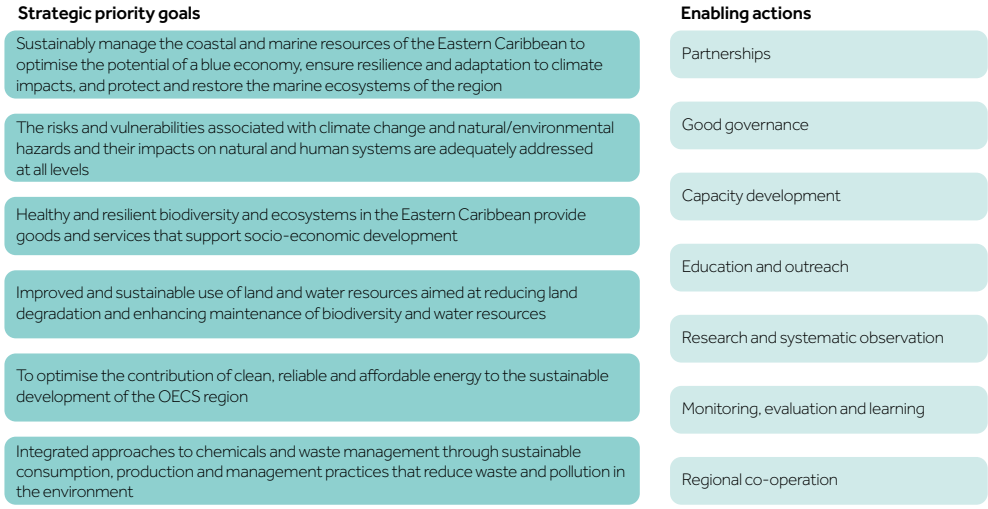
The OECS Development Strategy (2019–2028) ('the ODS') represents the systematic approach adopted by the OECS Economic Union to holistically respond to pressing threats to the common ideal of social and economic betterment of the peoples of the OECS (OECS Commission 2018). The ODS has been developed around three mutually reinforcing goals, each with a comprehensive list of strategic objectives (Figure 2.3).

2.5.2 St Georges Declaration 2040

Originally adopted in 2001, the *St George's Declaration of Principles for Environmental Sustainability in the OECS* (SGD) was an effort to respond to a rapidly evolving global policy environment in a manner that reflected the contexts and priorities of OECS member countries. Following an internal review of the SGD in 2017, the OECS Council of Ministers for Environmental Sustainability mandated the OECS Commission to revise and update the SGD, to better align it with national and regional circumstances, priorities and international frameworks.

The resulting SGD 2040 responds to priority environmental problems and opportunities for nature-based solutions in the OECS region: climate change and sea-level rise; threats to biodiversity; threats to freshwater resources; land degradation; degradation of coastal environments and marine resources; pollution and waste management; and high energy costs. SGD 2040 affirms that sustainable development in the OECS region

Figure 2.4 St Georges Declaration (2040) strategic priority goals and enabling actions



can be achieved only through a broad alliance of people, governments, civil society, the private sector and international development partners.

SGD 2040 focuses on six strategic priority goals, and a number of key enabling actions (cutting across all strategic priorities), which will consolidate and strengthen the delivery of the transformative and strategic actions identified for each of the programmes (Figure 2.4).

2.5.3 OECS Green-Blue Economy Strategy and Action Plan

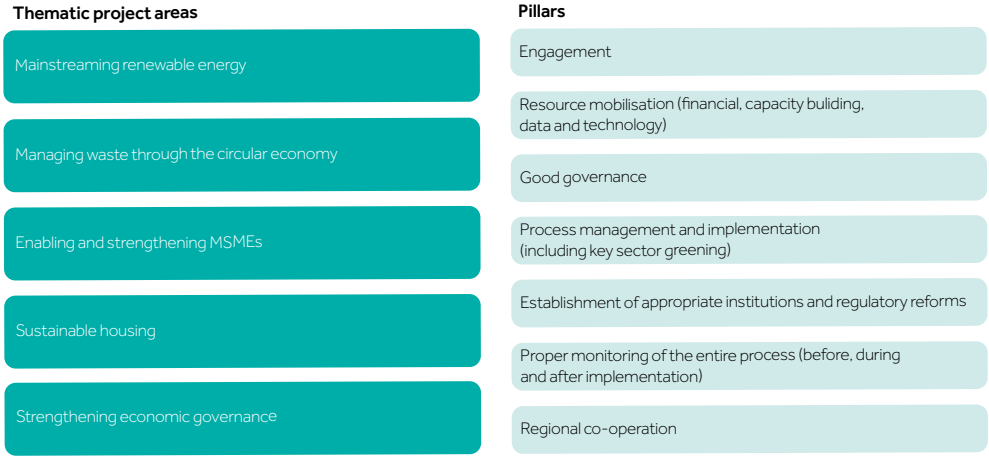
The Draft OECS Green-Blue Economy Strategy and Action Plan (G-BE SAP) arose as a result of a diagnostic study by the Caribbean Natural Resources Institute (CANARI) (McHale 2018). The study identified several major policy recommendations, to support a transition to a more structured sustainable development strategy in the OECS, including *inter alia* the development of an *OECS Green-Blue Economy Strategy and Action Plan* that defines key principles, objectives, policy needs, pathways and capacity needs for economic transformation (Figure 2.5).

2.5.4 Eastern Caribbean Regional Ocean Policy (2020)

While the development of existing and new blue economy sectors could contribute to the goals articulated in the various instruments presented above, such development must recognise the interdependencies of the environmental, social and economic dimensions of sustainable development and seek to integrate them in a more holistic manner to support the transition to a blue economy.

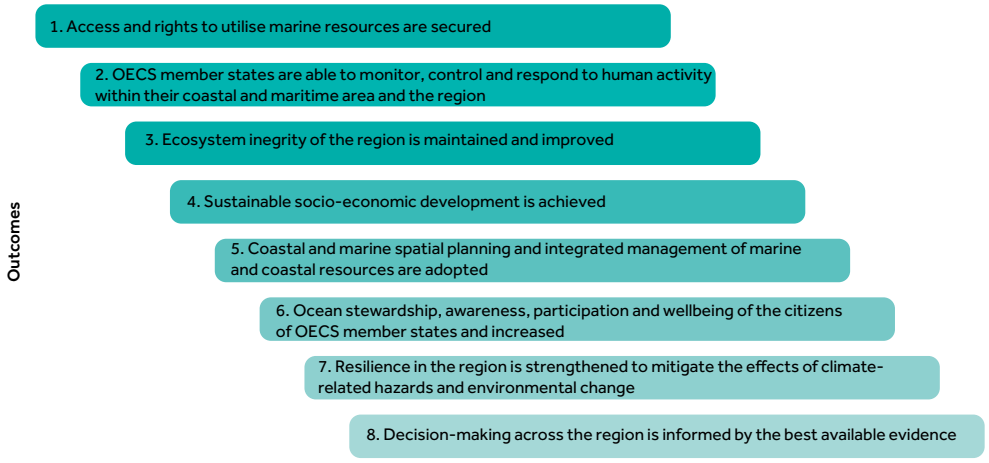
To this end, the OECS Commission continues to develop a comprehensive governance framework to support sustainable development of the OECS' maritime space. Underpinning this framework is the Eastern Caribbean Regional Ocean

Figure 2.5 Thematic project areas and pillars of the OECS Green-Blue Economy Strategic Action Plan



Policy (ECROP),[4] formulated to guide the activities of OECS countries to support regional co-ordination and collaboration, and the harmonisation of national and regional actions, in respect of the management of the maritime waters of the OECS region. This includes inter-sectoral planning and development of ocean activities in a rational and sustainable manner, to generate jobs and income and to contribute to social inclusion. ECROP consists of a vision, principles, policy outcomes and goals and is complemented by the development and implementation of national ocean policies (Figure 2.6). In this regard, while ECROP is not the framework for a blue

Figure 2.6 ECROP strategic outcomes



4 Originally adopted by OECS Heads in 2013, the Eastern Caribbean Regional Ocean Policy and Action Plan (ECROP) was updated in 2019, to reflect the principles endorsed in recent regional and global agreements as well as to align it with the 2030 UN Sustainable Development Agenda.

economy, it does provide the policy basis for the sustainable development of the OECS' maritime space.

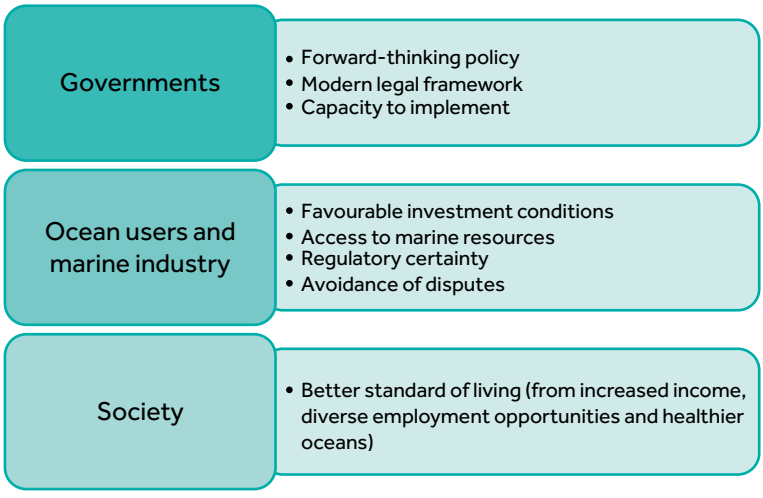
2.6 Enabling conditions necessary to unlock the blue economy

To create ocean solutions that are sustainable, we must recognise the interdependencies of the environmental, social and economic dimensions of sustainable development and seek to integrate them in a more holistic manner to support the transition to a sustainable and resilient blue economy. Enabling this transition requires governance and policies that integrate environmental and economic considerations. This must include good laws and regulations, strong institutions and multi-agency co-operation, inclusive decision-making processes involving all stakeholders (including business), along with evidence-based support (Economist Intelligence Unit 2015). Moreover, clear, co-ordinated institutional mechanisms for integrated ocean management, established and implemented across all maritime sectors, will be essential to accommodate and resolve conflicts between the vast range of marine-related interests and values. More importantly, translating new opportunities into productive sectors will require investment in research and development, building technical capacity, and creating the right environment to attract and retain outside investment. These must be fundamental principles of the blue economy.

Ultimately, the blue economy must deliver acceptable economic benefits, both to those making investments to harness the oceans' resources and to local people and communities (Figure 2.7).

In implementing the blue economy, we must therefore understand the values and limits of each stakeholder (government, private and public), and how to align government objectives with global goals. To achieve this, the blue economy needs to

Figure 2.7 Needs and interests of different stakeholder groups



provide the governing structures and platforms that will allow new and innovative collaborations to be shaped and implemented. It needs to ensure the security of the resource base and the wider marine environment to ensure the long-term integrity of the ecosystem.

Building on work previously undertaken by the Commonwealth Secretariat (Roberts and Ali 2014) and further developed by the World Bank (Patil et al. 2016), this analysis identifies seven key thematic areas (**enablers**) that are vital for creating the conditions for growth and investment. These enablers are not prioritised in order of importance and there are strong inter-relationships and synergies between them. They are, *inter alia*:

i. A healthy, resilient and productive marine environment.

ii. Integrated approaches to planning and governance.

iii. Sustainable finance and investment frameworks.

iv. Develop the institutional and human capacity to act.

v. Develop existing and emerging business opportunities.

vi. Research, technology and marine information; and

vii. Maritime surveillance and enforcement.

If pursued with the support of development partners such as the Commonwealth Secretariat and the World Bank, these seven enablers can help transform the promising concept of the blue economy into a sustainable process of implementation, thereby supporting development of the various opportunities identified in this report.

2.7 Status of enablers in OECS

The OECS Commission, with the support of development partners, has made considerable progress towards the development of this enabling environment and further work is planned. The progress to date is certainly laudable. However, a number of systemic challenges persist that need to be overcome if the transition to a blue economy is going to be long term and sustainable. While a number of critical challenges can be highlighted – such as: inadequate policy and legal frameworks; limited access to good scientific knowledge and data; limited ability to police illegal activity; limited awareness by local communities of the importance of the marine environment; and limited engagement by civil society in planning and decision-making – chief among these challenges is the human and technical capacity to effectively manage the region's maritime space.

Several initiatives are underway to strengthen capacity across the OECS region, through a variety of different development partners. The following key initiatives aim to address some of those challenges, but alone will not be sufficient to support the full transition to a sustainable blue economy. This will require considerable political will to implement and maintain the necessary policy, legal and institutional reforms.

2.7.1 World Bank initiatives

To address many of these needs, implementation of ECROP and broader blue economy initiatives continues apace within OECS, while numerous OECS and Caribbean-wide initiatives are providing support to realise the ECROP vision. Critical among these initiatives are the Caribbean Regional Oceanscape Project (CROP) and the Unleashing a Blue Economy of the Eastern Caribbean (UBEEC) Project, both financed through the World Bank.

- The Global Environment Facility (GEF)/World Bank/OECS Caribbean Regional Oceanscape Project (CROP) supports implementation of ECROP through strengthening the capacity for ocean governance and marine spatial planning in OECS member countries. Key outputs from the projects include: the updated ECROP; national ocean policies, regional- and national-level marine spatial planning frameworks, including enhanced data management to support planning, information and awareness raising for OECS communities; and capacity building to support ocean governance.
- The Unleashing a Blue Economy of the Eastern Caribbean (UBEEC) Project aims to stimulate economic recovery in the participating countries,[5] strengthening marine and coastal resilience, and improving the competitiveness of their economies in three critical and interconnected sectors/areas: tourism, fisheries and aquaculture, and waste management. UBEEC has an inter-disciplinary 'regional' component, including support for medium, small and micro enterprises (MSMEs) that would be implemented by the OECS Commission to support the blue economy.

2.7.2 Commonwealth Secretariat initiatives

The Commonwealth is also providing support to OECS member countries, with specific support to develop the capacity of the OECS and member countries to effectively implement the revised ECROP, national ocean policies, and coastal and marine spatial plans. In addition, the Commonwealth has a long history of providing technical assistance to countries in the region to negotiate and settle outstanding maritime boundaries.

A more recent initiative that is also relevant to the OECS region is the adoption by Heads of Government of the Commonwealth Blue Charter (CBC), an agreement by Commonwealth countries to actively co-operate to: (a) solve ocean-related problems; and (b) meet commitments for sustainable ocean development. The CBC works through a set of ten Action Groups, each one championed by one or more Commonwealth countries and devoted to a particular ocean issue (Figure 2.8).

The CBC provides a practical means by which states can work together to meet their shared ambitions, transforming high-level commitments into real 'on-the-water' realities. As of June 2023, 48 of the 56 Commonwealth countries had participated in one or more of these Action Groups.

5 Dominica, Grenada, Saint Lucia, St Vincent and the Grenadines, and the Dominican Republic.

Figure 2.8 Commonwealth Blue Charter Action Groups and Champions

Source: Commonwealth Secretariat (2021a)

To support the implementation of the CBC, the Commonwealth Secretariat has formally signed partnerships with several organisations to provide a range of technical support to the Action Groups. These include: Bloomberg Philanthropies through their Bloomberg Ocean Initiative; the Nekton Foundation (marine scientific research and discovery); Arizona State University (access to the Allen Coral Atlas); and eXXpedition (an NGO focused on marine plastic pollution).

The CBC Project Incubator supports the development of governments' projects under the CBC that accelerate their transition to fair, sustainable and inclusive marine conservation and maritime development, while mitigating and adapting to climate change. The Incubator supports Commonwealth governments and their partners to develop solutions that address shared ocean issues. While the grants are modest (£5k - £50k), the scope is large, and can include project-related capacity building, the writing of larger project proposals, 'rapid assessments' and proof-of-concept pilot projects. The initiative is supported by an initial contribution from the Commonwealth Fund for Technical Co-operation, with additional commitments from Bloomberg Philanthropies.

While the activities under the ten Action Groups have largely focused on awareness raising through the provision of webinars, toolkits, case studies and online trainings, the CBC also supports a knowledge hub to allow communication across the Action Groups. In addition, more targeted capacity building is being provided to support member countries in areas such as stakeholder engagement and project proposal development – a critical skill (and gap) required to support the development of blue economy projects for funding. Some more practical sharing of experiences has also been undertaken between countries, such as that undertaken through site visits to aquaculture facilities in Cyprus. In the long term,

Table 2.4 OECS member countries' participation in the CBC action groups

	Action groups									
	Clean Ocean Alliance	Coral Reef Protection and Restoration	Mangrove Ecosystems and Livelihoods	Marine Protected Areas	Ocean Acidification	Ocean and Climate Change	Ocean Observation	Sustainable Aquaculture	Sustainable Blue Economy	Sustainable Coastal Fisheries
Anguilla										
Antigua and Barbuda	✓								✓	
British Virgin Islands										
Dominica				✓						
Grenada										
Montserrat										
St Kitts and Nevis				✓					✓	
Saint Lucia	✓									
St Vincent and the Grenadines	✓					✓			✓	

it is anticipated that the Action Groups will provide a range of tools and advice to policy-makers to assist countries in planning and managing their ocean space (Commonwealth Secretariat 2021b).

Of the 11 full and associated members of the OECS, 9 are members of the Commonwealth. Despite the possible benefits of participating in the CBC Action Groups, OECS countries are very poorly represented in the membership of these groups (see Table 2.4) and are, therefore, potentially missing out on opportunities that may arise from such participation. It is considered that OECS countries would benefit from wider participation in the CBC, either individually or collectively through the OECS Commission.

2.7.3 Other complementary initiatives

In addition to the specific interventions outlined above, a broad range of complementary initiatives are highly relevant to realising the OECS' aspirations of a blue economy. While it is not possible to provide detail on all these initiatives, a summary of the key projects and programmes is provided in Annex B. In the context of the seven enablers listed above, Table 2.5 provides a snapshot of how each of the initiatives listed above and in Annex B contributes to strengthen the overall enabling environment for the blue economy.

Notwithstanding this broad portfolio of initiatives providing direct and indirect support to the OECS, it must be acknowledged that co-ordination and coherence of policies and activities continues to be an issue at the regional level. While initiatives such as the GEF-funded Caribbean Large Marine Ecosystem (CLME+) Project are attempting to provide a platform for greater policy coherence and co-ordination across the wider Caribbean, the OECS Commission has an important role to play in strengthening policy coherence and capacity across the OECS region in order to reduce overlaps and duplication of resources and effort.

2.7.4 Addressing capacity constraints to support the blue economy

The institutional capacity gap is a common theme across all blue economy sectors and requires strong public leadership, backed up by a coherent top-to-bottom planning and management regime. At a broad level, the human capacity to implement the necessary policy reforms remains constrained across the OECS region and, in many countries, the clear authority to lead the strategic development of countries' maritime space is lacking. Notable exceptions include the recently created Ministry of Maritime Affairs and the Blue Economy in Barbados (non-OECS) and the Ministry of Blue and Green Economy, Agriculture, and National Food Security in Dominica.

OECS countries, the OECS Commission and development partners supporting this process can work collectively to devise new ways of working that lever greater capacity from current systems to make change happen. This could be through, for example, increased regional co-operation, sharing of costs and public/private partnerships. Addressing three practical issues can help support the development of institutional and human capacity to act.

Table 2.5 Relative contribution of complementary initiatives to fulfilling the requirements for blue economy enablers

		OECS/World Bank		UNDP/ GEF	TNC	UNDP (Barbados and OECS)		FAO			Common-wealth
		CROP	UBEEC	CLME+	CCI-CBF	Blue-Invest	BlueLab	CC4FISH	Steward-Fish	CBP	Blue Charter
ENABLERS	Healthy, resilient and productive marine environment										
	Integrated approaches to ocean governance										
	Research, technology and marine information										
	Sustainable finance and investment										
	Education and capacity building										
	Develop existing and emerging business opportunities										
	Maritime surveillance and enforcement										

Responds to the requirements of the specific enabler in a comprehensive way

Partially responds to the requirements of the specific enabler

Responds to the requirements of the specific enabler in a limited way or not at all

- First, through **sharing and creating joint capacity**. Many governments, including many Commonwealth Caribbean member governments, have made commitments to sustainable growth and resource protection and management, not just at the national and global scales, but often at the regional level. A key 'short cut' to implementing the blue economy is to identify like-minded governments and share capacity on issues of critical concern in a creative, effective and politically appropriate manner. This is precisely the purpose of the ten Action Groups established under the CBC, hence the recommendation for OECS countries to engage more with this initiative.
- Second, through **increasing co-operation and co-ordination** on ocean issues of common concern. Increased co-operation on issues that are common across the region, coupled with greater co-ordination across governments, can help reduce costs and speed up the transition to more sustainable governance and management arrangements. Governments can analyse current actions and commitments and identify and implement new opportunities at the regional and global scale, for closer co-operative and co-ordinated working in making the transition to a blue economy. The approaches being developed to support implementation of ECROP will contribute to this, but will need strong support and leadership going forward.
- Third, a specific measure that could help catalyse the institutional capacity to act, which could be supported either directly or indirectly by development partners, involves the conduct of an **OECS cross-sectoral skills gap analysis for the blue economy**. This could be followed by a strategy to address the revealed skills gaps. This initiative could be supported through partnership with all OECS countries, other coastal and small island developing states (SIDS) and regions, other developing countries, development partners, academic partners and others.

2.7.5 Addressing identified gaps

It is clear that the OECS Commission and its partners are striving to establish a comprehensive enabling environment to support sustainable economic (including blue) growth in the OECS. However, several gaps remain largely unaddressed in the implementation of this enabling framework.

First, the OECS still lacks a robust framework to guide, manage and disperse the levels of finance required to restore and protect coastal ecosystems, support growth and innovation in economic sectors, and attract the levels of private sector investment necessary to sustainably grow the blue economy.

Second, despite an understanding of the economic potential of the blue economy and the desire to diversify and strengthen the economies of OECS member countries, little substantive progress has been made towards developing new sectors of the blue economy. At the same time, the existing mature sectors require substantial investment and innovation to make them both more sustainable and profitable.

Many of these future opportunities have an essential technological component that will, in some cases, require substantial capital investment. Technology can also be

deployed to address some of the barriers to developing a sustainable blue economy (discussed further in Section 4.2).

While there remains considerable work to be done to implement the framework described above, it is beyond the scope of this analysis to address all gaps in a comprehensive manner. Instead, this analysis will focus specifically on three key themes that are considered to have received little or no attention to date, and which are broadly identified as priorities in the various policies, strategies and development plans outlined in Section 2.5. These themes are:

1. the design and deployment of sustainable finance instruments to support the blue economy transition;
2. the development of existing and emerging business opportunities to grow the blue economy – with a specific focus on capture fisheries, aquaculture, biotechnology and marine energy; and
3. the application of science and technology to address key ocean sustainability challenges facing the blue economy – including to improve maritime surveillance and enforcement.

Chapter 3

Financing the Transition to a Sustainable Blue Economy

3.1 Financing needs for the blue economy

Blue economy investments across the OECS region are constrained by several challenges. Meanwhile, the required capital for financing the post-COVID-19 transition to a sustainable blue economy is beyond the resources available either to the OECS through CROP and UBEEC, or individual member countries. A critical challenge facing many OECS countries remains the persistent high levels of public debt, resulting in a drag on economic growth and development, while constraining the allocation of resources for productive and new investments (CDB 2018). These levels of debt are only likely to rise, at least in the short term, because of the COVID pandemic. As of 2017, the majority, if not all OECS member countries had debt-to-GDP ratios more than the generally accepted prudential benchmark for fiscal sustainability of 60 per cent. Although some Caribbean governments have been able to restructure national debt, these restructuring operations typically entail heavy social and economic costs. As a result, there are both fiscal and commercial challenges to taking on additional debt.

Considering the level of investment needed to finance the transition to a sustainable blue economy, increasing the amount of financial resources available to support the blue economy will require new approaches to draw on existing pools of development finance (CDB 2018). One of the major challenges facing OECS countries will therefore be to develop the financing structures, business models, partnership arrangements and sustainable operating mechanisms necessary for sustainable blue economy investment projects to be implemented.

To transition to a sustainable blue economy, it is essential to have in place, *inter alia,* mechanisms that will provide long-term and reliable financing to support blue economy activities. These mechanisms include:

- Conservation, restoration and sustainable management initiatives for marine and coastal resources (see, for example, Box 3.1, Case Study 1).
- Investments to improve the sustainability and profitability of existing sectors, including fishery improvement projects, efforts to recognise the true economic value of marine ecosystem services, and projects that link ocean ecosystems to climate change adaptation (see, for example, Box 4.1, Case Study 3).
- Investment to support the development of emerging sectors (such as ocean-based renewable energy and 'blue biotechnology') by bridging the gap between the high upfront costs and uncertainty associated with such emerging sectors and the likely delayed financial returns that might be an impediment to companies investing in them (see, for example, Box 3.2, Case Study 2).

Taking these actions/mechanisms would help to sufficiently 'de-risk' the business environment to an extent that entrepreneurs and investors perceive more certainty. They will then have the confidence that there are solid opportunities to achieve the requisite scale and competitiveness that would make new innovative blue economy business models financially viable and sustainable.

3.2 Sustainable blue finance options

The challenges associated with sustainably financing the blue economy transition are not unique to OECS countries and a considerable and growing body of work exists around how to mobilise resources to support SIDS' transition to a more diversified ocean-based economic model. For example, in 2020, Friends of Ocean Action published the *Ocean Finance Handbook*, a comprehensive and up-to-date overview of the full range of sustainable blue finance instruments and mechanisms available to support blue economy implementation (De Voss and Hart 2020). The Caribbean Development Bank (CDB) has similarly published guidance on the application of sustainable blue finance instruments in the context of the Caribbean (CDB 2018). Meanwhile, the UN Environment Programme's Sustainable Blue Economy Finance Initiative (UNEP-FI SBE) recently launched a toolkit for financial institutions to pivot their activities towards financing a sustainable blue economy (UNEP-FI, 2022; UNEP-FI 2021).

While it is beyond the scope of this report to provide a comprehensive discussion of the different sustainable finance instruments available to support the blue economy, the following section provides a broad introduction to the types of instruments that might be applicable in the context of the OECS.

3.2.1 Types of financial capital

Investment exists along a spectrum, dependent on requirements to return a financial profit, how much of a financial profit and at what levels of risk. At one end of the spectrum lies pure philanthropy and grant finance, where there is no expectation of financial return, while at the other end of the spectrum, highly risk-averse commercial finance is driven purely by the potential for financial return, or profit. In the case of the latter, returns may either be fixed or variable. Broadly speaking, three types of capital exist:

Impact only

Impact-only money is typically long term, but small scale in comparison to the larger types of commercial finance (such as bonds and public equity). Since it does not need to generate a financial return, it is less appealing for capital holders to provide. As a result, the primary sources are public and philanthropic, with funds provided typically in the form of grants for projects that are unable to generate an attractive return on investment, but serve a public good (such as ecosystem monitoring, public education or coastal defence). In the context of the blue economy, it is estimated that impact-only money is much more prominent and significant than commercial capital.

Debt

Broadly speaking, debt instruments (such as loans and bonds) are low-risk, low-reward types of capital that offer a high degree of freedom to both the borrower and investor. Because of the relatively limited influence that lenders have over the investment, debt providers are typically more risk-averse and slower to invest in sustainability initiatives than are equity investors. However, opportunities for scale are substantial once a sector has demonstrated returns – as exemplified by the expansion of the climate and green bond markets.

Equity

Equity works on the basis that assets can be broken up into shares, which can be sold by the owner to raise capital. Asset holders use the proceeds from the sale of their shares to invest in the asset, help it grow and thus raise the value of the shares, which investors can then sell off at a future date at a higher value. In addition, shares pay out a periodic dividend to shareholders out of annual profits.

Equity broadly subdivides into publicly traded (that is, through a share market) and privately traded equity (for example, venture capital taking a direct stake in a company).

3.2.2 Investment models

Table 3.1 provides a summary of the most common types of investment model, currently relevant to the sustainable blue economy, under each of these capital types. Not all the investment models listed in Table 3.1 are equally relevant to all sectors of the blue economy, with some being more suitable for certain applications than others. Figure 3.1 illustrates the alignment between major types of financing and example investments into sectors of the blue economy, illustrating the best investment models for projects in different sectors.

In many cases, different types of capital can also be combined to achieve different results. This is referred to as 'blended finance': the process of combining different types of capital, from different providers, as a means of unlocking greater amounts of capital for projects that require it but are deemed too risky for any one capital provider to be able to provide the money on their own (see, for example, Boxes 3.1 and 3.2, Case Studies 1 and 2).

Public–private partnerships are a common mechanism for blending capital, where a public entity (such as a development bank or government agency) works with a private entity (such as a private equity fund or corporation) leveraging each other's strengths to work together in pursuing a common goal. The deployment of blended finance to support fishery improvement projects has gained considerable attention in recent years. These types of investment typically require considerable upfront capital, with limited potential for returns to be sustainable. By using philanthropic, public or concessional capital upfront, more commercial capital can be attracted towards the tail end of the project, where revenue-generating activities that are dependent on a sustainable foundation can take place (De Voss and Hart 2020).

Table 3.1 Summary of investment models currently relevant to the sustainable blue economy

IMPACT ONLY	**Grants** Grants, from philanthropic sources as well as development agencies and corporations, are a key existing source of funding for ocean conservation. They have acted as a vital resource for communities, NGOs and early-stage businesses working on developing a sustainable blue economy. **CSR investments** Corporate social responsibility (CSR) is a form of corporate philanthropy (sometimes called 'corporate giving'). Here, corporations invest non-return-seeking capital for a social and/or environmental good.
DEBT	**Microfinance** Microfinance is the application of existing financial instruments at the smallest scale. Microfinance is typically debt based and unsecured (with comparatively high interest payments). It can be offered both for-profit by commercial banks and not-for-profit by NGOs. **Revolving loan fund** Revolving loan funds provide lending to small business owners who cannot otherwise access capital. In a revolving loan fund, loans are allocated from a central fund, which is replenished as individuals pay back their loans. Once replenished, the fund can then issue new loans to other actors, hence 'revolving'. **Bank loans** Typically being unsecured, bank loans are among the most common financial instruments. They are particularly valuable for early-stage project ideas, provided the borrower has a clear means to repay the loan. For most projects, a loan is a straightforward and often most advisable means of raising capital. **Conservation/environmental impact bond** These are financial instruments where private capital is invested upfront for conservation purposes, against agreed conservation outcomes. Investees work with governments, philanthropic institutions and NGOs to support deal structuring. When agreed conservation outcomes are verified, the investor is repaid. **Project bonds** In the private sector, project bonds are bonds raised specifically to finance the operations of a specific project, such as a new wind farm or factory. They will be paid back exclusively by the proceeds from this one activity, without recourse to the issuer's other potential revenue streams. Related to project bonds, corporate bonds are bonds raised by a corporation, to support efforts to expand, acquire or (re) capitalise specific business areas. They are repaid through the corporation's revenue streams. **Sovereign bonds** The mechanism for a sovereign bond is much the same as for a corporate or project bond, with the main difference being that the issuer is a sovereign entity. As a result, the appetite for risk is usually lower than in the private sector, hence the coupon is typically a lower yield.
	Impact investing These are investments made with the intention to generate positive, measurable social and environmental impact alongside a financial return. While equity is a common feature, impact investment models are often blended, and can include debt and several capital providers to create and support the environment in which an investment is likely to be successful and profitable.

(*Continued*)

Table 3.1 Summary of investment models currently relevant to the sustainable blue economy

EQUITY	**Seed financing** Offering high-risk, early-stage investment for new companies, seed financing is often the first round of investment for a start-up. It is common across many sectors, with notable prominence in technology-based investments. It is often linked to project accelerators or incubators to build a pipeline of projects or investments. Proceeds are typically used for product development, market research and other capital expenditure. **Crowd funding** This is a form of seed financing where investors invest relatively small amounts, which are aggregated with other individuals to purchase equity stakes in a start-up. This opens up investment opportunities both to start-ups that may not have a business profile able to attract traditional investment, as well as to investors who don't have the capital to invest at a larger scale, potentially unlocking substantial new sources of finance.

Source: Summarised from De Voss and Hart (2020)

While investment from public bodies such as the World Bank and Inter-American Development Bank (IDB) can help mobilise private capital by building confidence and reducing risk, these are insufficient for the scale of transformation required. The private sector has a critical role to play to provide finance needed to achieve the

Figure 3.1 Alignment between major types of financing and example investments into sectors of the blue economy

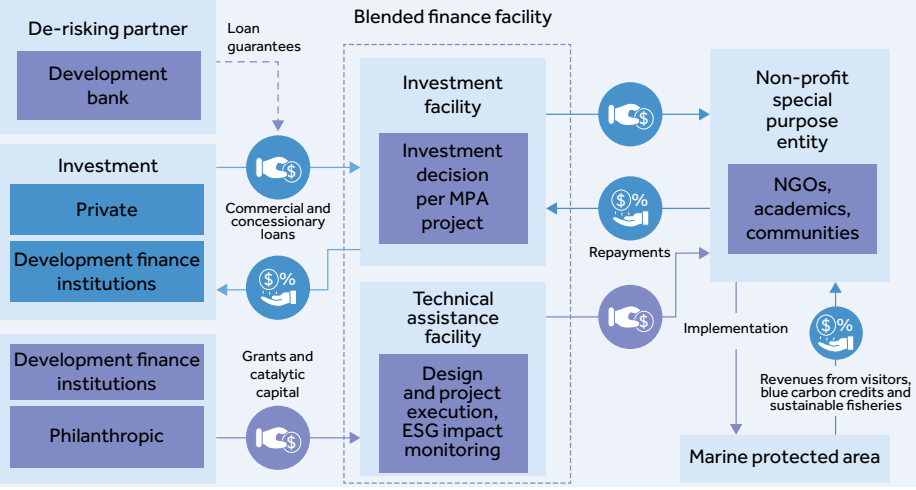
Source: De Voss and Hart (2020)

Box 3.1 Case Study 1: Sustainable finance for marine protected areas in the Dominican Republic

Since mid-2017, Blue Finance[1] has been working closely with the Government of the Dominican Republic to spearhead establishment of a public–private partnership (PPP) agreement to support and finance co-management of the *Arrecifes del Sureste* Marine Sanctuary. Established in 2009 as a marine protected area (MPA), the sanctuary covers 8,000sq.km, including 100km of coastline, coral reefs and two tourism centres. However, due to a lack of adequate funding and effective management, the MPA has been little more than a 'paper park'.

Funding for the PPP is provided via the establishment of a blended finance facility that uses catalytic and development finance to mobilise commercial impact finance, through which development and philanthropic finance is used to mobilise commercial finance towards sustainable development. This facility will aggregate investment through a co-management special purpose entity (SPE), essentially a non-profit company, to support the creation of new job opportunities for local communities in blue economy sectors while at the same time supporting conservation of critical ecosystems and providing basic financial returns to communities and investors. The SPE comprises two local conservation NGOs, two local foundations of the major tourism holdings in the country and other associations.

Figure 3.2 Generic blended finance investment and operating model for marine protected area (MPA) financing



Source: Coalition for Private Investment in Conservation[2]

1 2

1 See: http://blue-finance.org/

2 http://cpicfinance.com/channeling-private-finance-into-marine-protected-areas/.

US$1.4 million of anchor financing has already been pledged for its initial capital expenditures by the Sustainable Ocean Fund, an impact investment fund dedicated to creating, accelerating and executing sustainable fishery, aquaculture and coastal conservation projects globally, while applying 'best-in-class' social and environmental governance.

The blended finance facility is targeting a total investment of some US$3 million, with projected positive impacts for 800,000 hectares (ha) of marine habitats and 18,000 households. In time, the SPE is expected to be financially sustainable and will generate its own incomes from charges on divers exploring the coral reefs and from other tourists, giving it an independent income stream.

Box 3.2 Case Study 2: Development of a MARPOL-compliant waste reception facility in The Bahamas

Having secured a license from the Grand Bahama Port Authority to collect and process liquid waste from ships arriving in The Bahamas in 2019, the Clean Marine Group Ltd (CMG) signed a co-financing deal with the Inter-American Development Bank (IDB) to establish and operate a port reception facility, that satisfies the requirements of the International Convention on the Prevention of Pollution from Ships (MARPOL) in the Port of Freeport. The first facility capable of handling liquid waste in the Caribbean, the facility will process an estimated 70,000,000 gallons of liquid waste each year from cruise ships and other commercial vessels that call in for service or repair.

A US$1.5 million IDB loan will co-finance the expansion of CMG's existing port reception and treatment facility. This will provide significant environmental and health benefits to the populations that reside in, or depend on, ocean-related activities for their well-being in The Bahamas, as well as in all the other Caribbean countries that are affected by the improper disposal of marine waste and pollutants that are dumped into the ocean. The US$1.5 million was matched by private Bahamian investors and an international investment fund, the Althelia Ocean Fund (Mirova 2020), will help to finance the rest of the projected US$10 to 12 million cost of the project. A grant of US$276,000 will also be used to promote the creation of public goods that benefit the population and governing bodies of The Bahamas and the wider Caribbean. This will be through activities that help to improve the regulatory framework for MARPOL in the region and increase the number of Caribbean countries that develop an interest in and the capacity to follow MARPOL regulations. This grant will also evaluate the applicability of new technology to address land-based environmental or water-quality issues in The Bahamas, and the capture, synthesis and dissemination of the knowledge generated from this project.

Sustainable Development Goals (SDGs) and a sustainable blue economy. There is also an important role for 'impact investors' – private sector investors that seek to make a profit from their investments, as well as generating environmental and social benefits (The Economist Group 2020).

3.3 Mobilising finance in the OECS

The concept of sustainable finance is already well established in the OECS. For example:

- The Sustainable Energy for the Eastern Caribbean (SEEC) Programme – a multipartner, blended finance trust facility that supports investments in renewable energy and energy efficiency, as well as technical assistance for institutional strengthening and project support.
- The Sustainable Energy Facility (SEF) for the Eastern Caribbean – a blended finance facility designed to contribute to the diversification of the energy matrix in the Eastern Caribbean by promoting the implementation of energy efficiency and renewable energy technologies. SEF is operated through CDB, financed through loan, grant and contingently recoverable grant resources, as well as additional capitalisation from the Green Climate Fund.

Both initiatives are almost exclusively publicly financed, with little or no private sector investment.

In terms of the blue economy, two initiatives have the potential to mobilise public and private sector resources:

- Through UNDP (Barbados and the OECS), work is under way to deploy a blended finance facility to support the blue economy. *Blue Invest* is planned as a US$10 million technical assistance and investment facility to accelerate project identification, formulation, financing and implementation. It will fill the capability gap in the technical and financial structuring of an investment pipeline of blue economy projects, by leveraging: (i) existing grant programmes from development partners; (ii) development finance institutions' financing; and (iii) its own financial instruments and incentive schemes to crowd-in private capital.
- If effectively deployed, Blue Invest could potentially mobilise at least US$50 million worth of investment in projects in priority blue economy sectors over a four-year period to support three Eastern Caribbean countries (Barbados, Saint Vincent and the Grenadines, and Grenada) by catalysing available finance into blue economy-linked investments.
- Similarly, the World Bank UBEEC project aims to direct investments into blue economy activities. This initiative supports a regional grants programme, to improve the resilience of MSMEs, helping them to ensure business continuity, create jobs and mitigate the socioeconomic impacts of COVID-19; and fisheries insurance, to support fishers' livelihoods against extreme climatic events.

This initiative is also designed to enable private sector-led growth by financing a Project Preparation Facility for resilient infrastructure development in tourism, fisheries and aquaculture, and waste management.

The initiatives outlined above are a positive and important start. However, these financing mechanisms need to be institutionalised at the country level and will require regional institutional support from regional and national financial institutions (such as the CBD and IDB).

3.3.1 Mobilising domestic resources

According to a recent survey by the Economist World Ocean Initiative (The Economist Group 2020) as many as nine out of ten institutional investors are interested in financing the blue economy. Growing appetite in the venture capital and impact investment communities for ocean investments has also resulted in the establishment of several new funds in recent years. Thus, the opportunities to leverage domestic resources by blending different types of finance with private equity are promising. However, while there is an adequate supply of investment capital available to support blue growth, what is missing is a robust pipeline of investable projects, particularly in developing countries.

A government's ability to design and fund such a project pipeline is extremely limited. Instead, a government's role in the transformation process must be to facilitate private sector development by easing the process of doing business. According to the Caribbean Export Development Agency, approximately 65 per cent of employment in the Caribbean Forum (CARIFORUM) region is supported by micro, small and medium-sized enterprises (MSMEs), including the seafood industry. In the context of OECS countries, high-value sustainable blue economy products present a viable option for the development of MSMEs within the blue economy value chains. Finance for MSMEs will be a key aspect of this enabler. There is, therefore, a need to examine the mechanisms available to government to encourage start-up MSMEs, to assist with capacity and technology development, and to define the pathway to an effective blue economy investment promotion strategy.

In particular, there is a need to reduce impediments for private sector investment and secure innovative and sustainable finance. Building on the work undertaken for the OECS Blue Economy Investors' *Roundtable and Partnership Forum*, to develop the Blue Investment Portfolio, the OECS Commission and individual governments need to work with the business sector to identify and develop investment opportunities. Such a collaboration would focus on resolving the major challenges facing MSMEs in the blue economy – in terms of marketing, product development, operational management and finance. In this regard, the second round of the Blue Economy Roundtable was scheduled to take place in September 2021, which would enable development partners, private sector entities and project developers to showcase bankable investment plans to support the blue economy transitioning. The momentum behind this and related initiatives must be maintained and built on to fully engage the private sector and investment community to mobilise the necessary resources to support a long-term and sustainable blue economy transition.

A key focus of such an effort should be on how to support pioneer investors through fiscal incentives and de-risking (for example, through seed funding to catalyse investment, the provision of necessary infrastructure, or by developing the skills of workers and capabilities of local suppliers). In this regard, the role of regional and domestic finance institutions such as national banks, the CBD and IDB will be critical, since they can provide support in the form of concessional loans and other preferential financial instruments, which can de-risk and provide guarantees for investments (Box 3.2, Case Study 2).

Chapter 4

Economic Opportunities in the Blue Economy

While there is a need for broad investment in the full range of blue economy sectors, through its Blue Investment Portfolio, the OECS has expressed a specific interest in the development of the following blue economy areas:

- Fish processing and added value (including aquaculture development)
- Blue biotechnology
- Ocean energy
- Waste management

Efforts must therefore be focused on supporting the development of, and investment in, these sectors.

4.1 Fish processing and added value

Coastal fisheries in the Eastern Caribbean have suffered sharp declines in recent years, with catches of conch, lobster and some demersal fish all declining. The reasons for this vary but include: open access fisheries with no resource allocation; poor stock management due to lack of resources, human capacity and scientific knowledge; illegal, unregulated and unreported (IUU) fishing, both at the national level and by fishers from other countries; and unsustainable fishing practices, such as harmful gear and overcapacity due to subsidies. Without comprehensive investment to address these drivers of degradation, opportunities to increase returns by increasing yields remain limited.

Opportunities do exist, however, to capture more value from the fishery value chain through:

- **Increasing operational efficiency:** That is, reducing the cost of fishing and delivering fish through the supply chain, improving profit margins and thus magnifying the returns from fishing as a whole.
- **Increasing market value:** That is, by improved market access, certification, branding and long-term partnerships that return more value to fishers.

Fish is a highly perishable commodity and hence susceptible to high post-harvest losses at all stages in the value chain. Minimising these losses must be a key strategy to increase revenues and food security without the need to increase catch volumes. In terms of storage and handling, improving cold storage throughout the value chain and improving sanitary standards via the application of certified Hazard Analysis and Critical Control Point (HACCP) standards is likely to lead to a stronger, more viable market overtime (see, for example, Box 4.1, Case Study 3).

Box 4.1 Case Study 3: Grenada tuna fishery investment plan

Among the fisheries of Grenada, the commercial longline tuna fishery is considered to hold the greatest promise, by increasing tuna quality and value for fishers, exporters and the government. As a pilot initiative under the Caribbean Billfish Project, Wilderness Markets has prepared an investment case to improve the operational efficiency of the tuna supply chain and improve the market value of export products.

The proposed reforms include a shift to circle hooks from traditional J-hooks, and increasing the hook set depth via a conservation agreement mechanism linked to proposed investments in improved data gathering and a fisheries improvement project. Implemented together, these changes are projected to result in: 1) reduced pressure on the billfish stocks; 2) reduced mortality of captured billfish (both on the line and after release when required to meet quota needs); and 3) improved quality of tuna landed. Compensation for the additional costs of adopting sustainable fishing practices will be generated from increased revenues achieved through improved operational efficiency. These interventions are further linked to investments for:

– improved cold storage and processing facilities; and

– data capture and a digital supply chain.

Further improvements to the supply chain will include technology and block chain applications to improve traceability of the tuna supply chain and enhance product quality with advanced testing.

With improved processing techniques, it is estimated that the value of local basic grade tuna can be increased by approximately 50 per cent for export grade tuna. Thus, the investment case projects that an investment of US$362,500 will be paid back within three years and generate a 28 per cent internal rate of return (IRR) to investors over the five years of the investment. This assumes a 7 per cent interest rate and proposed 1 per cent royalty on the value of exports. It also assumes that fishers are paid an increase of 20¢ per pound for higher-quality tuna in compliance with proposed changes in gear and practices to successfully achieve a reduction in billfish landings as well. Over five years, harvester aggregate profits will increase by US$1.1 million based on an estimated aggregate of 5.92 million pounds of tuna landings.

An improvement in sanitary standards that reflects international standards could also help countries penetrate export markets and expand their trade.

In many developing countries, processed fish typically outweighs fresh fish by volume and number of traders. Furthermore, these types of processing typically produce little waste when compared to fillet processing. Therefore, developing actions aimed at adding value to local products should also be a component in the strategy that the fisheries sector needs to develop in order to meet current and future economic challenges.

The potential for innovation in the use of fish by-products is also high for the food, biotechnological, fashion and cosmetic industries. This, however, will require access to affordable research and development technologies, which OECS countries lack and may not be able to afford in the short to medium term.

4.1.1 UNCTAD/OECS/CITES Blue Biotrade initiative

In 2020, the UN Conference on Trade and Development (UNCTAD), the OECS Commission and the Secretariat for the Convention on International Trade in Endangered Species (CITES), together with the EU, jointly established a pilot project entitled 'Seizing the trade and business potential of Blue BioTrade products for promoting sustainable livelihoods and conservation of marine biodiversity in selected Organisation of Eastern Caribbean States (OECS) Countries' ('the Blue BioTrade Project'). The Blue BioTrade Project falls under the OECS-EU Regional Integration Through Growth, Harmonisation and Technology (RIGHT) Programme, which is funded by the EU's 11th Economic Development Fund. The aim was to support the development of Blue BioTrade through the commercialisation of goods and services derived from marine biodiversity that adhere to a set of sustainability guidelines known as the 2020 BioTrade Principles and Criteria (P&C). The value chain selected for this pilot project was queen conch (*Strombus gigas*) in the first phase and sea moss and *Sargassum* seaweed in the second one.

Building on existing work done on queen conch in the countries and region, phase 1 of the project will undertake stakeholder-owned value chain assessments of queen conch products in the three beneficiary countries[1] and developing a Blue BioTrade regional implementation plan of action. This will involve mapping key stakeholders and processes, the ecological state of queen conch, and, importantly, the opportunities to enhance sustainability and income generation by following the BioTrade P&C. It will also assess implementation of the *Regional Queen Conch Fisheries Management and Conservation Plan*.

In doing so, the project aims to foster stakeholders' capacity to identify, design and implement enhanced sustainable production and trade opportunities in the queen conch value chain, thereby empowering small-scale coastal producers from OECS member states to produce and trade queen conch products in domestic, regional and international markets under the 2020 BioTrade P&C.

This initiative should be an important component of the development of the fishery sector, with lessons learned being applied more broadly to other subsectors over time.

4.1.2 Implications of WTO fishery subsidy negotiations for OECS countries

Notwithstanding the need for economic diversification, OECS communities will remain dependent on fisheries for food security and socio-economic development. Long-term sustainable benefits will, however, only be possible if management of those resources is significantly improved. This requires efforts that address, among other things: improved

1 Grenada, Saint Lucia, and St Vincent and the Grenadines.

knowledge and understanding of fishery resources; the needs and perspectives of the stakeholders; and the economic factors influencing the state of those resources, including the impacts of subsidies that can alter trade behaviour through increased fisheries production or consumption, and in diverting investment into the fisheries sector.

There is universal recognition that subsidies result in overexploitation of resources, with concomitant environmental impacts (Bahety and Mukiibi 2017). International trade initiatives are, therefore, part of the solution to developing sustainable blue economies. The bargaining process regarding the disciplines on harmful fisheries subsidies has been a long-standing issue at the World Trade Organization (WTO). Discussions range from issues relating to overfished stock, overfishing, overcapacity, IUU fishing, transparency, fisheries management, and special and differential treatment. That said, not all subsidies are harmful. Indeed, many subsidies are used to improve stock management and increase the sustainability of fishing practices (Kumar et al. 2020). At its twelfth Ministerial Conference in 2022, WTO members adopted the Agreement on Fisheries Subsidies that partially complies with target 6 of SDG 14.

The subsidy debate is a difficult one for many SIDS, including those in the Caribbean. While subsidies are generally not considered a major issue affecting SIDS artisanal fisheries, the provision of fisheries subsidies for low-income and resource-poor fishers is important for sustaining the fisheries sector and for overall socioeconomic development. In many developing countries, artisanal and small-scale fishing operations may require support and incentives to overcome the high setup costs encountered for large-scale commercial fishing activities. With the elimination of fisheries subsidies, developing countries that possess fishing vessels and provide specific subsidies may be compelled to exit the market over time due to high operating costs.

At the same time, it is well recognised that the cost of inaction will be detrimental to the livelihoods of the coastal dwellers and countries dependent on fish for income generation and food security.

Assessing the effect of the elimination of subsidies in SIDS is complex, as this depends on multiple factors (Haughton 2001). On the one hand, reducing or removing subsidies may make OECS countries more competitive by reducing the price disparities created by subsidies. However, as noted above, the volume of fisheries exports from OECS is extremely small – they are net importers and therefore may be adversely affected by import price increases.

On the other hand, although many subsidies are trade distorting, there is certain support that can help fishers in SIDS countries to overcome the high costs associated with commercial activity. This includes, for example, access to credit to modernise fleets and equipment. Moreover, subsidies to meet quality and food safety standards need to be considered to help these firms access global markets. To reach their full potential in fisheries trade, and in particular the promotion of value-added activity, OECS countries will need to invest in a variety of within-sector and cross-sectoral enablers.

As such, it is critical for OECS countries that any disciplines agreed to do not hinder their ability to develop the fisheries sector. Most domestic fleets in OECS countries are small and comprise mainly small, open day vessels. To allow for the development

of their fleets within sustainable levels, some flexibility will be required to allow certain subsidies, while curtailing harmful subsidies that contribute to overcapacity and depletion of fisheries resources (Bahety and Mukiibi 2017). Any existing trade preferences should be maintained to protect their products from tariff escalation, which requires policy space that would enable the development of landing, processing and marketing facilities through provision of subsidies.

4.2 Aquaculture development

Worldwide demand for fishery products is expected to surge in coming years, to maintain the role of fish in diets. Globally, aquaculture is already a multibillion-dollar industry, but the Caribbean has yet to tap into its true potential to expand marine and freshwater aquaculture. This is because the aquaculture sector is not well developed in the region. The CRFM has identified the promotion and development of aquaculture as one of its priority programme areas, with the formulation of aquaculture development policy and legislation as key areas for attention. A 2014 FAO study found that aquaculture could increase total fish production in CARICOM states by 30 per cent, within 10 years, if essential investments were made in enabling aquaculture policy and legal frameworks, supported by applied research, capacity building and information (FAO 2014).

While limited aquaculture is practiced in several OECS countries, the sector as a whole has never operated at scale. However, aquaculture offers the region significant potential for diversification, increased employment and reduced fishing pressure on existing wild fish stocks, while at the same time addressing issues relating to food security and offering an additional source of export revenue.

4.2.1 Recommendations for fostering the development of an aquaculture industry within the blue economy

Listed below are various strategic-level recommendations that could assist in the development of an aquaculture industry.[2]

Initial sectoral prioritisation

The products of aquaculture are globally traded, and it is unlikely that many OECS countries will be able to compete in the global market on the basis of price. Therefore, aquaculture development should be based on products for the domestic/regional market or niche products that attract a higher price, such as eco-labelled products.

Create management and regulation frameworks based on the ecosystem approach to aquaculture

At this stage, it is not clear to what extent aquaculture is specifically provided for in national policy/legal frameworks. A comprehensive aquaculture policy based on

2 For more detailed information around the development of this sector, readers should refer to Volume 2 of the Commonwealth Secretariat's *Blue Economy Report Series* (Hughes et al. 2016).

the ecosystem approach to aquaculture (EAA) would allow the industry to develop within a framework that provided economic and environmental sustainability. Management, regulation and policy should be based on sound scientific principles and evidence.

Coherent cross-policy activity

The blue economy framework should be used to assist in the development of clear action plans, while activities should be rationalised under different policy initiatives.

Integrating planning of sectors within the blue economy

Considering the possibilities of multisector development in integrated scenarios would identify overlap in actions (for example, in relation to research or local infrastructure), address possible conflicts, and develop dialogue on the comparative costs and benefits, within the context of sustainable development.

4.2.2 Feasibility of an aquaculture sector in OECS

The development of an aquaculture sector across the OECS is not without its challenges. Previous experience from several OECS countries does demonstrate that there is both an opportunity and demand for farmed produce. However, future development and expansion of the sector will require strong regulatory, financial and technical support to make it successful.

On that basis, one approach would be to start at the low-complexity end of the spectrum of development and to allow the aquaculture industry to grow organically (supported by government investment via fiscal incentives and commercial policies) and to move up the complexity spectrum as local capacity and infrastructure develop. Table 4.1 illustrates a number of groups of 'low-trophic level' species that offer the potential for significant aquaculture operations in developing economies.

If OECS countries wish to pursue the development of more complex organisms (such as finfish and shellfish), this will require greater investment in infrastructure, research and development (R&D), capacity and a range of technical assessments and studies to inform the future development options. This would undoubtedly require a substantial investment partner to reach scale. Having said that, there are clearly examples of successful aquaculture of higher trophic-level species such as tilapia and rock lobster (see Box 4.2, Case Study 4).

4.3 Blue biotechnology[3]

The term 'biotechnology' is widely employed and has different connotations. A useful and all-encompassing definition is provided by the OECD: '*The application of science and technology to living organisms, as well as parts, products and models thereof, to*

3 For a more detailed overview of this sector and its possible development, readers should refer to the Volume 5 of the Commonwealth Secretariat's *Blue Economy Report Series* (Day et al. 2016).

Table 4.1 Possible low trophic-level species groups that may offer aquaculture potential

GROUP	MARKET	NOTES
Seaweeds	The global seaweed market is worth approximately US$6 billion annually; it is used mainly for direct human consumption or as a food ingredient.	Globally, most of the production comes from aquaculture. There are several species indigenous to SIDS for which both a market and cultivation techniques exist.
Sponges	Large specimens attract a premium for the bath sponge market and take approximately two years to grow to size.	Sponges have a range of commercial uses, including in cosmetics, collagen and bioactive compound production, and are relatively simple to culture.
Sea cucumbers	A fishery for sea cucumbers exists globally in the tropics, but stocks have become severely depleted. Currently, China produces 10,000 tonnes per annum through aquaculture.	In many SIDS, there is an existing fishery for sea cucumbers for which there is a well-established aquaculture industry and demand in Asia.
Corals	The trade in live corals for aquariums has grown at approximately 9 per cent per annum since 1990, and on average coral retails at US$56 a piece in the US.	Aquaculture production is normally by fragmentation of donor colonies. In the beginning, these donor colonies are from wild coral colonies on reefs.
Cultured live rock	Traditionally, Fiji Islands has been the main source of live rock for import to the US. The value of this trade is US$50 million globally.	Live rock is much used in ornamental aquariums and can be easily cultivated.

Box 4.2 Case Study 4: Spiny lobster aquaculture in the British Virgin Islands

In 2017, Caribbean Sustainable Fisheries (CSF) started a pilot lobster farming facility in the British Virgin Islands (BVI). BVI was selected due to its high-quality marine environment, suitable climate for growing *Panulirus argus* and stable governance. CSF is currently the only such facility in the entire Eastern Caribbean and has the potential to catalyse a significant industry that the BVI could be the epicentre of, provided the right enabling conditions are in place to support the venture.

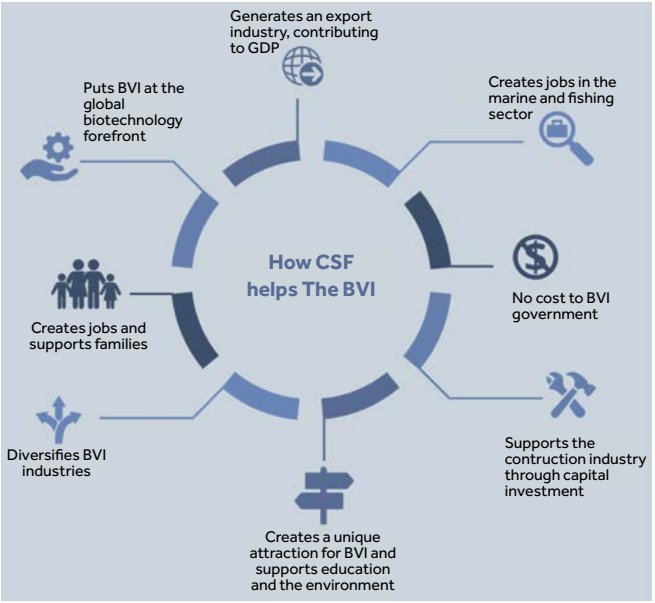
While most marine aquaculture is undertaken in open water in ponds or pens, the CSF facility uses a land-based recirculation system to produce market-size lobster in approximately 12 months. This means all the variables that effect lobster marketability, such as size, availability and freshness can be controlled. The

value of farmed lobster is high because of the consistently high product quality and the continuity of supply of fresh product to the market. As a result, prices for farmed lobster command a premium of around 30 per cent over wild-caught lobster.

At present, in its pilot project form, the facility can produce approximately 15,000 pounds (lb) annually. However, the farm has submitted applications for permits to allow for a staged expansion to full-scale production. Once approved, the facility will produce around US$4 million worth of lobster annually with potential for further expansion in the future, either in BVI or another island in the region.

This project provides significant trade opportunities in the high-end seafood and high-growth sustainable aquaculture sectors. Country-wide, the BVI benefits directly through a contribution to GDP from an export industry and diversification of the economy, as well as being positioned at the forefront of a new biotechnology/aquaculture sector. The facility is projected to create around 40 full-time positions, along with jobs in support industries such as supply chain logistics, management, finance and administration, R&D, and the education sector, and part-time roles, including for fishers, scientists, marine biologists, aquaculture technicians, engineers, mechanics and electricians.

Along with its employment creation potential, this project provides a significant opportunity for capacity building within the local workforce and delivers opportunities for education and training in new and emerging areas such as aquaculture and aquaculture technology.



Source: Sustainable Food Enterprises

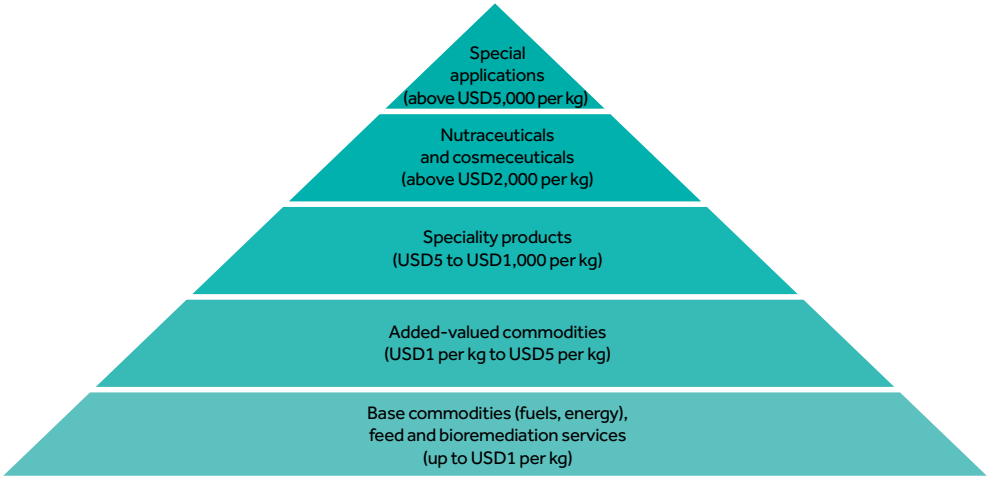
alter living or non-living materials for the production of knowledge, goods and services.' (Day *et al.* 2016)

The limited biotechnology activities in OECS countries to date have focused on the use of fish waste and *Sargassum* seaweed to produce novel products such as fertilisers, nature-based plastics and animal feedstuffs (Thompson et al. 2020). Further work on *Sargassum* is anticipated under the Blue Biotrade Project discussed above. However, marine biotechnology encompasses a wide range of activities and can include everything from bioprocessing of harvested materials (fish, algae, etc.) to cultivating marine microbes. Some examples include:

- health, beauty and personal care products (cosmeceuticals);
- bioactive compounds and pharmaceutical products;
- food products and additives;
- industrial products and processes, such as novel sources of enzymes and polymers; and
- algal-based biofuels.

Figure 4.1 shows a range of different products and services that can be generated from marine resources, categorising them based on their commercial value, from top-end pharmaceutical compounds to low-value bioenergy produced from organic waste. Many of these products are considered to be 'special application' products, described as low volume, high value, while at the other end of the scale, base commodities are invariably high volume, low value. In the OECS, it would make sense to focus initially on the latter category since the technological, financial and capacity demands will be much lower.

Figure 4.1 Value pyramid of products obtained from the marine environment



Source: Day et al. (2016)

Lessons from other countries may be useful in terms of scoping and framing an emerging biotechnology sector in the OECS. Iceland, in particular, provides an interesting model, having invested heavily in infrastructure, research and innovation, and product development through a public/private partnership arrangement and the establishment of a platform for SMEs. Such models could be applied at the regional level, perhaps using innovative financing as the mechanism to attract funds. A regional R&D platform would also be more attractive to international researchers and investors. The OECS Commission could provide an effective focal point for locating such capacity.

4.3.1 Feasibility of a blue biotechnology sector in OECS countries

Whereas the production of some biotech products, such as bulk chemicals and pharmaceuticals, may not be practicable, because of lack of land availability, investment or infrastructure, the production of niche products such as cosmeceuticals and nutraceuticals could be commercially viable.

In the case of many OECS countries, these could benefit from exploiting linkages with the tourism sector – especially the 'well-being tourism' subsector – to connect to international markets. This approach has been successful in Iceland, where cosmetics (skincare products and treatments) based on Icelandic algae grown in photo-bioreactors are marketed as health products at local spa resorts.

Although bioprospecting for pharmaceuticals is a possible option with the involvement of external partners, niche products, based on biological resources, developed, produced and marketed worldwide from any SIDS, provide a more realistic opportunity to generate high-value jobs and diversify the economy of the country.

4.4 Ocean energy[4]

Sustainable energy provision is fundamental to the transition to a low-carbon economy, and the basis for progressing towards sustainable development globally. SDG 7 highlights the importance of sustainable energy and industrial development, with particular reference to SIDS. As such, renewable energy will play a key role in the decarbonisation of global energy systems in the coming decades. In 2019, around 11 per cent of global primary energy came from renewable sources, with a total global installed capacity of approximately 3.5 million MW. While currently less than 25,000 MW of this comes from marine renewable energy (MRE) (97 per cent of which is offshore wind), there is a significant global focus on the development of this sector.

The development of MRE in the Caribbean can support the achievement of renewable energy objectives and provide energy security through greater independence from imported hydrocarbons. Regional co-operation enables strategic use of capacity,

4 For a more detailed overview of this sector and its possible development, readers should refer to Volume 4 of the Commonwealth Secretariat's *Blue Economy Report Series* (Greenhill et al. 2016).

mobilisation of donor resources and development of a stronger collaborative vision to support national-level action. There has been notable progress in this regard through CARICOM, resulting in the production of a Regional Energy Policy, followed by the Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS), which aims to provide CARICOM member states with a coherent strategy for transitioning to sustainable energy.

A broad range of different technologies exist for the generation of renewable power from marine sources, although most of these (apart from wind) remain unproven commercially. These include:

- Offshore wind (fixed and floating)
- Wave
- Tidal (rise and fall, currents)
- Ocean currents
- Ocean thermal energy conversion (OTEC)
- Salinity gradients (osmosis)
- Marine-based biomass, for example, algae

Recent research from Stanford University also demonstrates the feasibility of producing hydrogen from seawater using solar power, without the need to desalinate the water first, representing a significant shift in the low-carbon energy balance that would pave the way for hydrogen-powered vehicles and ships (Garcia de Jesus 2019).

While MRE may be feasible in the long term, there are also significant challenges facing the sector globally, as it is an emerging sector and demonstrated commercial success is not yet evidenced in most technologies (Greenhill et al. 2016). Notable challenges include access to financial capital, institutional capacity to plan and develop renewable energy projects, and local infrastructure and human capacity for engineering works. Solar and wind have proved reliable and adaptable solutions for generating clean electricity in many locations, and their costs have decreased dramatically over the past decade. As a result, MRE is struggling to find its place in an already crowded energy marketplace.

This notwithstanding, with continued political support for renewable energy as a source of clean, secure and reliable energy, technologies are expected to develop in the coming decade, and to become increasingly attractive and cost-competitive. As such, in the long term, MRE may be a realistic consideration for the Caribbean region.

4.4.1 Feasibility of developing marine renewable energy in OECS countries

While MRE is generally considered to be a realistic medium- to long-term energy option for many SIDS, in the case of the OECS it is questionable whether MRE can be competitive against the existing options that are being pursued in several countries

(particularly geothermal, wind, hydro and solar). That is not to suggest that it should not be considered in the overall portfolio of renewable energy options being studied, but rather that it seems doubtful whether it will be cost-effective against those other options.

This notwithstanding, there may be an argument that small-scale scalable MRE options for off-grid areas could address the current and future power needs of remote communities.

4.5 Waste management

The last few decades have seen waste problems increase significantly, driven by population growth and changing consumer behaviour. While plastic represents only a fraction of the solid waste that is generated, it is a major constituent of marine and coastal litter and has been recorded widely throughout the Caribbean. After the Mediterranean, the Caribbean is one of the most plastic-polluted basins in the world, much of which has been shown to originate from within the region (Diez et al. 2019). According to Forbes (Ewing-Chow 2019), of the top 30 global polluters per capita, 10 are from the Caribbean region, including Anguilla, Antigua and Barbuda, Grenada, St Kitts and Nevis, and Saint Lucia. This is almost certainly a function of mass tourism consumption rather than domestic consumption, but nonetheless illustrates the scale of the challenge facing OECS countries.

In the context of the OECS region, while between 90 and 95 per cent of households are covered by municipal waste collection services, these facilities do not focus on on-site segregation, reduction, end-of-life-use processing or recycling. For the most part, there is no source separation or collection of recyclables, nor any readily accessible local markets for recycled waste, while the cost of managing solid waste is high.

This notwithstanding, business opportunities do exist to demonstrate that segregation can be effectively practised on a large scale in an island context. Given the economies of scale that an OECS-wide approach presents, waste management businesses in areas such as recycling of scrap, electronics, plastic, rubber and wastewater, should be explored.

Many of the islands are seeking to address the issue of plastics pollution, but effectively managing solid and liquid waste issues remain challenging. Opportunities therefore exist to:

1. Improve waste management practices, thereby reducing the amount of waste sent to landfill. Companies adding value to plastic waste by cleaning or processing it have two main revenue streams: a tipping fee from municipalities or property owners and revenues from the sale of recycled materials. Most of the revenues in emerging markets come from the latter.
2. Replace plastic (particularly single-use plastics) with more sustainable alternatives, some of which could be created using organic marine materials (see Box 4.3, Case Study 5).

Box 4.3 Case Study 5: Bioplastics from *Sargassum*

Although many bioplastics are better for the environment than their conventional counterparts, some of the base materials require land that would otherwise be used for food crops. One solution is the use of seaweed as the base products for the manufacture of bioplastics.

A team from the University of the West Indies has been exploring the potential of using polysaccharides extracted from *Sargassum* seaweed to produce bioplastic membranes and prototype bioplastics.

By combining these with other plant-based starches, it is possible to create a material that could be used to manufacture more robust products. The project has recently received financial support from the UNDP Blue Lab.

The advantages of algae-based bioplastics include:

– they take less time to break down than conventional plastics;

– they are renewable – particularly in the case of *Sargassum;*

– they require less energy to produce;

– they are easier to recycle; and

– they are not toxic.

The research coincides with a ban on petroleum-based plastic in Barbados, as the government pursues a policy to create a 100 per cent green and carbon-neutral economy by 2030. Hence, the intention is to use this technology to develop biodegradable plastic bags from *Sargassum*. Not only does this reduce dependence on foreign oil, but it also provides a domestic solution to a problem that has plagued eastern Caribbean beaches for several years.

Bioactive polysaccharides extracted from brown seaweeds, such as *Sargassum sp*., also have potent antioxidant, antitumor, antibacterial, antiviral, anti-inflammatory properties and nanomedicine applications and could therefore be used to develop new drugs.

4.6 Engaging with the private sector to grow the blue economy

At present, the capacity to fund the scale-up of blue economy activities in the public sector across the OECS region is low. Growing the blue economy requires further engagement with development partners and, in particular, the private sector. However, responsible private capital cannot be expected to mobilise in support of the blue economy at scale until the risks are reduced through a robust enabling environment and improved governance (tenure, fiscal, financial, legal, etc.). To this

end, there is a need to reduce impediments for private sector investment and secure innovative and sustainable finance.

Both the OECS Commission and individual governments need to work with the business sector to identify and develop investment opportunities. A key focus should be on how to support pioneer investors through fiscal incentives and de-risking (for example, through seed funding to catalyse investment, provision of the necessary infrastructure, or by developing the skills of workers and capabilities of local suppliers). Where necessary, governments could engage in limited direct economic activity as part of a 'crowding in' process.

The key to developing these sectors in the OECS is the recognition of the important role of MSMEs, since they can bring innovative niche products to market and play a significant role in value chains as they touch many cross-cutting areas in society. There is, therefore, a need to examine the mechanisms available to government to encourage start-up MSMEs, assist with capacity and technology development, and to define the pathway to an effective blue economy investment promotion strategy. A number of mechanisms could be used to incentivise MSMEs, such as tax incentives, training or seed infrastructure investment.

4.6.1 Building regional blue economy business capacity

Although the development of individual businesses will generally take place at the national level, developing the critical mass needed to accelerate investment across the blue economy will be beyond the scope of individual countries and would benefit from a more co-ordinated regional approach.

For example, the successful development of aquaculture will require production of good quality seed, which requires hatcheries. The establishment and greater promotion of centralised trans-national facilities would be a significant benefit to any emerging industry, since it would share the costs across different countries. Similarly, taking a regional approach to monitoring, disease management programmes, biosecurity control (for example, standards for importing seed or broodstock), food safety standards and genetic resources, would all offer significant benefits, including reduced costs and increased international acceptance and confidence in products from the region.

While there are options for basing the development of new sectors on expertise, technology and investment from outside the OECS/Caribbean, developing a new sector based solely on expatriate expertise poses risks for the sustainability of that sector. The future development of the blue economy across the OECS region should instead rely on local workers becoming involved in a sector that is largely new to the region. However, a critical barrier to this is the lack of technical training courses and the necessary research capacity currently available in the region. Pulling together and funding public/private commercial/academic partners across national boundaries could make the OECS region a significant contributor to aquaculture and biotechnology development, with significant benefits for the region.

Options should therefore be explored to establish partnerships between local and foreign companies and training/research institutes that would utilise expatriate expertise at the outset, but would rapidly develop local capacity to sustain the future of the sector. Access to technology can also be improved in the short term by establishing demand-led and responsive relationships/structures (for example, technology extension services delivery structures) that facilitate faster adoption of already-available technology (which is more often the challenge, as opposed to research to generate virgin technology).

Moving forward, government leaders, civil society organisations, funders and other blue economy stakeholders will benefit from the regionally grounded opportunity areas to narrow the field of potential blue economy initiatives to those that contribute to larger systems change and are most likely to succeed given present conditions. But how exactly can governments kickstart and scale this economic growth? The answer to that question can be found in building blue economy or ocean clusters.

4.6.2 OECS Blue Economy Cluster

'Ocean clusters' are geographic concentrations of similar or related firms – such as shipping, seafood, marine technology and/or port operations – that share common markets, technologies and worker skill needs, and are often linked by buyer–supplier relationships and operate in close interactions with one another directly and through multiple networks. Linked to this are the technology providers, who develop the tools and equipment for the companies in the network. In some cases, ocean clusters have emerged as organisational entities that aim to enhance the competitiveness and collaboration among their ocean/maritime company participants, related institutions and other stakeholders.

Numerous clusters have developed in recent years, notably in Canada, Iceland, Norway, Scotland and the US. The idea behind a 'cluster' is that tacit knowledge, innovation and business opportunities can be maximised through an interactive network. By matching industry investment, and facilitating collaboration and close alignment with the business environment, academia, science, local communities and government, ocean clusters are able to support sustainable ocean innovation by building a robust business network that is well-connected and well-equipped to rapidly innovate, commercialise solutions and deliver on the growing ocean opportunity. They do this by:

1. creating a new model for ocean growth, and reducing risk for companies;
2. increasing data exchange across ocean stakeholders to maximise value and minimise duplication;
3. strengthening connections to develop commercial, sustainable ocean solutions;
4. building an inclusive and highly capable workforce; and
5. developing solutions that also address ocean health.

While the examples above are all from large, developed economies, the small size of SIDS may be an asset in supporting the blue economy. The small population size in many island nations means momentum can build quickly as personal relationships can set and drive collaborative efforts. In these settings, convening stakeholders and getting support and co-operation for projects or initiatives can be catalytic (Hansen 2020).

In the context of the Caribbean, the Compete Caribbean Partnership Facility (CCPF) – a multi-donor programme focused on private sector development[5] – is poised to invest US$4.5 million to support private sector driven projects in the blue economy in the Caribbean. As part of the programme, CCPF has launched an initiative to provide support for the development of economy-focused, private sector cluster initiatives that can help Caribbean firms grow and diversify to better confront the COVID-19 crisis.

Examples of what CCPF could finance include: adoption of technology across seafood value chains to enhance the product (for example, fresh fish instead of frozen fish, or value-added products from fish processing); traceability across the blue economy by supply chains (seafood, fish, etc); training and changes in practices across supply chains for adoption of sustainable practices; adoption of public health measures in blue economy-based sectors; decarbonisation of supply chains; the circular economy and cleantech supply chains; and tourism initiatives that monetise conservation (Compete Caribbean 2020).

By developing new processes and products, promoting international connections, generating opportunities for MSMEs to scale and integrate into Caribbean and global value chains, and by creating new employment opportunities, an OECS Blue Economy Cluster would be well positioned to take advantage of these new opportunities in a sustainable manner.

In light of the ongoing work being undertaken by the OECS through CROP and the UBEEC projects, consideration should be given to establishing one or more OECS-wide blue economy clusters that could focus on both core and emerging blue economy sectors. The initial focus for such a cluster in the OECS region should be to:

1. build a shared competitive advantage for OECS members by developing and commercialising technologies, and by positioning the entity as a regional ecosystem for technology and capability development;
2. position firms, in particular SMEs, to scale and integrate into regional and global value chains, transition to high-value activities, and become regional market leaders;
3. foster a critical mass of growth-oriented firms and strengthen connections and collaborations between private, public and academic organisations; and
4. transform the OECS into a Caribbean hub for ocean innovation and collaboration.

5 CCPF is financed by the IDB, the Government of the United Kingdom, the Caribbean Development Bank and the Government of Canada.

4.7 Developing inter-sectoral linkages in the blue economy

Traditional blue economy sectors have tended to be developed in isolation of, or even in competition with, each other. However, taking a holistic approach that recognises the inter-dependencies between different sectors can catalyse and add value to the socioeconomic benefits each sector contributes. For example:

- In some countries, the tourist market for fish products is far stronger than the domestic market. Increasing utilisation of locally produced fishery products by the tourism sector could contribute to saving of foreign currency, improvements in balance of payment deficit, and reduced vulnerability to rising food prices and other forms of external economic shocks. This needs to be considered when determining the extent to which the fisheries sector contributes to the economies of the region (CRFM 2016).
- Similarly, in many countries, there are strong links between the tourism sector and marine conservation, with resorts in some countries operating and financing *de facto* MPAs. Furthermore, as major tourist attractions in themselves, user fees from tourist visitors can be a critical source of revenue to support management of MPAs.
- In port facilities, renewable energy sources, such as solar and wind, can be used to generate shore power for ships. This can generate important revenue for the ports, while reducing operating costs for ship owners and decreasing air emissions from running ships engines. At a broader level, such infrastructure could support the transition to greener forms of shipping based on electricity.
- Biotechnology can be applied to solve critical challenges, such as the example of bioplastics illustrated in Case Study 3 (Box 4.1) and by processing fish waste, thereby reducing waste handling costs and waste taken to landfill.

The matrix shown in Table 4.2 illustrates some examples of how links between the different blue economy sectors are relevant from the perspective of developing an integrated blue economy development approach.

Opportunities to strengthen inter-sectoral links will vary from sector to sector and between countries. However, broadly speaking, a focus on raising awareness across sectors of the blue economy and its benefits would be an important first step in this process. The idea of an OECS Blue Economy Cluster, discussed in the previous section, could be a valuable mechanism to bring different sectors together with a common goal.

As an initial step, it is suggested that a small number of pilot initiatives be trialed with key economic sectors to test the approach and adapt it as necessary to local conditions.

Table 4.2 Examples of positive inter-sectoral linkages in the blue economy

		SECTORS						
		Marine ecosystem services	**Fisheries and aquaculture**	**Tourism**	**Ports and shipping**	**Biotechnology**	**Renewable energy**	**Waste management**
SECTORS	**Marine ecosystem services**		– Sustainable fisheries and aquaculture	– Scuba diving – Eco-tourism and wildlife tourism – Beach tourism	– Natural storm protection provided by coastal habitats	– Marine genetic material for biotech applications	– Natural sources of energy through wind, waves and tides	– Nature based solutions for pollution control – Nature based bioplastics
	Fisheries and aquaculture	– Aquaculture techniques can reduce pressure on wild stocks and assist with habitat recovery		– Fish for restaurants and hotels – Visitor experience (e.g., fish fry)	– Job creation through boat maintenance and repair facilities – Fees for port services	– Base and waste products for biotech applications	– Co-location with offshore aquaculture structures	– Extending the value chain to reduce waste generation and disposal
	Tourism	– MPA visitor fees – Conservation volunteers – Resort-based conservation	– Source of revenue through demand and pricing – Visitor fees		– Income through cruise tourism – Imports to support tourism industry – Marina facilities	– Market for nature-based products such as health and well-being	– N/A	– Market for 'waste-to-craft' products
	Ports and shipping	– N/A	– Provision of port services	– Cruise tourism – Water taxis – Yacht facilities		– N/A	– Provision of infrastructure and engineering services	– Can create a natural 'sink' for waste capture and recovery
	Biotechnology	– Reduce pressure on natural systems through resource optimisation	– Creation of aquaculture foods – Reduce pressure on natural resources	– Manufacture of health and beauty products	– N/A		– Algae-based biofuels	– Processing of raw waste material to productive uses
	Renewable energy	– Reduced CO_2 emissions – Structures as habitats	– De facto MPAs and fish aggregating devices (FADs)	– Opportunity to enhance 'clean-green' image – Micro-energy facilities for resorts	– Additional revenue through user fees and demand for engineering services	– N/A		– Reduce pollution and waste oil – Energy for waste processing
	Waste management	– Reduce impacts on the marine environment and resources	– Reduce impacts on the marine environment and resources	– Waste-based craft products	– Improve waste handling from ships – Revenue generation from waste handling	– Possible feedstock for biotech applications	– N/A	

Chapter 5

Applying Science and Technology to Address Key Ocean Sustainability Challenges

One of the key areas for future focus for the OECS and its member countries should be how technology may be deployed to facilitate the blue economy transition, since considerable potential exists to support blue economy innovation through science and technology. Emerging technologies are increasingly accessible, as they advance to commercialisation in parallel sectors or more developed nations (Hansen 2020). Recent developments, such as mobile technologies, smart networks, drones, remote-sensing and distributed computing, as well as disruptive technologies, such as blockchain and artificial intelligence, are serving as the premise for a 'digital revolution', whereby management of resources can potentially be highly optimised, intelligent and anticipatory (Blaha and Katafono 2020). New surveillance and product-tracing technologies make it possible to crack down on illegal fishing. Remote vehicles embedded with sensors can monitor the ocean and warn of changing conditions, while machine learning and artificial intelligence can help make sense of the large volumes of ocean data.

In the context of the main blue economy sectors of capture fisheries, tourism and shipping, those technologies aimed at improving traceability of seafood and improving tradability of fish products are likely to be the most promising areas for further investigation for OECS countries in the immediate future, since they can create new incentives for more sustainable practices.

5.1 Marine science and data

It is widely accepted that marine planning and management decisions should be based, as far as practicable, on the best available information concerning the natural, social and economic processes that affect ocean environments. Decision-makers should be able to obtain and understand quality science and information in a way that facilitates sustainable use of marine resources.

Despite historically having some local capacity for marine environmental research and monitoring, indigenous marine research in OECS countries has not been well supported during the past 20 years or so. Existing research capacity has declined, leaving a strong reliance on the University of the West Indies and overseas marine research agencies, such as the US National Oceanic and Atmospheric Administration (NOAA) and the UK Centre for Environment, Fisheries and Aquaculture Sciences (CEFAS) and the National Oceanographic Centre (NOC). This strong reliance on external providers has resulted in indigenous marine science capacity being poorly developed, due to a lack of funding and research institutions. This in turn

has led to chronic gaps in the technical capacity for marine research, planning and decision-making.

Although some broad-scale knowledge of topography, bathymetry and marine landscapes in the OECS region does exist, there is a pressing need to validate and update this information to support future decision-making. Moreover, while some data relating to habitats and biodiversity in many OECS countries have been collected and documented, detailed and consistent information concerning the habitats and biodiversity throughout the OECS remains lacking. Data relating to the deeper waters of the continental shelf to the east of the region, in particular, are largely absent. Similarly, information concerning the presence of mineral and hydrocarbon potential is limited and significant work and investment are required to acquire information needed to support decision-making concerning future development opportunities.

Various avenues exist, or can be created, to fill essential data gaps if a coherent and integrated approach is developed. Understanding where the real gaps in data are will provide a basis to decide what areas are worth focusing on in the short to long term. To address this need, the OECS Commission has already prepared and adopted a regional Marine Scientific Research Strategy (OECS 2016a), with an associated code of conduct for undertaking marine scientific research (OECS 2016b) and data standards (OECS 2016c). However, while this strategic framework does provide the basis for developing a regional approach to marine scientific research, it requires considerable resources to implement.

Faced by the disadvantage of a limited range of solutions and resources to address such challenges, states often require specialised gathering and diagnostic methods, which are extremely expensive, difficult to achieve and highly dependent on foreign expertise. However, the rapid development of technology may offer some solutions that OECS could benefit from. Over the next decade, satellite imaging, remote sensing, 'big data' and artificial intelligence will generate unprecedented amounts of ocean information. According to Stuchtey et al. (2020), it is now technically possible to sample the ocean on its true spatial and temporal scales, with a remote sensing network covering the physical, biological, ecological and chemical properties of the global ocean surface using a broad range of sensors and platforms. The connection of intelligent devices into an 'internet of things' is moving from land to sea, allowing for an ever-more complete picture in near real time.

Recent innovations are also improving our capacity to translate these data into useful information and advanced processing techniques, coupled with new visualisation portals, enable a wide array of decision-support tools. This explosion in new ocean data has the potential to reshape how we understand and manage the ocean, with the urgent challenge being to ensure that these data are available and useful to ocean managers (Leape et al. 2020).

At a more local level, opportunities also exist to engage civil society in 'citizen science' programmes, if the right frameworks can be created to catalyse local community engagement.

5.2 Innovative technologies

5.2.1 Satellite technology

The proliferation and rapid development of low-cost, satellite-based remote sensing platforms now means that the ability to monitor activities across large areas of ocean space in near real time is becoming affordable for many countries. Imaging satellites can track changes to coastal and ocean ecosystems, so can be used to understand coastal development patterns, monitor nutrient run-off and track pollution from ships. Increasing access to satellite technologies has also enabled real-time, precise vessel tracking. With the advent of Global Positioning System (GPS)-enabled smartphones, even small-scale fishers can be monitored.

International initiatives such as Global Fishing Watch[1] use satellite tracking to monitor the activities of fishing vessels to determine which ones are fishing, based on the identity, speed and direction of broadcasting vessels. The tool uses a global feed of vessel locations extracted from Automatic Identification System (AIS) tracking data, revealing the movement of vessels over time. Using artificial intelligence, the system automatically classifies the observed patterns of movement as either 'fishing' or 'non-fishing'.

By combining satellite technology with innovative tracking and analysis tools, Caribbean countries could therefore create a system that would help the region close the gap on illegal fishing and related criminal activity. These facilities already exist, for example, within the Commonwealth, and can be shared with Caribbean countries if development partner funding can be secured at an early stage.

5.2.2 Drones and autonomous vehicles

Autonomous vehicles and drones are pilotless craft that operate through a combination of technologies, including computer vision, artificial intelligence and object avoidance technology. They may operate above, on or below the surface of the water. Autonomous underwater vehicles and swarms of sensors can gather visual and chemical information on vessels. Drones and buoys equipped with acoustic sensors are particularly good for understanding human activity. Drones offer similar imaging to satellite imagery, but at a more granular level. They are a cost-effective way of reaching offshore areas, allowing managers to see what is happening at a distance through real-time video streaming.

Within the maritime sector, drones can be used for tasks such as stock assessments, maritime safety support, or surveillance of MPAs or exclusive economic zones (EEZs) and have the technical capacity to be used in court cases to provide visual or audio records of events. Additionally, conservationists are combining drone technology with technologies such as geographic information system (GIS) to monitor and track animals on land and at sea, or to remotely map potential conservation areas (Girard and Tu Payrat 2017).

1 See: https://globalfishingwatch.org

Box 5.1 Case Study 6: Using autonomous surface vehicles (ASVs) to map coral ecosystems in Belize

In 2018, under the UK government's Commonwealth Marine Economies (CME) Programme, scientists from the UK's National Oceanographic Centre (NOC), working alongside government scientists from Belize, deployed an innovative portable marine science laboratory known as CAMEL (the Containerised Autonomous Marine Environmental Laboratory). The CAMEL facility consists of an autonomous surface vehicle (ASV) and a mini remotely operated underwater vehicle (ROV), as well as a fully featured mobile laboratory, control centre and a small inflatable boat with an outboard motor.

The system can deliver a range of marine surveying tasks, safely and cost-effectively, and can be operated remotely or autonomously. The ASV is designed to carry different, easily swappable payloads: a hydrographic payload, which comprises a high-grade multibeam echo sounder; a geophysical payload with a high-grade side scan sonar system and sub-bottom profiler; and an oceanographic payload, made up of a variety of sensors for measuring environmental quality parameters.

CAMEL was deployed at *Turneffe Atoll* – the largest Atoll on the Mesoamerican Reef – to survey the lagoon and assess the impact of sea-level rise on sensitive mangrove environments. Other surveys have also been conducted within MPAs and across important shipping lanes around Belize City. Together, these surveys are helping to characterise the sensitivities of the marine environments to the impacts of climate change and human activities, and are providing the best possible data to support decision-makers in managing Belize's coastal environments.

As a result, the programme has already delivered high-resolution mapping of seagrass meadows, detailed bathymetric surveys and an extensive programme of river water sampling further inland.

5.2.3 Artificial intelligence (AI)

There is a wide range of existing definitions for artificial intelligence (AI), and while a consensus remains elusive, AI in general can be said to be a task performed by a programme or a machine that, if a human carried out the same activity, would be assumed to be accomplished by application of intelligent thought.

Within the field of AI, machine and deep learning are frequently used for a wide array of environmental management projects to calculate patterns of anything from predicting the future effects of climate change to improved efficiencies at sea. When combined with the data-collection capabilities of autonomous vehicles, AI can be used to process and interpret large quantities of remotely collected data for rapid use by decision-makers (see, for example, Box 5.2, Case Study 7).

Box 5.2 Case Study 7: Caribbean BlueBot Initiative

With financial support from the UNDP BlueLab, Bajan Digital Creations Inc (BDCI) – a Barbados-based technology company focused on innovation in emerging technologies – is developing a fleet of semi-autonomous robots ('BlueBots') that will enable remote monitoring and mapping of Caribbean coral reefs using artificial intelligence (AI) and evolving technologies.

Supported by propriety AI software, the BlueBot Project uses emerging underwater robotic machinery to capture high definition video data that can be deciphered by custom-trained deep learning algorithms. These algorithms process the data into labelled datasets that provide the scientific community with data lake labelling, mean water temperature readings, coral reef health metrics, ocean turbidity data, data on fish species, fish density and fish locomotion, coral type and spread data, and other oceanic metrics. The drones possess long-range observation capabilities, with depth and water temperature sensors. They have a three-hour battery life and can operate at a maximum depth of 100 metres. This provides the region with an extremely broad and beneficial sample of real-time oceanic data.

This project introduces an innovative approach to creating sustainable and adaptable marine solutions to equip the Caribbean's blue economy with advanced methods for capturing, recognising, classifying, storage and supply of real-time oceanic data.

Beyond assisting scientific study and the region's participation in the model-based definition (MBD) market, the BlueBot Project offers regional states the benefits of:

- advanced global and regional access to processed oceanic data;
- a better overall view of the Caribbean's marine ecosystem;
- increasing capacity for the monitoring and management of invasive alien species (IAS);
- access to uniquely tailored deep machine learning and AI software;
- access to 'easy to learn' aquatic machinery;
- a more immediate transfer of scientific knowledge and skills to strengthen the capabilities of the Caribbean's workforce;
- training in emerging technology that can then be synergised with local knowledge; and
- predictive mitigation, predictive marine resource management and optimised maintenance of marine assets.

The BlueBot Project gives the region a stronger position and leverage in the face of anthropogenic climate change, and offers a significant boost to the region's marine capacity building and high marine technology.

Source: Bajan Digital Creations Inc (2021)

5.2.4 Blockchain technologies

One of the most discussed technologies at present is blockchain technology, which is likely to significantly improve traceability and modify stakeholder behaviour along the fisheries value chain (Jouanjean 2019). A blockchain is a secure digital ledger of transactions duplicated and distributed across a network of computer systems. Each 'block' in the 'chain' contains numerous transactions, and every time a new transaction occurs, a record of that event is added to all the participant's ledgers, meaning that if one block in one chain is changed, it is immediately apparent to all users.

Consumers are increasingly calling for fully traceable seafood that does not come from illegal fisheries or those that engage in human rights abuses. Wholesale and retail seafood buyers are asking for improvements in transparency and traceability, to reduce the risk of their brands being associated with dubious and illegal activities. Blockchain also has potential to significantly decrease illegal activities by supporting secure data transactions for traceability and sales; blockchain technology can help track the journey of a single fish, recording information regarding where it was. As a result, many in the fisheries supply chain are increasingly looking to blockchain, and other distributed ledger technologies, to support supply chain traceability (Leape et al. 2020).

There is at least one example (Pacifical), a client of the Marine Stewardship Council label, that uses blockchain to support the documentation of the chain of custody required to maintain certification regarding the integrity of the product bearing the logo of the ecolabel, particularly in the case of purse-seine caught tuna certification (Blaha and Katafono, 2020). Typically, this also involves tagging individual tuna on capture and recording key data as the fish passes through the supply chain. Most applications of this nature use traceability techniques, such as genetic tools, sensors and electronic tags, or QR codes on the tuna product packaging that can be used to communicate the origin story of the fish and track fish throughout the supply chain.

To date, all blockchain traceability projects in the seafood industry have been led by NGOs and/or the private sector (see Box 5.3, Case Study 8). These initiatives show that it is possible to have a blockchain-based system operating at a micro level for specific seafood value chains. However, to date, there has been no example of where an entire industry agrees to use the technology to improve value chain transparency in that industry.

In the context of the OECS region, the Government of Barbados has been working with the FAO to explore the potential application of blockchain in tuna traceability as part of a tuna value chain project. As part of its BlueLab, UNDP is also planning to launch BlueDIGITAL, which may also explore blockchain applications in food traceability (Nikola Simpson, UNDP, personal communication, 2021).

5.2.5 Sensors

A sensor is a physical device used to sense and respond to electrical or optical signals. They can be deployed from a variety of different platforms, including satellites,

Box 5.3 Case Study 8: Traceability to combat IUU and slave labour in the tuna industry

Illegal, unreported and unregulated (IUU) fishing remains a persistent problem in the Pacific region and blockchain technology can help 'lift the veil of secrecy' that hides this activity. The buying and selling of Pacific tuna are currently either tracked by paper records, or not at all.

In 2018, the World Wide Fund for Nature (WWF) partnered with global blockchain venture studio ConsenSys, information and communication technology (ICT) implementer TraSeable, and tuna fishing and processing company Sea Quest Fiji Ltd on a pilot project focused on the Pacific islands tuna industry. The goal of the pilot was to decrease incidences of IUU and slavery in the supply chain, by increasing transparency and data security through secure traceability. To achieve this, fishers registered their catch on the blockchain through radio-frequency identification (RFID), e-tagging and scanning fish, which travelled with the fresh or frozen fish from harvest to sales. Consumers were then able to scan a barcode located on the can to trace their product's journey back to the point of origin.

This revolutionary blockchain technology, the first of its kind for the Pacific region, is set to help stamp out illegal fishing and human rights abuses in the Pacific islands' tuna industry.

vessels, aircraft and autonomous vehicles. In the ocean environment, physical sensors are frequently used for underwater study and assessment. Ranging from simple handheld devices to complex remote underwater or buoy-based systems, sensors can be used to measure physical changes in the environment, including metrics such as temperature, turbidity, transparency, depth, pressure and water flow.

5.2.6 Specific applications of ICT for fisheries data collection

Small-scale fisheries are often in isolated areas, characterised by multiple actors, landing sites, fishing gear and species. This makes routine collection of reliable catch and effort data inefficient. The data that are collected often have limited value for stock assessment. As a result, in many small-scale fisheries, including those in the Caribbean, there is a general lack of quantitative fisheries data from most small-scale fisheries (Fujita et al. 2018).

The near real-time analytical potential of digital monitoring systems allows for collecting reliable, high-resolution (that is, at the level of individual fish) data, which can serve both statistical and stock assessment purposes, but also cost-efficiently verifies data being inputted in remote locations. In the future, innovation through information and communication technologies will be a key enabler in developing the blue economy, particularly regarding the collection of fisheries data, monitoring of human activities and transforming seafood value chains.

Smartphones and ICTs are increasingly recognised as a tool for participatory fisheries data collection, with potential to increase the accuracy of small-scale fisheries data, facilitating communities in achieving sustainable development, an improved quality of life, and supporting the poor and excluded. Because smartphones and feature phones are quite widespread among fishers, even in many small-scale fisheries, a number of mobile apps have been developed for catch monitoring. These include apps that:

- collect catch and effort data from fishers and use it to fill out required forms (electronic logbooks);
- log catch information such as quantity, type, weight and location;
- use logbook data as inputs and transfers catch and other information to buyers and consumers;
- link to GPS devices to allow vessel tracking; and
- use facial recognition software to identify fish species from photos, thereby allowing fishers to identify and sort catch more accurately and efficiently, with a view to reducing by-catch.

While electronic logbooks and smartphone apps for catch reporting have the potential to increase the amount and quality of catch data, they are subject to the challenges associated with all self-reported data: accuracy and reliability. Some fisheries will likely require catch and effort monitoring that does not depend entirely on self-reporting. Low-cost cameras, coupled with image analysis, may make independent catch monitoring possible in fisheries that lack the requisite resources and analytical capacity for electronic monitoring systems.

Chapter 6

Conclusions and Recommendations

6.1 Concluding remarks

A blue economy-centred development approach, which sustainably utilises ocean resources, has the potential to mitigate some of the inherent structural challenges of small states. These include small undiversified economies, limited fiscal space and the high unit costs of providing public services. These challenges are partly the result of having small populations, small domestic markets and limited conventional natural resources. The structural limitations and limited economic diversification have meant that the impact of the COVID-19 pandemic on OECS economies has been significant and the outlook for the region remains uncertain.

It is, therefore, quite reasonable that OECS countries should be exploring the full range of opportunities to diversify and strengthen their economies, thereby making them less vulnerable to future economic and environmental shocks. The strategic investment of post-COVID-19 recovery and stimulus funds into the blue economy offers opportunities to accelerate the sustainable and equitable growth of blue economy sectors, thereby securing the long-term health and resilience of the ocean and blue economy.

Several promising sectors have been identified that could contribute to such a transformation, including fisheries, marine transport and marine-based tourism. Perhaps the greatest opportunities, however, lie in countries diversifying into high-value emerging sectors such as sustainable aquaculture, marine biotechnology and marine renewable energy. These can attract private investment, encourage local sourcing or produce goods higher up the value chain. The most successful countries are likely to be those that are willing to pursue a dual strategy of investing in both improving the management of existing sectors and in the development of new sectors, for which limited experience or capacity may currently exist. As such, countries should continue to pursue technological innovation, such as digitalisation and FinTech, to improve efficiency, reduce cross-border transfers costs and facilitate international trade.

Since the adoption of the ECROP in 2013, the OECS Commission and its partners have, and continue to, put in place numerous measures aimed at creating a comprehensive enabling environment to support development of the blue economy in the OECS. More broadly, the OECS Commission is revising its overall development framework, taking into account future environmental, social and economic development needs. While it is tempting to view the blue economy in isolation, it should instead be viewed more broadly in the context of the OECS' overall sustainable development framework.

With the support of international and regional development partners, the OECS Commission continues to strengthen the enabling framework required to support blue growth across the region. Against this backdrop, this report has sought to highlight some specific perceived gaps that not only will be required to support a blue economy agenda but are also critical from the perspective of the broader regional development framework being implemented by the OECS Commission. These gaps are:

- mobilisation of private sector resources to grow the blue economy – with a specific focus on capture fisheries, aquaculture, biotechnology and marine energy;
- design and deployment of sustainable finance instruments to support conservation and restoration of key marine ecosystems; and
- innovative application of science and technology to address challenges facing the blue economy.

Based on this brief and high-level analysis, the following suggested actions are recommended for consideration of the OECS Commission and its member countries.

6.2 Recommendations

1. The concept of the blue economy should not be seen as a development strategy in and of itself, but rather, viewed more broadly in the context of the OECS' sustainable development framework. Strategies to support development of existing and emerging blue economy sectors should be embedded not only under sector-specific management agencies, but also in the portfolios of those government agencies responsible for fiscal policy, economic planning, business development and tourism development.

   Support for blue economy development should therefore take place in parallel with support for the development of SMEs, information technology (IT) and technology innovation, and trade reforms.

2. Addressing institutional capacity gap requires strong public leadership, backed up by a coherent top-to-bottom planning and management regime. OECS countries, the OECS Commission and development partners supporting this process must work collectively to devise new ways of working that force greater capacity from current systems, making change happen through, for example, increased regional co-operation, sharing of costs and public/private partnerships. Addressing three practical issues can help support the development of institutional and human capacity to act:
   - by sharing and creating joint capacity;
   - through **increased co-operation and co-ordination** on ocean issues of common concern; and
   - by conducting an **OECS cross-sectoral skills gap analysis for the blue economy**, which can be followed by a strategy to address the revealed skills gaps.

3. As part of a broader programme to develop regional capacity, it is recommended that OECS countries participate more widely in the various Action Groups under the Commonwealth Blue Charter initiative, either individually or collectively through the OECS Commission.

4. For OECS countries to fully support the transition to a sustainable blue economy, it is necessary to have in place a sustainable financing mechanism that will provide long-term and reliable funding to support blue economy activities. These activities include:

   - conservation, restoration and sustainable management initiatives for marine and coastal resources;
   - investments to make existing sectors more sustainable and profitable, including fishery improvement projects, efforts to recognise the true economic value of marine ecosystem services, and projects that link coastal and marine ecosystems to climate change adaptation; and
   - investment to support the development of emerging sectors (such as ocean-based renewable energy and 'blue biotechnology') by reducing the up-front risk for companies investing in these sectors.

   Taking action to address these needs would support sufficiently 'de-risking' the business environment to an extent that entrepreneurs and investors perceive more certainty. They would then have the confidence that there were solid opportunities to achieve the necessary scale and competitiveness to make new innovative blue economy business models financially viable and sustainable.

5. While opportunities to leverage domestic resources by blending different types of finance with private equity are promising, there is currently a critical lack of investable projects that can attract such finance. Key to developing these sectors in the OECS is the recognition of the important role of SMEs. These businesses can bring innovative niche products to market and play an important role in value chains, as they touch many cross-cutting areas in society.

   Building on the work undertaken for the OECS Blue Economy Investors' Roundtable and Partnership Forum, to develop the Blue Investment Portfolio, the OECS Commission and individual governments need to work with the business sector to identify and develop investment opportunities. This collaboration would focus on resolving the major challenges facing micro, small and medium-sized enterprises (MSMEs) in the blue economy, namely: marketing, product development, operational management and finance.

6. In parallel, OECS governments should examine the mechanisms available to encourage start-up MSMEs (such as tax incentives, training or seed infrastructure investment), and to assist with capacity and technology development and to define the pathway to an effective blue economy investment promotion strategy. In addition to the Unleashing the Blue Economy of the Eastern Caribbean (UBEEC) Project (of the World Bank), the OECS Commission should engage

more closely with the UN Development Programme's (UNDP's) programme to support MSMEs' economic transformation.

Leveraging the existing initiatives being implemented by UNDP and the World Bank, the OECS Commission and individual governments must increasingly work with the business sector to identify and develop investment opportunities and to support the development of a robust pipeline of investment opportunities. A key focus should be on how to support pioneer investors through fiscal incentives and de-risking. In this regard, it is critical that the OECS Commission maintains and builds upon the momentum of the OECS Blue Economy Round Table initiative.

7. Moving forward, government leaders, civil society organisations, funders and other blue economy stakeholders will benefit from the clear definition of regionally grounded opportunity areas to narrow the field of potential blue economy initiatives to those that contribute to larger systems change and are most likely to succeed given present conditions.

8. Considering the ongoing work being undertaken by the OECS through the Caribbean Regional Oceanscape Project (CROP) (of the World Bank) and the UBEEC project, attention should be given to establishing one or more OECS-wide 'Blue Economy Clusters' that could focus on both core and emerging blue economy sectors. The initial focus for such clusters should be to:

    - build a shared competitive advantage for OECS members by developing and commercialising technologies, and positioning the entity as a regional ecosystem for technology and capability development;
    - position firms, in particular SMEs, to scale and integrate into regional and global value chains, transition to high-value activities, and become regional market leaders;
    - foster a critical mass of growth-oriented firms and strengthen connections and collaborations between private, public and acadewmic organisations; and
    - transform the OECS into a Caribbean hub for ocean innovation and collaboration.

9. To support establishment of such clusters, options should be explored to establish partnership arrangements between local and foreign companies and training/research institutes. These would utilise expatriate expertise at the outset, but would rapidly develop local capacity to sustain the future of the sector. Access to technology can also be improved in the short term by establishing demand-led and responsive relationships/structures (for example, technology extension services delivery structures) that facilitate faster adoption of already-available technology (which is more often the challenge, as opposed to research to generate virgin technology).

10. In addition to a focus on the development of individual sectors, the OECS Commission and member countries should focus on developing strategies that strengthen the linkages both within and between different sectors. As an initial step, it is suggested that a small number of pilot initiatives be trialed with key economic sectors to test the approach and adapt it as necessary to local conditions.

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Annex A. Summary of blue economy industry sector trends and drivers

Sector	Subsector	Future trends	Sector drivers
Fishing	- Pelagic fishing - Reef finfish - Crustacean and shellfish fishing - Fish processing - Marketing and sales - Logistics - Fisheries science and management	- Rising demand globally and overexploitation - Significant lack of data affecting most fisheries - Great potential for GIS and spatial - Emphasis on traceability and data-rich supply chains - Interest in more sustainable seafood includes growing pressure to reduce waste and bycatch	- End-buyer sustainable sourcing commitments - Improved technology for monitoring fleet activity - Need for data - Decreasing stocks and increasing seafood demand
Coastal and marine tourism	- Cruise tourism - Beach/leisure tourism - Adventure and ecotourism - Water activity rentals and gear - Diving and dive operations - Whale watching and nature viewing at sea - Marketing, branding - Beach-related tourism - Restaurant and retail related to tourism market	- Before the COVID-19 outbreak, coastal tourism was expected to grow significantly and likely at a faster rate than tourism as a whole. - However, a rapid recovery was thought unlikely to happen in 2020 - Europe was expected to be the region concentrating the most tourist arrivals, with over 700 million international arrivals, followed by Asia and the Pacific with over 500 million arrivals in 2030 - Marine tourism is a viable pathway to support conservation of marine biodiversity, while maintaining economic value	- Protocols for health and safety - Niche tourism - Customised, technology-driven experiences - Local and regional-based tourism
Shipping	- Maritime fleet transportation - Boat building, repairs and maintenance - Transport and trade	- Recent years have witnessed a rise in application of digital software technologies to improve co-ordination, regulation and efficiencies in the global shipping industry. - Greening of the global shipping industry is also underway, driven by international regulations, positive incentive programmes and advancements in new technologies, especially regarding decarbonisation of shipping and cleaning of air emissions - Within the Caribbean region, a growth of the shipping sector coincided with the 2016 widening of the Panama Canal	- Increase in trade volume and trade distance - Cheaper alternatives to air, rail and freight transport

(*Continued*)

Sector	Subsector	Future trends	Sector drivers
Aquaculture	- Finfish marine aquaculture - Shellfish and freshwater aquaculture - Offshore aquaculture - Farm construction and maintenance - Marketing and sales - Logistics - Feed science - Breeding and selection	- At the industrial or commercial level, mariculture tends to be single species in focus, but there is an increasing trend towards integrated multispecies approaches, including finfish, shellfish and seaweeds - Diversification beyond food - Research and development for farmed fish health - Movement away from fish-based feeds to those that rely on plant or insect-based proteins or utilise scraps from seafood processing	- Improvement programmes such as fishery improvement projects - Electronic monitoring and reporting systems - Blockchain traceability - Blended capital solutions
Renewable energy	- Offshore wind - Wave/tidal energy - Ocean-driven thermal energy - Solar - Biological and mineral resource mapping and valuation - R&D - Coastal and offshore infrastructure - Prototype testing - Power generation, transfer, storage	- The marine environment presents a relatively untapped energy source and offshore installations are likely to produce a significant proportion of future energy production - Renewable marine technologies are still in their research and development phases, with tidal stream and wave power showing the most promise for future commercial applications in the next five-to-ten years, respectively - Marine renewable energy installations may increase local biodiversity and potentially benefit the wider marine environment when installations have the capacity to act as both artificial reefs and fish aggregation devices	- Increased energy demand - Cost-effectiveness - Low-carbon energy systems - Energy security - Indirect economic impact by cutting down reliance on imported fuels

(*Continued*)

Sector	Subsector	Future trends	Sector drivers
Biotechnology and marine products	- Pharmaceutical and cosmetics - Food products - Fertilisers - Chemicals and plastics - Other - Biological and mineral resource mapping and valuation - R&D - Marketing and branding - Processing - Logistics (export and domestic)	- The high potential for commercialising ocean products has shaped the development of marine biotechnology - Drug discovery from marine natural products has enjoyed a renaissance in the past few years - Marine resources have demonstrated great cosmetic prospects, having several health benefits like anti-inflammatory, anti-allergic, anti-aging and anti-wrinkling effects	- Opportunity to substitute away from scarce resources - Optimise efficiency and reliability of marine sources - Current market is still passive towards marine products for use outside of consumption
Maritime surveillance and safety	- Surveillance - Monitoring - Enforcement - Biological and mineral resource mapping and valuation - R&D - Technology implementation - Data analytics and response co-ordination (national and international) - Inspection	- Regional multinational alliances for surveillance and monitoring - Use of big data for better analytics - Smart vessels and ports - At the industrial or commercial level, mariculture tends to be single species in focus, but there is an increasing trend towards integrated multispecies approaches, including finfish, shellfish and seaweeds - Diversification beyond food - Research and development for farmed fish health - Movement away from fish-based feeds to those that rely on plant or insect-based proteins or utilise scraps from seafood processing	- Regional co-operation and co-ordination - Clear-defined maritime boundaries by surrounding nations - Technologies, such as satellite tracking, marine GIS, and remote and field sending

Source: adapted from Hansen (2020)

Annex B. Complementary regional initiatives relevant to the development of the blue economy in the OECS region

Agency / organisation	Initiative	Description
UNDP	The Accelerator Lab for Barbados and the Eastern Caribbean	The Accelerator Lab's objective is to promote 'out of the box' thinking and experimentation to support SIDS in the sustainable development of their ocean-based economic sectors in areas such as fisheries, biotechnology and waste management.
	Blue Economists Programme	Through the Blue Economists Programme, the University of the West Indies and UNDP are collaborating with the Ministry of Maritime Affairs and the Blue Economy to conduct a blue economy scoping study. This preliminary assessment will identify current blue sectors, as well as potential opportunities for future sustainable development.
	Blue Invest	This is a technical assistance and investment facility.
	Partnership on Action on Green Economy (PAGE)	The partnership supports nations and regions in reframing economic policies and practices around sustainability, to foster economic growth, create income and jobs, reduce poverty and inequality, and strengthen the ecological foundations of their economies. In the Eastern Caribbean, PAGE activities contribute towards the achievement of SDG 8 (decent work and economic growth), SDG 9 (industry, innovation and infrastructure), SDG 12 (responsible consumption and production), SDG 14 (life below water), and SDG 17 (partnerships).
	Bilateral technical assistance	This involves support to the Governments of Dominica, Virgin Islands and Montserrat, with scoping opportunities for development of the blue economy at a national level, including development of national strategic road map documents. Further assistance is planned to support the Governments of Grenada and Saint Lucia.

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Agency / organisation	Initiative	Description
FAO	Climate Change Adaptation of the Eastern Caribbean Fisheries Sector Project (CC4FISH)	The CC4FISH Project objective is to increase resilience and reduce vulnerability to climate change impacts in the Eastern Caribbean fisheries sector, through introduction of adaptation measures in fisheries management and capacity building of fisherfolk and aquaculturists. The components of the project are: 1. increased awareness and understanding of climate change impacts and vulnerability for effective climate change adaptation in the fisheries and aquaculture sector; 2. improved resilience of fisherfolk and coastal communities and aquaculturists; 3. climate change adaptation mainstreamed in multilevel fisheries governance; and 4. project management, monitoring and evaluation.
	Developing Organizational Capacity for Ecosystem Stewardship and Livelihoods in Caribbean Small-Scale Fisheries ('StewardFish')	The StewardFish Project supports implementation of the CLME+ SAP within the small-scale fisheries of the members of the Caribbean Regional Fisheries Mechanism.
	Fish Silage – Production and Use (Barbados)	The primary object of the project is to make use of discarded fish offal and reduce the large percentage of fish thrown back into the near shore, which pollutes waters and creates an environmental hazard. The project will explore the conversion of the parts of the fish that are typically discarded into safe and nutritious products for the consumption of livestock. The unutilised fish parts can be converted into liquid fish silage with the help of enzymes in the fish itself, as they break it down into smaller pieces, along with an added acid, which helps speed up the process while preventing bacterial spoilage.The pilot project has three phases. 1. feasibility study funded by the FAO, which will be conducted by the Blue-Green Initiative Inc.; 2. training and capacity building with technical assistance from Argentina; and 3. implementation of the knowledge and skills acquired.
	Caribbean Billfish Project	The Caribbean Billfish Project aims to reduce mortality among billfish and increase billfish stocks by developing conservation actions that protect billfish species from unsustainable harvests, while maximising their economic value using alternative methods.

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Agency / organisation	Initiative	Description
UNCTAD	Seizing the trade and business potential of Blue BioTrade in selected Organisation of Eastern Caribbean States (OECS) Countries	This project aims to conduct stakeholder-owned value chain assessments of queen conch products in the three beneficiary countries – Grenada, Saint Lucia, and St Vincent and the Grenadines – and to develop a Blue BioTrade regional implementation plan of action.
UN Environment – Caribbean Environment Programme	Integrating Water, Land and Ecosystem Management in Caribbean Small Island Developing States (GEF IWEco)	GEF-IWEco is a multifocal, regional project that addresses the challenges faced by ten Caribbean SIDS as they seek to preserve fragile marine and terrestrial ecosystems and ensure the sustainability of livelihoods.
Inter-American Development Bank Compete Caribbean	Blue Tech Challenge	The Blue Tech Challenge seeks to support business models that apply new technologies to deliver products and/or solutions that foster the long-term sustainability of the ocean economy in the participating countries, including Barbados.
	'*Totally Traceable Tuna: Technology and Blockchain Enhancement of the Barbados Tuna Supply Chain for Export*'	In Barbados, Ten Habitat Inc. has already successfully been granted funding to evaluate methods to improve traceability of the tuna supply chain and enhance product quality with advanced testing. It will employ a combination of technologies, which include portable histamine testing, electronic radio-frequency (RFID) tags, quick response (QR) code tags, and scanning devices to develop better handling methods and collect information about the journey of a tuna at various points along the supply chain ('Totally Traceable Tuna').
	Sustainable Islands Platform	The platform aims to build an online community of innovators and leaders who are committed to pursuing sustainable ocean development. This will bring new pathways to light and mobilise the private sector to engage with new technologies and business models to support island territories in their pursuit of sustainability and prosperity.

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Agency / organisation	Initiative	Description
	Bilateral technical assistance	Support to the Governments of The Bahamas and Barbados to undertake national-level mapping of blue economy opportunities and to develop strategic implementation plans for the blue economy. This work also supports specific sector development, institutional and policy reforms, and capacity building.
Commonwealth Secretariat	Commonwealth Blue Charter	OECS countries are variously members of the following Commonwealth Blue Charter Action Groups: • the Commonwealth Clean Ocean Alliance (CCOA) Action Group on Marine Plastics – led by the UK and Vanuatu; • the Marine Protected Areas Action Group – led by Barbados and Seychelles; • the Sustainable Blue Economy Action Group – led by Antigua and Barbuda and Kenya; • the Ocean and Climate Change Action Group – led by Fiji.
Government of the United Kingdom, Foreign, Commonwealth & Development Office	Commonwealth Marine Economies Programme	Scientific and technical support to various OECS countries (Antigua and Barbuda, Dominica, Grenada, Saint Lucia, St Vincent and the Grenadines), including undertaking marine scientific data collection and analysis, science infrastructure development, training and capacity building, resource stock assessments, and assessing risks associated with climate change.