

## Rethinking Innovation for a Sustainable Ocean Economy

Realising the full potential of our seas and ocean demands responsible, sustainable approaches to their economic development. A durable balance between increasing ocean uses and marine ecosystems' integrity requires actions on multiple fronts, and new thinking and fresh approaches are required in many areas. This need is occurring at a time when science, technology and innovation (STI) activities are undergoing major changes. Galvanised by digitalisation, the transformation of research and innovation processes is speeding up, while the adoption of disruptive technologies and new collaborative mechanisms is gaining ground in many parts of the world.

The OECD report *Rethinking Innovation for a Sustainable Ocean Economy* emphasises the growing importance of STI in managing the responsible development of the ocean economy. Marine ecosystems sit at the heart of many of the world's global challenges: climate regulation, food, medicines, new sources of clean energy, job creation and inclusive growth. But managing a wide diversity of maritime economic activities and exploiting marine resources requires judiciously improving our ocean-related knowledge and taking precautions to preserve fragile marine ecosystems. STI will play a central role in reconciling these objectives.

### The quick read

New thinking and fresh approaches are required to meet the challenges of developing a truly sustainable ocean economy. This publication, building on the conclusions of the 2016 OECD report *The Ocean Economy in 2030*, advances on four objectives:

- offering a forward-looking perspective on scientific and technological innovation across a range of marine and maritime applications, with a particular focus on some of the innovations already in the pipeline
- contributing to the growing body of evidence suggesting that, with the help of innovation, the development of economic activity in the ocean and sustainability of marine ecosystems can often go hand-in-hand with one another, and providing four in-depth case studies that illustrate the potential for generating such outcomes
- investigating the emergence of new forms of collaboration in the ocean economy among research communities in the public sector, the academic world and a diverse range of private-sector stakeholders, using the example of innovation networks that have sprung up in recent years around the world
- highlighting new approaches to measuring the ocean economy, notably by exploring the use of satellite accounts for its twin pillars – ocean-based economic activities and marine ecosystem services – and by examining ways to better measure the benefits that sustained ocean observations provide not only to science, but also to the economy and society more generally.

The original analyses conducted in this work recommend three priority areas for action at all levels, from local to international: 1) encourage innovation that produces win-win outcomes for ocean business and the ocean environment; 2) seek ways to nourish the vitality of ocean economy innovation networks; and 3) support new initiatives to improve measurement of the ocean economy.



## What innovations are on the horizon that may benefit both economic growth and environmental sustainability?

The ocean is being used more intensively than ever before, raising questions about its physical capacity to cope. At the same time, however, scientific understanding of the ocean and its ecosystems – their properties and behaviour, their health and their role in weather and climate change – is gradually improving. The breadth and depth of scientific and technological advances in today's ocean economy are the product of a flourishing, highly dynamic innovation landscape. Ocean innovations in the pipeline – especially those building on generic advances in science (e.g. biochemistry, physics) and technology (e.g. artificial intelligence, robotics, big data) – appear set to enhance knowledge and understanding of marine ecosystems and their functions and improve ocean industries' performance markedly. Four in-depth case studies, selected in view of their different degree of technical and business maturity and their possible impacts, serve to highlight the opportunities of cross-sector innovations and provide some interesting lessons learned:

- progress in ballast water treatment in ships, to combat the spread of (alien) marine species
- floating offshore wind power and its capacity for generating renewable energy and reducing greenhouse gases
- innovations in the marine aquaculture sector that may contribute to making the industry economically and environmentally more sustainable
- conversion of decommissioned oil and gas rigs and energy renewables platforms into artificial reefs.

Preliminary assessment suggests that the innovations presented in these case studies have the potential to foster ocean economic activity, with possible positive impacts beyond the marine environment, though some face more challenges than others (Table 1). In addition, while science has led to many of the developments under consideration, the case studies show that major knowledge gaps exist in relation to marine ecosystems' biophysical characteristics. These gaps are likely to constrain future developments and call for precautionary approaches. Win-win solutions exist, but a continued effort is required to deliver progress on both the scientific and technological fronts.

**Table 1.** Potential benefits to marine ecosystems may be significant, but knowledge gaps remain

|   | <b>Examples of potential direct benefits to marine ecosystems</b>   | <b>Examples of potential indirect benefits to marine ecosystems</b>   | <b>Examples of knowledge gaps that need to be tackled</b>  |
|---|---|---|--|
| <b>Floating offshore wind farms</b>                 | Less interference with seabed, as compared to traditional offshore wind farms.  | Possible contribution to slower growth in greenhouse gas emissions (GHG) from energy systems.                   | Too few floating platforms in operation for evidence-gathering, need to study possible impacts of large-scale operations on bird life, fish and marine mammals, as well as on seabed and marine habitats.  |
| <b>Progress in ballast water treatment in ships</b> | Reduction in spread of (alien) marine species and in the use of chemicals.  | Lower levels of bio-fouling leading to lower fuel consumption.  | Issues surrounding practical implementation of on-board ballast water treatment and efficacy of currently available technologies in different marine environments.   |
| <b>Advances in marine aquaculture</b>               | Reduction in coastal water pollution, in use of wild fish stocks for feed/cleaning, and in antimicrobial treatments                                 | Reduction in CO <sub>2</sub> emissions from lower energy consumption due to automation, remote monitoring, etc. | Few open ocean farming projects currently in operation globally due to considerable technical hurdles. Data on ecosystem impacts weak and concerns surround operations at very large scale.  |
| <b>Rigs and renewable energy platforms-to-reefs</b> | Enhancement or restoration of fish/mollusc stocks and hard substrate ecosystem networks; reduction in damage to seabed and benthic fauna and flora. | Lower GHG emissions from reduced dismantling of platforms and transport to and from port.                       | Risk of chemical pollution from infrastructure left in place. Some studies available on effects on fish populations (the "stock enhancement" versus "attraction" debate) but little thorough-going research into other ecosystem effects (bio-diversity, benthic habitats, etc.) especially at deep-sea sites. |

## Ocean economy innovation networks: a new kind of organisational innovation among marine and maritime actors?

As developments in many other sectors of the economy illustrate, successful innovation often requires fresh thinking in the organisation and structure of the research process itself. And so it is with ocean-related research, development and innovation. The report explores the development of ocean economy innovation networks, which strive to bring together a diversity of players (public research institutes, large enterprises, small- and medium-sized enterprises, universities etc.) into flexibly organised networks. Such networks leverage their organisational and skill diversity to benefit their partners and ocean research more generally. They work on a range of innovations, in many different sectors of the ocean economy (e.g. marine robotics and autonomous vehicles; aquaculture; marine renewable energy; biotechnologies; offshore oil and gas).

Three insights emerged from an OECD survey of ten innovation networks with publicly (at least partially) funded organisations at their core:

- Where independent assessments of these networks have been carried out, innovation networks have shown generally positive impacts within and beyond the ocean economy. However, more effort to assess the cost-effectiveness of public expenditure on innovation network centres is required, if their value to society is to be better understood.
- Benefits associated with ocean economy innovation networks are generated in response to the challenges posed by increasingly multi-faceted research and development in the ocean economy. Examples of benefits produced include improved cross-sector synergies, access to research facilities and specialised knowledge, and dedicated support for start-ups. Other broader benefits include the building of scientific capacity and knowledge, and contributions to sustainable economic activity in general.
- Challenges faced by the innovation network centres include successfully building bridges between organisations with differences in purpose and objectives; balancing opportunities for fundamental research and commercial potential; and maintaining a culture of innovation among all partners.

## What new approaches to ocean economy measurement and monitoring should be pursued?

Governments' policies towards science and research guide and influence business development and marine preservation; moreover, they are instrumental in matters of stewardship, regulation and management of our seas and ocean. To perform those multiple assignments effectively, their policies increasingly need to be evidence-based and coherent across sectors. Three advances in economic measurement and monitoring could signify decisive breakthroughs in offering public authorities (but also many other stakeholders) the evidential support they require:

### 1. Standardising approaches to measuring and valuing ocean industries, and integrating them into national accounting via satellite accounts

Satellite accounts for the ocean economy would provide a highly organised method for collecting consistent ocean economy data. Building upon existing data collection efforts (which should be enhanced), they can offer a robust framework for monitoring aspects of a country's ocean economy not shown in detail in the core national accounts, while allowing for greater flexibility for ocean-based industries not covered by industrial classifications, and enabling international comparability.

### 2. Measuring and valuing natural marine resources and ecosystem services, and also exploring ways to integrate them into national accounting frameworks

Given the strong interdependency between ocean economic activities on the one hand and marine ecosystems on the other, ultimately it is a national accounts framework that offers a future path to integrating the measurement of these two pillars of the ocean economy in a meaningful and policy-relevant way. As the knowledge base on marine ecosystems' accounting builds up, more efforts to share experiences widely would greatly benefit the process of refining both the international environmental accounting guidelines and marine ecosystem services' classifications.

### 3. Better identifying and measuring the benefits of public investment in sustained ocean observation systems

Fresh approaches are needed to close gaps in knowledge surrounding the societal impacts of publicly funded ocean observation systems. Possible solutions include improved tracking of users (both scientific and operational), the mapping of value chains, and improvements to methodologies through the development of international standards or guidelines to conduct socio-economic assessments.

## Further reading

OECD (2019), *Rethinking Innovation for a Sustainable Ocean Economy*, OECD Publishing, Paris, <https://doi.org/10.1787/9789264311053-en>.

OECD (2016), *The Ocean Economy to 2030*, OECD Publishing, Paris, <https://doi.org/10.1787/9789264251724-en>.

## Website

The Ocean Economy and Innovation on the OECD Innovation Policy Platform:  
<https://www.innovationpolicyplatform.org/ocean-economy-and-innovation>.

## Directorate for Science, Technology and Innovation Policy Note

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