Foresight Future of the Sea project

Foresight overview

The Government Office for Science Foresight programme provides robust evidence to policy-makers to help produce policies that are more resilient to the future. The programme is led by the Government Chief Scientific Adviser and works closely with academics and officials across government. Recent analyses include the UK's ageing population, urbanisation in the UK and mental capital through the life course.

Foresight projects last about 12 months and take a user-needs approach to scope where new or emerging science can inform policy. Project outputs depend on the customer requirement, but usually include an expert evidence base, a final report setting out the implications for policy-makers, and bespoke products to support departments and Ministers on specific issues. The criteria for Foresight projects are usually where:

- A meaningful contribution can be made by interdisciplinary research and science
- Department(s) act as sponsors (although the work is often interdepartmental)
- The topic is of particular relevance to the UK
- The project will likely result in meaningful contributions to policy
- There is a significant futures element

Project overview

The sea covers 70% of the world's surface and is essential to regulating global temperature, oxygen and water. The UK has the world's 5th largest Exclusive Economic Zone (EEZ), boosted by UK overseas territories such as South Georgia and the South Sandwich Islands, Pitcairn Island and Tristan da Cunha. Until recently the sea has been poorly measured but technological advances are opening new opportunities to understand the sea, how oceanic processes affect the globe and the resources that may be under the sea floor – for example the Prime Minister has suggested the new international seabed mining industry could be worth £40bn to the UK economy over the next 30 years.

Intended objective and outcome of work

The objective of the project is to provide a synthesis of interdisciplinary science, evidence and long term thinking on the future of the sea to UK policy makers. The intended outcome would be a rigorous and innovative evidence base as a platform to enable long term, coordinated government activity in this area where required. Potential customers include government departments such as Defra, BIS, FCO, DECC, DfT, DfID, MoD, DCMS and UKTI and executive and funding agencies.

Possible policy implications

The project will be structured to include an inception phase whereby Foresight works with government departments to identify and prioritise policy areas. Our initial hypothesis is that policy implications will relate to the following interrelated areas:

Resources/economy of the sea

1. **Releasing economic potential from sea resources**: including the opportunity relating to new resources from the sea (such as via seabed mining) and the possible transformative applications to existing areas such as human health, aquaculture and biotechnologies.

2. **Changing demands for UK port/water connections and infrastructure**. New technologies such as satellites, SMART logistics and unmanned surface or aerial vehicles may transform the way goods are transferred on the surface of the sea. Coupled with environmental changes, such as changing ice patterns in northwest and northeast passages, there may be significant challenges and opportunities for UK ports and the infrastructure that connects ports to the rest of the UK (including road and rail).

3. **Building and maintaining long term resilience in terms of sea-based trade**: this could include increased resilience to ship-based trade to ensure UK energy and food security, as well as understanding the effects of changing storm patterns on risks to shipping, people and infrastructure.

4. **Benefits to the UK from mapping and monitoring the seas and seabed:** including economic and industry benefits, better marine planning, opportunities relating to decommissioning and alternative use of offshore structures, as well as increased options for the UK to contribute to global efforts to monitor climate, sea level rise and ocean acidification.

Environmental issues

5. **The global hydrological cycle and the UK's role as a global actor:** the sea is profoundly important for global processes which sustain life on this planet. Climate change, sea level rise and ocean acidification are three examples of how human activity is affecting such essential oceanic processes. These are global problems, yet the UK is a global actor and has opportunities to use diplomacy, science and technology to ensure the ocean's critical role is protected and sustained.

6. **How the UK can harness innovation to help natural capital management**: key risks and opportunities provided by technology to UK priorities in terms of sea stocks, conservation, marine pollution/litter and wider environmental objectives (e.g. ecosystem services, coral reefs).

7. **How improved understanding of the complex links between the seas and oceans and human health and wellbeing** can support national efforts to improve health and enhance wellbeing.

8. **Trade-offs and cumulative pressures relating to resources and commodities** including the national and global demand for resources; how such resources are used and by whom; which parts of the sea-floor are they found; and what may be political or environmental ramifications, for example balancing conservation and food/energy security. This analysis may consider potential for

conflict between sectors using limited marine resources and space, especially competition in the shelf seas, leading to a greater focus on offshore opportunities.

Governance

9. **Implications for global and UK governance relating to the sea**. This could include governance relating to shipping routes, exploitation of the seabed, satellites and surveillance technologies or specific issues like piracy, migration or trafficking. There are also geo-political issues such as the situation in the South China Seas and a growing number of maritime boundary disputes across the world as more states look to exercise rights under the UN Convention on the Law of the Sea (UNCLOS) to declare EEZs, thereby securing jurisdiction.

10. **Challenges and opportunities for UK overseas territories:** current issues experienced by communities in these territories often relate to their isolation from major trade routes or population centres. Opportunities and risks may be posed by technology, economic and environmental trends.

The costs and benefits analysed will range from those more focused on private industry (minerals, fisheries, marine employment, offshore industry renewables and shipping), to those that are for the public good (biodiversity and ecosystem services, climate change, mitigation and recreation), alongside social and cultural aspects. We shall explore including public dialogue early on in this project.

The role that can be played by science

Science will play a key role in our approach to the future of the sea and will impact resources and the economy of the sea, environmental issues and governance. This will include disruptive technologies which pose new problems; science to deepen our understanding of how both the sea affects our lives and we are affecting the sea; and harnessing science and technology to provide solutions.

Disruptive technologies are developing which may have transformative applications above the sea, on the surface, in the water column or on the sea bed. Technologies such as autonomous / remotely operated water craft may open up access to resources not previously economically recoverable. In turn this may bring both economic opportunities for UK business and governance challenges relating to exploitation of areas in international jurisdiction. Technological trends could also have environmental implications, including via unlicensed activities, resulting in pollution, pressure on biological resources (such as sea stocks) and impacts on ecosystem services.

Data, modelling and scientific analysis can help us better understand the role that the oceans and seas play in sustaining life on earth, and how future trends are affecting this role. This is facilitated by developments such as advances in autonomous monitoring systems, satellite imagery, and ‘big data’ analytics to process resultant information. An analysis of major environmental trends affecting the sea could include sea level rise and glacier melt (including impact on artic passages), rising sea temperatures, ocean acidification, coral bleaching and increased frequency of severe weather events. There is evidence of the changing inputs of waste, including plastics, to the marine environment linked to changing patterns of development and trade. Economic and demographic analysis can help us

understand future pressures from: global population growth; changing distribution of the population around the world (especially substantial growth in Africa); development of globally significant middle classes, for example in Asia; increasing urbanisation, often near the sea; and the increased use of marine assets.

There may be **technological solutions** to environmental or governance concerns. For example, conservation could be boosted by technologies and methods to improve scale and resolution of seafloor habitat mapping, and new technologies to monitor health and movements of marine fauna and their interactions with humans and the environment. Another example is that surveillance technologies – including sensor systems, radar/optical imaging, acoustic surveillance and satellite systems – may lead to more effective detection of illegal, unreported and unregulated fishing and illegal trade, and monitoring of sea stocks and conservation areas.