



PLANNING OF GESAMP ACTIVITIES: MARINE GEOENGINEERING

Terms of reference and work plan for the second phase of the GESAMP Working Group 41 On Ocean Interventions for Climate Change Mitigation¹

Background and context

- 1 The original Terms of Reference for this Working Group were agreed in 2015, see attached annex. The work programme was envisaged to take place over a two to three-year period.
- 2 The overall aims of WG 41 set at that time were:
 - .1 to better understand the potential environmental and wider societal implications of different marine geoengineering approaches on the marine environment; and
 - .2 to provide advice to the London Protocol Parties to assist them in identifying those marine geoengineering techniques that it might be sensible to consider for listing in the new annex 4 of the Protocol;
- 3 From 2015 to 2019 the Working Group on Marine Geoengineering carried out the first phase of the work which culminated in the report of WG 41, entitled *High level review of a wide range of proposed marine geoengineering techniques*, published in March 2019 and which can be downloaded from the GESAMP website: <http://www.gesamp.org/site/assets/files/1996/rs98e-1.pdf>
- 4 That report provided an initial high-level review of a wide range of proposed or suggested marine geoengineering techniques based on published information, addressing the first of the Working Group's 2015 Terms of Reference (ToR 1). It also addressed the first element of the 2015 ToR 2 by producing a more detailed review of a subset of proposed marine techniques with potential for climate change mitigation, that focused on their efficacy, practicality, knowledge gaps, verification of carbon sequestration (i.e. providing evidence that sequestration was achieved) and potential environmental and social/economic impacts and other side-effects. However, the Working Group was unable to complete the 2015 ToR 2 due to the limited scientific evidence.
- 5 The report presented recommendations for the future work of the group to:
 - .1 develop a flow chart and questionnaire with guidance to elicit information from proposers of marine geoengineering approaches, including individuals, institutes, government agencies or others looking to undertake marine geoengineering activities, to enable a preliminary assessment (including constructive feedback) of their relevant techniques by regulators, policy-makers, funders or anyone considering or permitting proposals;

¹ Note that the Working Group will still address non-climate related techniques that fall within the London Protocol's definition of marine geoengineering e.g. fisheries enhancement.

- .2 develop a holistic assessment framework that includes social, political, economic, ecological, ethical and other societal dimensions by using a systems approach framework such as that presented at the March 2019 workshop (see below); and
- .3 address the remaining elements of the original 2015 ToR 2.

6 The availability of funding from the Government of Canada enabled WG 41 to hold a small workshop at IMO in late March 2019 to focus on the societal issues of marine geoengineering, involving some members of GESAMP Working Group 41 with experts from the humanities and social sciences, mainly from the United Kingdom with some participants from Europe. The idea was that the workshop would inform the next phase of WG 41 activities.

7 The overall objectives for the workshop were:

- .1 to develop an appreciation where the social sciences stand in terms of being able to contribute substantively to the work of the GESAMP WG and where the knowledge gaps are; and
- .2 to think about a way that allows the WG to benefit from the social science work.

8 Outcomes from the workshop were:

- .1 all the disciplines that we had planned to cover in the workshop were relevant to the consideration of marine geoengineering;
- .2 participants, representing a wide range of disciplines, recommended to move away from use of the term 'geoengineering' towards that of 'climate intervention';
- .3 framing the topics, around climate intervention, is essential as context and methods can affect outcomes. This issue was raised by almost every speaker regardless of their discipline; and
- .4 there was general consensus that the WG should integrate natural sciences and societal disciplines into a holistic assessment of marine geoengineering techniques and that a systems approach framework would be useful means to do this.

9 Following discussions at the March 2019 workshop and comments from GESAMP members, it was decided to change the name of the working group to the 'Working Group on Ocean Interventions for Climate Change Mitigation'. This was done to better reflect the primary focus of the Working Group and to provide a clearer message about the work of the group to non-specialists.

Terms of reference for second phase

10 The overall aims of GESAMP Working Group 41 for the second phase are:

- .1 to better understand the potential environmental and societal impacts of different ocean interventions for climate change on the ocean;
- .2 to develop a framework to integrate inputs from natural sciences and societal disciplines into a holistic assessment of ocean interventions for climate change mitigation or other purposes; and
- .3 to provide advice to the London Protocol Parties to assist them in identifying those ocean interventions for climate change mitigation, or other purposes, consistent with the London Protocol's definition of marine geoengineering, that it might be prudent to consider for listing in the new Annex 4 of the Protocol.

- 11 The second phase of the GESAMP Working Group 41 study should:
- .1 Develop a flow chart and questionnaire with associated guidance to elicit information from proposers of ocean interventions for climate change mitigation or other purposes consistent with the London Protocol's definition of marine geoengineering, to enable a preliminary assessment (including constructive feedback) of their techniques by regulators, policy makers, funders or anyone considering or permitting proposals. The flow chart and questionnaire with associated guidance will be aimed to facilitate the London Protocol 'Guidance for consideration of marine geoengineering activities' (IMO, 2015). The Working Group should also consider additional incentives that can be provided to proposers of ocean interventions for climate change mitigation to comprehensively report their approaches in the permanent public record, drawing upon the discussions of these incentives in the Working Group report. Examples of such incentives to proposers of ocean interventions for climate change mitigation include modelling assessments (externally funded) that straddle conceptual, box models on to more complex approaches such as CDRMIP (Carbon Dioxide Removal Model Inter-comparison Project).
 - .2 Develop a framework to integrate inputs from natural sciences and societal disciplines into a holistic assessment of ocean interventions for climate change mitigation or other purposes consistent with the London Protocol's definition of marine geoengineering, to be used by regulators, policy-makers, funders or anyone considering or permitting proposals, exploring the use of a systems approach framework such as that presented at the March 2019 workshop (see Elliott *et al.*, 2015; Cormier and Elliott, 2019; Barnard and Elliott, 2015).
 - .3 Provide advice to the London Protocol Parties:
 - a) identifying promising ocean interventions for climate change mitigation or other purposes i.e. those consistent with the London Protocol's definition of marine geoengineering, that might be worthwhile to consider for listing in the new annex 4 of the Protocol, including techniques having the potential to move to field testing;
 - b) developing an outline of the specific issues to be addressed in an assessment framework for each of a subset of techniques identified 11.3(a) above, using the London Protocol Assessment Framework for Scientific Research Involving Ocean Fertilization as a template;
 - c) providing an initial assessment of monitoring and verification approaches, including the difficulties and challenges, for each of the techniques, meriting detailed scrutiny, identified under 9.3(a) above; and
 - d) identifying significant gaps in knowledge and uncertainties associated with each of the small suite of techniques identified 9.3(a) above that need to be addressed to assess their implications for the marine environment and, where appropriate, the atmosphere.
 - .4 Provide brief updates, based on new scientific evidence since the WG 41 report was published in March 2019 (in particular from the IPCC 'Special Report on the Ocean and Cryosphere in a Changing Climate' published in 2019, and the forthcoming IPCC 6th Assessment Reports) on:
 - a) any new proposed ocean interventions that may have potential for climate change mitigation or other purposes consistent with the London Protocol's definition of marine geoengineering such as fisheries enhancement, and their scientific practicality and efficacy; and

- b) the potential environmental and societal impacts of ocean interventions for climate change mitigation or other purposes consistent with the London Protocol's definition of marine geoengineering, on the marine environment and, where appropriate, the atmosphere.
- .5 Produce reports and potentially peer-reviewed scientific papers on the points above at appropriate points in the work plan.

Work plan

12 The working methods of the Working Group will be a mix of face to face meetings, intersessional work/correspondence and videoconferencing/telephone-conferencing.

13 Provisional timeline for the second phase (subject to availability of funding):

- .1 Co-chairs and technical secretary of the Working Group to produce a detailed scope of the work to address the Terms of Reference for the second phase and finalize potential Working Group members in xxx;
- .2 Full Working Group meeting in xxx to address the Terms of Reference;
- .3 Deliver a meeting report by xxx;
- .4 Potential additional Working Group meetings xxx;
- .5 Deliver draft final report addressing points 8.1 and 8.3 of the phase 2 Terms of Reference by xxx;
- .6 Peer review of the draft final report addressing points 8.1 and 8.3 of the phase 2 Terms of Reference required by xxx;
- .7 Presentation of draft assessment framework integrating natural sciences and societal disciplines into a holistic assessment of [marine geoengineering or climate intervention] techniques at a stakeholder workshop in xxx 2022 for review by experts from all relevant disciplines (subject to specific funding being available);
- .8 Deliver final report by xxx;
- .9 Prepare workshop report within 8 weeks after the workshop;
- .10 Alternatively, instead of points 7, 8 and 9 above, carry out a wide peer review process
- .11 Revise draft assessment framework based on results of the workshop or wide peer review process;
- .12 Prepare draft final report, by xxx;
- .13 Peer review of the draft final report covering the draft assessment framework, i.e. point 8.2 above required by xxx;
- .14 Deliver final report by end 2022; and
- .15 Provisions for publication, dissemination and outreach.

Administrative arrangements:

14 Administrative arrangements for the second phase of the Working Group are provided below:

Lead Agencies:	IMO, IOC-UNESCO and WMO
WG Co-Chairs:	Dr. Chris Vivian (United Kingdom) and Professor Philip Boyd (Australia)
WG members:	To be confirmed during second quarter 2020. As stipulated by GESAMP participation in the second phase needs to be more geographical representative and gender balanced.
WG Technical Secretary:	Andrew Birchenough (IMO)

References:

- Barnard, S. and Elliott, M. (2015) The 10-tenets of adaptive management and sustainability: A holistic framework for understanding and managing the socio-ecological system. *Environmental Science and Policy* 51: 181-191.
<https://www.sciencedirect.com/science/article/abs/pii/S1462901115000817?via%3Dihub>
- Cormier, R., Elliott, M. and Rice, J. (2019) Putting on a bow-tie to sort out who does what and why in the complex arena of marine policy and management. *Science of the Total Environment* 648: 293–305.
<https://www.sciencedirect.com/science/article/pii/S0048969718331322?via%3Dihub>
- Elliott, M., (2015) “And DPSIR begat DAPSI(W)R(M)!” - A unifying framework for marine environmental management. *Marine Pollution Bulletin* 118: 27–40.
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- GESAMP (2019) “High level review of a wide range of proposed marine geoengineering techniques”. (Boyd, P.W. and Vivian, C.M.G., eds.). (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UN Environment/UNDP/ISA Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 98, 144 p.
- IMO (2015) Guidance for consideration of marine geoengineering activities LC-LP.1/Circ.67. International Maritime Organization. <https://docs.imo.org/Shared/Download.aspx?did=90294>

ANNEX

Original Terms of Reference for GESAMP Working Group 41

1 The Terms of Reference for this Working Group were agreed at the forty-second session of GESAMP, held in Paris, France, in 2015. The work programme was envisaged to take place over a two to three-year period.

2 This GESAMP study aim is to:

- .1 better understand the potential environmental (and social/economic) impacts of different marine geoengineering approaches on the ocean; and
- .2 provide advice to the London Protocol Parties to assist them in identifying those marine geoengineering techniques that it might be sensible to consider for listing in the new Annex 4 of the Protocol.

The specific Terms of Reference are:

3 The GESAMP study should provide an overview to GESAMP Agencies and their respective Member States of a wide range proposed marine geoengineering techniques and their potential implications by:

- .1 providing an initial high-level review of a wide range of proposed marine geoengineering techniques, based on published information, addressing:
 - .1 the main rationale, principle and justification of the techniques;
 - .2 their potential scientific practicality and efficacy for climate mitigation purposes;
 - .3 the potential impacts of different marine geoengineering approaches on the marine environment and the atmosphere where appropriate;
 - .4 identifying those techniques:
 - i. that appear unlikely to have the potential for climate mitigation purposes, and
 - ii. that appear to be likely to have some potential for climate mitigation purposes and that bear further detailed examination;
- .2 providing a detailed focused review of a limited number of proposed marine geoengineering techniques that are likely to have some potential for climate mitigation purposes addressing:
 - .1 The potential environmental and social/economic impacts of those marine geoengineering approaches on the marine environment and the atmosphere where appropriate.
 - .2 An outline of the issues that would need to be addressed in an assessment framework for each of those techniques, using the London Protocol Assessment Framework for Scientific Research Involving Ocean Fertilization as a template.
 - .3 Their potential scientific practicality and efficacy for climate mitigation purposes.
 - .4 An assessment of monitoring and verification issues for each of those marine geoengineering techniques.

Identification of significant gaps in knowledge and uncertainties that would require to be addressed to fully assess implications of those techniques for the marine environment and the atmosphere where appropriate.

.3 produce reports on the above work at appropriate points in the work plan.

4 The expertise required by the Working Group includes:

.1 marine scientists and engineers with expertise in marine ecology (in particular plankton ecology, macroalgae and benthos), fisheries, marine chemistry/geochemistry/biogeochemistry, physical oceanography (including modelling), atmospheric chemistry and climate science;

.2 scientists and engineers who have studied marine geoengineering techniques and their potential impacts; and

.3 social scientists with expertise including environmental economics.

Provisional work plan

5 The working methods of the Working Group will be a mix of meetings and intersessional work/correspondence, including video-conferencing/telephone-conferencing where appropriate.

6 Provisional timeline:

.1 Workshop in 1st -2nd quarter 2016 to address point 1 of the Terms of Reference;

.2 Deliver a workshop report by end June 2016 addressing point 1 of the Terms of Reference;

.3 Deliver draft report addressing point 1 of the Terms of Reference by end October 2016;

.4 Workshop in 4th quarter 2016/early 1st quarter 2017 to address point 2 of the Terms of Reference;

.5 Deliver a workshop report by end May 2017;

.6 Deliver draft final report addressing point 2 of the Terms of Reference by end August 2017;

.7 Peer review of the draft report required;

.8 Deliver final report by end January 2018; and

.9 Provisions for publication, dissemination and outreach (PR).
