Ocean-based Negative Emission Technologies

OCEAN NETs

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Author(s)	Judith Meyer, David Keller
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Abstract: The aim of this deliverable is to establish a strategy for the proper exploitation and dissemination of the results obtained in OceanNETs. We develop guidelines for knowledge management and protection as well as dissemination goals and also identify the target audiences and define the relevant communication channels and tools.

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Summary

The overall aim of the OceanNETs project is to assess to what extent, and under what conditions the deployment of ocean-based negative emission technologies could contribute to realistic, sustainable and effective pathways for Europe and the world to achieve climate neutrality and reach the goals established in the Paris Agreement. The project also intends to identify and prioritize options with the most potential in regard to CO_2 mitigation, environmental impact, risks, co-benefits, technical feasibility, cost effectiveness, and political and societal acceptance. For OceanNETs research to be of maximum use, the project results must be disseminated and communicated to relevant audiences in a comprehensive and understandable manner. The project aims to provide information for major scientific assessments on national and international level, including IPCC and IPBES, and inform decision- and policy-makers as well as society as a whole about optimal climate mitigation strategies.

This document presents the exploitation and dissemination plan of the OceanNETs project. It provides a summary of OceanNETs as a whole and outlines the expected impacts of the projects with respect to the recommendations that will emerge from it. These aim to provide an enhanced capacity for the EU and the international community to develop optimal pathways to reach the Paris Climate Agreement goals. To make project expertise and results easily accessible for use within the project and for all stakeholder, this document then sets the dissemination and communication's objectives and principles and lastly outlines details on the communication strategy and on the identified stakeholders and users. Professional science communication strategies and concepts will be used to ensure that relevant and meaningful information reaches a wider audience beyond academia and the policy world. Professional data management will ensure that this data is easily accessible and remains so even after the project ends. Through the stakeholder dialogue we will enhance the project acceptance and strengthen the social and environmental sustainability and benefits. We also anticipate providing information and feedback that can be utilized immediately by stakeholders when making decisions and for strategic planning. Overall, we expect that project results will become widely known and exploited.

This document will serve as a "living document" throughout the project, guiding the communication and dissemination effort carried out by the consortium. Updates will be released anytime it will be needed to ensure effective management of these activities and their integration in the project as a whole. At the end of the project, a final version will be presented, together with the products and results of each dissemination activity, reporting also future-oriented dissemination and exploitation activities, foreseen by each partner, after the end of the project.

1. Introduction

The impacts of climate change are already being felt and projected to increase unless much more action is taken to limit warming. The Paris Agreement (2015)[1] and the IPCC Special Report on the impacts of global warming of 1.5°C (2018)[2] describe the international goals and broad measures required to limit global warming to "well below 2°C above pre-industrial levels" and to pursuing efforts to limit the temperature increase to 1.5 °C. Many actions must be taken to achieve this goal. In addition to emission reductions urgently needed to achieve this goal, the IPCC Special Report on Global Warming of 1.5°C highlighted with *high confidence* that all projected pathways that limit warming to 1.5°C also require use of carbon dioxide removal (CDR) on the order of 100–1000 GtCO2 over the 21st century. The majority of pathways that limit warming to 2°C also require use of CDR. CDR approaches are also known as Negative Emission Technologies (NETs). Proposed NETs encompass a range of methods aimed at reducing atmospheric CO_2 levels by either seeking to engineer the removal and subsequent storage of CO_2 or by deliberately enhancing land and ocean carbon sinks to increase the removal of CO_2 from the atmosphere. Understanding of NETs potentials, feasibilities, and risks are limited, even though it is now clear that NETs will be needed at scale within very few decades to complement other climate change mitigation activities. To date the majority of research on NETs has focused on terrestrial-based methods. From this research it is already clear that achieving the Paris Agreement goals with land-based NETs alone, will be extremely difficult, if not impossible. However, much less is known about ocean-based NETs, although some of them appear promising, especially with respect to the potential scale of application.

Thus, OceanNETs responds to the societal need to rapidly provide a scientifically rigorous and comprehensive assessment of ocean-based NETs. It focuses on analyzing and quantifying the environmental, social, and political feasibility and impacts of ocean-based NETs. The project aims to identify to what extent, and how, ocean-based NETs can play a role in keeping climate change within the limits set by the Paris Agreement. The project also includes potential interactions with non-ocean-based NETs in the analysis and closely interacts with stakeholders to develop societally and politically relevant feasibility assessments of ocean- based NET deployment strategies.

The three main objectives of the OceanNETs project are:

- Determine the most effective ocean-based NETs with low environmental and ecological risks (e.g., to biodiversity, ecosystem services) and high co-benefits.
- Identify for different ocean-based NETs the degree of (and factors affecting) social and political acceptance, affordability, and societal impacts and risks (e.g., to food

[1] UNFCCC. Adoption of the Paris Agreement. Report No. FCCC/CP/2015/L.9/Rev.1, http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf (UNFCCC, 2015). 2. UNFCCC. INDCs as communicated by Parties. http://www4.unfccc.int/ submissions/indc/Submission%20Pages/submissions.aspx (2015).

[2] IPCC 2018a. Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change ed V Masson-Delmotte et al (Geneva, Switzerland: IPCC).

security, human safety).
- Comparatively assess ocean NETs - by combining new multi-disciplinary data, stakeholder knowledge, and case study assessments - and provide this information to society and policymakers to increase their capacity to enable and design optimal medium-to-long-term sustainable mitigation pathways.

1.1 Project Objectives that will be realized through the PEDR

1) Become a widely recognized, internationally leading and referenced knowledge resource on ocean-based NETs.
2) Raise the general public's awareness of the project and advance it's understanding of ocean-based strategies for preventing and mitigating climate change impacts.
3) Engage stakeholders from the very beginning of the proposed work in order to use stakeholder knowledge for an optimal implementation of our research case studies, scenario modelling, participatory approaches, and analysis and assessment.
4) Exchange experience with projects and groups working in the field of negative emission technologies in order to join efforts, minimize duplication and maximize potential.
5) Advance the expertise and knowledge on ocean-based NETs and support major international scientific assessments.
6) Put the OceanNETs results to use in policy and decision making.

The dissemination strategy will follow principles and best practices for successful dissemination:

1) All research results/reports will be duly reviewed and a copy will be sent to relevant partners involved in the project before these are published and disseminated. When appropriate, the reports will refer to other research projects and build on the existing results and literature.
2) Research will be conducted following sound analysis and scientific principles, taking into account as much as possible policy requirements and needs.
3) All partners who will contribute to the project activities will be duly informed about the final outcomes and implications stemming from the project results.
4) All public results will be accessible from the project website and usable from all parties who may benefit from them.
5) The results will be shared with potential users and stakeholders through a variety of dissemination practices.

PEDR objective:

1) Describe how OceanNETs will construct, update and maintain internal tracking of dissemination activities.
2) Describe how OceanNETs will establish and maintain internal (consortium) and external (International Scientific Advisory Board (IAB), Stakeholder Reference group (SRG)) communication.

3) Describe how OceanNETs will establish and support a two-way communication dialogue with the scientific community, stakeholders and policy/decision makers through the OceanNETs website, promotional material, networking activities, publications, flyers, posters etc.
4) Describe how OceanNETs will raise the awareness of the non-specialist audience about ocean-based NETs.
5) Plan how to shape OceanNETs products for the best possible interoperability and to maximize their impacts.

2. Impact

2.1. Expected impacts

OceanNETs results will contribute directly to the expected impacts for the Horizon 2020 call on "Negative emissions and land-use based mitigation assessment" and push the EU to the forefront of research on ocean-based solutions to climate change, which have until now been largely neglected in favor of terrestrial measures. In particular, Ocean NETs will investigate sustainable levels of deployment and possible co-benefits of marine CDR methods (e.g. mitigating acidification, alleviating biodiversity loss/degradation, coastal protection). This will better prepare the EU to lead the international community, and if warranted, to begin implementing more promising solutions. OceanNETs partners have a proven record of high-impact papers and policy-oriented assessment reports in their fields and are ready to extend this record through major new findings. Professional science communication expertise / tools are and will continue to be used to ensure that meaningful and engaging information reaches audiences beyond academia and the policy world. Through the stakeholder dialogue we also anticipate providing information and feedback that can be utilized immediately by stakeholders when making decisions and for strategic planning.

Table 2.1: Output/Products from OceanNETs**	**WP***	**Potential user groups**
Report and publications on carbon accounting schemes suitable for (ocean) NETs; required to integrate (ocean) NETs into climate policies by providing information about efficacy, side effects, and guidance for governance schemes	1	Policy makers (EU, members states, international), regulators, NGOs, financial actors, consultants, implementing companies
Report and publications on operative and overall economic costs of ocean NETs, summarized in a cumulative cost curve; required to improve estimates for future emission scenarios	1 & 6	Policy makers, financial actors, consultants, implementing companies
Database and map of existing and planned ocean-based NET projects	1	Policy makers, regulators, academic community
Integrated assessment models that allow assessing i) side effects and ii) strategic incentives to deploy ocean NETs	1	Policy makers, academic community
Report identifying challenges and opportunities for emerging ocean-based NETs in regional and global ocean governance frameworks considering available technologies and potential future scenarios.	2	EU, Member States, regional and global policy makers, regulators, academia, NGOs and industry
Policy brief highlighting the potential application and risks of ocean-based NETS for achieving climate neutrality when considering regional and global ocean governance frameworks. Key lessons learnt and considerations for implementing ocean-based NETs within regional and global ocean governance frameworks will be highlighted.	1- 6	EU, Member States, regional and global policy makers, regulators, academia, NGOs and industry
Report and publications on public interest, opposition, and support related to ocean-based NETs and their deployment incentives	3	EU and member state policy makers, NGOs, academia

Report and publications assessing mineral behavior during simulated alkalinization in the natural environment and associated biological responses, including their possible impacts on ecosystem health and potential feedbacks on CDR effectiveness	5	Academic community, environmental ministries
Report and publications on NET efficacy, environmental impacts, and interactions in different modelled deployment scenarios	4, 5	EU, member states, and international policy makers, academia, NGOs, companies, public
Open access data sets from ESM NET deployment scenarios	4	Academic community, NGOs
Report and publications on ocean alkalinization case-studies that assess the potential for incorporating these into existing national industries. This will include an analytical framework that can be easily used by other nations to assess their potential pathways for ocean alkalinization.	1- 6	EU and member states, policy makers, academic community, companies, NGOs, public
Stakeholder forum – a platform for networking and providing 'added value' to the dialogue between project scientists and stakeholders	7	Stakeholders and project partners
Public website to provide information on ocean-based NETs and the project	7, 9	Public and stakeholders
Transdisciplinary assessment of the natural and societal dimensions of ocean-based negative emissions	Joint effort	EU, member states, and international policy makers

2.1.1 Supporting major international, national, and EU scientific assessments

OceanNETs delivers new knowledge on the potential, risks, and co-benefits of using ocean-based NETs for climate change mitigation. CDR is already a focus of IPCC AR6, and it is likely that OceanNETs results will contribute to subsequent IPCC assessments. More specifically, the carbon dioxide removal model intercomparison project (CDRMIP; a project coordinated by two OceanNETs PIs) which is endorsed by WCRP contributes to AR6. OceanNETs will contribute to analyses of the ocean-based CDRMIP experiment. OceanNETs research will also deliver results for inclusion in future IPBES Assessment Reports. Principal investigators and their close colleagues have been and currently are involved in writing IPBES and IPCC reports. We are committed to efforts to continue contributing to IPBES and IPCC assessments in the future (see section 3.1.6).

The EU and individual nations must assess and continue to update plans to meet their Paris Agreement pledges and for coastal nations we anticipate that OceanNETs results will be highly relevant during this process. WP1 will produce a database and map of ocean-based NET projects that will be valuable for assessing past, present, and planned activities (D1.4). Regarding policy development and governance issues, OceanNETs will also bring together knowledge on traditionally fragmented governance frameworks (sectoral, environmental, and climate) and thereby vastly contribute to integrating knowledge, concepts, and information across multiple regulatory landscapes. For the research program FutureEarth, OceanNETs will provide both new fundamental research results as well as knowledge that can be used for concrete actions to tackle the challenge of climate change

and associated impacts. The marine component of Earth system science in FutureEarth, including core programs IMBeR and COASTS, will be boosted through OceanNETs. OceanNETs will contribute to tackling the WCRP Grand Challenges on *Carbon Feedbacks in the Climate System* and to achieving objectives of CLIVAR (Climate and Ocean: Variability, Predictability and Change). OceanNETs will also add to the knowledge base for the GESMAP working group 41 on marine geoengineering, which includes ocean-based NETs, and updates of the UN 2030 Agenda for Sustainable Development and associated follow-up assessments.

Impact #1 Performance Indicator	**Target (minimum quantity)**
Multiple peer-reviewed publications from each WP (all deliverables which are cited as a report will eventually result in one or more peer-reviewed publications); the list of papers and their impact (journal impact factor, number of citations) will be monitored by the OceanNETs project office/coordinator; further monitoring and reporting will be carried out on the citations/use of OceanNETs work in international assessments	Publications in Year 1: 4 Year 2: 8 Year 3: 12 Year 4: 16 Total: 40
OceanNETs PIs invited to be IPCC, IPBES, GESAMP, etc., assessment report authors or reviewers	4-5 invitations (aspirational)
Database and currently already existing or announced ocean NETs projects, including a world map of projects	Database and map available in month 24 and annually updated

2.1.2 Developing a comprehensive medium-to-long term vision and analytical framework on pathways to achieve climate neutrality in the perspective of reaching the Paris Agreement goals

OceanNETs will provide necessary information for developing strategies to achieve climate neutrality. Our research will facilitate the integration of ocean-based climate mitigation measures into relevant national and international policies, strategies and planning. Specifically, understanding of how ocean-based NETs could potentially be implemented within the current and possible future ocean governance landscape (contributing to the EU International Ocean Governance Agenda), and create a consolidated outlook for applying ocean-based NETs by identifying e.g. shared policy objectives, concepts, principles, and terminology. Such an understanding will provide an enhanced capacity for the EU and other policy makers to contribute to better, more effective and sustainable policy making at all levels and across all relevant policy fields. The dialogue with stakeholders will enable the identification and consideration of potential pathways for ocean NETs within different future governance scenarios (WP2 Task 2.2). OceanNETs results will also support actions towards achieving SDGs, with numbers 13 (*Climate Action*) and 14 (*Life Below Water*) being of high relevance. The SDG analytical framework developed in WP7 and applied to other WP outputs will provide understanding of how ocean-based NETs could sustainably contribute to pathways that achieve climate neutrality. Importantly, this framework will also provide information concerning unsustainable NETs or levels of deployment, i.e., pathways to avoid. Furthermore, the

ocean alkalinization case studies (WP6) will provide realistic understanding of how two ocean-based NET approaches could be used in the medium-to-long term.

Impact #2 Performance Indicator	Target (minimum quantity)
SDG analysis framework for evaluating ocean-based NETs developed and applied	1 publication describing the analysis framework and how "sustainable" different ocean-based NETs are and how they would contribute to achieving the 2030 Agenda and SDGs Use of the analysis framework in other OceanNETs publications
Qualitative governance scenario-building exercise conducted with stakeholders; analysis of results	1 publication describing the scenarios
Assessment of the potential application and risks of ocean-based NETS for achieving climate neutrality when considered within regional and global ocean governance frameworks	1 policy brief
Ocean alkalinization case studies completed	2 publications (one for each case study)
Core theme synthesis products	3 high level publications (1 per core theme)

2.1.3 Improved ex-post, spatially explicit monitoring of the mitigation performance of the land sector

While the land sector is not the primary focus of OceanNETs, our results can be used to improve monitoring of the mitigation performance of the land sector in the case that ocean-based NETs are utilized. This is because NET efficacies (at lowering atmospheric CO_2) are partially determined by the response of the carbon cycle to CO_2 removal. When carbon is deliberately transferred to or removed from a reservoir, the carbon cycle responds by redistributing the carbon in other reservoirs, as well as within them, as biological, chemical, and physical processes adjust to the changing quantities of carbon within the reservoir and steeper gradients at the reservoir interfaces. By reducing the greenhouse effect, which leads to cooling, CDR also triggers climate-carbon cycle feedbacks. That is, taking CO_2 out of the atmosphere will weaken natural carbon sinks and can lead to backfluxes of CO_2 from the ocean and/or the land – responses that oppose CDR. Interactions (synergies or trade-offs) between NETs could also affect efficacy. Together, these responses mean that any land-or ocean-based method removing 1 Gt of CO_2 from the atmosphere will not ultimately reduce the atmospheric CO_2 inventory by 1 Gt. Understanding interactions between NETs and the carbon cycle, and combinations of NETs is thus, needed to quantify the mitigation performance of any sector, the AFOLU (Agriculture, Forestry and Other Land Use) sector in particular. OceanNETs will provide understanding and quantification of the impacts of ocean NETs on the global carbon cycle, including feedbacks with the land and atmosphere. Interactions between land- and ocean-based NETs will also be assessed in the project. This information will then be communicated to appropriate agencies and managers (e.g., Food and Agriculture Organization of the United Nations; FAO) so that better plans, which can account for

carbon cycle responses, can be developed to verify and monitor the mitigation performance of the land sector.

Impact #3 Performance Indicator	Target (minimum quantity)
Communication channels to the appropriate authorities and projects established	4 at the international level 6 at the national level (e.g., in partner countries)
OceanNETs information incorporated into project analyses, best practice guides, and/or management regulations	Each established contact (minimum of 10)

2.1.4 Enhanced international cooperation

International cooperation is especially important for ocean-based NETs as many proposed methods would need to utilize international waters and rely upon national and international industries to develop and deploy the NETs. Even NETs deployed within national waters could have downstream effects on other coastal nations. In OceanNETs we investigate many issues of international relevance and provide the information needed to make international cooperation possible. In particular, through the case studies and participatory approaches, which focus on European nations (e.g., Norway and Germany), China (including Taiwan), and Canada, the middle-East (desalination industries) we provide nation specific information that is also considered in an international context, e.g., to provide advice on international governance. OceanNETs also directly brings together partners from Finland, Norway, Germany, the United Kingdom, Spain and Australian and stakeholders from across Europe and other areas of the world. In particular the Stakeholder Reference Group (SRG) is expected to bring together a multi-national group of NGOs, industries (e.g., national and international cement and desalination industries), and political bodies and provide an opportunity for them to communicate with each other and project partners concerning ocean-based climate solutions. The SRG will facilitate feeding the OceanNETs results into the strategy development, planning and decisions at international agencies such as FAO Fisheries and Aquaculture, UN Environment, UN-OCEANS, Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO), UNDP Water and Ocean Governance, UN Department of Economic and Social Affairs (UN-DESA), UN Division for Ocean Affairs and Law of the Sea (UN-DOALOS) and the International Maritime Organization (IMO). OceanNETs results will also be transferred to EU and national environmental agencies and ministries including the European Commission's Directorate-Generals DG Clima, DG Mare and DG Env, and specifically to negotiators of international greenhouse gas reduction protocols and participating bodies in the global stocktake of greenhouse gas emissions and inventories for implementing the outcome of the Paris Agreement.

In the long term, OceanNETs will build the foundation for a future cross-sectoral platform for decision makers and other relevant stakeholders to collaborate on shared NET policy visions and pre-emptively consider potential governance opportunities and challenges arising from various regulations. This will therefore underpin future regional and global

collaboration and cross-sectoral coordination. An International Scientific Advisory Board (see Section 3.2) will also provide advice and expertise that can be used to facilitate international cooperation (e.g., to help establish new channels of communication with relevant national stakeholders, to provide awareness of hard to find data, etc.). WP5 will also participate in AQUACOSM (an EU network of mesocosms facilities for facilitating global collaboration; https://www.aquacosm.eu/) so that funding is available to allow external research groups (transnational access) to participate in the mesocosm experiments.

Impact #4 Performance Indicator	Target (minimum quantity)
A diverse group of stakeholders join the Stakeholder Reference Group (SRG)	10 stakeholders in SRG
OceanNETs results utilized by international managers and agencies (these may be members of the SRG or targeted during dissemination)	Each established contact (aspirational)
Relevant advice from International Scientific Advisory Board (ISAB) incorporated into the project; new stakeholder connections facilitated by ISAB	As required and agreed upon by the consortium
AQUACOSM funding applied for / successful	12 international external mesocosm participants

2.2 Other substantial impacts

OceanNETs will have several additional impacts that enhance innovation capacity, create new market opportunities, strengthen the competitiveness and growth of companies, and bring other important benefits for society. These include:

New market opportunities: Ocean-based NETs are not yet commercial products. Therefore, there is the opportunity for companies to use OceanNETs research to develop promising NETs as commercial products for climate mitigation purposes. Some ocean-based NETs may also have other environmental or social co-benefits (e.g., artificial upwelling has been proposed as a means of enhancing fisheries) and companies may be interested in developing technologies for these purposes, regardless of whether or not the technology is feasible for CDR.

Strengthen competitiveness and growth of companies: Since NETs are needed at scale within decades to meet climate targets, companies need information on NETs to prepare for NET-related disruptions or development opportunities. OceanNETs will provide this information so that companies can plan strategically to remain competitive and continue to grow.

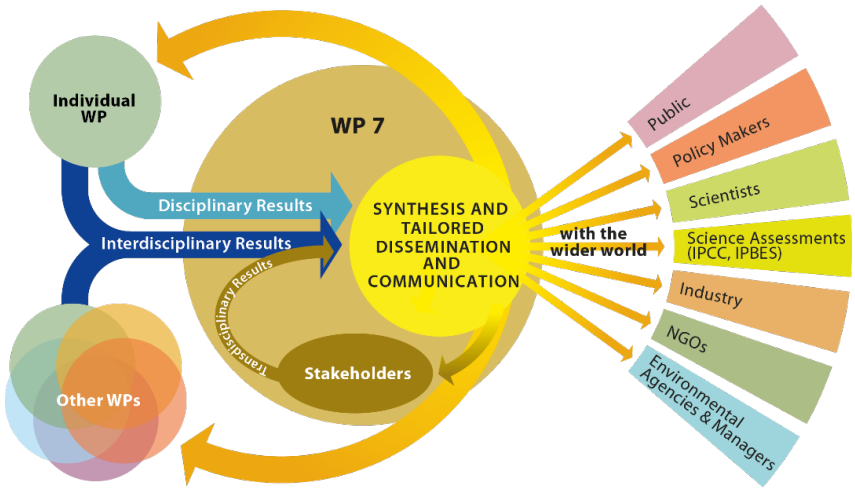
Other benefits for society: The development of new research fields (e.g., on NETs) and technologies often leads to unintended discoveries or applications that can be used to benefit society. We anticipate that OceanNETs research will find ocean-based NET related opportunities to benefit society. For example, seaweed farming NET applications may also be beneficial for countering coastal eutrophication. Blue carbon sink enhancement, if managed properly, could also increase biodiversity, serve as nurseries for important fish stocks, and provide new recreational opportunities.

Research Policy: OceanNETs will contribute to forming future research directions by providing input and advice to research policy makers and international research programs – see also section 3.1.

3. Dissemination plan to enable exploitation of results

OceanNETs will carry out a coherent analysis of the potential, risks, and challenges of using ocean-based NETs for climate change mitigation. For our research to be of maximum use (i.e., exploited), it must be disseminated and communicated to relevant audiences in a comprehensive and understandable manner. Some of our top priorities are to support major international scientific assessments, such as the IPCC, and to provide concise information for decision and policy making for the expected climate actions in conjunction with the Paris Agreement. The project results will also be communicated to the general public in order to generate useful feedbacks regarding acceptability and governance issues, in addition to satisfy legitimate education and information needs.

Figure 1. Concept of how disciplinary information from individual WPs and interdisciplinary results from multiple WPs are combined with stakeholder information to be disseminated and communicated to the wider world outside of the project, as well as used within the project.



The overarching outreach aim of the project is to become a widely recognized, internationally leading and referenced knowledge resource on ocean-based NETs. OceanNETs outreach strategy will focus on maximizing the use and uptake of the project results, by advancing stakeholders' and the general public's understanding of ocean-based strategies for preventing and mitigating climate change impacts. To fulfil its goal, OceanNETs will engage stakeholders from the very beginning of the proposed work in order to use stakeholder knowledge for an optimal implementation of our research case studies, scenario modelling, participatory approaches, and analysis and assessment, and to unlock the full potential of the stakeholder involvement for putting the OceanNETs results to use in policy and decision making.

3.1 Exploitation and dissemination strategy

To achieve maximum societal and policy impact as requested in the topic call, OceanNETs will enable the best possible exploitation of project results by the different stakeholders.

Special emphasis is placed here on informing international assessments and policy and decision making. OceanNETs wants to make sure that project results are easily accessible for non-expert stakeholders and aims at supporting stakeholders in making policy decisions. This will be achieved through the interactions with stakeholders where the project's results will be combined with existing stakeholder knowledge and expertise. These activities will be operated in WP7 and monitored in WP9. This interaction will shape OceanNETs products for the best possible interoperability, as well as shape how the project's outcomes will be communicated, not only pertaining knowledge to be communicated but also how that knowledge will be communicated.

3.1.1 Dissemination and exploitation through the SRG

As the most powerful tool for interaction with stakeholders, OceanNETs has begun establishing a Stakeholder Reference Group (SRG) including stakeholders from complementary domains and activities related to the ocean and climate change mitigation. The purpose of the SRG has two main objectives, (1) to enter into a dialogue with stakeholders in a manner that will shape research outcomes and (2) to maximize dissemination and exploitation of the project results. The SRG (Table 3.1.1) reflects a mix between European and international expertise, from regional to global level, from private sector as well as from authorities, with a gender balance considered. If contacted stakeholders are not interested in participating in the SRG dialogue, we will give them the opportunity to join a mailing list to stay informed of the project results. Stakeholders that join this mailing list will receive target dissemination materials (Table 3.1.1)

The engagement with stakeholders will take place within a standing dialogue mechanism sustained by the stakeholder reference group manager while drawing on insights and tools from living lab approaches. The SRG manager, Judith Meyer, is also the project manager who already has experience in engaging with diverse stakeholders. In addition, individual WPs will also engage directly with stakeholders as part of the research (WP1, 3, and 6). These WP activities will be monitored and documented to provide opportunities for inclusion in wider engagement activities.

The SRG manager will keep the stakeholders informed and engaged through a consistency in communications, making them part of the wider project strategy instead of only through isolated events (Task 7.2). The results of the engagement and action on information gained through the exchange will be documented and collected in a web- based SRG interaction-platform, a separate user-oriented section of the OceanNETs website (the website is further described in section 4). This information will also be accessible through the project data/knowledge base. The availability of documented interactions will consider stakeholder concerns regarding private and proprietary information.

We aim to go beyond traditional stakeholder meetings and carry out special sessions in plenary with the entire consortium and the SRG (preferably at the project general assemblies or respective back-to-back meetings). We will in particular address issues of accessibility of knowledge through both pathways: User to scientist – and – scientist to

user. What do users want to know? How can scientists learn from users? How can users exploit the scientific results and understand them in the first place?

Table 3.1.1 *Entities to be approached to take part in OceanNETs Stakeholder Reference Group (SRG) and for dissemination and exploitation purposes. Additional entities may be approached as well.*

Stakeholder	Claim/interest of stakeholder	Goal to be achieved through SRG	Relevant to WPs
International scientific assessments ▪ Intergovernmental Panel on Climate Change (IPCC) ▪ Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES)	To provide policymakers with regular scientific assessments, their implications and potential future risks, as well as to put forward adaptation and mitigation options.	Learn what information is desired for these assessments and deliver new knowledge on negative emission technologies; optimally streamlining OceanNETs results for syntheses. Contribute to sustaining Europe's leadership in climate change mitigation.	IPCC - all IPBES - 1, 4, 5, 6
Policy and decision makers of international environmental organizations ▪ United Nations Framework Convention on Climate Change (UNFCCC) ▪ United Nations Environment Program (UN Environment) ▪ Convention on Biodiversity (CBD) Secretary	Safeguard the environment through international frameworks.	Inform about the feasibility and potential impacts of using NETs to mitigate climate change. Learn what decision makers want to know and provide it.	2
Policy and decision makers of international ocean organizations ▪ UN-OCEANS ▪ Intergovernmental Oceanographic Commission (IOC-UNESCO) ▪ UNDP Water and Ocean Governance Program (UNDP-WOGP) ▪ UN Division for Ocean Affairs and Law of the Sea (DOALOS) ▪ International Seabed Authority (ISA) ▪ International Maritime Organisation (IMO)	Safeguard marine environment and coordination of ocean affairs	Inform about the feasibility and potential impacts of using NETs to mitigate climate change. Learn what decision makers want to know and provide it.	all, especially WP 2
Policy and decision makers of other international organizations dealing with, food security, economic & social affairs as well as human health & safety	Promotion and support of sustainable development and implementation of 2030 Agenda, interface between global	▪ Input regarding challenges/compatibility of OceanNETs with 2030 Agenda and SDG14.	1, 2

Stakeholder	Claim/interest of stakeholder	Goal to be achieved through SRG	Relevant to WPs
▪ United Nations Department of Economic and Social Affairs (UN-DESA) ▪ Food and Agriculture Organization of the United Nations (FAO, in general and FAO Fisheries and Aquaculture)	commitments and national action.	▪ Find out links between ocean-based NETs and nutrition and health. Relate ocean mitigation options to food production problems on land (i.e., do ocean-based NETs reduce the need for land-based NETs that are in conflict with food production).	
Policy and decision makers of regional organizations ▪ Regional Fisheries Management Organizations RFMOs (SPRFMO, ICCAT, IATTC, SEAFO, NEAFC)	Advisory and/or regulatory function for commercial fishing of transboundary fish stocks.	Input regarding challenges / compatibility of ocean-based NETs with RFMO agreements.	WPs 1, 2
▪ Regional Sea Conventions - RSCs (CPPS, OSPAR, Abidjan, Nairobi, etc.)	Advisory and/or regulatory function for environmental protection of transboundary marine zones (EEZs).	Input regarding challenges/compatibility of ocean-based NETs with RSC agreements.	
▪ European Commission, EC (selected departments such as DG Clima, DG Mare and DG Env); European Environment Agency (EEA)	Executive of the European Commission proposing, implementing and enforcing regulations, and promoting policies, e.g. integrated maritime policy.	Input regarding challenges / compatibility of ocean-based NETs with European regulations and policy goals.	all
National Climate policy makers and negotiators National environmental agencies and ministries, specifically negotiators of international GHG reduction protocols and participating bodies working on the implementation of the outcome of the Paris Agreement, such as: ▪ German Environmental Agency (UBA) ▪ Department for Business, Energy & Industrial Strategy (United Kingdom) ▪ Norwegian Environmental Agencies	Target for best management guidelines towards reducing greenhouse gas emissions, and healthy coastal environments	Learn what decision makers want to know about ocean-based NETs and provide information on them. Learn about the requirements for presenting science results to decision makers.	all
Leaders/managers of environment protection NGOs and other NGOs	Actions for environment protection and for alleviation of poverty.	Raise awareness about ocean-based NETs. Learn about the perception of climate change	all

Stakeholder	Claim/interest of stakeholder	Goal to be achieved through SRG	Relevant to WPs
▪ Ocean Health Index ▪ WWF ▪ Friends of the Earth International (FoE) § ETC Group ▪ International Union for Conservation of Nature (IUCN) ▪ Climate Analytics ▪ Oxfam ▪ atmosfair ▪ Greenpeace ▪ Marine Stewardship Council (MSC)	Information of the general public. Participate in political debate. Take part in trans- disciplinary research.	threats and favored mitigation strategies.	
Key persons from ethics organizations, arts, philosophy, psychology, journalism ▪ JuliesBicycle (charity that supports the creative community to act on climate change and environmental sustainability) ▪ Climate Home News ▪ Climate Outreach ▪ CarbonBrief ▪ Climate Justice Now! ▪ FridaysForFuture ▪ Environmental philosophers (e.g. Konrad Ott at Uni Kiel)	Safeguard any values from NET related damage.	Receive information, in which way the avoidance of dangerous climate change furthers the well-being of humanity beyond metrics based on economic issues.	all
Managers and leaders of science projects, programs, initiatives and climate service ▪ FutureEarth and associated programs and initiatives such as: o International Geosphere Biosphere Program (IGBP) o International Human Dimensions Program on Global Environmental Change (IHDP) o IMBeR — Integrated Marine Biosphere Research ▪ The Ocean and Climate Platform ▪ Leaders of other EU H2020 projects (COMFORT, CRESCENDO, etc.) ▪ Program directors of	Identify new knowledge gaps. Design new research programs. Quantify links to NETs.	Achieve synergies between OceanNETs and related research on climate change mitigation.	all

Stakeholder	Claim/interest of stakeholder	Goal to be achieved through SRG	Relevant to WPs
WCRP, Global Carbon Project, GOOS, etc. ▪ Climate services such as GERICS (Climate Service Center Germany)			
Decision makers of economic/industrial and trade organizations ▪ World Trade Organization (WTO) ▪ International Centre for Trade and Sustainable Development (ICTSD)	Avoid economic loss through impact of climate change. Develop circular economies.		all
▪ European Energy Research Alliance (EERA) ▪ International Energy Agency (IEA)	Streamline regional, national and European research efforts. Enhance the reliability, affordability and sustainability of energy.	Receive input on what knowledge is required for organization. Discuss NET options and opportunities.	
Business & Industry ▪ Energy Industries Council (EIC) ▪ Cement Industry, e.g., Holocim ▪ Marine and Environmental Engineering Companies, e.g., the DEME group	Avoid economic loss through impact of climate change. Develop circular economies. Provide business services.	Receive input on what knowledge is required by economy and trade to react to the threat of abrupt climate change and impacts. Discuss NET options and opportunities.	all

3.1.2 Targeted interaction with certain groups of stakeholders

The SRG is composed of individuals representing diverse groups with different goals, agendas, and interests as specified in Table 3.1.1 In regards to the wider stakeholder dialogue activities, a targeted interaction with specific groups of stakeholders will consider relevant project results for the specific interests of this stakeholder group. The use of more targeted communication and dissemination channels and measures, is therefore necessary in addition to the general approaches as described above. This applies specifically to the adjustment of scientific language and jargon to easily perceptible language. The SRG structure as well as personal contacts established through the SRG and prior projects/contacts will be used to initiate the dialogue with this target audience. These specific communication measures and products will be developed in conjunction with the users, and will, therefore, be in the most suitable format and repositories for the target audience. Communication activities and measures as outlined in section 4, will complement these dissemination and exploitation activities. This approach is summarized in Table 3.1.2, and some examples for these group-specific stakeholder interactions are explained below in further detail.

In collaboration with the different WPs/Core Themes, illustrations of key social (CT 1), natural (CT 2), and crosscutting (CT 3) results will be created responding to the SRG's

needs. Specific attention will be given to the visualization and communication of the information to improve user understanding and use of the information. Specific guidance material will be included that describes how the project results can be interpreted and used, its limitations, and its relation to other available studies/knowledge. For each ocean-based NET and WP key topic dissemination materials in various formats will be created describing the basics/novelty/relevance for the users (Task 7.4 and Deliverable D7.5). These dissemination materials will not only consist of traditional written documents, such as fact sheets, but also infographics, animations, videos and attractive visualizations of the project's work and outcomes.

We have contacted authors of the easy to use interactive En-ROADS IAM (integrated assessment model, https://www.climateinteractive.org/tools/c-roads/) to take up OceanNETs results (emissions, damages, mitigation measures, what damage reduction you get). This updated model version will be easily understandable for nonscientists and help in negotiations of greenhouse gas emission reduction frameworks, e.g., En-ROADS is often used to educate politicians about how different decisions affect the climate.

Next to the direct interaction of the SRG, the project managers will take care to forward selected publications in the peer-reviewed literature to the relevant stakeholders. This forwarding will include a brief summary of the major publication findings specifically dedicated to the language used by the respective stakeholder. The project office will enforce the use of glossaries and explanations/list of acronyms in all OceanNETs publications in order to facilitate this process.

In particular for the decision makers of economic/industrial and trade organizations, relevant companies, as well as leaders/managers of environment protection NGOs and other NGOs we aim to give selected presentations at suitable meetings of their organizations. Such presentations can be made in person (if feasible) or through video-conferencing. For persons from ethics, arts, philosophy, psychology, and journalism organizations, we will primarily use specialized dissemination materials (factsheets, infographics, animations, videos and attractive visualizations, brief summaries).

Table 3.1.2 a *OceanNETs results to be disseminated to the different stakeholders and users, expected impact and channels to be used.*

Stakeholder	Expected project results of interest	Expected impact	Dissemination channel
International scientific assessments	▪ Results on ocean-based NETs potential, feasibility, side-effects, and impacts. ▪ Interdisciplinary synthesis publications, and other scientific publications in the peer-reviewed literature on ocean-based NETs.	▪ Close knowledge gaps for IPCC and IPBES reports. ▪ Provide scenarios that include ocean-based NETs. ▪ Narrow down or estimate adequately uncertainties in projections. ▪ Contribute to sustaining Europe's leadership in climate science and mitigation.	▪ SRG and SRG interaction platform ▪ All scientific publications ▪ OceanNETs members as lead and contributing authors

Stakeholder	Expected project results of interest	Expected impact	Dissemination channel
Policy and decision makers of international environmental organizations; Climate policy makers and negotiators	▪ Transdisciplinary synthesis paper on the natural and societal dimensions of using ocean-based NETs to mitigate climate change. ▪ Policy brief on governance issues concerning ocean-based NETs ▪ Results on sustainable levels of ocean-based NET deployment and potential pathways of deployment.	▪ OceanNETs results and knowledge to be used for informed decisions to sustain the EU and the European nations during the negotiations within the UNFCCC process. ▪ Enable effective measures and protocols for greenhouse gas emission reductions. ▪ Input to updates of UN's 2030 Agenda for Sustainable Development ▪ Take urgent action to combat climate change and its impact – SDG 13.	▪ SRG and SRG interaction platform ▪ Dissemination materials (policy brief, factsheets, infographics, animations, videos and attractive visualizations) ▪ Selected scientific publications specifically on governance and feasible NET mitigation pathways ▪ Policy brief on governance issues
Policy and decision makers of international marine/maritime environmental organizations;	▪ Transdisciplinary synthesis paper on the natural and societal dimensions of using ocean-based NETs to mitigate climate change. ▪ Policy brief on governance issues concerning ocean-based NETs ▪ Results on ocean-based NETs side-effects and impacts. ▪ Results on sustainable levels of ocean-based NET deployment and potential pathways of deployment.	▪ Enable effective measures and protocols to monitor and regulate ocean-based NET activities ▪ Input to updates of UN's 2030 Agenda for Sustainable Development. ▪ Enable sustainability of oceans – SDG 14.	▪ SRG and SRG interaction platform ▪ Dissemination materials (policy brief, factsheets, infographics, animations, videos and attractive visualizations) ▪ Selected scientific publications specifically on ocean governance and feasible ocean-based NET mitigation pathways ▪ Policy brief on governance issues
Policy and decision makers of other international organizations dealing with, food security, economic & social affairs as well as human health & safety	▪ Information on industries involved in ocean-based NETs (i.e., the implications expansions of these industries have) ▪ Results on ocean-based NETs side-effects (including co-benefits) and impacts. ▪ Results on sustainable levels of ocean-based NET deployment and potential pathways of deployment.	▪ Input to updates of UN's 2030 Agenda for Sustainable Development. ▪ Prepare for NET synergies and tradeoffs.	▪ SRG and SRG interaction platform ▪ Dissemination materials (policy brief, factsheets, infographics, animations, videos and attractive visualizations) ▪ Selected scientific publications specifically on ocean governance and ocean-based NET impacts upon biodiversity (fisheries) and resources ▪ Policy brief on governance issues

Stakeholder	Expected project results of interest	Expected impact	Dissemination channel
Policy and decision makers of regional organizations	▪ Transdisciplinary synthesis paper on the natural and societal dimensions of using ocean-based NETs to mitigate climate change. ▪ Policy brief on governance issues concerning ocean-based NETs ▪ Results on regional ocean-based NETs side-effects and impacts.	▪ Enable effective measures and protocols to monitor and regulate regional ocean-based NET activities ▪ Prepare for NET synergies and trade-offs	▪ SRG and SRG interaction platform ▪ Dissemination materials (policy brief, factsheets, infographics, animations, videos and attractive visualizations) ▪ Selected scientific publications specifically on ocean governance and ocean-based NET impacts upon biodiversity (fisheries) and resources ▪ Policy brief on governance issues
Decision makers of economic/industrial and trade organizations	▪ Information on industries involved in ocean-based NETs (i.e., the implications expansions of these industries have) ▪ Assessment of NET mitigation options and possible pathways of deployment ▪ Interactions between NETs (synergies and trade-offs)	▪ Contribute to technical developments for ocean-based NETs. ▪ Choose optimal regions for long-term investments. ▪ Prepare for potential NET regulations.	▪ SRG and SRG interaction platform ▪ Dissemination materials (factsheets, infographics, animations, videos and attractive visualizations) ▪ Selected presentations at meetings of these organizations ▪ Selected publications on ocean-based NETs
Leaders/managers of environment protection NGOs and other NGOs	▪ Transdisciplinary synthesis paper on the natural and societal dimensions of using ocean-based NETs to mitigate climate change. ▪ Critical appraisal of ocean-based NETs.	▪ Create a multiplier effect for raising public awareness. ▪ Engage the general public and politicians in the discussion about ocean-based NETs. ▪ Help to protect environments in regional and local hot spots	▪ SRG and SRG interaction platform ▪ Dissemination materials (factsheets, infographics, animations, videos and attractive visualizations) ▪ Selected presentations at meetings of these organizations ▪ Selected publications on ocean-based NETs
Key persons from ethics organizations, arts, philosophy, psychology, journalism	▪ Transdisciplinary synthesis paper on the natural and societal dimensions of using ocean-based NETs to mitigate climate change. ▪ Critical appraisal of ocean-based NETs.	▪ Integrate ethical considerations into the scientific context. ▪ Raise awareness about sustainable lifestyles. ▪ Help to protect environments in regional and local hot spots. ▪ Use unique approaches, (e.g., art), to show the public the implications of ocean-based NETs	▪ SRG and SRG interaction platform ▪ Dissemination materials (factsheets, infographics, animations, videos and attractive visualizations) ▪ Selected publications on ocean-based NETs ▪ Dedicated space on project website for creative material (videos, poems, performances, etc.)

Stakeholder	Expected project results of interest	Expected impact	Dissemination channel
Managers and leaders of Earth system science projects, programs, and climate services; NETs research community	▪ Interdisciplinary synthesis publications, and other scientific publications in the peer-reviewed literature on ocean-based NETs. ▪ Assessment of NET mitigation options and possible pathways of deployment ▪ Assessment of ocean-based NETs using a SDGs framework ▪ Interactions between NETs and other mitigation activities (synergies and tradeoffs)	▪ Contribute to the improvement of NET representation in integrated and Earth system models. ▪ Feed OceanNETs results about CDR potential and the side effects and impacts of ocean-based NETs into the workflows and decisions. ▪ Share developments made in the project across the research community, maximizing impact and reducing duplication efforts. ▪ Provide new pathways to meet the Paris Agreement goals, sustaining Europe's leadership in climate change mitigation science.	▪ Direct data sharing as described in WP8, tasks 8.3 and 8.4 ▪ Open access publications, presentations at conferences and workshops ▪ Development of scientific collaborations ▪ Scientific publications
Business & Industry	▪ Information on industries that will need to be involved in further developing ocean-based NETs (i.e., the implications expansions or use of these industries have) ▪ Results that can be used to engineer products or cut costs	▪ Contribute to technical developments for ocean-based NETs. ▪ Choose optimal regions/technologies for long-term investments.	▪ SRG and SRG interaction platform ▪ Dissemination materials (factsheets, infographics, animations, videos and attractive visualizations) ▪ Selected presentations with interested industries/companies ▪ Selected publications on ocean-based NETs

Table 3.1.2 b *Other dissemination activities not listed in Table 3.1.2 a.*

Dissemination Target audience	Objective	Content	Communication channel	Time line
OceanNETs partners, International Scientific Advisory Board, and SRG	Ensure an effective and integrated project, ensure integration of advisory bodies in the project	Progress and results from the WPs and their tasks	Project Newsletter Project meetings Targeted email lists Telephone- and video-conferences Internal project webpage	Quarterly newsletter Project meetings Other contacts as required Regular internal website updates

NET research community, related projects	Share knowledge between projects Maximize impact and exploitation Integration with other projects	Project progress and results Contributions to international assessment reports	Project's data portal International Scientific Advisory Board (ISAB) Jointly organized workshops/conference sessions Existing networks and contacts	Whenever appropriate conferences/workshops take place We aim for meetings with other projects funded by this call
Wider scientific community	Share knowledge, improved coordination of research	Project results and their implications	Presentations at relevant scientific conferences (posters, oral presentations) Publications in relevant open access scientific journals Science news sites Directly to IPCC report authors (and through reviews of international assessments)	At appropriate conferences/ workshops/symposia Whenever publishable project results are available Press release when relevant result is available
National governments and European institutions and policy makers	Greater understanding of the potentials, risks, and challenges of NETs	Project objectives, progress and results	Targeted news release Targeted communication material (Policy briefings, Factsheets) Social media updates linked to project website	Press release whenever a relevant result is available Policy brief when results are ready

3.1.3 Dissemination among OceanNETs partners and with SRG and ISAB

To achieve a continuous integration of the advisory bodies within the project in between project meetings, a quarterly project newsletter will be shared with the International Scientific Advisory Board (ISAB) and the SRG. This newsletter will contain reports on progress and results from the WPs, announce and reflect project events, and highlight dissemination activities and measures. More targeted mailing lists will also share specific administrative and practical information with specific managerial bodies within the project. Further details for internal communication procedures within the project consortium are described below.

3.1.4 Dissemination to other projects funded by this and related Horizon 2020 calls

To maximize NET understanding, channels of communication have been established with the other project funded by this call, the NEGEM project, as well as other relevant national and international projects that investigate NETs such as the H2020 project COMFORT

and the German DAM mission on carbon removal. We aim for complimentary collaborative research, joint synthesis products, and joint meetings or workshops will be established. As a first step towards establishing connections between EU "sister" projects the OceanNETs and NEGEM coordinators have been made members of the sister project International Scientific Advisory Boards. We anticipate that a final policy event will be held, in conjunction with the other projects funded by this call, to disseminate the major findings of our research.

3.1.5 Dissemination to the Scientific Community

Close collaboration with scientists who investigate climate change and mitigation is essential to complement OceanNETs results and to maximize exploitation of project results and policy impact such as contribution to IPCC assessments. Data produced in OceanNETs will be continuously shared with other scientists through the OceanNETs data portal. Well-known scientists from this community and PIs from related projects have already agreed to become members of the OceanNETs International Scientific Advisory Board (IAB), which acts as a direct two-way communication channel, see section 3.2(a) for members and responsibilities of the IAB. OceanNETs project partners themselves are central members of the climate change mitigation research community and will use their existing networks to initiate interactions. Possible communication and collaboration measures are co-organization of sessions on relevant scientific conferences such as the EGU General Assemblies, the AGU Fall Meetings and AGU Ocean Sciences Meetings, the ASLO Aquatic Sciences Meetings, open science conferences of FutureEarth core projects (especially the SOLAS and IMBER open science conferences), Negative Emissions Conference, Annual conferences of Environmental and Resource Economists (EAERE or WCERE). We will include OceanNETs results also in educational courses taught by project partners.

In line with the project's open access strategy and to enable improved coordination of research, project results and their implications will be shared with a wider scientific community. This will be achieved by presenting project results at relevant scientific conferences and through publications. Publications will be made through the scientific peer-reviewed literature with special emphasis on journals using the open-access gold standard (such as Nature Communications or the European Copernicus journals Biogeosciences, Earth System Dynamics, and Earth System Science Data). Open access repositories will be used in parallel (green standard, in cases where gold standard cannot be followed due to requirements concerning target audience and when specific high-level journals may have to be used to maximize the impact).

3.1.6 National governments and European institutions and policy makers

National governments (such as environment and agricultural ministries, greenhouse gas agencies), European institutions (such as the European Marine Board), international organizations (such as the Intergovernmental Oceanographic Commission IOC and

UNFCCC related bodies), and policy makers will be informed through dedicated material such as fact sheets, policy briefs, specific news items on new publications and new results. This activity will go beyond the stakeholders included in the SRG, but suggestions from the SRG for dedicated target audiences will be requested.

3.2 Open access to project results

To enable the exploitation of OceanNETs results by most possible users, both those mentioned in Table 3.1.1, Table 3.1.2 a and others, OceanNETs will pursue an open-access approach of all project results, with IPR issues considered, see below. This includes direct data sharing according to the FAIR principle as described below, and publishing of scientific results in open access journals as a rule. The project office will advertise and log any new project publication through the project website. One of OceanNETs most ambitious publications, which we assume will create a broad scientific and political impact, will be a transdisciplinary synthesis paper on the natural and societal dimensions of using ocean-based NETs as a means of climate change mitigation. This effort will be coordinated by WP7.

3.3 Management of intellectual property rights and research exploitation

The consortium agreement will regulate all issues on Intellectual Property Rights (IPR) and their protection including the use of previous knowledge to be exploited by OceanNETs. We will explicitly encourage the use of open access journals for publications in order to make all material including figures, easily usable and exploitable by others. An IPR panel will oversee the handling of Intellectual Property Rights in the project and will contribute to solving potential cases of conflict before they become an issue.

WP8 Data management will ensure a proper handling of all data and their metadata ensuring that the Intellectual Property Rights of scientists are protected, that all OceanNETs related data are easily accessible to relevant stakeholders and users and fit for purpose following international standards and best practices, and that relevant data policies are fulfilled in order to maximize the impact and exploitation of observational as well as model output data. All these operations are described in WP8. The networking among the scientific and database partners will be realized according to international standards and protocols. A professional data management plan (DMP, Deliverable 8.1) will formalize what data will be generated within OceanNETs, how those will be shared within and outside the consortium in respect to protect Intellectual Property Rights, and how and when those data will be made public. All project metadata and resulting data (observations, model results and codes) will be made publicly available meeting the requirements of the H2020 FAIR policy and Open Research Data Pilot.

4 Communication Plan

In order to successfully promote OceanNETs, its progress, results and achievements, it is important to identify suitable measures for communicating with target audiences. OceanNETs communication strategy will, as the project goes through different phases, change with time:

Starting phase (0 – 6 months) and phase I (6 – 12 months)
Initially, most of OceanNETs activities will be preparatory and focusing on setting the scene, internal communication and planning. For this phase, many WP7 Stakeholder Reference Group (WP7 - SRG) and WP9 (management and communication) activities will also be preparatory. This will include 1) general promotion of the project, 2) setting up relevant SRG, 3) creating and discussing expectations amongst the OceanNETs consortium, all WPs and with SRG members, 3) making decision on key messages generated through OceanNETs and on relevant and effective communication channels. In this phase expectations from both, the OceanNETs Project office and SRG members, will be established.

Intermediate phase – phase II (12 – 42 months)
With results progressively being generated, initial result dissemination will also occur. In the intermediate phase there will be a balance between general and specific promotion with increasing efforts set in releasing formal outputs and getting feedback as the project advances. The core base of dissemination activities will be formed by datasets, conference and meetings contributions (oral presentations, posters) as well as outreach events.

Final phase – phase III (43 – 48 months)
Approaching the end, the project will capitalize on its results ensuring that scientific knowledge is incorporated in policy making and all possible steps were taken to maximise the policy-makers impact. This will be achieved through publications, reports, graphical dissemination material, meetings with policy makers, SRG channels, synthesis papers and a policy event coordinated with other NETs H2020 projects. In the final 6 months the project results will be capitalized to leave a mark and fully meet the overarching outreach goal: "provide a best possible estimate of the potential and consequences of utilizing so far underexplored ocean-based climate mitigation strategies".

The transition through phases will be a continuum, and timing will vary for the different WPs and tasks within specific WPs.
All communication activities are coordinated by the OceanNETs project office, namely by the communication manager (represented by the overall project manager) who is working together with a graphic artist and the project coordinator, as well as project partners, to produce targeted communication material.

Target audiences, objectives, content, channels, and the time line for communication are outlined in Table 4.

Table 4 *Communication targets and plans.*

Target audience	Objective	Content	Communication channel	Time line
All audiences	Information about the project as a resource	General description of goals and contact	Leaflet in print and on project website (distribution as hard copy and through email)	Within month 3 from project start
Wider audience interested in climate change mitigation	Increase project visibility to the interested public Inform about the project aims and results Provide an example for minimizing own carbon footprint	Project objectives and activities Relevant scientific progress and results Reports on stakeholder interactions FAQs Report on measures to minimize the project's carbon footprint	Established social media channels Press releases; our own and via local PR contacts at partner institutions Targeted communication material in various formats Science news sites Local/national science festivals Public lectures and presentations	Regular publications in social media Press release at project start and when results become available Invitations to relevant events
Wider audience in the partner countries	Increase general project visibility Increase NET mitigation literacy among the general public	Project objectives and activities Central project results	News release in various formats, targeted distribution via local PR contacts at partner institutions	At project start Whenever central project results become available via press releases
Educators and students in partner countries	Increase NET mitigation literacy	Project objectives and activities Central project results	Established social media channels Targeted communication material in various formats Science news sites Local/national science festivals Lectures and presentations	At project start information will be distributed to education outreach offices at partner institutes As opportunities arise via outreach activities at partner institutes

Experts and policy makers	Increase project visibility Inform about the project aims and results Information about the project as a resource	Project objectives and activities Central project results	Targeted communication material in various formats Science-policy briefings & reports Strategic events	At project start and when results become available Regular publications in social media Invitations to relevant events

The project target audience is segmented in different groups (e.g. stakeholders, wider audience, educators etc.); therefore, the communication strategy encompasses different messages and channels, tailored to each particular audience. The distinct target audiences have been identified in Table 4 and the proposed communication activities are outlined below:

4.1 Website & media

Scope: The project's website was established (Sept. 2020, www.oceannets.eu), where both background information of the project and project news products, dissemination material in various formats is and will be made available as project results come in. All communication channels used with the different target audiences will direct back to this website. The website also provides links to other resources such as institutional websites of OceanNETs partners and any other relevant information. The project website is updated on a regular basis (at least once per month) to ensure seamless project communication. It also provides access to password-protected areas for SRG members and OceanNETs consortium, where all documentation associated with the project and its activities, project management information and EU glossary is stored. The website will also be used as archive of all news updates. **Target audience:** All communication channels used towards the different target audiences will direct back to this website and thus, it is intended for a varied audience. **Timeline:** The OceanNETs website has been online since the end of Sept. 2020 and will be updated on regular basis. **Quantitative indicators of impact:** Google Analytics have been set up in order to monitor e.g., number of sessions per user, page views, number of pages per session, average session duration as well as demographics of the audience. These statistics will be monitored regularly.

4.1.1 Web-based multipliers

OceanNETs will use number of web-based multipliers to broaden the range of communication and dissemination activities. These include OceanNETs Twitter (https://twitter.com/OceanNETs_EU) and social media channels of the coordinating institute GEOMAR, as well as all other communication offices. Social media channels of all partner institutions will be combined in a list and contact has been initiated. This will enable reaching to a broader audience than via OceanNETs social media channels (communication hubs).

FACEBOOK. **Scope:** For any news release the GEOMAR Facebook account and network will be utilized. The communication hubs will also be informed about the news release. **Target audience:** Due to a broad social media network of all communication hubs, this activity will cover most of the target audience identified in section 4. **Timeline:** Frequency of posting will strongly depend on the activities relevant to report about. The frequency will increase during phase II of the project to reach a peak throughout phase III when the most results of OceanNETs will emerge. **Quantitative indicators of impact:** Facebook statistics including likes and shares of respective accounts.

TWITTER. **Scope:** Raise the awareness of the topics addressed by the project and key OceanNETs results. Examples of tweets will include release of scientific publication, news, events, meetings. **Target audience:** Mainly scientific community but also NGOs, decision and policy makers, journalists and non-specialists. **Timeline:** The OceanNETs Twitter account was created in July 2020. Tweets will not be distributed evenly but clustered around the 'event' with reference to the examples above. **Quantitative indicators of impact:** Twitter statistics, target being at least 100 new followers per year and at least 5K impressions/month.

MAILING LISTS. **Scope:** Internal mailing lists set up within OceanNETs will share specific administrative and practical information with specific managerial bodies within the project and will be used for mainly internal communication announcements about e.g. publications, job openings, relevant events etc. **Target audience:** There are three mailing lists that were set up targeting: 1) OceanNETs scientists, 2) Principle Investigators, 3) administration contact points at each partner institution, and 4) stakeholders. **Timeline:** mailing lists, except for (4), were set prior to start of the project and will remain active until at least 1 year after the end of the project. Frequency of use will depend on the overall progress of OceanNETs and is expected to intensify throughout the phase II and phase III of the project. **Quantitative indicators of impact:** over 50 people can be reached through internal mailing lists. However, quantitative measure of the impact is not possible. Qualitative feedback will be obtained from the OceanNETs consortium and administration.

SLACK. **Scope:** A Slack group has been set up for the OceanNETs consortium to facilitate internal communication. **Target audience:** OceanNETs consortium members. **Timeline:** Established in Sept. 2020 and will remain active until at least 1 year after the end of the project. Frequency of use will depend on the overall progress of OceanNETs and is expected to intensify throughout the phase II and phase III of the project. **Quantitative indicators of impact:** All consortium members can be reached through Slack. However, some members are more frequent users of Slack and quantitative measure of the impact is not possible. Qualitative feedback will be obtained from the OceanNETs consortium and administration.

4.2 Texts and visuals

Texts and visuals will be used during communication. In addition to texts and pictures used on the OceanNETs website, the following have been or will be created:

OCEANNETS COMMUNICATION TOOLBOX. **Scope:** A communication toolbox is available on the website for OceanNETs partners to use at meetings, conferences, workshops, etc. for promotional and communication purposes. The toolbox will include OceanNETs logos; digital leaflet translated to local languages; template layouts for presentations; one-slider presentation. **Target audience**: depending on the purpose of the communication/dissemination activity, the communication toolbox will cover most of the target audience identified in Table 4. **Timeline:** Some items of the OceanNETs communication toolbox are available now and will be expanded with planned additional items and as the need arises. **Quantitative indicators of impact:** Not applicable, qualitative feedback will be obtained by OceanNETs partners and communication hubs.

NEWSLETTER. **Scope:** To achieve a continuous integration of the advisory bodies with the project in between the annual project meetings, a frequent project newsletter will be shared with the consortium, ISAB (international scientific advisory board), and the SRG (Stakeholder Reference Group). A newsletter will include the latest updates on OceanNETs activities including communication activities, publications, conference contributions, meetings, announce and reflect project events, and highlight dissemination activities and measures. It will provide information exchange among international scientists and partners. **Target audience:** The newsletter will target the OceanNETs consortium + SRG + ISAB. **Timeline:** Quarterly with increasing frequency in phase two and three if necessary. **Quantitative indicators of impact:** The total audience size is predicted to be around 75-100 people.

NON-TECHNICAL FLYERS AND POSTERS. **Scope:** A flyer and poster visually summarising OceanNETs objectives, rationale and approach in plain language exists in English and will be translated to local partner languages. Another flyer summarising OceanNETs findings will be produced towards the end of the project. The flyer and poster are (initial ones) available on the website and will be distributed amongst all communication hubs. **Target audience:** The non-specialists' audience is the primary target audience, although may also be used in communication with wider audiences, including specialists ones. **Timeline:** Initial material is currently available. The final ones we aim to produce between project months 46 and 48. **Quantitative indicators of impact:** Web statistics for visualisation/download, aiming at 100 – 200 visualisations/year.

NON-TECHNICAL PRESS RELEASES. **Scope:** Non-technical press release will primarily be aimed at popular magazines, newspapers, and online CDR groups. The press release will be channeled through OceanNETs communication hubs, e.g., Twitter, and archived on the project website. If needed in special cases and if feasible, translation to local languages will be pursued. **Target audience:** Non-specialist audience. **Timeline:** Non-

technical press release will depend on project's output, but an estimate of one per year likely reflects progress in OceanNETs. The 1st press release occurred in early July 2020 to coincide with the start of the project. **Quantitative indicators of impact:** The number of published articles related to press release and an estimation of the magazines' or newspapers' reading audience will serve as an indicator of impact. A more precise quantification may be possible for on-line magazines.

NON-TECHNICAL SUMMARIES OF SCIENTIFIC PUBLICATIONS. **Scope:** Although all scientific output of OceanNETs will be available to any user through Open Access, its outreach and impact on non-technical audiences is reduced due to technical language. Therefore, all OceanNETs scientific publications posted on the OceanNETs website will be accompanied by a plain language summary and policy impact summary of findings. **Target audience:** The non-specialist audience, including SRG members without expertise in the specific field, is the main target of this activity. Relevant publications and their summaries will be forwarded to specific stakeholders and will be available on the OceanNETs website. **Timeline:** Non-technical summaries will be released along with related scientific publications. Most of these are expected to emerge in phase II and more frequently in phase III of the project. **Quantitative indicators of impact:** The release of non-technical summaries targeting non-specialist audience, including policy and decision makers, is not a common practice in science. This makes quantification of this activity somehow difficult. However, the average number of visualisation/downloads of summaries from the OceanNETs website will be used as an indicator.

DISSEMINATION MATERIAL TARGETED AT POLICY AND DECISION MAKERS. **Scope:** Policy briefs and fact sheets will summarise concisely the most pressing and key results of OceanNETs in a plain language, including policy options and some recommendation on the best options. These materials will be available on OceanNETs website and will be distributed to the SRG members and any relevant institutions and individuals identified as well as all the communication hubs. See Table 2.1 for a list of planned policy briefs. **Target audience:** Mainly policy and decision makers, as well as selected stakeholders, will be a target group of this activity. **Timeline:** Policy briefs and fact sheets will be released in conjunction with publication of scientific results as well as specially prepared to summarize results (see Table 2.1). **Quantitative indicators of impact:** It is difficult to quantify an impact of this activity as exploitation of policy briefs will mostly occur after the project has finished. However, we can monitor the distribution of briefs, as well as downloads.

KICK-OFF AND ANNUAL MEETING PRESENTATIONS. **Scope:** Presentations from the kick-off meeting (pptx or pdf) are available online to the OceanNETs consortium, interested stakeholders, and the ISAB. They have also been distributed upon request to interested parties. Presentations from future meetings will also be made available, although unpublished scientific content may be restricted to the OceanNETs consortium, SRG, and ISAB. Recordings of presentations will also be considered in the future. **Target audience:**

OceanNETs consortium, SRG, and ISAB. **Timeline:** Presentations from the kick-off were available within several days of the meeting. Future presentations will be available within 2 weeks of the meeting. **Quantitative indicators of impact:** Currently OceanNETs consortium consists of 38 members, which is expected to increase over phase I of the project and 6 ISAB members. The SRG is still being formed, but already has several members. The number of downloads will be used as an indicator. We estimate 50-75 views/per year are possible.

4.3 Communication hubs

Scope: To reach a wider audience in each partner country, local PR contacts at each partner institution have been established. The local PR contacts will translate the news releases provided by the project office (see above) into local languages and channel them to the relevant target audiences in the partner countries. The local PR contacts will also assist the project office in identifying relevant local media contacts for project meetings and events that will take place in the partner countries. **Target audience:** Due to a broad communication network of all communication hubs, this activity will cover most of the target audience identified in Table 4. **Timeline:** The local communication hubs will be contacted as frequent as there OceanNETs related news release. **Quantitative indicators of impact:** Likes, shares, re-tweets, social media statistics and press release downloads will be used as indicators of impact.

4.4 Scientific publications, presentations at conferences, and Open Access

Scope: In line with the project's open access strategy and to enable improved coordination of research, project results and their implications will be shared with a wider scientific community. This will be achieved by presenting project results on relevant scientific conferences and through publications to contribute to scientific progress. Publications will be made through the scientific peer-reviewed literature with special emphasis on journals using the open-access (OA) gold standard (such as Biogeosciences, Earth System Dynamics, and Earth System Science Data). Green OA standard will be used in cases where gold standard cannot be followed and when specific high-level journals may have to be used to maximise the impact. Peer-reviewed publications will be stored in parallel in i) repository chosen by lead author (aligned with the EU requirements) and/or ii) project website. In order to maximize the impact of scientific results, posts and announcements will be included on the OceanNETs website (along with non- technical summaries of scientific publications described above) and communication channels mentioned above. Additionally, a summary of relevant paper will be forwarded to specific stakeholder. Presentations or links to them (if at a recorded online conference) will be made available via the website/data portal. If presentations contain unpublished scientific data access may be restricted to consortium members, the ISAB, and SRG. **Target audience:** This activity is targeted at the specialist audience and relevant stakeholders. However, considering the variety of platforms used and the Open Access character of this activity, it is possible that more diverse audience will be attracted. **Timeline:** Most publications and presentations are

expected to emerge in phase II of the project. All these activities will be listed on the OceanNETs website communication and dissemination database as well as the news and event page. Approximately 30 - 40 releases among publications and presentations at international conferences are expected by the end of the project. **Quantitative indicators of impact:** Impact of publications will be monitored and evaluated based on i) impact factor of journals ii) downloads from the various platforms where the documents are stored iii) number of citations. A minimum audience size of 2000 (combined number) attendants/year will be a target number for communication at international conferences.

4.5 Meetings, networking opportunities and other events

ANNUAL MEETINGS. **Scope:** The project kick-off meeting marked the effective launch of the project. The kick-off reinforced the common sense of all partners and identified the responsibilities of each in the endeavor. This will continue in subsequent annual meetings with the addition reports from governance panels (Early Career Scientists, IPR, Gender, Arbitration), science communication and work package teams, whom will report on their progress in plenary and plan their work for the next project period in break-out sessions (if meetings are in person; online meetings will allow for separately scheduled break groups and panel meetings). Annual meetings will also be an opportunity to communicate with the SRG and IAB members. **Target audience:** Annual project meetings will involve the OceanNETs consortium, ISAB and SRG members. Additionally, the kick-off meeting was attended by interested stakeholders and members of our sister project NEGEM, which expanded the total number of the audience. **Timeline:** The kick-off took place on July 2, 2020 in an online format (due to COVID-19 travel restrictions), Annual meetings will take place at months 15, 30, and 48 or very soon thereafter. **Quantitative indicators of impact:** The number of participants will be recorded and reported. Approximately 40-75 participants are expected to attend each annual meeting.

STAKEHOLDERS REFERENCE GROUP MEETINGS. See section 3 for detailed explanation of SRG interaction plan.

OUTREACH EVENTS (public lectures, presentations, and webinars + local/national science festivals). **Scope:** Raise awareness of ocean-based NETs and their potential role in climate change mitigation. **Target audience:** Mainly non-specialist audience. **Timeline:** These activities are planned to start from phase I and will occur throughout phase II with increasing frequency in phase III. To date the project coordinator and one of the WP6 leaders have participated in a public webinar on Enhance Mineral Weathering (ocean alkalinization) [video available at https://www.american.edu/sis/centers/carbon-removal/webinars.cfm]. **Quantitative indicators of impact:** Approximately 10 events are expected to occur with 15 – 80 people audience per event.

POLICY EVENT. **Scope:** A policy event will be organized in conjunction with other NET projects like NEGEM in order to provide wide-ranging and comprehensive information and policy advice. **Target audience:** This communication activity is targeted

purely at the policy and decision makers. **Timeline:** One policy event is tentatively planned to occur at the end of the project. **Quantitative indicators of impact:** Policy event is targeted at high impact policy and decision makers with small audience (10 – 15 people) if in person, and potentially a larger audience if held online. It is difficult to quantify the impact of this activity.

4.6 Educational outreach

Scope: Educating the next generations is important because decisions made about climate change mitigation and use of NETs will have a large impact upon their lives. OceanNETs will work closely with institute educational outreach offices and take advantages of other opportunities to reach students. We will closely coordinate with education outreach offices at partner institutes to facilitate these activities and to increase awareness of our activities on education related social media, websites, at science festivals, and through lectures or seminars. The timing of some of these activities is difficult to anticipate as science festivals and lecture opportunities are usually only announced a few months in advance. **Target audience:** Primarily high school and undergraduate university students. Others as opportunities arise. **Timeline:** As opportunities arise. The OceanNETs project coordinator has already given an invited seminar on NETs at Kiel University (CAU) in Germany for an undergraduate class that focused on the carbon cycle (block seminar 'Carbon Cycling in a Changing Climate' from 7-11 September 2020). **Quantitative indicators of impact:** It is difficult to quantify the impact of this activity except through student feedback. However, the number of events attended or lectures/seminars given will be recorded.

Table 4.1 *Indicators and targets for measuring progress of the communications, exploitation and dissemination.*

Indicator	Target
Number of events for stakeholders and experts	4
Number of policy briefs and summaries for policy makers on the project results	3
Number of media pieces (e.g., articles in the press, videos in digital media or TV, audio in radio, tweets etc.) that stem from project results (based on press releases or academic publications)	20
Number of scientific publications in peer-reviewed journals	40
Number of citations of scientific publications in peer-reviewed journals	100
Number of citations of project outcomes in policy relevant documents and discussions	20
Number of downloads/page views of scientific publications in peer-reviewed journals	2000
Pieces of dissemination material (e.g., brochures, flyers) produced to present the project or its results	4
Number of presentations mentioning OceanNETs at scientific conferences or other related events	30
Number of persons that the project directly reaches through meetings, workshops and presentations	2000
Number of research exchanges within the consortium	20