- *DRAFT Scoping Paper, June 2021* -

Net Zero Ocean Capability.

As part of the UK G7 Presidency in 2021, a G7 Ocean Decade Navigation Plan[1] was agreed providing a framework for G7 collaboration in support of the UN Ocean Decade. Net Zero Ocean Capability was identified as one of three 'spotlight activities' to advance as part of the FSOI's global ocean observing work to support the UN Ocean Decade societal outcomes of a 'predicted', 'accessible', and an 'inspiring and engaging' ocean. The goal here is to consider approaches, evaluate developments and opportunities, and share best practice in moving towards low or zero carbon approaches to ocean observations and research.

1. Background Information

As part of the UK G7 Presidency, an Ocean Action was developed under the Climate and Environment Ministerial Track. The agenda included support for the UN Decade of Ocean Science for Sustainable Development (UN Ocean Decade) and support for the Global Ocean Observing System (GOOS) through the Future of the Seas and Oceans Initiative (FSOI). As an outcome of the UK G7 Presidency, a G7 Ocean Decade Navigation Plan was agreed as a framework for G7 collaboration in support of the UN Ocean Decade. Three initial 'spotlight activities' were identified as Net Zero Ocean Capability (this paper), Digital Twin Ocean Capability and a Global Ocean Indicators Framework. It was agreed that these 'spotlight activities' will be executed through the G7 FSOI.

The Intergovernmental Panel on Climate Change (IPCC) has stated that if we cut global emissions to net zero by 2050, we can keep warming of the planet below 1.5 degrees. As part of the Paris Agreement, Parties to the UNFCCC have agreed to move towards net zero carbon emissions. Within environmental science, there is a responsibility to lead by example, to ensure we reduce the carbon footprint of marine science activities. In addition, other environmental policy considerations, such as the Net Zero Plastics commitment of the G20 in Tokyo, 2019, underpin the importance to consider the footprint of our activities. Hence this is an opportunity;

a) in the medium term, to consider how to optimise the design and utility of our observing system and data infrastructures to ensure maximum utility for investment.
b) in the longer term, to horizon scan in a holistic way; the science needs, policy developments and new technologies – including shops, fuels, autonomous technologies, sensors, communications and data systems.

The infrastructure that supports oceanographic research often remains founded upon the traditional methods of collecting data, i.e. a team of scientists and technicians embarking upon a dedicated ship-based research expedition. As various aspects of our observational capability become autonomous, we have an opportunity to consider how we establish a multiplatform sustained observing infrastructure to meet a broad range of needs which can be leveraged for experiments, etc. whilst also considering the role of ships and other components in this observation 'ecosystem'.

[1] G7 Ocean Decade Navigation Plan https://www.gov.uk/government/publications/g7-climate-and-environment-ministers-meeting-may-2021-communique/g7-ocean-decade-navigation-plan

The global endeavour to improve our knowledge of the ocean, understand its role in regulating the climate and manage it sustainably, contributes to climate change. As the maritime transport industry works to reduce carbon emissions, the system supporting marine science must do the same.

The tipping points – 2050 is difficult but is it too late?

Progress towards 'smart' ships that can deploy a flotilla of autonomous robots is accelerating. This progress is matched by research into 'green' marine fuels and investment into the supporting coastal infrastructure. Similarly, satellite technology is advancing to enable the exponential increase in use of autonomous platforms. Those platforms will use miniaturised sensors and onboard processing/machine learning technology. Sharing best practice and utilisation of core capabilities removes many of the risks, as well as maximising our ability to obtain data. Advances in technology are opening up opportunities which require a strategic view to be taken regarding the next generation of oceanographic research infrastructure. The 20th century paradigm must give way to a low-carbon system and consider the science and policy needs alongside the technological opportunities (see figure 1).

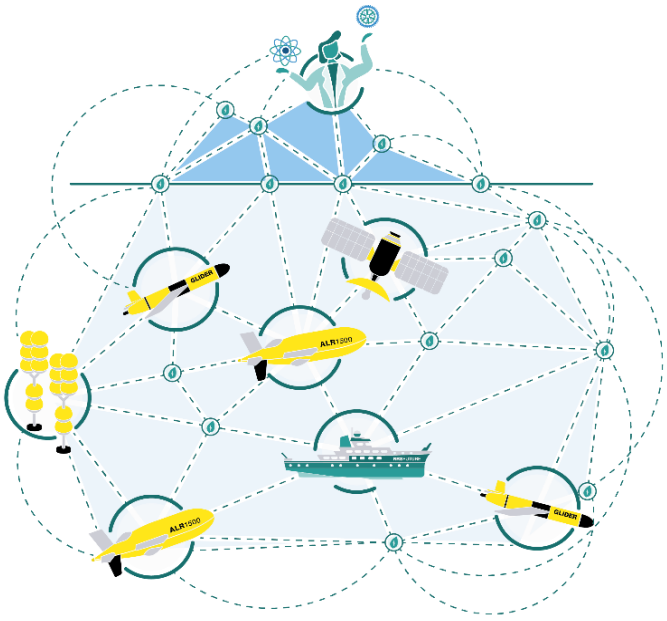

Figure 1 *A research vessel, powered by green fuels, becomes one part of a more complex, adaptable ecosystem supporting the research. Data flows from multiple platforms and is used by multiple users for different purposes.*

What are we trying to achieve?

In the UK, the Natural Environmental Research Council (NERC) has commissioned a Net Zero Oceanographic Capability project (NZOC) which seeks to enable managed, incremental but increasingly impactful change over the next 15 years with 2035 as a key headmark for replacing large parts of the current infrastructure with new technologies. This timeframe is challenging as the changes require large-scale decarbonising of current and future investment in multiple areas including infrastructure, people, data management and regulation. This re-wiring of the current system is difficult and made more complicated as the progress is non-linear i.e. there is a period during which old and new technologies and supporting systems will overlap. Working with partners to share technologies, align investment into data flow management and co-ordinate the transfer to a new system such that risks are shared, is possible by building upon current collaborative arrangements across Europe, the Atlantic and beyond.

How can we take steps towards reducing our carbon footprint, and moving towards net zero?

The drive towards net zero, and minimising our environmental footprint in general, is another motivator to consider holistically how we observe the ocean. This includes thinking about how we can take a systems approach – not just to how we design the observing system, but also how we fund it, implement the observing system as a system, and how we deliver data

from the system to ensure we achieve optimum value in terms of data and products and its utility, for investment of funds and effort.

How we fund and coordinate ocean observations. The current observing system is an impressive achievement but it is fragile, largely funded through short term projects and grants reliant on the determination of committed individuals and institutions to hold it together. Transitioning funding to ensure that the core of the observing system is funded as a form of infrastructure would enable more strategic approaches to observing system design, the stability to form partnerships and collaborations, and the investment in targeted technology development and innovation to observe the ocean smarter. Such an 'infrastructure' approach would also require inclusive planning and prioritisation processes to ensure investment will have optimum benefit and utility to a broad range of partners and stakeholders.
(see associated G7 FSOI proposed activity on Governance, Coordination and Funding of Sustained Observations).

How we evaluate observing system requirements, evolve observing system design and target investment, including in new technologies. This will enable us to move towards a strengthened integrated design of the observing system to ensure (a) it works optimally in concert with data and prediction systems, and (b) we close gaps in the observing system in space, time or variables c) that we continually observe the ocean *smarter* to deliver to more requirements, applications and hence deliver *more* benefit for investment,*(See associated proposed activity on an Observing System Evaluation Framework, in coordination with the GOOS programme for the UN Ocean Decade, ObsCoDe).*

How we target innovation to develop and integrate new technologies. Development of underpinning capabilities, ideally co-ordinated across the G7, is required urgently. Users of oceanographic data will require similar or better levels of accuracy/quality/repeatability in the future, with demand for global scale observations of a broader range of variables, particularly biology. Increased research and development into sensors, optimisation of autonomous platforms and communications systems and the rapid expansion of the associated data ecosystem will ensure that options for managing the technological transition remain open and de-risk the shift to net-zero of larger research infrastructure. Partnerships with industry will be important if a shared understanding of the obstacles is realised. In 2017, the FSOI Working Group identified a set of actions for strengthened coordination on sensor development. We proposed building on these previous working group discussions, and expanding the discussion to consider the range of technological developments and challenges in light of the drive towards net zero.

How we implement the observing system: Recognising that ocean observing is a global collaboration, how do we ensure we have the frameworks in place to take a systems approach to optimise effort and utility of capabilities at sea e.g. coordinated approaches to our research vessel operations to support deployments of the sustained observing system and through agreements on infrastructure sharing (see associated *G7 FSOI proposed activity on Governance, Coordination and Funding of Sustained Observations).*

How we deliver data to meet a broad range of needs. Data must be findable, accessible, interoperable and reusable (FAIR). In other words, advancing the 'collect once use many times philosophy will vastly improve the cost per unit of information value if we maximise data use and it will be important to go the extra steps to optimise data delivery, utility and benefit through the development of a well-designed data ecosystem, which is also a key motivator also of the development of digital twin ocean capability *(see associated G7 FSOI proposed activity on enabling Digital Twin Ocean capability*).

2. Description of Activity and next steps

We propose convening the G7 to share best practice on activities which contribute to the development of net zero ocean capability, aligning with the observing system evaluation activities in coordination with the GOOS UN Ocean Decade proposed activity on integration. Linking to data concepts described in the digital twin ocean is critical. Building upon joint planning systems, collaborative arrangements and data sharing arrangements that cut across disciplines/data centres provides a basis for further integration.

Phase 1:

- **Form a small task team** of representatives from across the G7, and as part of the wider Future of the Seas and Oceans Initiative (FSOI), to take forward focused tasks, to:
    - Consider approaches which could improve efficiency and maximise synergies, integration and utility of ocean observation and data systems.
    - Identify activities across G7 members which contribute to the development of net zero ocean capabilities. This could cover areas including ship technologies / green fuels, data infrastructure and marine autonomous systems.
    - Publish a report sharing experiences and best practices in moving towards net zero ocean capabilities, including recommendations for next steps. This might include a) integration of net zero considerations into existing G7 FSOI activities, and/or b) the development of an ongoing net zero focused activity.
- **Organise a showcase event** under the UK G7 Presidency and inspired by the NZOC project and the activities of G7 members and international partners, highlighting the opportunities and potential of new technologies and approaches as we move towards net zero.

Phase 2:

Depending on the outcomes of phase 1, consider the development of an activity focused on coordinated approaches to technological development, testing and integration into the observation system.

3. Resourcing

Phase 1:

- 20% FTE Support from the G7 FSOI coordination Centre
- Expert engagement in a Task Team to develop initial report
- UK Gov/Defra support for Showcase Event.

Phase 2:

- To be determined.