

Net Zero Oceanographic Capability - Scoping Study

WP2: Future Policy & Regulation

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In 2019, UKRI (NERC) commissioned the National Oceanography Centre to identify the options for developing a world-class oceanographic capability with a reduced carbon footprint by presenting a range of options for transitioning to low or zero carbon capabilities. 6 work packages were initiated to examine the science and policy drivers for a future research capability and the various technologies that could enable the capability. The findings of the 6 work packages and a number of independent reports commissioned under the NZOC banner were combined in the [NZOC Summary Report](#) that provides more information about the project.

This report covers the detailed findings of Work Package 2: Future Policy & Regulation, addressing the policy, legal and regulatory considerations for a future capability.

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SUMMARY OF KEY MESSAGES

The overarching message of this paper is that UK and international policy, regulation and legislation are not yet mature enough to ensure that the choices made to enable NZOC to become a reality, are not without risk both financially and legally. However, there is also a significant amount of freedom to make choices in this, as yet, relatively unregulated area and NZOC has the opportunity to shape future legislation, regulation and policy.

A shift is underway towards interdisciplinarity in marine policy. The recognition that natural science alone is insufficient to support marine policy has prompted growth in interdisciplinary ocean policy. Future NZOC will need to reflect this new reality and recognise that data needs should reflect more holistic ocean governance.

The transition to a sustainable blue economy is a priority. This will require the ocean to be viewed more holistically, including as a driver of social and economic benefits. This transition may mean that data collected via the NZOC will be combined with social and economic data in unpredictable ways.

Ocean protection will increase by area and quality. Securing clean, healthy, productive and biologically diverse seas and oceans is a long-term priority at the core of the Marine Policy Statement, UK sustainable Ocean Initiative, and the 25 Year Environment Plan (issued in 2018). The target to achieve 30% coverage of marine protected areas is also included in the draft post-2020 global biodiversity framework.

The natural capital approach will be central to policy-making and delivery. The aspects of the marine ecosystem that support economic and social development will be better-managed to safeguard their value to the economy.

Ocean literacy will connect ocean science to civil society. Ocean literacy strengthens the relationship between people and the ocean to support civic actions that reduce societal impacts on the ocean, including policy-making as well as individual actions, such as consumer choice. Ensuring that ocean data collection provides metrics that speak meaningfully to citizens will be important in fostering ocean literacy.

Ocean plastic pollution will remain a key policy issue.

It looks likely that the process to develop a global agreement on reducing single use ocean plastic pollution will be initiated at the UN Environment Assembly in February 2022. Any NZOC will need to pre-empt the focus on ocean plastic in marine policy.

Net Zero Shipping is not yet widely regulated. Despite the plan for legally binding carbon budgets that include shipping, and a desire for shipping to reach net zero, at the time of writing this report there is very little clear regulation to provide direction for those building, designing and operating net zero ships, like NZOC.

UK Shipping is not entitled to use carbon offsetting to reach net zero. In April 2021 the UK Government introduced a carbon offsetting and reduction scheme for

international aviation, however, the Government has not yet introduced a similar scheme for shipping and there is no indication that it will.

There is currently very little regulation of new fuels, although the International Maritime Organisation (IMO) has made some progress towards providing safety guidance on new and alternative fuels, and the Maritime and Coastguard Agency (MCA) intends to address the use of lithium batteries by workboats. Also still to be addressed is how current legislation and regulation might inadvertently block new fuels options from becoming a reality.

There is no reason why net zero platforms will not be compliant with UNCLOS.¹ However, there is a small risk that coastal States may seek to limit access to their waters depending on their individual approach to net zero solutions.

NZOC should not be afraid to investigate technical specifications outside current regulations, on the understanding that agencies like the MCA intend to take an equivalence approach to net zero vessels and regulations in the short term.

There is an opportunity for NOC to play a key role in coordinating the use of vessels of opportunity, and lead the way in terms of showcasing the environmental and operational benefits of using other vessels.

The evolution of the governance of the use of AI and Digital Twin technology, as is the case of any rapidly developing innovation, is behind that of the capability.

The difference in permission regimes for space borne sensors compared to ship-borne sensors has yet to be resolved. Potential resolution of this issue could result in a restriction in use of space borne sensors to collect ocean data in other States maritime zones.

Legislation to ban plastic waste is likely to impact upon NOC's ability to rely upon non-recoverable scientific sensors. This should be included as part of the NZOC net zero compliance.

Underpinning legislation and regulation is likely to be required to support global involvement in oceanographic science data sharing. The challenge to date seems to have been global coordination of this information, accessibility and championing the requirement.

If the NZOC solution, or parts of that solution, are uncrewed:

Uncrewed or autonomous systems still face a challenge in terms of their ability to comply with legislation, due to a lack of clarity regarding the interpretation of terms including such as 'vessel', 'crewed', 'manned' and 'on board', however, this is being addressed in a number of fora. The IMO and MCA are leading this work. It is highly

¹ The United Nations Convention on the Law of the Sea 1982.

unlikely that legislation and regulations will be interpreted in such a way that they are not relevant to those commanding and operating uncrewed vessels from ashore.

Uncrewed vessels greater than 24m should be able to seek Diplomatic Clearance (DIPCLEAR) using established procedures in Part XIII of UNCLOS, however, there is no documented evidence of Coastal State practice in this area.

The theft or piracy of small uncrewed vessels from both the surface and subsurface of the sea, cannot be prevented but can be protested if we know who has taken the vessel.

Insurance of net zero vessels may be challenging, therefore, if possible NZOC should be underwritten by the government. Increasing levels of automation would also add to the difficulty in finding a commercial insurer.

1. INTRODUCTION

The ocean is facing three planetary crises - climate change, nature loss and pollution. These are closely interconnected and place the well-being of current and future generations at unprecedented risk. Driven by global policy action, including the UN Sustainable Development Goals (SDGs) and management of the high seas, national action on marine spatial planning, marine protected areas, effective fisheries management and control of plastic pollution, the oceans are high on every policy agenda worldwide. This report is intended to capture the policy and regulatory considerations related to the transition to a net-zero oceanographic capability by 2035. This is particularly challenging, as the policy and regulatory landscape is highly dynamic. It is also multi-scaled, with relevant policy and legal considerations existing from global to local scale - many of which also interact. In this report, we try to capture these influences and consider the general direction of travel of relevant policies and legal considerations and their potential influence on a future net zero oceanographic capability (NZOC).

The definition of net zero we have used to plan NZOC is:

“on balance, emitting no made greenhouse gases from UKRI owned operations by 2040. This may be achieved through a combination of carbon reduction measures and carbon mitigations”

Whilst seeking to make NZOC a reality, we are faced with a situation in which policy, regulation and legislation are still developing. In some areas, current policy, regulation and legislation is sufficient to enable NZOC to be designed and built, as well as to operate globally post-2035, but in other areas; such as the use of marine autonomous surface systems (MASS) and novel power solutions, there is either a question over the suitability or it is obvious that current governance is insufficient. Worse, in some cases the current policy, regulation and legislation will block the move to a NZOC if no changes to the existing governance structure are made or new legal frameworks are formulated and put in place at State and international levels. Whenever there are major changes in any significantly important sector, the ‘chicken and egg’ issue of the need for policy, regulation and potentially legislation becomes a factor. Introduce the policy, regulation or legislation too early, and it risks undermining development, innovation and investment, but bring it in too late and the same risks arise through lack of industry certainty.

This report aims to review the broad spectrum of issues for which policy, regulation and legislation are a relevant consideration for NZOC in terms of purpose, design, build and operation, and to signpost areas in which detailed work and/or research are, or will be, required. The report also seeks to identify and prioritise those policies, regulation or laws, which should be addressed first in order to facilitate the transition to a NZOC. The report was compiled through literature and policy analysis; an online workshop of invited marine policy and law practitioners and researchers held on 18 February 2021 at which attendees were encouraged to contribute to plenary and breakout group discussions; and detailed one-to-one online meetings with targeted experts, which are listed in Annex A. In chapter 2 of this report, we present a narrative

description of our findings, with the key findings highlighted in bold throughout the document. Specific recommendations are presented in blue text at the end of each sub-section.

2. POLICY DIRECTION AND REGULATORY FRAMEWORKS

Chapter 2 explores the inter-twined policy, legal and regulatory considerations likely to influence a future NZOC. There are two main types of consideration discussed in this section:

1. The policies and laws that a future NZOC will need to service through the provision of evidence to support policy formulation, compliance, and monitoring. This is, in part at least, a parallel analysis to the 'science needs' to which the future NZOC should respond. As such, the policy and science needs together represent the key drivers of what the NZOC should be able to deliver from a data collection perspective.
2. The legal and regulatory environment in which a future NZOC will operate, including consideration of legal constraints. These are the considerations that influence or control the application of NZOC technologies globally.

These two broad considerations are closely intertwined, and so are discussed together in this chapter of the report. Instead, this chapter is structured by scale. Global considerations are presented first, then regional, then UK-specific. There are also cross-cutting trends that will be presented separately, but which are relevant at all scales.

Global

The Sustainable Development Goals

The 2030 Agenda specifies a suite of 17 Sustainable Development Goals (SDG). These are interconnected and inseparable global development objectives (as shown in Figure 1) that support the transition to a sustainable future. SDG 14, life below water, is focused on the sustainable use and protection of the ocean. However, in practice, given the ocean's role in underpinning benefits for people and the economy, goal 14 is connected to every other. The Sustainable Development Goals are an important indicator of the direction of travel of ocean policies towards sustainable resource use, the protection of critical natural capital, and the importance of integrated and holistic resource management. Put simply, **as we look to the future of oceanographic data collection, we need to consider more carefully the role of people, their relationship to the ocean, and the evidence we need to capture the complexities of interactions between people and the ocean.** **Recommendation:** The current sustainable development goals expire in 2030, at which point they will presumably be replaced or updated. Any future NZOC will need to reflect upon any future global sustainable development framework.



Figure 1. The sustainable development goals. Presented to emphasises the importance of a well-managed biosphere, including the ocean, in support of all societal and economic goals.

UN Decade on Ocean Science for Sustainable Development 2021-30²

The UN Decade on Ocean Science for Sustainable Development, which officially commenced in January 2021, is intended to support the ‘science we need for the ocean we want’, to fill critical knowledge gaps to support the transition to a healthy ocean that supports the achievement of the sustainable development goals. The vision for the Decade is “to develop scientific knowledge, build infrastructure and foster relationships for a sustainable and healthy ocean”². The Decade is ambitious. It is intended to “meet the needs of scientists, policy makers, industry, civil society and the wider public, but it will also support new, collaborative partnerships that can deliver more effective science-based management of our ocean space and resources”².

Perhaps most notably, for NZOC, the Decade exhibits a narrative for the need to transition ocean science to a situation in which it better serves society, with the need for “more targeted and effective information flows” and “innovative ways of conducting and using ocean science”. Within the Decade literature, it states that this transformation will be achieved through:

- “Encouraging more inclusive and participatory approaches in designing and executing the science (well-educated citizens will be invited to collect data, scientific NGOs will be encouraged to share their data, the business potential for ocean data collection, sharing and management will be explored);

² <https://www.oceandecade.org/>

- building reinforced dialogues (science-policy interface as well as multidisciplinary approaches, bringing new disciplines and integrating natural, social and engineering sciences and giving value to the traditional/indigenous knowledge);
- Promoting knowledge and information that are more equitably shared around the world (closing the knowledge gaps amongst countries, balancing the knowledge systems and taking into consideration the needs of coastal communities and more particularly the most vulnerable such as the Small Island Developing States and Least Developed Countries);
- Giving value to the ocean services and sciences (the Decade will be aimed at shifting people's values and at articulating what are the economic, cultural or security values of the Ocean);
- Developing innovative ways to communicate ocean science by simplifying the language used to communicate, and offering an open, comprehensible and wide access to sound knowledge as well as by raising awareness within the Ocean communities but also beyond the Ocean sphere, by promoting Ocean Literacy);
- Seeking alternative funding systems (promoting public/private partnerships, new investments, alignment of Decade priorities with the philanthropic sector priorities, or crowdfunding)"².

The Decade, arguably, represents a redefinition of ocean science, by placing the creation of a sustainable ocean as its core purpose. Given the triple crises facing the ocean, this is an understandable position, but the degree to which there is buy-in for this from the scientific community is unclear. The Decade illustrates particular emphasis on how to improve the relationship between society and the ocean through improved communication of, and engagement with, ocean science. **While the uptake of a net-zero capability for ocean science is not prominent in the Decade's ambitions, it is entirely in line with the Decade's ambitions for a sustainable ocean for the specific aim of finding "innovative ways of conducting and using ocean science". Offering global leadership on the national-scale level development of a NZOC would present a significant contribution to the UN Decade. Recommendation: The design of any future NZOC should monitor, and take account of, the Decade's direction of travel as the Decade evolves.**

Ocean literacy as a global policy priority

The desire to improve the human relationship with the ocean, as expressed within the UN Decade, is no more evident than in the debate surrounding ocean literacy. Although a somewhat contested term, once merely reflecting the inclusion of ocean content in school curriculum, ocean literacy today is focused on understanding and recasting the relationship between society and the sea in order to generate a more sustainable Ocean. This requires unparalleled engagement with marine social sciences and a combination of natural and social evidence to help frame governance responses to the ocean crisis, to which an altered relationship between people and the ocean is critical. The importance of ocean literacy should not be underestimated. As well as forming a key component of the UN Decade, DEFRA has recently launched the ocean

literacy working group to explore how ocean literacy can be incorporated into UK ocean policy, and there is increasing research attention being focused on ocean literacy itself, including the development of a global research agenda as part of the UN Decade.

The relevance to NZOC is that understanding the relationship between people and the ocean is not just a social sciences question. It requires interdisciplinary approaches that capture the complexity and diversity of the relationship between social, economic and natural ocean systems. This, in turn, requires marine scientists, social and natural, to work together to identify areas of critical ocean literacy research along with relevant sources of evidence. Data generated through a future NZOC should therefore be shareable across a wide range of disciplines who may find it useful to support ocean literacy outcomes. A further consideration raised though the research for this report, was the need to provide ocean information in a form suited for consumption by the general public - perhaps as a dimension of ocean literacy, but also as a platform for anyone to get a sense of the health of the ocean and the adequacy of the global response to the ocean biodiversity, pollution, and climate crises. **Recommendation:** to ensure that there is adequate consideration given to the need to support an improved societal relationship with the ocean in the design of the future NZOC. **Recommendation:** to consider the establishment of a public-facing knowledge platform on ocean health to support interested public members to engage with critical ocean issues.

G7 Summit Declaration 2021³

The group of seven most developed economies (G7) exert considerable influence over other nations and international partnerships. As such, G7 summits are a useful touchpoint to consider how the G7 sees critical global issues. As the UK is currently the president of the G7 and hosted the recent G7 in Cornwall, the Summit Declaration is perhaps a particular reflection of UK thinking. **Building back better from the COVID-19 pandemic was the central theme of the 47th G7 Summit Declaration, 2021.** The Declaration contains a shared agenda for directing global action to revitalise global economies, strengthen partnerships, protect the planet's environment, secure future prosperity, improve equality and ending the COVID-19 pandemic.

The G7 pledged to achieve net zero emissions by 2050 and to conserve 30% of the G7's territorial and oceanic areas by 2030 (in line with the post-2020 biodiversity protection agenda). Furthermore, the G7 adopted the 2030 Nature Compact which directs action over four pillars; accountability, transition, investment and conservation. **The investment pillar of the G7 Nature Compact focuses on financing nature-based solutions while the transition pillar supports the global system change to a more sustainable green and blue economy.** Accountability is ensured through frequent progression reviews and is accompanied with the planned G7 Leaders' Summit in 2026, which will review options to confirm delivery of the 2030 vision. Finally, the

³ G7 (2021) Carbis Bay G7 Summit Communique - Our Shared Agenda for Global Action to Build Back Better.

conservation pillar promotes championing biodiversity targets, conserving land and sea territories and supporting MPA projects in the Southern Ocean. In addition, the **G7 countries pledged to halt and reverse biodiversity loss by 2030 and recognised that net zero carbon emissions are not the final goal as they highlighted the desire to become nature positive**. Moreover, the agenda promoted strengthening global partnerships, not only with other countries, but also with stakeholders, partners and indigenous peoples so as to lead global system change, which undertakes a holistic, inclusive and sustainable approach. Displaying the ambition to transition towards more sustainable blue and green economies by working with nature rather than against it.

Also announced within the Summit was the G7 Research Compact. It outlined the importance of using up to date scientific research and data sharing as has been required throughout the COVID-19 pandemic. **The G7 Research Compact represents the G7's commitment to increase and improve open research collaborations as well as transitioning to more flexible and multidisciplinary research so that evidence-based responses are used to tackle future global challenges**. This emphasises the importance that G7 countries place on the need for best science practices and shows the ambition to improve global partnerships so that a more integrated approach is taken. Notably, the direction of travel of the G7 is aligned with the direction of the UN Decade of Ocean Science for Sustainable Development. Both emphasise the role of ocean science in supporting societal social and economic outcomes as well as scientific questions. This suggests that **ocean science must consider its role much more broadly than perhaps it has previously, as it is increasingly being positioned as central to achieving global ocean sustainability as well as generating the benefits needed to support human communities**. **Recommendation:** to ensure that the future NZOC is capable of contributing to the holistic and interdisciplinary approaches necessary to support the transition to a sustainable ocean that supports social and economic outcomes as well as a healthier ocean environment.

Post 2020 global biodiversity framework⁴

The first draft of the post 2020 global biodiversity framework, under the Convention on Biological Diversity, was issued in July 2021. The post 2020 global biodiversity framework replaces the Aichi Biodiversity Targets, which expired in 2020. **The vision of the new framework is a world of living in harmony with nature where by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people**. The framework, which aims to galvanize urgent and transformative action by Governments and all of society, consists of goals focused on 2050 with action targets for assessment in 2030. Action Target 3 is to **“ensure that at least 30 per cent globally of land areas and of sea areas, especially areas of particular importance for biodiversity and its contributions to people, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of**

⁴ Convention on Biological Diversity 2021. [First draft of the post-2020 global biodiversity framework](#). CBD/WG2020/3/3

protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes". This represents a significant increase from the current Aichi Target 11 of 10% global marine protected area coverage. As such, **ocean protection will increase sharply 2021-2030 and beyond.** **Recommendation:** to ensure that the future NZOC can generate the evidence needed for the selection, designation and future monitoring of marine protected areas.

Global action on plastic pollution

At the global level, there is no binding, specific and measurable target agreed to reduce plastic pollution. However, there has been a continuous effort by the UN Environment Assembly (UNEA) to address the problem of plastics in our environment, including Resolution 1/6 on marine plastic debris and microplastics, Resolution 2/11 on marine plastic litter and microplastics, Resolution 3/7 on marine litter and microplastics, and Resolution 4/9 on addressing single-use plastic products pollution. Furthermore, through the ad hoc expert group on marine litter and microplastics (AHEG), established under Resolution 3/7 and whose mandate has been extended through Resolution 4/6, Member States and other stakeholders have discussed possible response options at the national, regional and global level. This including national marine litter action plans, regional marine litter action plans, development of global design standards and a new international framework (e.g. treaty or other international agreement to tackle marine plastic litter). Indeed, **it looks likely that at UNEA5.2 (March 2022) there will be a major push for a legally binding global agreement to tackle ocean plastic pollution.** However, one global commitment is already in place to tackle ocean plastic pollution at the global level. **The Osaka Blue Ocean Vision, agreed under the Japanese G20 presidency in 2019, voluntarily commits G20 countries to "reduce additional pollution by marine plastic litter to zero by 2050 through a comprehensive life-cycle approach",** thereby ensuring that by 2050, the net volume of plastic entering the ocean is zero. A total of 86 countries and regions had endorsed its vision in January 2021. **From an NZOC perspective, it is likely that data to support the formulation, implementation and monitoring of a global agreement on ocean plastic pollution will be required.**

Given that the definition of net zero used to plan NZOC is "on balance, emitting no made greenhouse gases from UKRI owned operations by 2040. This may be achieved through a combination of carbon reduction measures and carbon mitigations", it is unlikely that the creation of plastic waste via NZOC will not be one of the measures of effectiveness by which NZOC success will be judged. **However, to create a net zero capability, which is then responsible for contributing to plastic waste in the world's oceans would seem to be contradictory and a wasted opportunity.**

Oceanography and ocean data collection rely to a large extent on novel sensors deployed on a mixture of research floats, small USVs, UUVs and ship launched sensor packages, all of which contain plastic and all of which are either intentionally placed in the oceans and not recovered, or can be lost due to adverse weather or technical difficulties. Actively leaving oceanographic floats, such as ARGO floats, in the water with no intention to collect them is currently recognised as 'placement' within current

applicable legislation such as the London ‘Dumping Convention’⁵ and its 1996 protocol⁶. The main source of oceanographic pollution is likely to be the large number of floats deployed; in the case of ARGO currently 4000 have been deployed, with an average life span of 3 years and global distribution. Their ultimate abandonment is having a negative impact upon the environment, in particular when they break down over time. There are likely to be other components within the equipment, in addition to the plastic, which are also polluting such as oils, lubricants and metals such as copper, lithium aluminium and titanium.

Discussions with FCDO have indicated that those drafting the international Biodiversity Beyond National Jurisdiction (BBNJ) legislation are keen to include a requirement that Environmental Impact Assessments (EIAs) are conducted for every survey and every action which places something into the ocean. Their view is that in the longer term it will be unacceptable to intentionally leave anything plastic or polluting in the sea. **Failing to prepare for this position could change the currently positive perception of marine science to a negative one.** Discussions with an expert from DEFRA took a more sanguine approach, preferring to see oceanographic single use plastics as a greater good as opposed to perfection, comparing the issue with the use of offshore wind farms, which are imperfect, but in the round are a preferable means of energy generation than traditional methods such as burning fossil fuels. **Recommendation:** The issue of single use plastic oceanographic equipment is kept under review through the maintenance of dialogues with the applicable UK Government departments who are policy leads on this matter such as FCDO and DEFRA. **Recommendation:** Whatever NZOC approach is taken, reliance on the use of non-recovered single-use equipment (plastic or otherwise), is an issue that should be considered as part of any of the NZOC solutions.

The shift towards a sustainable blue economy

The sustainable blue economy facilitates the creation of equitably shared economic and social benefits, including across generations, from ocean and coastal resource use, while ensuring that the ecosystems upon which most ocean and coastal resources depend are not degraded and, where possible, are restored to a healthy functioning state. In simple terms, a sustainable blue economy is the practical application of sustainable development in the ocean and drives contributions to all Sustainable Development Goals. The transition to a sustainable blue economy will require the ocean to be viewed holistically, including as a driver of social and economic benefits. **The transition to a sustainable blue economy may mean that data collected via the NZOC will be combined with social and economic data in new or unpredictable ways.** There may also be an acceleration of the shift already evident in ocean research towards social and/or financial aspects, for which the NZOC should be prepared to contribute.

⁵ Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters 1972.

⁶ 1996 Protocol to the Convention on the Prevention of Marine Pollution by dumping of Wastes and Other Matter T, 1972 as amended in 1996. Placement is described in Article 4.2.2

Countries are increasingly looking to develop their ocean economies while working towards meeting international targets such as the United Nations Sustainable Development Goals, as well as biodiversity and climate targets. The Sustainable Blue Economy has the potential to address these intentions. The COVID-19 pandemic has highlighted again the critical importance of overcoming disconnected management and addressing the planet's economic, societal and ecological needs through one coherent approach. **The transition to sustainable blue economies, evident in the policy agendas of countries worldwide, represents an approach to ocean science that mirrors that described in the UN Decade of Ocean Science for Sustainable Development. Both agendas emphasise that ocean science must serve critical social and economic purposes as well as the largely knowledge driven natural science agenda it has traditionally served.**

Compliance with UNCLOS

Unless a future NZOC is dangerous to the environment, polluting, nuclear powered or considered to carry nuclear or other inherently dangerous or noxious substances⁷, it is not considered that actions taken in the design or build of NZOC to meet net zero emissions, (i.e. fuel type) would put it in a position where it breaches UNCLOS. **Therefore, whilst there is a danger that coastal States may seek to limit access depending on their individual approach to net zero solutions, they could not do so based on UNCLOS.** Under UNCLOS Article 202, NZOC is likely to attract an obligation on the UK to provide technical assistance to developing States, to “promote programmes of scientific, educational, technical and other assistance... for the protection and preservation of the marine environment and the prevention, reduction and control of marine pollution”⁸. However, this is no different to the obligation that it already has in relation to existing pioneering scientific work around the world. **Recommendation:** That the identified potential for denying access to coastal State waters dependant upon the potential NZOC solution adopted, should form the basis of scrutiny by the future RV replacement project via dialogue with the FCDO. **Recommendation:** That NOC work with the FCDO to develop opportunities to provide technical assistance to developing States in relation to net zero oceanography, in accordance with UNCLOS Article 202.

Fuel Types

Net zero fuel option will be fully addressed by WP3, but there is currently very little regulation of new fuels. Also, still to be addressed is how current legislation and regulation might inadvertently block new fuels options from becoming a reality. The Energy Transitions Commission has recommended that, ‘Classification societies and

⁷ UNCLOS Article 22, 23, 192-196, 210-211.

⁸ UNCLOS Article 202. This article sets out a non-exhaustive list of the form that this assistance could take.

regulatory authorities [need] to develop necessary safety and fuel handling standards'.⁹ They point out that,

'Safety in both ports and at sea is paramount for the industry as marine fuels cannot be transacted at ports or handled on ships without approval of the relevant regulatory authority. It is possible to expedite domestic regulatory approvals by partnering with classification societies and interested regulators from the inception of the pilot projects. This is especially relevant for ammonia, as IMO regulations for methanol are expected to be approved shortly.'¹⁰

The IMO, as well as having a strategy on the reduction of greenhouse gases¹¹ and setting targets for a reduction in Ship emissions in MARPOL Annex VI,¹² has made some progress towards providing safety guidance on new and alternative fuels. The most recent work announced by the Sub Committee on carriage of cargoes and containers (6th session (CCC 6) 9-13 September 2019) was the, 'finalized draft interim guidelines for the safety of ships using methyl/ethyl alcohol as fuel' and 'progress in developing draft interim guidelines for the safety of ships using fuel cell power installations' amongst others.¹³ Additionally, a symposium hosted by the IMO in February 2021 to look at the pathway to decarbonizing shipping, took as one of its conclusions the need to develop the International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels (IGF Code).¹⁴

For hydrogen as a future fuel source, there is currently no international regulation that sets out how hydrogen should be produced (i.e., 'grey hydrogen' from natural gas and other hydrocarbons, 'brown hydrogen' from coal or 'green hydrogen' from water electrolysis). The UK has legislation and regulation that determines how gases such as hydrogen should be shipped, transported and stored,¹⁵ but nothing yet about how it should be produced.

The MCA have work underway to look at most likely fuel combinations, the regulation needed to enable them and the blockers to their introduction, although they have not identified any specific blockers yet in their work¹⁶. To do this they are creating a technology matrix to look at constraints by vessel types, and by supporting trailblazer

⁹ Global Maritime Forum 2020. [The First Wave A blueprint for commercial-scale zero-emission shipping pilots](#)

¹⁰ *ibid*, page 17.

¹¹ <https://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx>

¹² <https://www.imo.org/en/OurWork/Environment/Pages/Air-Pollution.aspx>

¹³ <https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/CCC-6th-session.aspx>

¹⁴ <https://www.imo.org/en/MediaCentre/PressBriefings/pages/Symposium.aspx>

¹⁵ For example, The Gas Act 2006 requires those shipping or transporting hydrogen to have a license. Storage is covered by The Planning (Hazardous Substances) Regulations 2015, the Control of Major Accident Hazards Regulations 2015 (COMAH) and The Dangerous Substances Atmosphere Regulations 2002.

¹⁶ Meeting with MCA, 15 March 2021.

projects. In relation to regulation, the MCA are applying equivalence¹⁷, which works until a completely new technology comes along. This workstream ties in with the work currently being undertaken by MCA to examine the Workboat code, making it relevant to vessels under 24 metres without any crew operating on board, i.e., remotely operated or autonomous. **With net zero in mind, the MCA intends to address the use of lithium batteries by workboats as part of their work on the Workboat Code.**¹⁸ **The MCA sees making a decision about fuel choice as likely to be the most problematic decision for NZOC. However, they also see net zero fuels the area for biggest gains in terms of environmental efficiency, with the technology that we have.**

Nuclear power is one of the fuel options being discussed as a net zero option. In discussion with the MCA, it was established that the UK Government does not currently have a policy view on whether nuclear power will be an acceptable source of net zero power. However, the MCA sees regulation as one of the biggest challenges to that option, as well as the currently limited number of locations that nuclear vessels can berth, not just in the UK but around the world. **It is also worth noting that under the UNCLOS¹⁹ nuclear powered ships can have their movements curtailed, compared to non-nuclear ships.** For example, they may be required to confine their passage to sea lanes when navigating in the territorial sea and observe special precautionary measures established by international agreements²⁰. **Recommendation:** Once fuel options have been narrowed down to two or three choices, this issue of regulation of fuel types be revisited.

Vessel Technical Specifications

The type of vessel or platform chosen for the NZOC design will trigger the need to comply with certain vessel technical specifications. Considerations such as size, crew, method of propulsion and activity undertaken will all bring relevant specifications with which NZOC must comply. For example, if under 24m the vessel will need to comply with the Workboat Code which details requirements such as engine machinery and battery specifications. As mentioned above, the MCA is already reviewing the Workboat Code for compatibility with the needs of autonomous vessels and net zero platforms. This review is due to be published in late 2021. Without some idea of what the NZOC solution might be, it is difficult at this stage to address any technical specifications which could undermine NZOC design, build or operation. **However, on the understanding that agencies like the MCA intend to take an equivalency approach to net zero vessels and regulations in the short term, NZOC should not be afraid to investigate technical specifications outside current regulations.** **Recommendation:** That as plans for NZOC mature, relevant technical specification regulations are kept under review, and additional advice sought.

¹⁷ Equivalence is the practice of equating a new practice or technology (for example) with that which is already recognised and addressed in legislation, due to there being sufficient similarity between the old and new.

¹⁸ No further information is currently available on this work.

¹⁹ The United Nations Convention on the Law of the Sea 1982.

²⁰ United Nations Convention on the Law of the Sea, Articles 22 and 23.

Regional

OSPAR Convention

The UK is a contracting party to the Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention'), which was adopted in 1998. The Convention's primary objective is the protection of the marine environment in the North East Atlantic. Specific strategic priorities are set out in time-bound North East Atlantic Strategy documents, with the 2020-2030 Strategy expected to be published at the OSPAR Ministerial meeting in October 2021. Given the UK's withdrawal from the European Union, the UK's engagement with the OSPAR Convention is a significant commitment to cooperation with European partners on marine matters. **Recommendation:** Review OSPAR strategic policies after the publications of the North East Atlantic Strategy 2020-2030. The OSPAR commission has also facilitated the implementation of the European Marine Framework Strategy Directive in the North East Atlantic. The Directive, which aims to achieve 'good environmental status' is a key mechanism for regional cooperation and data sharing to facilitate effective marine management and research. The OSPAR Annual Report 2019-2020²¹ notes that insufficient knowledge and data continues to present difficulties to fully develop sustainable management of the OSPAR marine region. Improved data collection capabilities of a future NZOC platform are likely to assist in addressing relevant knowledge gaps. OSPAR has considered several issues relevant to NZOC development including reduction of underwater noise, alternative fuels, ballast water management, and anti-fouling systems. In several ways, the OSPAR Convention may be important to a future NZOC. **Recommendation:** To engage with OSPAR policies and structures, to ensure a future NZOC gives due regard to relevant OSPAR agreements.

Commonwealth Blue Charter²²

The Commonwealth Blue Charter, launched in 2018, is a voluntary agreement supported by all 54 Commonwealth nations which encourages Commonwealth countries to collaborate to solve ocean-related problems and meet commitments for sustainable ocean development. **The Blue Charter specifically helps Commonwealth countries to work together on a fair, inclusive and sustainable approach to ocean protection and economic development.** It also acknowledges the complex interconnections between the ocean and its resources to cultural, social and economic development. **Other Blue Charter commitments include strengthened cooperation, particularly with sharing knowledge, information, best practices and expertise,** which may have relevance to a future NZOC.

²¹ OSPAR Commission [Annual Report](#) 2019-20.

²² Commonwealth Secretariat 2021. [Commonwealth Blue Charter](#)

The Blue Charter is driven by a suite of Action Groups²³, each focused on a particular ocean issue²⁴, and championed or co-championed by a Commonwealth country. Of key relevance to NZOC (although the transition towards net-zero marine science is not explicitly mentioned) is the **Commonwealth Ocean Observations Action Group**, led by Canada. This Group is focused on advancing:

- Opportunities to increase the innovation, development and deployment of ocean observational technologies;
- accessibility of ocean observational data, knowledge and best practices among Commonwealth countries;
- political cooperation to better integrate ocean observational data, information and knowledge into decisions, products and services within the Commonwealth; and
- gender issues within the context of ocean science.

In addition, the **United Kingdom and Vanuatu are co-championing the Commonwealth Clean Ocean Alliance Action Group which seeks to tackle marine plastic pollution**. Countries in this Group are urged to make a commitment to eliminate avoidable single-use plastic waste, to significantly reduce plastic bag use by 2021, and ban the manufacturing and sale of rinse-off cosmetic microbead care products by 2021. Members of Commonwealth Clean Ocean Alliance are also asked to adhere to Global Ghost Gear Initiative, the London Protocol and the UN Clean Seas campaign. This further supports the UK policy orientation towards tackling ocean plastic pollution. **Recommendation:** To engage with the Commonwealth to ensure a future NZOC gives due regard to relevant Commonwealth policies and agreements.

UK-specific

Marine Policy Statement 2011

The UK vision for the marine environment, as set out in the Marine Policy Statement, is for '**clean, healthy, safe, productive and biologically diverse oceans and seas**'. This vision is supported by five high level marine objectives, which outline in broad terms the expected outcomes of the Statement for the UK's marine area:

- Achieving a sustainable marine economy
- Ensuring a strong, healthy and just society
- Living within environmental limits
- Promoting good governance
- Using sound science responsibly

²³ Commonwealth Blue Charter [Action Groups](#).

²⁴ There are ten action groups: Commonwealth 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 and finally the Sustainable Coastal Fisheries action groups.

This vision and associated objectives remain in place today, noting that in light of Brexit, specific guidance on how the Marine Policy Statement should be interpreted has been issued²⁵. They have been delivered in the devolved administrations through the formulation of marine plans, which guide the spatial distribution of marine and maritime activities in UK waters, provided they are consistent with the Marine Policy Statement. From an NZOC perspective, the Marine Policy Statement provides a concise summary of UK marine policy direction of travel, however, this can change over time. It will therefore be important for NZOC to track, and ideally contribute to the development of future iterations of the Marine Policy Statement. **Recommendation:** as a minimum to track and ideally to actively contribute to the development of future versions of the Marine Policy Statement. This will ensure that a future NZOC is well-placed to respond to new policy directions as well as opening new policy opportunities (as appropriate) resulting from new and/or innovative data collection techniques.

Marine Spatial Planning (through the Marine and Coastal Access Act 2009²⁶)

The Marine and Coastal Access Act 2009 introduced a new system of marine spatial planning in England. This included a system of marine plans which set out in detail what is to happen in the different parts of the areas to which they relate. The Act includes provision changing the system for licensing the carrying on of activities in the marine environment. In England, the marine planning system is administered by the Marine Management Organisation, which specifies that “a marine plan will:

- encourage local communities to be involved in planning
- make the most of growth and job opportunities
- consider the environment from the start
- enable sustainable development in the marine area
- integrate with planning on land
- save time and money for investors and developers by giving clear guidance on things to consider or avoid
- encourage shared use of busy areas to benefit as many industries as possible
- encourage developments that consider wildlife and the natural environment”²⁷

As such, “a marine plan sets out priorities and directions for future development within the plan area, informs sustainable use of marine resources, and helps marine users understand the best locations for their activities, including where new developments may be appropriate”²⁸. Marine plans therefore will require considerable evidence to support their development and implementation over the coming decades. Indeed, the full suite of plans for English waters was completed in July 2021. The specific measures and priorities in each plan area will vary according to local needs and opportunities.

²⁵<https://www.gov.uk/government/publications/uk-marine-policy-statement/guidance-to-the-uk-marine-policy-statement-from-1-january-2021>

²⁶ https://www.legislation.gov.uk/ukpga/2009/23/pdfs/ukpga_20090023_en.pdf

²⁷ <https://www.gov.uk/government/collections/marine-planning-in-england>

²⁸ <https://www.gov.uk/government/collections/marine-planning-in-england>

25 Year Environment Plan²⁹

The 25 Year Environment Plan, published in 2018, has the overall aim to “deliver cleaner air and water in our cities and rural landscapes, protect threatened species and provide richer wildlife habitats” (DEFRA, 2018, p9). Moreover, it calls for land-use, fishing, agriculture and forestry management approaches to be changed to ecosystem-based and natural capital approaches. The government-led plan will work in tandem with two other strategies; The Clean Growth Strategy and the Industrial Strategy that together aim to achieve increased productivity rates and promote environmental and economic policies to deliver green growth. Although the plan largely focuses upon England, it frequently mentions the importance of protecting and securing the natural capital in neighbouring nations and overseas territories (OTs).

The ‘Securing clean, healthy, productive and biologically diverse seas and oceans’ chapter represents the fifth policy outlined in the 25 Year Environment Plan. In summary, this chapter advocates the development of a new sustainable fisheries policy along with boosting economic development in marine regions whilst simultaneously achieving good environmental status. Science-based planning, the implementation of the use of best science in policy decision making and ensuring seafloor habitats are effectively protected are examples of how this will be completed. Furthermore, **the plan reiterates the importance of the natural capital approach** and is exemplified by pledges to switch marine protection to a whole-site approach rather than an approach that protects targeted features. **Another emphasis in the report is its aim to champion and support conservation within the UK and in overseas territories.** In common with other UK and international policy documents, the 25 Year Environment Plan emphasises the importance of the ocean as a social and economic driver. It also advocates for the improved protection and management of the UK’s marine resources. The 25 Year Environment Plan is also seen as a key strategy document describing the UK’s intended direction of travel in its delivery of a ‘Green Brexit’. **Recommendation:** To ensure that the future NZOC takes due regard of the content of the 25 Year Environment Plan and how it might evolve during the design phase of the NZOC.

Future of the sea report³⁰

Published in 2018, the Future of the Sea Report aimed to inform the UK Government's long-term approach to strategically managing UK waters and associated activity sectors. The non-binding report identified four key areas for UK government action, namely improving the understanding of the marine environment, taking a long-term approach to decision-making, increasing coordination, and accepting and acting on the global nature of marine challenges. **More specifically, the report advocated that**

²⁹ DEFRA (2018) [A Green Future: Our 25 Year Plan to Improve the Environment](#).

³⁰ Government Office for Science (2018) [Future of the Sea - A Report from the Government Chief Scientific Adviser](#).

the UK government recognise the need for improved understanding of marine environments would support the evaluation of natural capital as well as the ambition to transition to a sustainable blue economy where natural resources and services are economic drivers. Moreover, it reiterated the need for an integrated multidisciplinary approach to ocean science in which knowledge, data and expertise are shared so that global marine issues are tackled more effectively.

Furthermore, the report advocated strengthening the relationship between ocean science and policy and highlighted that the use of best science and data is essential for a strategic and effective approach to managing marine issues. **A major emphasis is placed on supporting the technical and scientific advancements that the UK has to offer, with robotics and autonomous vehicles specifically identified.** The proposals also encouraged a stronger link between the various sectors of the maritime economy, as well as aiming for technological responses to common requirements through the creation of multi-use and multi-function infrastructures and spaces. The UK government has moved swiftly to implement many of the recommendations of the report, emphasising the importance of the marine environment and its associated scientific, technical, and economic maritime industries to guide the country towards a more sustainable future.

Natural Capital accounting³¹

Within the broad context of the goals of the 25 Year Environment Plan, the Natural Capital Committee provided recommendations on how the UK government could conserve and grow marine natural capital assets and services, and generally enhance its marine environment. Primarily it aims to improve the consideration given to marine environments in the UK via employing a 'natural capital approach' to management which would lead to environmental, economic and social benefits. Its recommendations only refer to English marine region but does not ignore the wider marine environment because of the flow of natural capital around the British Isles. The paper largely focuses on the near future within a 10-30 year timeline in tandem with the 25 Year Environment Plan.

A focal point within the paper revolves around changing the way marine areas are managed, through increasing protection levels, expanding Marine Protected Area networks and designating areas for their natural capital rather than for target features. Moreover, **it advocates for a more holistic and integrated approach between fisheries and conservation, alongside transitioning to a blue economy through the promotion of good stewardship of marine spaces.** A strong focus is placed on empowering both commercial and recreational sea users to undertake good stewardship. Another core feature of the paper is continued scientific research to improve knowledge of natural capital assets as well as being able to quantify the extent to which the value of these assets and services could increase and decrease in the future. **Recommendation: Any future NZOC needs to take into account the likely adoption of a natural capital approach to the management and potentially monitoring of marine ecosystems.**

³¹ DEFRA (2019) [Natural Capital Committee advice on marine and the 25 year environment plan.](#)

Spending Review 2020³²

The Spending Review 2020 policy paper presents the priorities for funding in the UK for 2021-22 and sets grants for devolved administrations. While spending priorities vary over time, spending reviews highlight the main direction of travel of governments at a moment in time. In terms of ocean-relevant policy, DEFRA will receive a £0.4 billion increase for its core resources and receive a £0.6 billion increase to the department's capital budget, resulting in a growth of the department's expenditure limit (DEL) to £5.8 billion. Within the Review, there is a planned doubling in investment for flood and coastal defence to £5.2 billion, with financial support for coastal resilience innovation programmes emphasising ecosystem based/soft engineering techniques in coastal management, rather than traditional hard defence structures.

The Spending Review 2020 outlined the government's ambitions to achieve carbon emission and climate change goals, through various projects included in DEFRA's settlement. Examples include the Green Recovery Challenge Fund, supported by a £40 million investment, which helps deliver the 25 Year Environment Plan through financing innovative projects that focus on nature restoration, connecting the public with nature and ecosystem-based solutions. Furthermore, the settlement aids the UK to be represented as conservation champions as it contributed £7 million to their overseas territories for biodiversity conservation projects. Funds are also diverted to support infrastructure that is critical to bringing people together with their local environment such as the £7 million investment into the Coast-to-Coast National Trail and the England Coast Path. These are essential as they represent the government's urge to connect more people to nature and to improve public access to coastal regions. The settlement seeks to grow DEFRA's scientific capabilities so as to make the UK a global science superpower, this is further supported by the £15 billion investment into R&D for 2021-22 by the government as well as the establishment of the Global Talent Route which aims to increase access to visas for scientists and innovators. **Within the spending review there was a clear indication that the UK wants to improve the relationship between nature and the public to promote better stewardship, as well as showing a desire to deliver climate change targets.**

Environment Bill 2019-21, 2021-22³³

The Environment Bill, although not yet enacted, continues the drive towards higher standards and environmental protection mentioned in other UK policy documents. There are four priority areas within the Bill: air quality, water and resource efficiency, biodiversity, and waste reduction. The Bill also ensures that the UK will be the first major economy to legislate for net zero. The Bill will also include binding targets on a series of outcome indicators, with progress reported annually. **Recommendation:** Major new pieces of legislation that affect the priorities for the management of the

³² HM Treasury. (2020). [Spending Review 2020](#).

³³ Houses of Parliament (2021) [Draft Environment Bill](#).

UK's marine areas should be scrutinised for their implications for NZOC. Those charged with developing the NZOC should engage with major new pieces of legislation to ensure their coherency with the NZOC programme.

Net Zero

The legislation underpinning the drive towards achieving net zero is set out in the draft Carbon Budget Order 2021, which was laid before Parliament on 21 April 2021³⁴. It prescribes a carbon budget of 965 million tonnes of carbon dioxide equivalent for the 2033-2037 budgetary period, which is a cap on the maximum level of the net UK carbon account for each five-year budgetary period and came into law on 24 June 2021. The Budget represents a 78% reduction in carbon by 2035 compared to 1990 levels and a 63% reduction against 2019 levels. Of relevance to NZOC is that for the first time the budget will include the UK's share of international aviation and shipping emissions within the target. The intent is that this will enable these emissions to be accounted for consistently. The inclusion of shipping within this draft Carbon budget follows the Climate Change Committee's pathway to the UK Sixth Carbon Budget and 2030 Nationally Determined Contribution (NDC) to the United Nations Framework, which specifically recommended that climate law be extended to cover aviation and shipping.³⁵ Government legislation on net zero is underpinned by increasing number of policy documents, including the Industrial Decarbonisation Strategy of March 2021³⁶, which sets out 'the policy framework that will be used to drive decarbonisation through the 2030s and 2040s'. The Ten Point Plan for a green industrial revolution states at Point 6 that:

'By taking immediate steps to drive the uptake of sustainable aviation fuels, investments in R&D to develop zero-emission aircraft and developing the infrastructure of the future at our airports and seaports – we will make the UK the home of green ships and planes. Internationally, we will continue to lead efforts to find solutions to global aviation and maritime emissions, including using our COP Presidency to develop a sector-led goal.... The UK has a strong history in shipbuilding, with the maritime sector employing 185,000 people. To complement our work on aviation, we will invest £20 million into the Clean Maritime Demonstration Programme to develop clean maritime technology. We are already running hydrogen ferry trials in Orkney and due to launch a hydrogen refuelling port in Teesside, as we seek to revitalise our ports and coastal communities.'³⁷

³⁴ Under sections 8(3) and 91(1) of the Climate Change Act 2008.

³⁵ <https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf>, page 16.

³⁶

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/970229/Industrial_Decarbonisation_Strategy_March_2021.pdf

³⁷

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/936567/10_POINT_PLAN_BOOKLET.pdf, page 18.

The Government has also called for ideas to ‘Create a plan to decarbonise transport’³⁸ which closed in August 2020. That project has yet to report back. It is clear that legislation and government policy are developing and it is unlikely that net zero targets and changes will become less challenging in the next 15 years. Against that backdrop, shipping in general must evolve and the NZOC project is ideally placed to design, build and operate innovative net zero platform(s). This innovation is not limited to a novel design for a replacement crewed research vessel, but could extend to a net zero ‘mixed platform’ capability that could include uncrewed surface vessels of a range of sizes, and greater use of unmanned underwater vehicles, moorings and other large sustainable oceanographic equipment. The challenge for all shipping is that with a 30-year technical life, unless net zero ships start being built now, we will not see high carbon ships being phased out by the internationally agreed target of 2050. The MCA states in its Business Plan 2019-2020 that a key priority for them is to further develop, ‘mechanisms needed to achieve the limitation or reduction of CO2 emissions from international shipping.’³⁹ In order to achieve this plan to establish a centre of regulatory expertise to encourage the testing and update of zero emission shipping technology in the UK. This priority also ties in with their work on Maritime Autonomous Surface Systems (MASS), discussed below.

However, despite the plan for legally binding carbon budgets that include shipping, and a desire for shipping to reach net zero, there is very little practical direction for those building, designing and operating net zero ships, like NZOC. The IMO is the key shipping governance forum to monitor in order to understand the evolution of both the international Community and States’ preferred net zero legal framework (see Fuel Types section below). The G7 has committed to supporting, ‘the development and adoption of ambitious mid- and long-term measures at the International Maritime Organisation (IMO)...’ Interestingly they then seem to push the IMO to go further, perhaps faster, by talking about, ‘...building a global consensus on strengthening the levels of ambition in the initial IMO strategy on reduction of GHG emissions from ships in the context of its forthcoming revision, with the aim of contributing to the Paris Agreement temperature goal.’⁴⁰ However, discussions with an expert at the FCDO indicated that net zero shipping is not a topic of significant discussion at international maritime legal fora as most States are not at the point of developing a capability.

The positive aspect of this lack of direction is that whilst many of those who attended the WP2 workshop called for greater clarity in terms of legislation and regulation for net zero, a less constrained regulatory landscape does allow for freedom of approach and experimentation. However, there is a risk that a lack of global regulation or a disjointed approach to the final net zero regulations would allow States room to decide their own approach to whether particular net zero solutions are acceptable. **There is**

³⁸ <https://www.gov.uk/government/consultations/creating-a-plan-to-decarbonise-transport-call-for-ideas>.

³⁹

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/790357/MCA_Business_Plan_2019_-_2020.pdf, para 1.16, page 11.

⁴⁰ G7 Climate and Environment: Ministers’ Communique, London, 21 May 2021, <https://www.gov.uk/government/publications/g7-climate-and-environment-ministers-meeting-may-2021-communique/g7-climate-and-environment-ministers-communique-london-21-may-2021>.

some risk that Coastal States may deny access to their waters and ports based on a perceived non-compliance with their approach to net zero regulation (see UNCLOS and Diplomatic Clearance sections).

Carbon Offsetting

Post-Brexit, the UK now has its own Emissions Trading System (ETS) which applies to energy intensive industries, the power generation sector and aviation.⁴¹ It covers ‘activities involving combustion of fuels in installations with a total rated thermal input exceeding 20MW (except in installations for the incineration of hazardous or municipal waste)’⁴². In April 2021 the UK Government introduced a carbon offsetting and reduction scheme for international aviation, which is entitled to use the UK ETS. **However, the Government has not yet introduced a similar scheme for shipping and there is no indication that it will. This is despite the two sectors being so clearly linked in the Government’s mind in terms of the Carbon Budget Order, etc, discussed above.** **Recommendation:** That a rolling review of net zero legislation and policy, including carbon offsetting, be maintained by the NZOC project, in order to identify any changes relevant to shipping and oceanography. This rolling review could be greatly assisted by establishing a closer working relationship (or working group) with the key Government departments/agencies FCDO, DEFRA, UKMCA, EA, and DoT, if not already in place.

Vessels of Opportunity⁴³

Whilst not strictly related to the design, build or operation of NZOC, one way to continue to conduct oceanographic research with a lower impact upon the environment is to make greater use of ‘vessels of opportunity’. Harnessing the power of the countless vessels making voyages around the world to capture oceanographic data would be a ‘force multiplier’, and was seen by many attendees to our workshop to be a real area of opportunity to move towards the NZOC goal. This would be particularly relevant when NZOC is used in the role of ocean monitoring. Legally, there is nothing to prevent vessels owned by other companies and governments from gathering data, with their permission. It would introduce the need for consideration of issues such as MSR permits, engagement with coastal and flag States as appropriate and consideration of any impact upon technical specification requirements, both for the receiving vessel and the equipment being fitted. Also, the technical and environmental impacts made by addition of oceanographic observing capability need to be understood and mitigated for. However, these are practical rather than solely regulatory or legal challenges. (See Insurance section below).

⁴¹ Established by The Greenhouse Gas Emissions Trading Scheme Order 2020
<https://www.legislation.gov.uk/ukxi/2020/1265/contents/made> .

⁴² <https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets>

⁴³ [The Ship Of Opportunity Programme \(SOOP\) \(wmo.int\)](https://www.wmo.int)

There is an opportunity for NOC to play a key role in coordinating the use of vessels of opportunity, and lead the way in terms of showcasing the environmental and operational benefits of using other vessels. Taking the lead could be achieved through the NOC's role within the G7 FOSI, as the focal point for the UK delegation at IOC-UNESCO. Greater adoption of vessels of opportunity could also be encouraged through the NOC's lead in the NOC association, membership of the EMB and other influential national and international oceanographic bodies of which the NOC is a member. **Recommendation:** As part of achieving NZOC, NOC should look to lead through its role as the UK's national oceanographic policy lead, to promote a greater use of the range of vessels of opportunity programmes at national and international levels to deliver both ocean monitoring and marine scientific research.

Diplomatic clearance (DipClear)

During the WP2 workshop, concern was raised about whether it might be difficult to obtain diplomatic clearance or 'DipClear' for a vessel⁴⁴ with increased or full autonomy, depending on how NZOC is designed. In conversation with FCDO Maritime Policy Unit who handle all DipClear requests coming into the UK and are engaged with UK flagged ships' requests elsewhere in the world, it was noted that this does not seem to have been an issue when seeking to operate autonomous vessels (USVs and UUVs) in coastal state waters so far. They saw the issue of DipClear being more clearly linked to the flag State of the vessel and the type of work that the vessel sought to undertake. However, previous DipClear requests have been related to UUVs and occasionally MASS that are less than 24 metres in length and as such have not drawn high levels of scrutiny from Coastal States approving DipClear requests. **Should the final NZOC solution include a MASS that is greater in 24 metres in length, then it is not clear from existing documented knowledge of Coastal States practice whether there might be an issue in granting clearance via a note verbale.** Article 248 of UNCLOS states that 'all States proposing to conduct MSR should provide the Coastal State a full description of the proposed research project at least six months in advance of the expected starting date of research activities.'⁴⁵ Once the Convention on Biodiversity Beyond National Jurisdiction (BBNJ) is agreed, the plan is that the DipClear process will remain the same. The UK has asserted that it will not accept a DipClear process for the high seas. **Recommendation:** That this issue is kept under review through the maintenance of dialogues with the applicable UK Government departments who are policy leads on this matter, such as FCDO.

Cross-cutting and emergent considerations

Salvage, Theft, and Piracy

⁴⁴ Under Article 248, Part XIII of UNCLOS.

⁴⁵ <https://www.gov.uk/government/publications/marine-science-research-msr-guidance/marine-science-research-msr-guidance> . See UNCLOS Article 248.

There is concern that removing people from platforms as they become more autonomous will leave the platforms more open to theft/piracy or spurious claims of salvage. During the WP2 Workshops, the topic of the applicability of salvage laws was raised and were felt to be ripe for review with respect to MASS. The MCA have also identified Salvage law and regulation as an area for future research in light of a move towards more commercial autonomous ships, but the research that they had planned has not been undertaken. However, the current UK MASRWG Codes of Conduct and Operation of MASS indicate that the current salvage laws both international and national are thought to be fit for purpose. Theft of un-crewed vessels is likely to be a challenge, and could fall within the definition of piracy if committed on the high seas⁴⁶. There has been a spate of recently published events of the Chinese PLAN Militia Fishing fleet being encouraged to remove unmanned systems found on the surface in the disputed South China Seas maritime area. However, no change of the law, regulation or policy is likely to prevent that. **The FCDO Maritime Policy view is that we cannot stop removal of small uncrewed vessels from the sea, but we can protest it if we know who has taken the vessel⁴⁷. The ability of the autonomous surface vessels to keep a good-look out will form part of not only what makes the vessel compliant with collision regulations, but should help to identify anyone seeking to steal or co-opt an autonomous vessel. Recommendation: That this issue is kept under review through the maintenance of dialogues with the applicable UK Government departments who are policy leads on this matter, such as FCDO and the MCA.**

The emergence of marine social sciences

The last 5 years has seen increased significance placed on marine social sciences, particularly in ensuring that we understand the entirety of the ocean system and that management interventions and conservation efforts take account of the human as well as natural components of the ocean system. This is important to a future NZOC as the ocean data it collects must be useful to the consideration of the ocean as a social and economic system as much as a natural system. **The UK is a particular focus for the development of the marine social sciences.** The UK hosts the Marine Social Sciences Network⁴⁸, which brings together marine social science researchers and practitioners to share practices, experiences, and offer mutual support and research activity. There is also greater emphasis being placed on marine social sciences in UK government departments and bodies. For example, there is a Marine Social Sciences team within DEFRA; within the Marine Sciences Coordination Committee, a marine social science working group has been established. The NERC-led Sustainable Management of Marine Resources (SMMR) research call emphasised the need to interdisciplinary approaches to the management of UK marine area, and the establishment of the new SMMR-Net which is focused on supporting the UK marine science and management community to better integrate social and natural sciences into trans disciplinary approaches.

⁴⁶ UNCLOS Article 101.

⁴⁷ Discussion with FCDO Maritime Policy Unit on 19 Mar 21.

⁴⁸ <https://www.marsocsci.net/>

The UN Decade of Ocean Science for Sustainable Development also places an emphasis on the human dimensions of the ocean. It recognises that the social, economic and cultural dimensions of the ocean have been under-studied for decades, and this knowledge gap represents a major weakness in how we manage the ocean. Perhaps more fundamentally, it asserts that any form of ocean conservation or governance that lacks due regard for the human dimension, is unlikely to be successful. **There is strong evidence for a major movement towards marine social sciences to better understand the human dimension of the ocean and to better inform future ocean governance that supports sustainable outcomes. This has implications for a future NZOC, as any credible future capability will need to consider the human dimension more than ever before.** This may require the collection of different data, at different scales, and in different places - in order to know this, more detailed and ongoing exchanges with the marine social science community will be necessary. **Recommendation:** to ensure that marine social science research and practice needs are considered in the design of NZOC and ensure that a line of dialogue is maintained between a future NZOC and the marine social science community.

Digital Twinning

The workshop supporting Work Package 5 introduced the concept of utilising a Digital Twin of the Ocean as a way of augmenting the physical collection of ocean observations and achieving the net zero target. The use of Digital Twins in general, and their use in the delivery of ocean observations specifically, is evolving at a fast pace. **However, the evolution of the governance of Digital Twin technology is evolving at a slower pace, as seen for most rapidly developing innovations.** For example, governance relating to Digital Twins of the oceans, which provide synthetic ocean data of all of the world's oceans and coastal waters to its operators, is yet to be developed, restricting the ability to provide synthetic ocean observations in the sovereign waters of a Coastal State without that State's permission. Coastal States, who are not part of the Digital Twin capability or without access to it, are very likely to object to the generation of data about their waters without their permission. **Recommendation:** That further investigation be undertaken to look at how the governance of the Digital Twin of the Ocean will be established at both the national and international levels.

Remote Sensing from Space

The use of space-based sensors to undertake marine scientific research and ocean monitoring has been a key oceanographic capability for a number of decades. Work Package 1 and its associated workshop addressed the role of remote sensing as part of any future NZOC solution. The NZOC project commissioned a supporting study that summarises the findings of a dedicated activity to examine the contribution of spaceborne systems to deliver oceanographic observing capability. As the study did not review the policy, legislation and regulation that governs the use of spaceborne sensors to deliver marine scientific research and ocean monitoring now and, in the future, the topic is addressed below. There are two pieces of international legislation of relevance:

- Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies. [Primary].
- Principles Relating to Remote Sensing of the Earth from Outer Space. [Secondary].

The pertinent legislation relating to spaceborne observation of the ocean environment are in the Principles, rather than the Treaty. The relevant Principles to the NZOC use of remote sensing are below:

Principle II

Remote sensing activities shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic, social or scientific and technological development, and taking into particular consideration the needs of the developing countries.

Principle IV

Remote sensing activities shall be conducted in accordance with the principles contained in article I of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, which, in particular, provides that the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and stipulates the principle of freedom of exploration and use of outer space on the basis of equality. These activities shall be conducted on the basis of respect for the principle of full and permanent sovereignty of all States and peoples over their own wealth and natural resources, with due regard to the rights and interests, in accordance with international law, of other States and entities under their jurisdiction. Such activities shall not be conducted in a manner detrimental to the legitimate rights and interests of the sensed State.

Principle V

States carrying out remote sensing activities shall promote international cooperation in these activities. To this end, they shall make available to other States opportunities for participation therein. Such participation shall be based in each case on equitable and mutually acceptable terms.

Principle VI

In order to maximize the availability of benefits from remote sensing activities, States are encouraged, through agreements or other arrangements, to provide for the establishment and operation of data collecting and storage stations and processing and interpretation facilities, in particular within the framework of regional agreements or arrangements wherever feasible.

Principle VII

States participating in remote sensing activities shall make available technical assistance to other interested States on mutually agreed terms.

Principle X

Remote sensing shall promote the protection of the Earth's natural environment. To this end, States participating in remote sensing activities that have identified information in their possession that is capable of averting any phenomenon harmful to the Earth's natural environment shall disclose such information to States concerned.

Principle XII

As soon as the primary data and the processed data concerning the territory under its jurisdiction are produced, the sensed State shall have access to them on a non-discriminatory basis and on reasonable cost terms. The sensed State shall also have access to the available analysed information concerning the territory under its jurisdiction in the possession of any State participating in remote sensing activities on the same basis and terms, taking particularly into account the needs and interests of the developing countries.

Principle XIII

To promote and intensify international cooperation, especially with regard to the needs of developing countries, a State carrying out remote sensing of the Earth from space shall, upon request, enter into consultations with a State whose territory is sensed in order to make available opportunities for participation and enhance the mutual benefits to be derived therefrom.'

Several elements of these principles echo those found in Part XIII of the UNCLOS relating to the governance of marine scientific research in general, and specifically when undertaken in a sovereign State's declared maritime zones. However, unlike UNCLOS Part XIII, the 'Principles Relating to Remote Sensing of the Earth from Outer Space' do not require the observing State to seek prior permission from the State whose territory is being observed; for example, if its coastal waters are being observed remotely.

During the 2010 review of the UN guidance on the application of Part XIII of UNCLOS, a number of participating States questioned if spaceborne observations of Coastal States waters by a third-party State should be subject to the permissions regime found in Article 246 of UNCLOS. However, this was considered out of scope of the meeting and was not progressed at that time. A key concern in this debate is the retention and protection of intellectual property rights of the Coastal State, concerning ocean data collected in its waters and the topic remains the subject of increasing academic debate. For future NZOC capability to rely on greater use of spaceborne sensors, this difference in permission regimes needs to be resolved. However, potential resolutions may result in a restriction in use of space borne sensors to collect ocean data in other States maritime zones. **Recommendation:** An overview by NOC be maintained of the governance of ocean observations from space as part of the ongoing support for the delivery of the NZOC.

Uncrewed Technologies

NZOC will straddle a period of significant change from traditional to net zero oceanographic capability. This will include the adoption of the new capabilities, including new modes of data collection. While it is considered unlikely that there will be a completely uncrewed vessel or completely uncrewed technologies undertaking oceanographic research within the next 15 years, crewless technologies are likely to play an increasingly important role in how NOC conducts its work.

The MCA states that there are significant numbers of regulations relevant to autonomous surface vessels. Increasing automation requires an understanding of how these regulations apply, how they might need to be amended, and what new regulations might be required. The most well known project to address the legal issues associated with the use of uncrewed technologies at sea is the IMO's Maritime Autonomous Surface Ships (MASS) regulatory scoping exercise. **The IMO defines MASS as 'a ship which, to a varying degree, can operate independent of human interaction'.⁴⁹ MASS have then been divided into four degrees of autonomy, the fourth of which is fully autonomous.**

UK and global industries investing in increasingly automated vessels and platforms are moving at pace and the IMO is trying to catch up. Their most significant published documentation to date has been to the interim guidelines for MASS trials⁵⁰, which effectively have the status of 'soft law'. The Marine Safety Committee working group on MASS convened in the last week of May 2021 and concluded the first part of their MASS scoping exercise⁵¹. At the time of writing this report, access to the findings was not available to the authors, but it is understood that they will be available soon. **Recommendation:** Ensure that the IMO MASS scoping exercise is analysed with a view to determining its impact on any NZOC solution or solutions.

In the UK, the MCA has been fully engaged in the MASS regulatory scoping exercise and has also been running the MARLAB Project⁵², in collaboration with Solis Marine Consulting, the Cabinet Office's Policy Lab, and NOC, in order to consider regulation of autonomous vessels. Given NOC's engagement with this project, attention is drawn to the reports which are held by NOC. The MCA studies concluded that, 'It was clear that regulation would have to be amended' and further it would be necessary to support testing new regulatory proposals on industry. The Policy Lab development of a Regulatory Workshop toolkit that uses innovative gaming techniques to explore potential new regulations is to be rolled out for use.⁵³ Notwithstanding the ongoing IMO MASS project, the MCA's current approach to regulation of autonomy in the

⁴⁹ <https://www.imo.org/en/MediaCentre/PressBriefings/Pages/08-MS-99-MASS-scoping.aspx>

⁵⁰ [https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/MS-1-Circ.1604%20-%20Interim%20Guidelines%20For%20Mass%20Trials%20\(Secretariat\).pdf](https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/MS-1-Circ.1604%20-%20Interim%20Guidelines%20For%20Mass%20Trials%20(Secretariat).pdf)

⁵¹ The outcome of the MSC's regulatory scoping exercise, as approved by the Committee, including the full analysis of treaties, can be found as an annex to the report of MSC 103 (MSC 103/21/Add.1, annex 8) and can also be found in circular MSC.1/Circ.1639 (Outcome of the Regulatory Scoping Exercise for the use of Maritime Autonomous Surface Ships (MASS)).

<https://www.imo.org/en/MediaCentre/PressBriefings/Pages/MASSRSE2021.aspx>

⁵² <https://www.gov.uk/government/publications/maritime-autonomy-regulation-lab-marlab-report/maritime-autonomy-regulation-lab-marlab-report>

⁵³ Ibid.

maritime is to take the safety case approach, using exemptions and waivers in the short term, before incorporating necessary updates into Legislation. **Their priorities in this area are an update to the workboat Code (already mentioned), supporting ongoing projects and MASS people (see below).** **Recommendation:** Ensure NOC's continued engagement in the MARLAB project is linked closely to the work of the NZOC project. Additionally, follow up work to this report should include an update from the MCA on the outcomes of the most recent IMO Maritime Safety Committee.

Artificial Intelligence

The NOC through its UUV historical and future programmes of R&D, have been at the forefront of the use of Artificial Intelligence (AI) in the safe navigation of UUVs while under the sea surface and under sea ice. These advanced programmes of AI usage for navigational purposes have largely been delivered in the absence of any extensive legal/governance framework. This absence reflects the lack of any body of agreed legislation on the operation of UUVs sub-surface at both national and international levels. To date has not impeded either the development or the use of AI for this purpose, or the final operational use of these vehicles to deliver Government funded marine science. **Discussions about the application of AI are not unique to the maritime or marine environments, but are in their infancy regarding the challenges and opportunities that AI might bring.** The MCA are considering AI but they describe themselves as being 'at the beginning of a conversation'⁵⁴. Cybersecurity, software assurance and AI are on their list of projects and they are looking at the landscape in other sectors to see what we might learn. **Where there is a lack of regulation, researchers rely on custom and practice which is effective in some cases, but has often been shown to be insufficient.** Another concern is the different approach that States may take in terms of granting access to their waters by foreign Ships or other unmanned platforms using AI. This will likely be driven by safety and security fears. It is driving the MCA's work, as well as broader DfT work to consider cybersecurity in the maritime. **Recommendation:** Those engaged in marine/maritime autonomy should discuss AI regulation and use with other sectors using AI to establish consistency with other industries, including transport and oil industries.

People and Skills

The removal of people from the onboard elements of command and control of ships is one of the key areas of concern in relation to increasing autonomy in all areas of shipping. For NZOC this could additionally mean the removal of the scientist from the practical conduct of experiments and data gathering. All of this has implications in terms of compliance with legislation and regulation, but also in the training and employment of people. Looking first at the issues related to compliance with regulation and legislation, this is not a new subject. To a certain extent, it is a matter of interpretation of terms such as master, crew and on board. **The interpretation of IMO Regulation and how such terms should be interpreted has been identified as one**

⁵⁴ Meeting with MCA, 15 March 2021.

of the key work streams for the IMO MASS regulatory scoping exercise. The Department for Transport (DfT) is also undertaking a scoping exercise to consider where it is necessary for people to be physically engaged in shipping and present on board, in order to comply with international and international law. This work will be instructive.

Some of the issues still to be formally addressed by the IMO or nationally are:

- Article 94(4) of UNCLOS, considering the duties of the flag state, contains a requirement for a master to be in charge of a ship, however, neither 'Master' nor 'in charge' is defined. An expansive interpretation would allow a 'person in charge' to operate from either on board or ashore, but this approach has yet to be approved/confirmed.
- Under UK Law a Master, '...includes every person (except a pilot) having command or charge of a ship'.⁵⁵
- The International Convention for the Safety of Life at Sea (SOLAS Convention) requires that, 'The Contracting Governments undertake, each for its national ships, to maintain, or, if it is necessary, to adopt, measures for the purpose of ensuring that, from the point of view of safety of life at sea, all ships shall be sufficiently and efficiently manned.'⁵⁶ The rules do not stipulate where people who 'man' the ship shall operate from.
- COLREGs, rule 5 requires that, 'Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.' There is no definition of 'proper look out', and no clarity as to whether such a proper lookout can be achieved without having watchkeepers on board.
- The Workboat Code applies to vessels of under 24m, carrying their crew and up to 12 people. Crew is defined as, 'a person employed or engaged in any capacity on-board a vessel on the business of the vessel'. The requirement for the crew to be 'on-board' would seem to rule out the application of the Workboat Code to uncrewed vessels under 24m. The Workboat Code is being reviewed by the MCA in light of the increasing prevalence of autonomous vessels.
- For those controlling autonomous vessels from a location other than on board, it is not clear whether the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW) requirements apply to them or not. The STCW watchkeeping requirements are entitled, 'Watchkeeping at Sea', although bar the reference to assistance being summoned to the bridge⁵⁷, the duties of the Watchkeeper are drafted in such a way as not to limit them to being conducted on board. Watchkeepers are required never to leave the bridge unattended⁵⁸, but there is no specific stipulation about where the 'bridge' should be. Of relevance, specific mention is made about the monitoring of unmanned

⁵⁵ The Merchant Shipping Act 1995, s. 313.

⁵⁶ SOLAS, Part IV, Regulation 13.

⁵⁷ International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW) STCW para 15.3.

⁵⁸ STCW Ch VIII, para 17 and 23.

machinery spaces (UMS)⁵⁹. Therefore, it is not too great a step to imagine the rules being relevant to the monitoring of an 'unmanned' bridge from ashore.

Whilst absolute certainty has not yet been reached, it is highly likely that the legislation and regulations set out above will be interpreted in such a way that they are relevant to those commanding and operating autonomous vessels from shore. **If it is considered that it is too difficult to either apply an expansive interpretation to the wording or amend the regulations easily so that autonomous ships are covered, new legislation and regulation will be required. The more common use of autonomous ships, alongside the work currently underway internationally and nationally, should ensure that it is in place by 2035.**

The skills and training that 'seafarers' and marine scientists will require in order to work remotely from autonomous ships is an area that will require evolution of the training which is currently in place. The MCA's 'MASS People' project is a working group set up to design world leading training for those operating autonomous Vessels. Until the working group's findings are confirmed and acted upon, the MCA is taking an equivalence approach and considering what certification will involve.⁶⁰ Concerns about a perceived regulatory requirement for scientists to remain on board NZOC that may be MASS based in order to conduct certain types of scientific experiments and monitoring was strongly expressed during the WP2 workshop. Questions were raised about whether regulations drive specific methods, which require ships crewed with people, e.g., the use of radionuclides in trace marker experiments. As part of the award of safety certification by the State where the vessel is registered, there is an agreed safe manning level, which also includes numbers of types, and level of certification. Personnel numbers/levels are part of the annual inspection made by the UK MCA for NOC vessels. Manning levels are part of the safety management system records kept by NOC. For the purposes of the application of IMO conventions, the research vessels have in the past been classified as special purpose ships, which attract their own safety manning levels.

Although more of an area for consideration by WP1, one positive of disconnecting the conduct of the science with the scientist is the fact that people will not have to be physically able to go offshore to be a marine scientist, thus enabling a workforce diversity that has previously been impractical. **Until the design and level of autonomy of NZOC is decided it is not possible to know exactly which people and skills issues will apply.** **Recommendation:** This subject area to be re-visited once the NZOC choices are clearer.

Definitions of Ship/Vessel and implications

Another area of long running debate about uncrewed or autonomous vessels is whether they can in fact be a vessel or ship. This is important because it has implications for how and where the platform will be able to operate. Many of the rules

⁵⁹STCW Ch VIII, para 17.7.

⁶⁰ Meeting with MCA, 15 March 2021.

in UNCLOS only apply to ships or vessels. For example, the right of innocent passage applies to 'ships of all States',⁶¹ and the right of transit passage is something enjoyed by 'all ships and aircraft'.⁶² In UK legislation the main definition of a ship as including 'every description of vessel used in navigation',⁶³ would include autonomous vessels. However, it is the definition of vessel in COLREGs that causes concern: 'The word "vessel" includes every description of watercraft, including non-displacement craft, WIG craft and seaplanes, used or capable of being used as a means of transportation on water.'⁶⁴

Many autonomous vessels are not, 'used or capable of being used as a means of transportation on water', due to their size and/or purpose. However, 'transportation' itself is open to interpretation and could be interpreted as the transportation of sensors and equipment. **If NZOC, is or uses an autonomous platform that can be considered a ship or vessel, the FCDO perspective is that the most important consideration will be its nationality status, depending on whether it is UK flagged.**⁶⁵ **The next consideration is whether it is a commercial vessel or a government ship operated for non-commercial purposes; government ships are entitled to immunities under UNCLOS that commercial ships are not.** **Recommendation:** Once the form that NZOC will take is determined, the question over its ship/vessel status should be revisited. Once its ship/vessel status is confirmed a decision needs to be made in respect of its designation as a UK commercial or UK government ship operated for non-commercial purposes. This will depend on the status of its ownership/leasing and the purposes for which it will be used.

Data Sharing

Much like the use of vessels of opportunity, improved and greater data sharing was seen by a number of attendees at the WP2 workshop as a means to conduct ocean science in a way, which is significantly more environmentally friendly. Attendees cited a lack of coordinated survey and science leading to a complete lack of information about some geographic areas, whereas attendees also asserted that other geographic areas see several vessels all conducting the same science at virtually the same time. Most data collection happens in a vacuum, not understanding other activities at an international level, causing carbon inefficiency and duplicating efforts. UNCLOS Part 13 envisaged the greater democratisation of data, and Article 244 specifically requires States and competent international organisations to, 'make available by publication and dissemination through appropriate channels information in proposed major programmes and their objectives as well as knowledge resulting from marine scientific research'.⁶⁶ **However, global coordination of this information sharing, as well as accessibility of data, remains a challenge.**

⁶¹ UNCLOS Article 17.

⁶² UNCLOS Article 38.

⁶³ The Merchant Shipping Act 1995, s,313.

⁶⁴ COLREGS, Rule 3.

⁶⁵ Discussion with FCDO Maritime Policy Unit on 19 Mar 21.

⁶⁶ UNCLOS Article 244.

In discussion with the FCDO Marine Policy Unit, there is optimism that data sharing will evolve, however, there is a need for a separate piece of globally engaged work to enable great sharing of information, as well as democratising the ability to interpret the data. A practical solution suggested during the workshop was the cloud-based storage of ocean data, collected by people who are technically competent, not necessarily researchers, which is available democratically and open to everyone. **To achieve this globally will almost certainly require underpinning legislation and regulation to be developed. International agreement is also likely to be required to clarify the ownership of the data and facilitate the sharing of the data fairly. This should include, but not be limited to, the sharing of data with the coastal State in whose waters the data has been collected.** **Recommendation:** The collaborative and coordinated collection of data is seen as something that NOC can lead on, alongside partners in DfT, BEIS and FCDO. This should form the basis of a separate work stream.

Freedom of Navigation

The current national oceanographic capability ranges from the individual equipment elements in the National Marine Equipment Pool, through the MARS fleet, to the two State registered Research Vessels. They all have and continue to play a fundamental role in the delivery of the UK's international diplomacy, as well as its specific ocean science and policy objectives. At the time of writing this report, the main manifestations of this diplomacy have been:

- The delivery of world class science to the benefit of both the UK and the global community, through the investigation of issues such as, but not limited to, the impacts of climate change, marine litter, and ocean acidification on the world's oceans.
- The lending of elements of the NMEP, deploying UK scientists and the Research Vessels to Small Island Developing States that are members of the Commonwealth countries and overseas territories⁶⁷ to deliver ocean science diplomacy, ocean literacy and capacity building.

However, the FCDO considers the freedom of operation of the two UK Research Vessels in other coastal States' waters under the pertinent parts of UNCLOS as an important 'plank' in the UK Governments Freedom of Navigation operations [FONOPS]. The recently published 'Global Britain in a competitive age: The Integrated Review of Security, Defence, Development and Foreign Policy'⁶⁸, states that this is a high priority for the UK Government:

⁶⁷ <https://www.gov.uk/guidance/commonwealth-marine-economies-programme> and <https://projects.noc.ac.uk/cme-programme/about> .

⁶⁸ Global Britain in a competitive age: The Integrated Review of Security, Defence, Development and Foreign Policy. Presented to Parliament by the Prime Minister by Command of Her Majesty. March 2021. CP 403

'Supporting a resilient ocean

The UK's vision is that by 2030 the ocean will be effectively governed, clean, healthy, safe, productive and biologically diverse, linking resilient and prosperous coastal communities around the world, and supporting sustainable economic growth for the UK, the Overseas Territories and the Crown Dependencies. To deliver this vision, the UK will combine its work on maritime security, the environment and trade. Fundamental to this will be an absolute commitment to upholding the UN Convention on the Law of the Sea in all its dimensions, as an essential enabler of global prosperity, security and a healthy planet.

- Deploy more of our naval assets across the world to protect shipping lanes and uphold freedom of navigation. The Joint Maritime Security Centre will support this, strengthening operational maritime coordination across government. The Royal Navy's Maritime Component Command in Bahrain will continue to ensure the flow of trade in the Gulf, including through support to part of the new International Maritime Security Construct.'

The 'Defence in a competitive age'⁶⁹ Command Paper published soon after the Integrated Review further supports this goal:

'Shaping the open international order of the future which we will support through: our adherence to International Humanitarian Law in our own operations; freedom of navigation operations in support of international maritime law efforts to shape responsible behaviour in cyberspace and space, and the ethical development and deployment of technology based on democratic values; and by embedding international laws, rules and norms in partners' approach to security through capacity building.'

Historically, during the period of the Cold War, UK Government/MoD policy and doctrine included an ability to 'take up' the operation of the Government owned Research Vessel fleet in support of national/international maritime security conflicts such as war and the relief/remediation of natural disasters. It is assumed that this historic formal requirement is no longer extant or explicitly documented. However, as seen with the Government's strategy for dealing with COVID, which saw the utilisation of both military personnel and equipment to support the combating of this pandemic, any future marine or maritime issues of great import may see the Government revert to being able to bring both the Research Vessels and the NMEP to bear to address a threat. **Recommendation:** Mindful of the potential calls by the UK Government on national oceanographic capability to meet the Government's stated security, defence and foreign policy as it relates to the oceans, any potential NZOC solution or solutions may need to address these latent requirements. Therefore, the relevant UK Government departments should be consulted to determine (a) the requirement for/degree of dependency on the national oceanographic capability to meet these

⁶⁹ Defence in a competitive age - Presented to Parliament by the Secretary of State for Defence by Command of Her Majesty. March 2021. CP 411

requirements and (b) whether the planned NZOC solution/solutions will address these requirements.

Insurance and Liability for Accidents

NOC and British Antarctic Survey (BAS) ships currently have P&I cover from British Marine Mutual, although they do not carry any form of hull and machinery cover. However, the insurance picture for the uncrewed vessels currently operated by NOC is more complicated and appears to depend upon whether they are operated from one of the insured ships, or independently. Even when operating MASS from a NOC ship, information provided by the insurance broker seems to indicate that insurance cover is based on:

- the operations being undertaken,
- the type of incident triggering an insurance claim,
- where the uncrewed vessel is being controlled from and
- how long the uncrewed vessel had been deployed away from the 'mother ship' at the time of any incident.

Discussion regarding where the liability for marine accidents will lie when the accidents involve vessels, etc that are to a greater or lesser extent autonomous is ongoing; the concern is that more autonomous the vessel the less obvious it is who will be responsible. Where there is an obvious 'Master', albeit ashore, the answer is less contentious, but when autonomy reaches a stage where there is no obvious master and the last 'person' to engage with the vessel was the programmer, there may be a shift from ship owners holding liability to technology companies. The type of accident is likely to play a part in where the liability lies. For example, liability for an accident caused by poor maintenance is likely to sit with the ship owner, whereas a failure resulting from a lack of product testing may see liability shift to the company responsible for production.

The ability of MASS to comply with The Collision Convention 1910 and the International Regulations for Preventing Collisions at Sea 1972 (COLREGS) is frequently cited as the greatest concern in relation to accident avoidance. Few insurance companies understand how the new technology fits with COLREGs, and it is unclear how familiar insurers are with the UK Maritime Autonomous Ships Industry Conduct Principles and Code of Practice⁷⁰. **Our discussion with the expert in the insurance industry indicated that the Code of Practice is not yet felt to be sufficiently underwritten by the government.**

COLREGs place all liability for accidents on the vessel or the owner, master or crew.⁷¹ The Merchant Shipping Act 1995 addresses liability, but does so in a way that foresees only liability of Ships, owners, masters and crew for their actions. Nothing has yet been done to update the regulations and legislation to address liability of insurers for

⁷⁰ <https://www.maritimeuk.org/media-centre/publications/maritime-autonomous-surface-ships-industry-conduct-principles-code-practice/>

⁷¹ Rule 2 of both the Collision Convention 1910 and COLREGS.

automated vessels. This contrasts with the Automated and Electric Vehicles Act 2018, part 1 of which addresses, 'Liability of insurers etc where accident caused by automated vehicle'.⁷² It even addresses accidents resulting from unauthorised software alterations. Having something similar for MASS would create more certainty.

One of the COLREG rules most frequently cited when talking about MASS collision avoidance is the requirement to keep a good look out and whether that can be achieved without people on board. A number of recent court cases⁷³ have highlighted the importance of a good look out, but there have not yet been any cases involving uncrewed ships or platforms. To overcome concern about the risk of using uncrewed capabilities, it seems government policy and legislation that supports trials is needed. For example, telling local authorities how to enable the trials in their ports. An example of government and business collaboration to give the insurers more confidence is a project in Norway to use autonomous lighters to transport fertiliser up the coast. The Norwegian Government enterprise ENOVA has provided a one third grant to Yara to build the autonomous ship the Yara Birkeland in order to prove the concept.⁷⁴ This kind of action would encourage future insurers to cover similar vessels and activities.

Worries about new technology in relation to insurance liability is also likely to impact upon net-zero platforms. Where autonomy and net-zero come together, there are bound to be concerns. Alternative fuel cells may also initially struggle to find hull and machinery insurance that will cover them. LNG has proven to be very efficient and green, but when its use goes wrong it is very expensive. It is also not yet in common use. For those reasons it discourages the P&I clubs from allowing those vessels to be insured by them. So how will that change? The example of offshore power is analogous. Wind power was difficult to insure, but is now common despite the significant losses due to cable faults, etc. An infrastructure support structure to address faults and problems was created, which meant that wind power became a known entity and was less risky to insure. However, it is apparently still difficult to insure wave or tidal technology because it lacks that infrastructure support network and the ability to understand the risk involved; net zero shipping will need infrastructure support networks to increase insurer confidence.

In terms of how NZOC should be insured, the subject matter expert that we consulted recommended that, if at all possible, it be underwritten by the government as alternative professional insurance was likely to be costly. We have been provided with information about the Shipowners P&I Club who provide Maritime Autonomous Vessel Liability Insurance, but it is not common. Having the government underwrite the vessel would also have the benefit of getting new technology operating at sea, setting a good precedent for insurers to follow. Most nuclear powered vessels are military and, therefore, underwritten by the government. How this may change as reactors become

⁷² <https://www.legislation.gov.uk/ukpga/2018/18/section/2/enacted> .

⁷³ *Global Mariner v Atlantic Crusader Collision Case* (2005 EWCA 380 (Admlty)); *Sakizaya Kalon v Panamax Alexander* [2020] EWHC 2604 (Admlty); *Ever Smart v Alexandra 1* ([2021] UKSC 6). The *Ever Smart v Alexandra 1* case is the first appeal in a collision action to come before the Supreme Court. It is approaching 50 years since the last such appeal before the House of Lords - *The Savina* [1976] 2 Lloyd's Rep 123.

⁷⁴ <https://www.offshore-energy.biz/norway-provides-grant-for-construction-of-yara-birkeland/>

smaller and potentially more available for use by commercial companies remains to be seen. If used commercially, nuclear vessels will also need to be insured. It is unclear if this would be problematic. However, there is a pool of underwriters authorised to insure nuclear waste ships.

Another challenge relates to insurance for platforms of opportunity (see Vessels of Opportunity section above). Whilst they offer significant opportunities in terms of data collection for a reduced carbon bill, insurance may become an issue if, for example, design standards are compromised by equipment attached to conduct underway seawater sampling. However, insurance companies are keen to display their green credentials (see Lloyds of London Environmental, Social and Governance Report 2020⁷⁵), but possibly find it difficult to find meaningful ways to take action. Insuring platforms of opportunity whilst undertaking scientific sensing work could be a relatively low-risk way for them to do so. Depending on the equipment fitted to undertake the scientific work, there may not even be a need to have the vessel re-surveyed for insurance purposes as long as they inform the class society.

Recommendation: Insurance of potential NZOC options should be kept under review.

3. KEY FINDINGS

It is clear that the character of ocean policy is moving towards holistic interdisciplinary outcomes that recognize that the ocean generates social and economic benefits that need to be managed and monitored. The emphasis on protecting important marine ecosystems remains, and is becoming strengthened through UK and international policy commitments. The transition to a sustainable blue economy, marine spatial planning, and the shift towards the use of natural capital as a decision framework in the UK, are key elements of the evidence base supporting this conclusion. As such, data generated from a future NZOC is likely to be used for a greater range of activities, by a wider group of users, and in association with different forms of evidence. A future NZOC will need to ensure its data collection approach takes account of this wider user community.

- **KEY FINDING #1. Delivering a sustainable blue economy that benefits everyone is a priority.** The transition to a sustainable blue economy requires that scientific data should sit alongside economic and social data and be available to inform/support government policy, compliance and sustainable use of the ocean and coastal areas. As such, marine policy, compliance and monitoring will continue to drive increasing connections across scientific, social and economic disciplines requiring data that span these areas to be collected and made available to all users in an easy, effective way. Future infrastructure should recognise the data needs of this shift to more holistic ocean governance and note that ocean policy will increasingly be underpinned by improved ocean literacy.

⁷⁵https://www.lloyds.com/~media/files/about/responsible-business/esg/lloyds_esgreport_2020.pdf

- **KEY FINDING #2. Securing clean, healthy, productive and biologically diverse seas and oceans is a long-term priority** supported by the Marine Policy Statement, International Ocean Strategy, the 25-year environment plan (2018) and a commitment to increase MPA coverage within the UK EEZ to 30% by 2030. As a result, the evidence needed for the selection, designation and future monitoring of MPAs is likely to increase significantly. This will have to accommodate activities that increase the uptake of CO₂ by the natural environment, support carbon capture and storage as well as the likely expansion of the offshore energy sector.
- **KEY FINDING #3. The UK will increasingly adopt a policy framework that uses a 'natural capital' approach across all aspects of the marine ecosystem.** Considering the marine environment as an asset that sits on the UK national balance sheet enables increased value through sensible, sustainable management to be recognised. This approach supports decisions being taken that consider trade-offs between different policy options that impact 'natural capital' in different ways.

The current and planned UK and international policy, regulation and legislation related to NZOC is not at a stage of maturity to ensure that the selection of NZOC infrastructure is without risk both financially and legally. However, this situation also creates a degree of freedom to make choices in this, as yet, relatively unregulated area. Those involved in the development of NZOC should grasp the opportunity to engage in relevant processes to shape future legislation, regulation and policy to ensure a positive enabling environment for future NZOC. There are some areas of legislation and regulation that will need to be updated by 2035 in order to be sure that NZOC can operate effectively and is compliant with law and regulation. However, many of these changes are already being addressed internationally and nationally, with the NOC well placed to engage with the projects as they proceed, i.e. MarLab and MASS. Soft law such as the IMO's interim guidelines for the safety of ships using methyl/ethyl alcohol as fuel is also beginning to appear.

- **KEY FINDING #4. Despite the plan for legally binding carbon budgets that include shipping, and a desire for shipping to reach net zero, there is currently very little practical direction for those building, designing and operating net zero ships.** The positive aspect of this lack of direction is that a less constrained regulatory landscape does allow for freedom of approach and experimentation. However, there is the possibility that 'blockers' will arise in terms of fuel choices or freedoms that can be exercised as regulation is created and States take a firmer position on net zero regulation. The UK government has not indicated it will introduce a carbon offsetting and reduction scheme for shipping in the way it has for aviation.
- **KEY FINDING #5. The MCA's current approach to regulation of marine autonomy is to take a 'safety case' approach, using exemptions and waivers in the short term, before incorporating necessary updates into legislation.** The IMO's work on MASS is catching up in this area and their four degrees of autonomy, the fourth of which is fully autonomous, are likely to become

internationally adopted, along with their definition of MASS as ‘a ship which, to a varying degree, can operate independent of human interaction’. Their priorities in this area are an update to the workboat Code, supporting ongoing projects and standards of training and certification of those involved in the operation of MASS

Until the composition of the future NZOC has been refined, it is challenging to provide tailored legal and regulatory advice. It is recommended therefore that additional research be undertaken into the following areas either immediately or once the form of the future NZOC has been narrowed down:

Immediate research needs:

- Consider how greater use could be made of vessels of opportunity.
- Consider how to recover more ‘disposable’ equipment and use more ‘reusable’ equipment.
- Maintain an understanding of the progress made by the IMO’s MASS Regulatory Scoping exercise and continue to engage with the MCA’s MarLab project, in order to understand regulatory and legislative changes relating to autonomous systems.
- Request engagement with DfT’s scoping exercise to look at regulatory impact of physical removal of people from ships.
- Maintain engagement with MCA’s MASS People project.
- Engage with MCA re. updating of Salvage Laws.
- Consider taking a lead on the collaborative and coordinated collection of data alongside partners in DfT, BEIS and FCDO, perhaps as a separate work stream.

Once NZOC options have been identified:

- Revisit current government policy and legislation with respect to net zero shipping to determine whether this impacts upon the choices being considered.
- Revisit current government policy and legislation with respect to carbon offsetting to consider whether this is an option to help achieve net zero. This should be done alongside consideration about whether carbon offsetting is something that NOC/NERC would wish to consider from an ethical perspective.
- Revisit IMO and MCA work and recommendations with respect to potential fuel types being considered. These should be kept under review as the NZOC project progresses.
- Keep relevant technical specification regulations under review, and seek additional advice where technical specifications appear to fall out with current regulations or policy as equivalence may apply.
- Revisit the question of whether the NZOC options can be defined as ships/vessels. Once confirmed, determine whether the NZOC infrastructure should be UK commercial, or UK government ships operated for non-commercial purposes. This will depend on the status of its ownership/leasing and the purposes for which it will be used.
- Revisit likely insurance status of vessel options and insurance options.

ANNEX A. Meetings

- 18 Feb 21 WP 2 Workshop
- 15 Mar 21 Meeting with MCA SMEs
Ruth Taylor
Katrina Kemp
Thomas Skew
- 19 Mar 21 Meeting with FCDO Maritime Policy Unit
Lowri Griffiths
- 16 Apr 21 Meeting with Marine Insurance SME (Subsea Beazley Leviathan)
Keith Broughton
- 23 Apr 21 Meeting with DEFRA, Head of Ocean Climate and International Science
Team
Tarquin Dorrington