MORECAMBE OFFSHORE WIND GENERATION ASSETS NSIP ('THE PROJECT') (PROJECT REF. NO. EN010121)

SELECTED RESPONSES TO APPLICANT'S DEADLINE 1-2 SUBMISSIONS AND FURTHER COMMENTARY AND SUBMISSIONS ON BEHALF OF BODORGAN MARINE LIMITED (BML)

DEADLINE 3

Preamble

1 The marine resource is limited in spatial terms. It is critical, therefore, that it is a resource that must be shared as efficiently and as fairly as possible. This is important both in terms of the need to pursue sustainable economic development/growth and is also true in terms of food security. It is for this reason that it is a central pillar of National policy that opportunities for co-existence and co-location must not just be taken: they must be 'maximised' (please refer to NPS EN-1 paragraph 4.5.3, for example). Co-existence and co-location are the terms used to describe the situation that arises (and which must arise, because it is a policy imperative) when the marine resource is shared in a sustainable way.

2 For far too long, the UK offshore wind industry has ignored this policy imperative and has sought to monopolise, rather than share, the marine resource, which is exploited for its potential for energy generation. It is telling (and, frankly, shameful) that there are at present no offshore aquaculture assets co-located within offshore wind farms in the UK, something that is rightly becoming standard practice in other European nations. This is a central element in creating the balance necessary to enabling the blue economy to play a sustainable role in our shared future. Instead, the most that is done by the UK Offshore Wind Industry is to mitigate, in some way or other, the adverse effects that wind farm provision causes to traditional fisheries and in particular in the Irish Sea scallop industry. The present case is a classic example of that approach.

3 The status quo must change for, if it does not, very substantial swathes of the marine resource will be lost to the present generation, at the very least. What will also be lost are opportunities to co-locate offshore aquaculture in the very places that co-location would be most suited, namely in marine areas which are less frequently fished by traditional fishing vessels, because of their proximity to wind turbines and generation assets. It is important to appreciate that the very thing that renders the marine blocks edged by turbines particularly unsuitable or unattractive for traditional fishing, makes them particularly suitable for aquaculture.

4 The marine areas at stake are vast. The Crown Estate through its various entities is leasing huge areas of Sea that, without a change of course, will be sterilised for the next 60 years, 60 years being the term of the standard Crown Estate lease. Current Crown Estate leasing practices facilitated by current DCO practices will lock out aquaculture operations and hence impede adequate provision for long-term food security. It is critical to note that it is the consenting of the DCO that is the event which causes the proposed lease in those terms to take effect. It is because consenting the DCO (absent the safeguards and measures contended

for by Bodorgan Marine Limited (BML) will give rise to these consequences, which are considered prejudicial in policy terms.

5 There are 50 OWFs operational in UK waters and the more than 2,700 turbines deployed in these areas currently cover significant parts of the UK territorial waters. The extent of the enormous broad Round 4 Bidding Areas concluded in January 2023 and the actual Round 4 Project Areas are shown on the diagrammatic maps in **Annex 3** below. It should be noted that the three Round 4 project areas within the Irish Sea account for a total area of 667km2 (or 66,700 hectares) (Mona OFW – 300km2, Morgan OFW – 280 km2 and **Morecambe OFW – 87km2 (this DCO application)**). Round 5 (launch of the tendering process commenced in February 2024) proposals identify a further 1,000km2.

But this current programme of Crown appropriation of the UK's marine commons is dwarfed by the amount of both UK and European sea space that is forecast to be devoted to wind energy:

- The UK has a target to increase renewable energy production from 15GW to 50GW by 2030 and at least 90GW by 2050. A significant proportion of this will be located offshore; and,
- One academic forecaster is predicting a huge 40,000km2 area for OWFs in European waters in the longer term *('Co-location of fisheries and offshore wind farms: Current practices and enabling conditions in the North Sea' by Prince O. Bonsu et al, from Science Direct on Marine Policy, Volume 159, January 2024, at page 21),* which is reproduced below, where the present scenario total figure is added to the mid-term scenario and then the long-term scenario.

	Present scenario		Mid-term scenario		Long-term scenario		NATIONAL MFD
	OWF area (km^2)	MFD	OWF area (km^2)	MFD	OWF area (km^2)	MFD	
UK	2722	806	13980	440	-	-	703
Germany	759	109	1575	103	1574	48	81
Sweden	-	-	-	-	-	-	-
Netherlands	626	121	1628	14	5177	26	56
Norway	-	-	-	-	1389	1	
Denmark	175	66	571	22	7867	27	37
Belgium	178	118	255	5	-	-	166
Total	4460		18008		16008	-	

- Another team of academic researchers *('Finding space for offshore wind to support net zero: A methodology to assess spatial constraints and future scenarios illustrated by a UK case study' by H. Putuhena et al 2024 in Science Direct, Renewable and Sustainable Energy Reviews, Volume 182, August 2023,* predict in the Conclusions (Section 9, Page 52) that in some scenarios even larger areas of the UK's Sea may be taken over by offshore wind farms.

  '*…future OW to meet net zero could require over 50% of the available space in the UK-EEZ.'*

6 Aquaculture is increasingly recognised as key to not only national but global food security by national governments, their agencies, University researchers and other highly credible forecasters. Perhaps the most striking recognition of the potential

of aquaculture is to be found in DNV's first Marine Aquaculture Forecast, 'Oceans Future to 2050: Marine Aquaculture Forecast, DNV (Det Norske Veritas), 2024' (included as a summary in Annex 4 below). DNV is an international accredited registrar and classification society headquartered in Norway and provides testing, certification, technical advisory services for several industries, including maritime, oil and gas, renewable energy and electrification. This DNV Report makes three important statements:

- *Marine aquaculture is set to play a critical role in securing supplies of food for a global population that will exceed nine billion by 2050';*
- *'Marine Aquaculture will be vital to secure supplies of protein'; and, '*
- *Marine aquaculture will more than double by 2050: As seafood demand rises with living standards and population growth, we forecast marine aquaculture production, excluding seaweed, will rise from 30 million tonnes per year (Mt/yr) live weight to 74 Mt/yr.*

7 Here in the UK, the importance of aquaculture for food security is increasingly being recognised by the Crown Estate in its emerging strategy for the management of the seabed and other organs of the UK governmental system. BML cites the following two instances:

a) 'Aquaculture & Blue Growth The Crown Estate Perspective, November 2023' (included in **Annex 4** below), a presentation by Caroline Price presented at the Aquaculture for a Thriving Future conference held at the Fishmongers Hall in November 2023, which states under Next Steps: *'Continue to make space for aquaculture – TCE WoS Programme and engagement with the statutory marine planning process.'*

b) The UK Parliament's Environment Audit Committee meeting on 8 January 2025 (which notably included a senior representative from CEFAS – referred to in Section 4 and 8 of this BML D5 submission), where it was acknowledged that of the seven main competing uses for the Sea that fishing and aquaculture was one of the oldest and most important uses.

8 It is for these reasons that the co-location of aquaculture assets within offshore wind farms (as opposed to offshore generally in areas unaffected by energy generation assets) represents, unarguably, the optimal manner in which the marine resource can be shared in a manner that enables the same marine resource to be used for energy generation and for the provision of food. It is possible, and of the utmost desirability, that the same marine resource is used to contribute to energy security and food security. Therefore, BML is at a loss to understand how aquaculture and its provision and co-location has been largely ignored by the Applicant.

9 There is absolutely no good reason why the Morecambe Offshore Wind Farm NSIP should not play its part in sharing the marine resource and in sustainably future proofing within the Order Limits. So far, the Applicant has not yet articulated any reasons why there is no provision for co-location of aquaculture, if the Applicant does not want to share this spatial resource. BML has shown here and below (and it cannot be gainsaid) that the technology for offshore aquaculture exists and (indeed it is being deployed and proven in other European countries); the appetite exists (it is waiting for a DCO to make adequate provision); there is no uncertainty about these matters; and, no material adverse effects on the Project itself or other existing users that would arise in the event that aquaculture took place within the Order Limits in appropriately located areas.

10 Why then does the Applicant not provide for co-location of aquaculture?

11 First, perhaps it did not understand that there was a demand for offshore aquaculture to be co-located within the Order Limits until this initial BML engagement in the DCO Examination. If so, then that, however, is the direct consequence of the Applicant's own failures to canvas an appropriately wide pool of consultees at the outset. There is an established centre of aquaculture excellence in and around the Menai Straits comprising: a) the School of Ocean Sciences at Bangor University with European-level expertise in aquaculture; b) a concentration of mussel and oyster farmers; and, c) a newly minted Several Order and management organisation for the Menai Straits mussel fishery. All of this expertise appears to have been ignored by the Applicant.

12 Second, it is understood from equivalent circumstances in the Mona Offshore Wind Farm DCO Examination (Project Ref. No. EN010137 and IP Ref. No. 20048554) and the Morgan Offshore Wind Farm Project DCO Examination (Project Ref. No. EN010136) that the Applicant believes that it is the Crown Estate leasing arrangements that will lock-out aquaculture from the Order Limits and not the DCO itself. That is simply a non sequitur. If (as it must) the draft DCO includes a new Requirement (refer to Section 8 below) to the effect that appropriate arrangements must be made to ensure the ability for aquaculture to be co-located with the Project, no doubt the Crown Estate lease will be amended in an appropriate manner. There is nothing statutorily (or, generally) immutable about the provisions of a lease. They can be amended both pre (as in the present case) or post execution. BML attaches to this D3 submission a marked-up version of a Scottish variant of the Crown Estate marine lease, which would do just that (refer to **Annex 2 below**). As can be seen, in drafting terms, it is a very simple exercise to make the necessary amendments to enable the Applicant to grant a sub-lease to BML for the purposes of aquaculture. It should be noted that BML have provided a marked-up a Scottish Crown Lease precedent in order to be helpful. Furthermore, some additional commentary has been added to Paragraphs 48 - 49 below to the review of the Crown Estate leasing arrangements.

13 BML firmly maintain that it is incumbent, in the context of Section 104, Planning Act, 2008 (PA2008), on the Examining Authority (ExA) to recommend that the draft DCO should only be confirmed if it makes appropriate arrangements for the sharing of the marine resource (that being the whole marine resource within the Order Limits, which is a small part of the area) and in particular the ability for aquaculture assets to be co-located within the Order Limits. If two private parties (namely the Applicant and the Crown Estate) take the position that they do not want to amend the draft lease so as to make provision for the leased marine resource to be shared in the limited manner that BML has advocated for in this Examination, then the upshot is that those two private parties are promoting a scheme that is not policy compliant and not in the public interest and cannot and should not therefore be consented.

1 Introduction

14 Further to the letter from Bodorgan Marine Limited (BML) dated 16 January 2025 and the Planning Inspectorate's (PINS) automated email response dated 16 January 2025, the Examining Authority (ExA) has not yet confirmed if BML can be registered as an Interested Party (IP) for the above project. We look forward to your response and the possibility of BML becoming an IP at this early stage in the Examination process.

15 Therefore, BML do formally request that the Examining Authority (ExA) do use their discretion to accept this D3 submission, given that there is still a further 3.5 months until 23 April 2025 to the end of the Examination and indeed there are three further deadlines (D4, D5 and D6), with reserve dates for further Hearings in February and March 2025 and the ExA's further Written Questions in late-February 2025.

In addition, given the importance, key issues and major concerns raised below in this D3 submission, BML considers that the basic principles of natural justice and the need to each participant in an Examination to be able to participate in that Examination on a fair procedural footing to be crucial. BML are and plan to be unequivocally a participant in the Examination, notwithstanding that they have not been afforded the formal status of an Interested Party. No injustice would be caused by enabling BML to make these representations. The matters raised herein are important and relevant considerations and accordingly *must* be considered in the context of S104, PA 2008. There is no power to exclude, by way of the making of a procedural direction, the statutory duty to have regard to important and relevant considerations, such as those contained herein.

16 This Deadline 3 (D3) submission does not respond fully to the applicant's Deadline 1 - 2 (D1 – D2) documents made available on 28 November and 16 December 2024 respectively. Comments on selected and relevant submitted documents can be commented on at the next deadline if PINS accept this D3 submission and so do not form part of this submission. However, this BML D3 submission has provided commentary on the latest 'tracked' versions of three key and highly relevant documents – the Schedule of Mitigation Rev02 (**REP2-017**), the Outline Fisheries Liaison and Co-Existence Plan (OFLCP) (**APP-147**) and the Commitments Register Rev01 (**REP1-094**).

17 Also, in the ExA's 'Initial Assessment of Principal Issues' (within the Rule 6 Letter issued on 23 September 2024, Appendix C (**PD-007**)), it is unfortunate that co-location or aquaculture provision is not covered. BML therefore request that these issues be considered as part of the subsequent Examination and consideration be given to the Recommendations in Section 9 below.

18 This submission should be considered to be a broad commentary on the lack of provision for aquaculture or indeed co-location opportunities as is required by NPS policies, referring specifically to three key application documents in the process. It is hoped that it can serve as an initial representation for BML's at this stage. If this D3 submission is accepted by the ExA, then it is BML's intention to integrate into existing procedural channels for the Examination and to continue to make further submissions at both D4, D5 and possibly D6 deadlines.

Role and Participation of Bodorgan Marine Limited

19 BML was established in 2022 and has entered into a partnership with DeepDock Ltd (DDL) a mussel farming company based in Anglesey and the Menai Straits. DDL has offshore aquaculture experience in the Irish Sea, including within the confines of the North Hoyle offshore windfarm. It is notable that there is an established centre of bivalve aquaculture in and around the Menai Straits (one of the leading areas in the UK for mussel production) and the Bangor University School of Ocean Sciences.

20 For your information, BML has been engaged in the nearby Mona Offshore Wind Farm (OFW) Examination (Project Ref. No. EN010137 and IP Ref. No. 20048554) since it began and has consistently sought to engage with the process throughout; and has recently engaged with the Morgan Offshore Wind Farm Project DCO Examination (Project Ref. No. EN010136). The Mona OFW and Morgan OFW Projects are, of course, promoted by the same joint Applicant. However, BML was not aware of the timetable for this Morecambe OFW project until recently and has not been engaged by the Applicant. The Applicant appears to have only relied on other commercial fisheries representatives, as outlined in its Consultation Report and relevant Appendix B, Part 1 (**APP-015 and APP-016**), such as through the Commercial Fisheries Working Group (CFWG) (**Section 3.2.1 of APP-147**).

21 It is clear that issues under discussion still include 'Co-existence approach which will be agreed through the development and implementation of the OFLCP including displacement of fishing activity during construction.'

22 It is unfortunate that the Applicant has not sought to engage with BML despite our engagement with Mona OFW over the last 9 months and more recently with Morgan OFW.

Structure and Content of D3 Submission

23 This D3 submission provides comments as set out below together with additional commentary of key aspects of the current DCO application, under sub-headings:

- Section 2 – Purposes of BML's Deadline 3 Submission
- Section 3 – Commentary on the Applicant's Three Key Submissions (amendments)
- Section 4 – Commentary on Key National Policy Documents
- Section 5 – Commentary on recent Crown Estate Policy Update
- Section 6 – Technical Commentary on Benefits, Support and Precedents for Bivalve Aquaculture Co-Location within Offshore Wind Farms – Multi-Use of the Marine Environment
- Section 7 – Bodorgan Marine Limited's (BML) 'Technical Ask'
- Section 8 – DCO Securing Mechanisms and Control Plan
- Section 9 – Commentary on the Technical Engagement between BML and the Applicant
- Section 10 – Final Conclusions

2 Purposes of BML's Deadline 3 Submission

24 BML would like to make five main points, as set out below. Consequently, the purpose of this D5 submission is to elaborate on the following 5 key points in turn. These 5 points can be listed, as follows:

- Comments on three key application documents – the Schedule of Mitigation Rev02 (**REP2-017**), the Outline Fisheries Liaison and Co-Existence Plan (OFLCP) (**APP-147**) and the Commitments Register Rev01 (**REP1-094**);
- National Policy Matters – in the design of its mitigation of commercial fisheries, the Applicant has failed to comply with key policy requirements in National Policy Statements (NPS) EN-1 and EN-3 and has misunderstood the meaning of 'co-existence' and 'co-location';
- Crown Estate Policy Update – to describe and comment on the new flexible policy towards marine seabed leasing;
- Consideration of Benefits, Support and Precedent for Co-Location – sets out in more detail the benefits, support and precedents for such co-location of bivalve aquaculture with offshore wind farms; and,
- 'Technical and DCO Asks' and Technical Engagement Issues – sets out the commitments that BML is seeking from the Applicant both technically and in terms of controls within the DCO process and offer a summary of its recent meeting with the Applicant.

25 This D3 submission explores these 5 purposes in more detail below.

26 Furthermore, as indicated above, at the end of this D3 submission it sets out the five key conclusions relating to this DCO application that should be of wider strategic interest and which are specifically requiring responses from the Applicant.

3 Commentary on the Applicant's Key Submissions (amendments)

Schedule of Mitigation (Rev02) (REP2-017)

27 The minor changes and changes in sections other than Table 2.1 do not require BML's comments, however, the following inadequate commitments to Commercial Fisheries at Ref. Nos. 13.1 – 13.5 should be noted.

28 It is understood that the OFLCP is largely secured through the dML, which is part of the offshore environmental management plan referred in Condition 9(1)(e) (but not present in the application documents) and Condition 9(1)(k) of Schedule 6 of the draft DCO (**REP2-003**) and is expected to be secured within the Deemed Marine Licence (DML). However, this OFLCP does not appear to be secured within this Schedule of Mitigation for this DCO. This is a concern.

29 Notwithstanding this, BML has no ability, except through this DCO process, to ensure that the OFLCP is adequate or covers any provision for aquaculture or commitment to be consulted through the dML process.

Outline Fisheries Liaison and Co-Existence Plan (OFLCP) (APP-147)

30 This document actively promotes both co-existence and co-location throughout. However, the proposals simply amount to the 'Co-existence and Mitigation Measures' (Section 3.2) and a Commercial Fisheries Working Group (CFWG).

31 There is no provision for aquaculture co-existence or co-location, with such provisions being restricted only to the very limited co-existence measures.

Commitments Register (REV01) (REP1-094)

32 The current Commitments are set out in Table 1 and cover 45 commitments, at present. There are no commitments relating to co-existence, co-location or

aquaculture. The only relevant commitments are to ongoing liaison based on FLOWW Guidelines, 2015; and, to the production of a Fisheries Liaison and Co-Existence Plan.

4 Commentary on Key National Policy Documents

Introduction

33 BML has ambitions to co-locate an offshore mussel farm on part of the seabed and in the water column within the Order Limits of the Morecambe OWF, which would comprise a suitable environment for offshore aquaculture (though this has not yet been recognized by the Applicant). The potential for such an asset to be co-located within the Order Limits comprises a significant economic opportunity in terms of increased food production and jobs (which also has not yet been recognised by the Applicant) and accordingly the failure to do so would comprise a significant economic opportunity cost, i.e. loss. Furthermore, since Brexit aquaculture production has significantly fallen with less access to EU markets caused in part by inshore water quality not being adequate, whereas offshore water quality is significantly better. These ambitions and in particular the opportunity to co-locate an offshore aquaculture asset within the Order Limits, are supported by the following:

- NPS-EN1 Section 4.5 (in particular paragraphs 4.5.2, 4.5.3, 4.5.4, 4.5.8, 4.5.11) – further detail is provided below; and,
- NPS-EN3 and in particular paragraphs 2.8.46–2.8.48 and 2.8.250–2.4.8.251 – further detail is provided below.

34 The Applicant's failure to make any provision for (or, indeed to provide any – let alone any adequate – explanation as to why) offshore aquaculture as part of the Project is not just a substantive failure mitigation (though it is that too); rather, it is a fundamental defect of the Project as a whole and means that:

- In the context of S104(3) PA 2008, the Project does not comply with EN-1 and EN-3.

35 The failure to make any (let alone any adequate) provision for the co-location of offshore mussel farms, as part of the Project, would be a missed opportunity of significant magnitude and should militate significantly against a grant of Development Consent.

National Policy Statements (NPS EN-1 and EN-3)

36 EN-1 paragraphs 4.5.1-4.5.12 indicate that decision-makers will have regard to marine planning documents and will '*determine if and how proposals meet the high-level marine objectives, plan vision, and <u>all relevant policies</u>*' (emphasis added). In this context albeit that marine plans are documents within S104(2)(aa) PA 2008, rather than NPSs within S104(2)(a), it is clear from EN-1 that the Government expects compliance with marine planning documents, save to the extent that they conflict with an NPS (EN-1, paragraph 4.5.12).

37 It is notable that NPS EN-1 itself (see paragraph 4.5.3) refers to the imperative to '*maximise co- location possibilities*'.

38 NPS EN-3 paragraph 2.4.48 requires Applicants to '*work collaboratively with those other developers and sea users <u>on co-existence/co-location opportunities</u>, shared mitigation, compensation and monitoring where appropriate*.' (underlining added). BML wishes to stress that the Applicant has failed in this respect. At no point

(whether during the formative stage of the DCO application or thereafter) has the Applicant sought to work collaboratively with the aquaculture community to identify opportunities for co-existence/co-location within Order Limits. This policy has been breached, therefore.

39 For the same reasons, NPS EN-3 paragraph 2.8.250 has been breached. As to NPS EN-3 paragraph 2.8.251, it clearly would be possible to '*enhance'* the benefits (both in the medium, but particularly in the long term) to the aquaculture industry in this broader project area. The failure to do so would be a significant missed opportunity and contrary to policy. Steps must be taken to rectify this matter.

40 The Applicant did not seek at any point to engage with the bivalve/mussel aquaculture sector representatives and only dealt with overarching fishing industry representatives. It is accepted that BML has not, until now, responded to the DCO process, but more importantly BML has not received any direct engagement from the Applicant over these critical issues, notwithstanding its participation in both the Mona OFW Project DCO Examination (Project Ref. No. EN010137 and IP Ref. No. 20048554) and the Morgan OFW Project DCO Examination (Project Ref. No. EN010136).

41 BML does not accept that enhancement through provision for aquaculture is not within the phrase *'where reasonably practicable'*, which is amply demonstrated in Section 4 below as being entirely feasible and practicable. Such provision does not necessarily require overlapping of existing operations and BML reject the Applicant's implied assertion that only scallop fishing interests are important and require equality of consideration.

CEFAS – A review of the potential for co-existence of different sectors in the Welsh Marine Plan Area, 2020 (refer to Annex 5 below)

42 In April 2020 CEFAS produced for the Welsh Government a report specifically with a view to reviewing the evidence in respect of various forms of OFW co-existence. Section 3.2.12.1 of that report deals with bivalve aquaculture and offshore wind energy and states, after referring to a co-location trial in Welsh waters at the North Hoyle OFW that:

> *'This trial demonstrated that aquaculture activities could be carried out without a negative impact on wind farm operations. Further commercial-scale trials were recommended to both refine the technology to grow mussels offshore on fixed gear and assess environmental impacts and economic performance. Anticipated socio-economic benefits from co-locating aquaculture within OWFs include (Syvret et al., 2013):*
> - *Job creation and employment opportunities;*
> - *Potential for expanding seafood provision from UK waters;*
> - *More space left in the see for other economic or recreational activities in the region; and,*
> - *Knowledge and experience acquired through the trial to mitigate impact on local fishing grounds.'*

43 The Report's conclusion on page 18 is, as follows: *'The mussel aquaculture sector appears to have the greatest current potential to be combined with offshore wind arrays, and thus meeting economic, environmental and technical requirements.'*

44 BML submits that the CEFAS Report is an important and relevant consideration and ought to have been regarded as such by the Applicant. If the Applicant had read and considered the CEFAS Report during the preparation of the DCO application, it is inevitable that they would have promoted some form of bivalve aquaculture co-location (or at the very least readiness for such) as part of the Project.

5 Crown Estate Policy Update

45 The Crown Estate's recently published a new policy document entitled **'Future of Offshore Wind'** in September 2024 and it was recently reported in the press by Sky News on 1 January 2025 – https://news.sky.com/story/fishermen-fear-for-livelihoods-as-offshore-wind-farms-pose-greatest-change-13282246. The Crown Estate report and the Sky News article are included as **Annex 1** below, for convenience.

46 The Sky News article stresses the possibility that the Areas of Opportunity may squeeze out fishing patterns and businesses and does not equally prioritise food security alongside energy security. It recognises the two main drivers of the wider fishing sector:

- being squeezed out by the offshore wind industry's exclusive use of the sea and seabed (especially during construction) that may have longer term impacts on the ecosystems in areas that are some of the most productive biologically; and,
- that areas of sea previously outwith the capability of the OFW sector due to depth profiles will now be used.

Also, it should be noted that the fish and seafood sector seem to be under-represented in discussions about food security.

47 There are several parts of this recent report that are both relevant and these are set out below.

- **Page 7** – *'Improving the coordination between the process of seabed leasing, energy infrastructure planning and grid connections, helping further accelerate the deployment of offshore wind, while considering other seabed users and the natural environment.'* This clearly opens the door for considering other seabed users, such as the aquaculture industry, by coordinating leasing.
- **Page 11** – '*The seabed and coastline are critical for net zero, nature and a wide range of marine sectors. As the sea space becomes increasingly congested, we must ensure we plan for the future of offshore wind in the context of nature and all sea users.' 'Identifying 2050 spatial pathways to enable the best use of the marine space in order to meet policy objectives and user needs across sectors. This will provide stakeholders with long-term visibility on the key areas of opportunity for each sector, including opportunities for co-location, and support early resolution of competing demands.'* Clearly, this promotes opportunities for co-location and early resolution of competing demands, not currently recognised by the Applicant.
- **Page 12** – the benefits of this Marine Delivery Routemap are cited as optimising the use of marine space, opportunities for biodiversity and nature and supporting economic development.

- **Page 13 –** this identifies 10 main discussion points, including co-location given an increasingly busy marine space, our (Crown Estate) view is that it is important to enable co-location in Areas of Opportunity through leasing design.
- **Page 25 –** this identifies the need for early identification of co-location options and agreeing the best use of space being critical.
- **Page 26 –** this acknowledges that there is overlap with current interests and future sector opportunities, including fisheries.
- **Page 27 –** this reiterates the points made concerning co-location on Page 13.
- **Page 38 –** this stresses the importance of '*seeking opportunities for positive environmental outcomes, nature inclusive design, and sector decarbonisation alongside broader approaches for creating inclusive communities and supporting economic growth.*'**,** including the wider aquaculture industry.
- **Appendix 2 –** this methodology requires that '*results demonstrate whether a scenario has met the demand requirements as well as prioritisation and co-location implications.'*

48 It is clear that the Crown Estate recognises the importance of co-location and provides for its priority in determining OFW provision. Whilst not referring specifically to aquaculture, it is clear that the fishing industry needs to be considered as part of the ongoing discussions with stakeholders and refinement of both 'Areas of Search' (AoS) and 'Project Development Areas' (PDAs), as set out on Page 21.

49 Crown Estate Leasing Latest Update – in the course of the Mona OFW DCO Examination process (Project Ref. No. EN010137 and IP Ref. No. 20048554) and the Morgan Offshore Wind Farm Project DCO Examination (Project Ref. No. EN010136), BML has requested that the Applicant(s) disclose a copy of their Crown Estate lease (and to be protected by an NDA). BML have demonstrated that the changes to the Crown Estate lease, set out in Paragraph 12 of the Preamble above and in **Annex 2** below, are not only not impossible, but readily deliverable.

50 In the Mona OFW Project (Project Ref. No. EN010137 and IP Ref. No. 20048554) and likewise for the Morgan Offshore Project, BML is calling for the Applicant to sub-lease 5 blocks of a minimum of 50 hectares each to BML for the purposes of aquaculture (see paragraph 68 below). Such a sub-leasing arrangement is eminently possible with the agreement of the Crown Estate and the Applicant as tenant. There is no legal impediment to these two 'head lease' parties bringing about a policy-compliant situation of making provision for co-located aquaculture. If the Crown Estate and the Applicant (one or both) simply do not *want* to do that, then they must not be granted the DCO.

6 Technical Commentary on Benefits, Support and Precedents for Bivalve Aquaculture Co-Location within Offshore Wind Farms -Multi-Use of the Marine Environment

Context

51 The principles of multi-use within the marine environment emanate from the wider development of the concepts of marine planning (MP) or marine spatial planning (MSP), as it was more often described in the earlier stages of its development. Discussions and development of thought around MSP began in the latter part of

the 1990's and early 2000's, largely occurring within the quasi-formal setting of the United Nations educational, scientific and cultural organization (UNESCO). The UN had committed to roll out of the Millennium Development Goals, which has subsequently been superseded by the wider UN Sustainable Development Goals and recognised of how vital the global oceanic environment was in achieving progress toward these goals.

52 Much academic study was undertaken during this period, also the time when the first commercial developments of offshore renewable energy were starting to manifest. By the mid 2000's some researchers, in particular in the Alfred Wengener Institute in Germany (https://www.awi.de/en/) recognised the possibilities for joint use of such areas and proposed some theoretical concepts.

53 The UK Marine and Coastal Access Act 2009 created a tiered approach to marine Planning in English, Welsh, Northern Irish and Scottish waters. The principle was driven by an understanding that the rapidly developing industrialization of parts of the UK marine zone was not adequately served through the previous consenting procedures, which were often piecemeal and disparate. Marine Planning was envisaged to be the solution to this, ensuring a more joined up mechanism that enabled the multi-dimension nature of the marine zone to be effectively described within the planning process; thus ensuring the most effective and efficient use of the space. However, it has not necessarily worked out this way.

Co-Use/Co-Location – Wales

54 OWF development off the North Wales coast began in mid 2000's with the development of North Hoyle and then Rhyl Flats OWF. The mussel cultivation sector in Bangor had/has a long-established relationship with the research community. Deepdock Ltd (DD) identified the potential for co-location and sought to trial this within the North Hoyle area. DD was and remains committed to the extensive seabed cultivation mussels – this is an approach where mussels (ideally juvenile or part grown) are transplanted from a source area to an on-growing location, i.e. an area which has suitable environmental conditions to engender that growth. The North Hoyle location met these site selection criteria (high primary productivity in the water column, correct substrate, etc.). DD reached out to the North Hoyle operator and developed a dialogue. Despite significant concerns by the OWF operator, codes of working practice were agreed between parties. One of the issues that facilitated this activity was that, given the type of cultivation practiced not requiring any insertion of markers into the fundus, no Crown estate sub lease was required, however, all other requisite permissions were acquired.

55 Whilst this pilot scale activity was successful at some level, no adverse interaction between the activities and the mussels grew; although then suffered unexplained mortality – the Crown Estate (TCE) posed a series of questions that the pilot activity had not sufficiently answered. They suggested a larger study of the potential that was not driven by a single company. As such the Shellfish Association of Great Britain (SAGB) obtained European Maritime fund funding to undertake a wider study on the principle (https://thefishsite.com/articles/shellfish-aquaculture-in-welsh-offshore-wind-farms-the-potential-for-colocation).

56 DD and Bangor University were granted a lease by TCE on a small experimental 6.5ha experimental area to trial sub surface long line technology, in part as recognition of future OWF were likely to occur in deeper waters, unsuitable for

seabed cultivation. In the subsequent decade significant study has demonstrated the viability for offshore shellfish cultivation within the challenging environment of the Irish Sea, with its high current and tidal regimes and increasingly frequent extreme weather. It has been demonstrated that mussels will settle on the sub surface ropes, grow and produce a viable market attractive product over an accelerated time frame in comparison to seabed and long line systems elsewhere.

57 DD (and its successor company for offshore shellfish cultivation – Open Sea Aquaculture LLP (OSA)) maintained an ongoing dialogue with the OWF sector developing off the North Wales coastline, with the operators of the Gwynt Y Mor OWF. Jointly DD and Gwynt Y Mor identified a 140ha area – immediately adjacent to the southern edge of the windfarm area, where a scaled co-location could be undertaken. OSA is currently in process of acquiring marine licence for this and two other stand-alone areas.

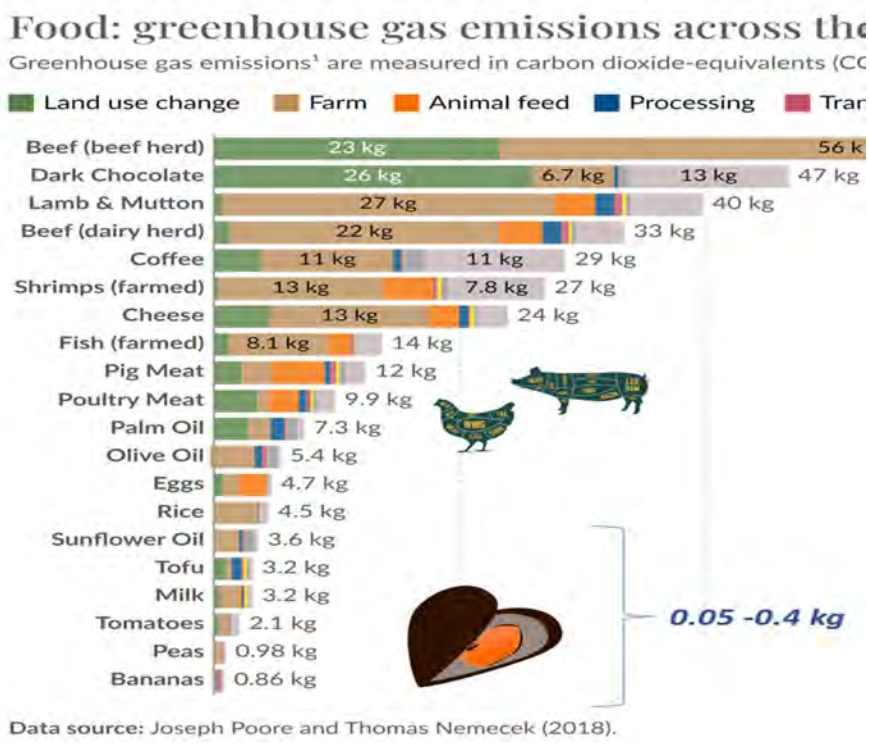
58 Bangor University is currently part of the ULTFARMS project (https://ultfarms.eu), which is seeking to further progress the commercial uptake of multiuse of OWF areas and overcome some of the remaining barriers.

Wider EU

59 Over the past 10-15 years there has been an ever increasing research base and real life application of co-location / co-use of shellfish and seaweed cultivation (collectively often referred to as 'Low trophic aquaculture') inside the frameworks of OWF areas in Belgium (https://www.bluecluster.be/projects/north-sea-aquaculture and https://www.h2020united.eu/8-blog/92-belgian-installation-longlines), Germany, the Netherlands, Norway and Denmark (https://www.nature.com/articles/s43247-023-01116-6#:~:text=Co%2Dlocating%20offshore%20wind%20farms,)%20and%20nutrients)%20(Fig; https://olamur.eu/ and https://ultfarms.eu/).

60 The European Union has to date funded projects with a total cost of +/-€100 million that have sought to progress the concept of co-location into large scale reality. It has done this in part in recognition of the growth and current scale of the Offshore renewable sector and in particular the OW sector and also in part in recognition of how much more growth is required to meet the EU and UK targets to decarbonise their economies in order to meet net zero objectives.

61 However, the EU has also funded and plans to continue to fund further projects to better enable co-location between low trophic (and other) aquaculture in recognition of the role that food production systems also need to de carbonize to meet the same net Zero targets. In the UK for example it is envisaged that food production (largely considered on the basis of the agricultural food system) will contribute up to 25% of UK GHG emission by 2035. Low trophic filter feeders, such as mussels, oysters, scallops, in addition to producing high quality nutrient dense protein, high in content for essential minerals and vitamins, also has one of the lowest GHG profiles for any food type.



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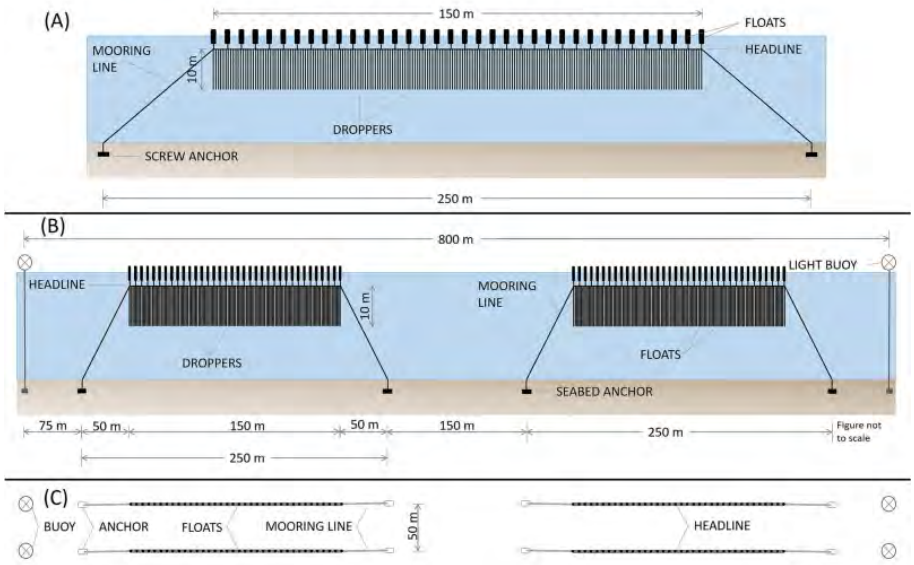
62 Furthermore, the same shellfish species are also acknowledged for the role that they play in natural remediation of the marine environment (a process known as bio-remediation) through the take up of excess nitrates and phosphorous that emanates from terrestrial food production (https://www.crownestatescotland.com/sites/default/files/2023-07/review-of-the-contribution-of-cultivated-bivalve-shellfish-to-ecosystem-services.pdf).

63 Recent research undertaken in Lyme Bay, on the activities within the Offshore Shellfish Limited shellfish farm, conclusively described the positive biodiversity effect of sub surface mussel cultivation at the micro ecosystem scale (https://www.sciencedirect.com/science/article/pii/S1470160X24011658).

What might Co-Location of Shellfish Cultivation and OWF look like?

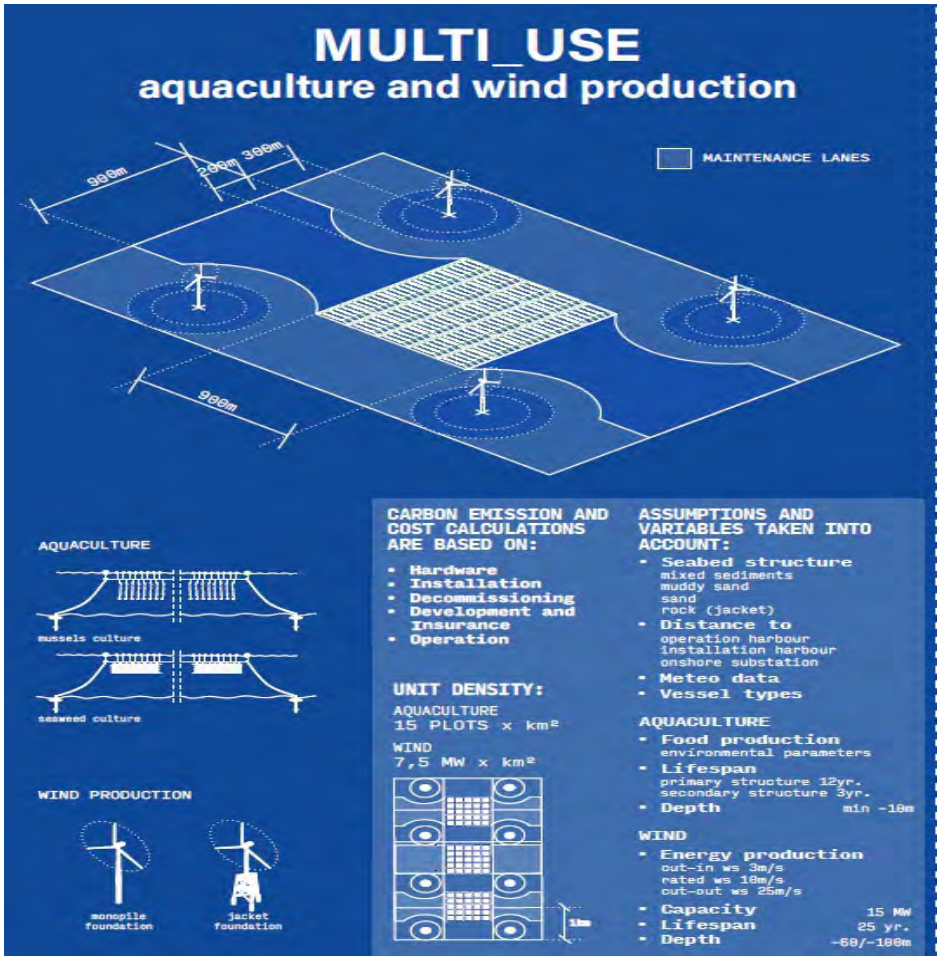
64 Much of the technology currently being utilised (and increasingly rolled out) for sub surface offshore mussel cultivation outside the confines of OWF will of course be equally applicable for activities within OWF areas.

65 These consist of 250m long apparatus anchored into the seabed through the deployment of helical screw anchors. These anchors have very high strength to weight ratio and have been proven in the Welsh environment to provide a highly secure basis for the sub surface systems.



66 Within a 50-56ha area, 14 to 21 such systems would be deployed. Productivity from each system is envisaged to be comparable to that experienced in other sites off the Welsh coastline with between 5-10kg/m of growing medium production per year – with some 1,750m of medium deployed on each sub surface system. At current market value it is expected that each such block of 14 to 21 systems would generate between £4-500k pa with a working time frame for each system being 8-10 years.

67 It is clearly an essential element in co-use of space that the interests and needs of the OWF operator are fully accommodated within the siting of the shellfish cultivation infrastructure. A recently produced graphic provides a very useful illustration of how this could be provided.



(@NorthCNeutral 2024)

Summary

68 Co-location between OWF and shellfish cultivation within the European marine area is happening and will happen with increasing frequency. It is implicit within EU and UK marine planning policy that the vast areas required for OWF development required to meet Net Zero/decarbonization commitments must not be seen as monopolistic use sites and should accommodate co-existence of other compatible activities. Low trophic shellfish cultivation and indeed all forms of aquaculture, are clearly activities that can be seen to satisfy the criteria to be considered compatible. They have a potentially significant to play in reducing the GHG loading from the current food system, all whilst naturally undertaking bio-remediation of the marine environment and having a potentially positive effect on biodiversity.

7 BML's 'Technical Ask'

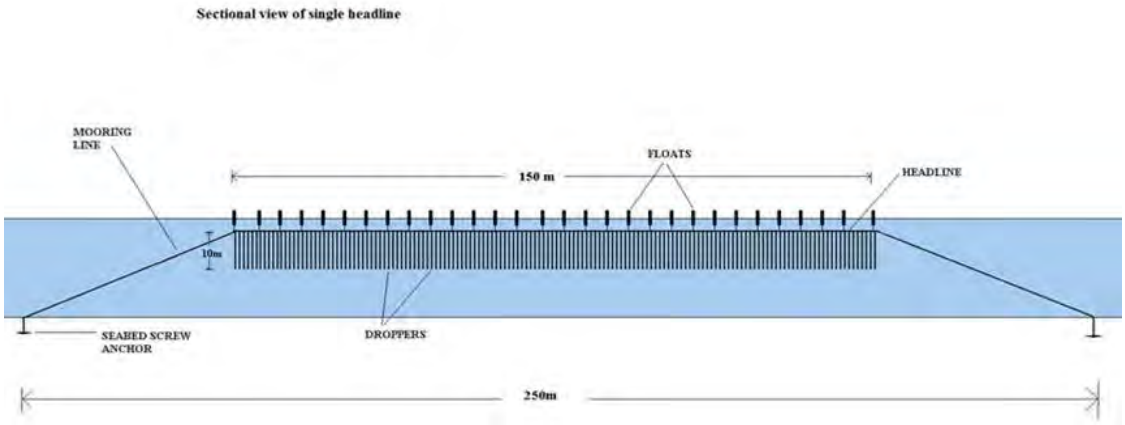
69 BML sets out below what is requires as a minimum and these are:

- The identification of not less than 5 blocks of marine space (surface and seabed) each block not being less than 50ha in area. This is relatively modest in size: the offshore mussel farm at Lyme Bay comprises 1,000 hectares, for comparison. Each block to be situated within the parameters of the Project Design Envelope (PDE) (as set out in Table 2.2 of the 'Planning, Development Consent and Need Statement, Rev02 (**REP1-011**) and through technical negotiations.

Note: the total area of 250 ha required for co-located bivalve aquaculture blocks is extremely modest in the context of the operational area of the project as a whole, which **BML estimate to be 2.87% of the DCO Order Limits Area of 87 kms2 or 8,700 hectares**). It would not compromise (to any extent) the suitability of the intra-turbine corridors to be subject to navigation (note that the aquaculture blocks would fall to be marked on Admiralty charts and other GIS maps and software) and would be situated so far away from individual turbines that the Applicant's ability to operate, inspect, survey and maintain the turbines (and cables) would not be compromised, again to any extent at all, including in emergency scenarios. It is for this reason that it is clear that aquaculture has the ability for frictionless co-location with the Project (and why this is becoming standard practice for OFW farms in other European countries);

- The grant of a sub-lease (or alternatively a surrender and re-grant of part or the assignment of part of the Applicant's 'head lease') on appropriate terms to BML in respect of the 5 blocks, so as to enable the delivery and operation of the aquaculture asset;
- The grant of a Deemed Marine License (DML) in respect of the use of the relevant areas for aquaculture (to the extent that this is possible). BML notes the contents of Schedule 6 of the draft DCO relating to the dML (**REP2-003**), which it proposes for amendment (as set out below in the second part of Section 8 below); and,
- The making of navigational arrangements and protocols (or at least the establishment of a framework for such arrangements and protocols to be developed in consultation with appropriate bodies) for the use of such area for that purpose (as covered in Section 7 below).

70 As to what the aquaculture asset 'looks' like, the ExA are invited to note that in the main this comprises the tethering of a headline and droppers to the mooring cables and screw anchors affixed to the seabed such that the droppers can be used for the cultivation of mussels. Floats on the surface tethered to the headline and droppers (i.e. the aquaculture unit) indicate the location and position of the headline and droppers at sea. The structure is designed to withstand tidal and wave energy. The cable is inspected and harvested by way of static line operations from a boat. The mussels on the droppers obtain the nutrition they require from the marine environment: no additional delivery of nutrition is required. An illustrative representation of one such unit (sectional detail) is shown below.



71 BML would ask the ExA to consider requesting further information from the Applicant under the provision in Rule 17 of the Infrastructure Planning (Examination Procedure) Rules, 2010 that allows for a range of further information to be requested from the Applicant.

72 BML notes that there is a possibility that it cannot be considered an Interested Party and consequently, it will be unable to be part of the initial list of parties requiring Statement of Common Ground (SoCG) (refer to Rule 6 Letter dated 23 September 2024 (**PD-007**, **Appendix G**). Consequently, BML requests the ExA to consider how a non-party can participate in the SoCG process or an analogous process (refer to Section 9 below).

73 BML requests the ExA and Applicant to note that the proportion of the total Morecambe Array area required for aquaculture is extremely small. The Morecambe Array area is 87 km2 (or 8,700ha) (refer to Section 3.2 of the Planning, Development Consent and Needs Statement, Rev02 (**REV1-011**)). The area required, as a minimum, by BML (as set out above) is 250ha (i.e. 5 x 50ha). **This represents only 2.87% of the total Morecambe Array area** and yet the benefits and minimal impact (as set out in Sections 6 and 7 above) contributes to sustainable resource development nationally.

8 DCO Securing Mechanisms and 'Control Plan'

Introduction

74 As the ExA is aware there are limited securing mechanisms with any DCO that will ensure commitments are delivered. These are broadly:

- The DCO Order itself, including Requirements (usually in Schedule 2);
- Certified and Control documents as set out in a 'Control Plan', each of which is secured within the draft Order; and,
- A separate Legal Agreement (often a Section 106 Agreement, but not relevant here).

75 The Control Plan is sometimes referred to as the 'Mitigation Route Map', but is the framework for mitigating, monitoring and controlling effects of the Project. It is usually made up of a series of 'control documents', which present the mitigation measures identified in the application that must be implemented during design, construction and operation to reduce the adverse effects of the Project. Each document within a Control Plan is secured within the draft DCO by means of an Article, a specific Requirement within Schedule 2 Requirements, Protective Provisions or the Deemed Marine Licence.

76 It is not clear to BML from its initial investigations into the current DCO documentation submitted by the Applicant, which is set out in the Examination Library, if a wider Control Plan exists beyond that of the Schedule of Mitigation, Rev02 **(REP2-017**). However, even with the Schedule of Mitigation, it is not clear how it is secured by the DCO documentation, even though it is listed as a certified document in Schedule 8 of the draft DCO (**REP2-003**). Documents where such an explanation and confirmation would normally be found is the Application Guide, Rev05 (**REP2-001**), which just lists all documents originally submitted. Furthermore, Schedule 8 of the draft DCO merely lists all documents to be certified under Article 42 of the PA2008 by the Secretary of State as true copies of those documents following the making of the Order.

77 It is acknowledged that the OFLCP is secured through the OEMP as part of the DML, which is part of the offshore environmental management plan in Condition 9(1)(e) of Schedule 6 of the draft DCO and is expected to be secured within the Deemed Marine Licence. However, BML has no current role in ensuring that the OFLCP is adequate or covers any provision for aquaculture or commitment to be consulted through the dML process.

78 Schedule 6 of the draft DCO (**REP2-003**) sets out the provisions relating to the DML in two parts (activities and conditions). It is clear that notification and consultation only occurs with the official licensing bodies list in Paragraph 1(4) and no other interests are represented, particularly the various commercial fishing or aquaculture interests, so as to ensure the OFLCP is relevant and is both monitored and complied with.

79 **BML requests that the Applicant clarifies its full and coordinated Control Plan/Mitigation Route Map and how each element is secured separately, particularly the Schedule of Mitigation (REP2-017). Also, it would be helpful to understand from the Applicant if the measures proposed below are agreed and delivered, how will BML be involved in the securing process.**

Proposed DCO Securing Mechanisms for 'Technical Ask'

80 Based on the latest version of the draft Development Consent Order (**REP2-003**) and of the Outline Fisheries Liaison and Co-Existence Plan (OFLCP) (**APP-147**), the following proposed securing mechanisms are set out below.

81 BML believes that the proposals set out in Section 7 above should be inserted into Section 3.2 on Mitigation and Co-Existence, within a new Sub-Section 3.2.2 (suggested header: *Co-location with future aquaculture developments during the operational and maintenance phase*) of the OFLCP. Moreover, that the OFLCP should have a more positive outlook and confirm a commitment to assist and facilitate future opportunities for co-existence and co-location. These measures would also need to be transposed into an updated version of the Schedule of Mitigation. Appropriate revisions to the *Environmental Statement – Volume 2, Chapter 13: Commercial fisheries* (**APP-050**) and the *HRA Stage 1 Screening Report* (**APP-028)** should be also considered by the Applicant.

82 Furthermore, consideration should be given to inclusion of the bivalve/mussel or wider aquaculture sector into the consultation bodies required by the MMO during the DML process.

83 Without the iterations/updates of the control documents in this manner BML submits that the Project remains 'not consentable' in the context of S104(3) and S104(7) PA 2008.

84 In order to ensure compliance with policy, notably the co-existence and co-location imperatives which afford significant public benefits, it is BML's position that the Morecambe Offshore Wind Farm should not sterilise or prevent aquaculture operations from being undertaken within the Order Limits of some 87 km2. The aquaculture industry should not be excluded from this area and it should be afforded future opportunities to operate in this area. Indeed, the wider and developing aquaculture community should be encouraged to take co-existence and co-location opportunities as they emerge and nothing in the draft DCO or the

OFLCP should be constructed as preventing TCE/the Applicant from providing further areas and rights to other commercial aquaculture entities. BML's position, is that it considers it should be supported by the Applicant to secure the policy objectives as part of its proposal. BML would like the Applicant to secure for the benefit of BML, these 5 marine blocks of 50 hectares each, as a minimum (as described below in BML's proposed updated text to the OFLCP) within the Order Limits as part of its leasehold arrangements with the Crown Estate. BML has, in an effort to be helpful and acknowledging that the OFLCP is a 'live' document, sought to draft a **new Sub-Section 3.2.2 within the OFLCP (APP-147).** This sets out its preferred wording below in bold italics (the numbering within this new section can be adjusted by the Applicant).

'Section 3.2.2 Co-location with future aquaculture developments during the operational and maintenance phase.'

The Applicant acknowledges that there are significant commercial, social and environmental benefits to be realised from the co-existence and co-location of the fishing and aquaculture industries within the Morecambe Offshore Wind Farm. This position is supported by the National Policy Statement (NPS EN-1 and EN-3) and the Applicant will therefore co-operate with these industries to ensure their continued and future operations within and around the Morecambe Offshore Wind Farm area.

To demonstrate its commitment to co-existence with the aquaculture industry the Applicant will ensure that its leasehold arrangements with the Crown Estate (TCE) do not prohibit or sterilise its demised area from use by the aquaculture industry.

To support the policy objectives for co-existence and co-location set out in the NPS, the Applicant will seek to identify and secure no less than 5 blocks of marine space (surface, airspace, water column and sea bed) (known as 'marine blocks') within the Morecambe Offshore Wind Farm for the benefit of Bodorgan Marine Limited, an aquaculture company. Each marine block will be no less than 50ha in area and each situated within the Project Design Envelope (PDE) parameters (as set out in Table 2.2 of the Planning, Development Consent and Need Statement, Rev02 (REP1-011)), in which aquaculture can take place.

In terms of securing the marine blocks on behalf of BML, the Applicant will ensure that an express right is obtained from TCE in favour of BML, which allows the Applicant to either:

- ***(i) sub-let up to 5 marine blocks (for a peppercorn rent) to BML for the purposes of aquaculture;***
- ***(ii) surrender part of its leasehold area and re-grant up to 5 marine blocks (for a peppercorn rent) to BML for the purposes of aquaculture; or,***
- ***(iii) assign that part of its leasehold area that comprises up to 5 marine blocks to BML (for a peppercorn rent) for the purposes of aquaculture.***

Moreover, as part of this commitment, the Applicant will also ensure that a framework for navigational arrangements and protocols is agreed with the aquaculture industry (including BML) to ensure the effective use and co-existence of the aquaculture industry with the Morgan Offshore Wind Farm.'

85 Further to the points made about the DML in Section 5 above, the proposed **amended drafting for Schedule 6** of the draft DCO (**REP2-003**) is set out in bold italics below, with instructions preceding each element of new drafting.

Insert into paragraph 1(1) (Interpretation) of Part 1 of Schedule 6c (Deemed Marine Licence: Morecambe Offshore Wind Farm Generation Assets) the following new defined term:

'CEFAS' means Centre for Environment, Fisheries and Aquaculture Science'

Insert a new paragraph 1(4)(i) (Interpretation) of Part 1 of Schedule 6 (Deemed Marine Licence: Morecambe Offshore Wind Farm Generation Assets), as follows:

'Centre for Environment, Fisheries and Aquaculture Science
Pakefield Road
Lowestoft
Suffolk
NR33 0HT
Tel: 01502 562 244;'

Insert reference to CEFAS in the list of bodies to be consulted (as appropriate) at Condition 9(1) of Part 2 of Schedule 6 (Deemed Marine Licence: Morecambe Offshore Wind Farm Generation Assets.

Replace condition 9(k) of Part 2 of Schedule 6 (Deemed Marine Licence: Morecambe Offshore Wind Farm Generation Assets) with:

'a fisheries liaison and coexistence plan in accordance with the outline fisheries liaison and coexistence plan to ensure that:

(i) the fishing and aquaculture industries are notified of commencement of the authorised scheme pursuant to condition 4(8); and,
(ii) the interactions between the authorised scheme and the fishing and aquaculture industries as set out in the outline fisheries liaison and coexistence plan are adhered to.'

Insert the following words at the end of condition 10(3) of Part 2 of Schedule 6 (Deemed Marine Licence: Morgan Offshore Wind Farm Generation Assets):

'in consultation with those relevant bodies (as appropriate) listed in condition 9(1).'

86 In addition, BML proposes for the ExA to include **an additional Requirement** that requires the Applicant to submit a draft TCE lease to the SoS for approval and must not commence any part of the offshore works until that approval is given in writing. Furthermore, the SoS must only approve that lease if he is satisfied that it contains adequate provision for aquaculture to take place within the (offshore) Order Limits and must, in deciding whether to approve the lease, have regard to Section 3.2.2 of the Outline Fisheries Liaison and Co-existence Plan (OFLCP), which should set out that what is needed is either:

1) a provision in the lease to sublet to BML for the purposes of aquaculture in an area comprising as a minimum the 5 blocks (for a peppercorn);

2) a provision enabling BML to call on the applicant to surrender its rights in an area comprising as a minimum the 5 blocks and enabling TCE to grant a new lease in respect of those areas to BML for aquaculture; or,

3) a provision enabling BML to call for the applicant to assign that part of its leasehold interest comprising as a minimum the 5 blocks.

'8 - No offshore works or ancillary works may commence until a draft form of lease between the undertaker and the Crown Estate in respect of the Crown land within the Order limits has been submitted to and approved in writing by the Secretary of State following consultation with Marine Maritime Organisation and the Secretary of State must ensure that:

(a) the proposed lease must not have the effect or preventing or restricting any form of aquaculture activity being brought forward within the Order Limits; and,

(b) the proposed lease is in compliance with the provisions of the paragraphs within the new section 3.2.2 of the Outline Fisheries Liaison and Co-existence Plan secured under Part 2, condition 9 of the deemed marine licence'.

9 Commentary on Technical Engagement between BML and the Applicant

Current Engagement between the Applicant and BML

87 BML is keen to engage with the Applicant with respect to the matters set out in Sections 5, 6, 7 and 8 above and respectfully requests that the ExA issue further written questions, seek further information and/or hold an ISH in respect of the issues raised herein, so that the detailed issues in respect of the imperative for the Project to accommodate the co-existence and co-location of sustainable industry can be fully explored and understood and appropriate arrangements for co-located aquaculture secured.

88 Within the Applicant's Consultation Report (**APP-015**) and its relevant Appendix B (**APP-016**), it is clear the extent of stakeholder engagement and the range and content of both the Non-Statutory and Statutory Consultation processes. Unfortunately, the Applicant did not consult with the representatives of the aquaculture industry and expertise in the broader local area (refer to Paragraph 11 of the Preamble above) – refer to Section 6.11, especially Table 6.2 in the Consultation Report (**APP-015**).

89 In the ExA's 'Initial Assessment of Principal Issues' (within the Rule 6 Letter issued on 23 September 2024, Appendix C (**PD-007**), the only issue expressed within Section 3, Commercial Fisheries, relates to the displacement of any fishing activities and effects. Unfortunately, considering proactively the potential of aquaculture within OFW was absent and it is hoped that the Preamble above has shown the value of such consideration. BML therefore requests that this is now given further consideration.

90 In the ExA's Rule 6 Letter dated 23 September 2024 in Appendix G, it sets out potential parties to any Statements of Common Ground (SoCG). However, the aquaculture industry or other expertise in this important field are not covered. BML contends that the ExA should consider that BML, the School of Ocean Sciences at Bangor University and other experts in this field for inclusion going forward as parties that can be progressing both discussions and a potential SoCG (joint or separately).

Recommendations

91 BML stressed that the requested support and provision for aquaculture within the DCO be seen by the Applicant as a very positive proposal and one in which the Applicant could be considered a 'Pathfinder' for UK practice to then be emulated on other projects. The Applicant is invited to react to this idea.

92 BML recommends that aquaculture provision and co-location be considered as a 'Principal Issue' to be subsequently covered in the Examination and that the ExA recommends that the Applicant engages with BML and others and explores the possibility of a new SoCG.

93 BML suggest that given the content of this D3 submission that it would be appropriate to hold a Hearing or part-Hearing to specifically discuss all these matters related to aquaculture.

10 Final Conclusions

94 In consideration of the information and commentary above, here BML distil, summarise and set out the 5 main issues that either require the Applicant's response or, BML would submit, further actions from the ExA. These are the following:

1 **Wider Strategic Concerns** – these are set out in the Preamble above in Paragraphs 1 – 13.

2 **Policy Compliance** – given the Applicant's views on its National policy compliance, BML's views are set out in Sections 4 and 5 above), there is clear disagreement that requires resolution. It is clear from Section 4 above that BML considers that the Project does not comply with S104(3) and (7) of the PA2008 (as covered in Paragraphs 33 – 41 above, in particular).

Furthermore, it is unclear if the Applicant considers that the proposed mitigation of commercial fisheries comprises enhancement as required by NPS EN-3 (refer to Paragraphs 33 – 41 above). It is notable that the Applicant for the Mona OFW Project has openly acknowledged that it is not delivering enhancement.

3 **Acknowledgement and Support by the Applicant of the 'Technical Ask' from BML and Provision for Aquaculture within the draft DCO** – this is set out clearly and in detail in Sections 6 and 7 above, but it requires the Applicant's written support and further actions as set out in Sections 7 and 8 above. The BML recommendations for straightforward additional drafting within the OFLCP, Schedule 6 and a new Requirement require positive consideration (refer to Section 8 above). The consequence of this not being delivered is the sterilisation of 87km2 for this project alone, preventing the valuable aquaculture sector from developing offshore (notwithstanding the 667km2 sterilisation involved in all three Irish Sea project areas).

4 **Technical Engagement from the Applicant** – the lack technical engagement so far by the Applicant with the aquaculture sector is evident, noting Paragraphs 8 – 11 of the Preamble above. However, now technical matters have been raised they should commence during the Examination to discuss and resolve these outstanding issues.

5 **Provision for Aquaculture and Co-Location as a new 'Principal Issue' and an Additional Hearing or part-Hearing between D3 and D6 to discuss aquaculture and co-location issues in more detail** – there has been limited consideration of co-location for aquaculture during the Examination so far. As recommended above, the consideration of the new 'Principal Issue' of Aquaculture and Co-Location' and a further Hearing or part-Hearing is requested and warranted given the content of this D5 submission.

ANNEX 1

‘Future of Offshore Wind’, Crown Estate, September 2024

and

Sky News Article – ‘Cornwall fishermen fear for livelihoods as offshore wind farms pose 'greatest change' the industry has faced’, 1 January 2025

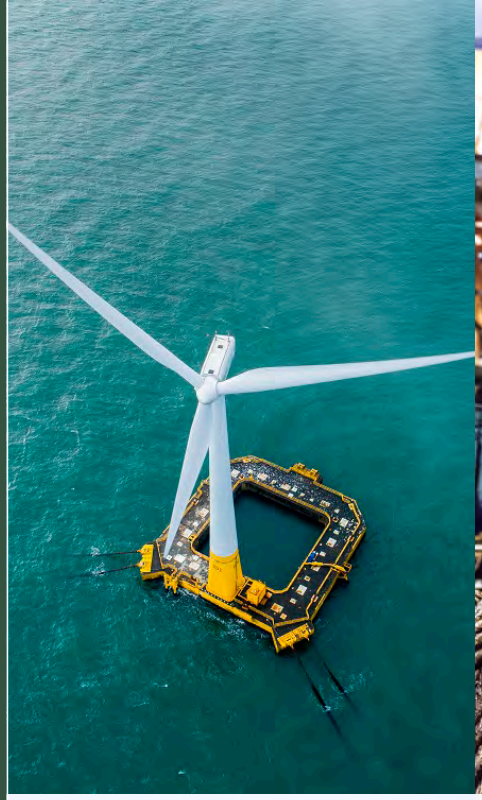
Future of Offshore Wind

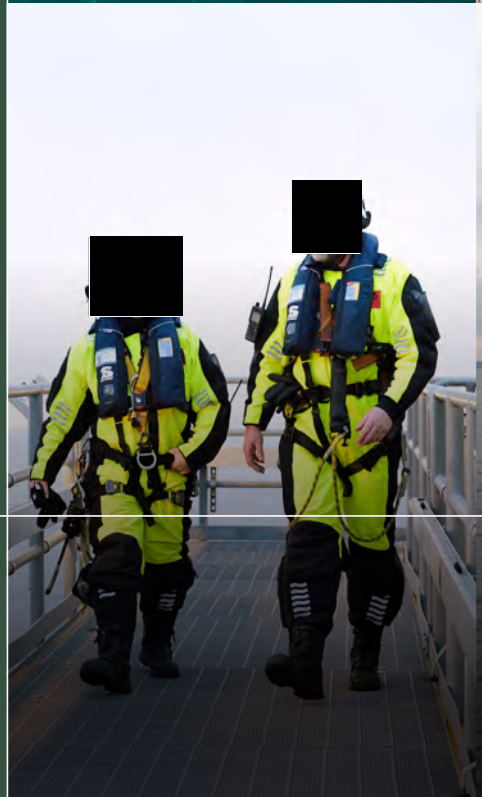
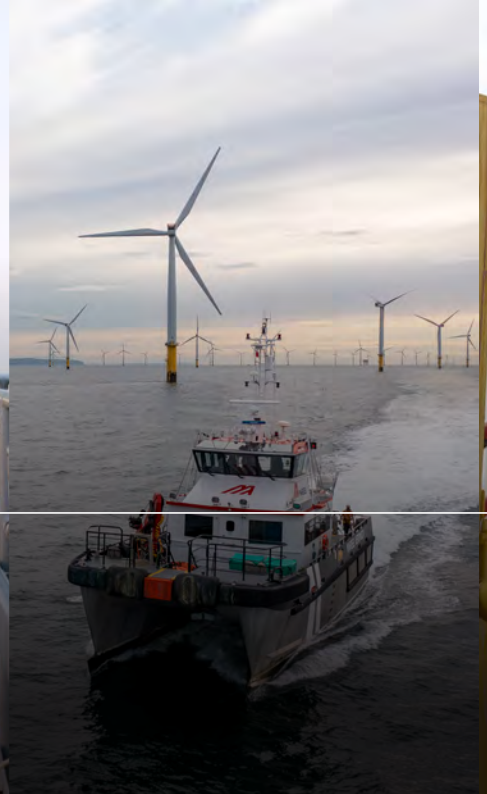
Considerations for development and leasing to 2030 and beyond

Marine Delivery Routemap | A Marine Delivery Routemap publication

A report on behalf of Great British Energy: The Crown Estate

September 2024




THE CROWN ESTATE

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"I am delighted that Great British Energy is partnering with The Crown Estate to write the next chapter of the UK's renewable energy story."

Juergen Maier
Chair, Great British Energy

Foreword

The UK is amongst the world leaders in harnessing the power of offshore wind, powering homes and businesses across the country, supporting the energy transition and attracting billions of pounds of investment into the economy. The scale of the sector is now very impressive, providing clean energy to millions of households and employing tens of thousands of people.

Great British Energy sits at the heart of the government's mission to accelerate this success and make Britain a clean energy superpower. It will be owned by the British people, for the British people, with the ability to invest to support clean power projects and create many thousands more valuable careers across the UK.

I am delighted that Great British Energy is partnering with The Crown Estate to write the next chapter of the UK's renewable energy story. There is a huge prize on offer and by bringing together Great British Energy's strategic industrial policy with The Crown Estate's internationally-recognised expertise and management of the seabed, we can ensure Britain continues setting the pace for global offshore wind. This will be backed by £8.3 billion of new money for Great British Energy, alongside new borrowing and investment powers for The Crown Estate which are currently being brought forward in Parliament.

To achieve our goals, we need to push ourselves to move faster and work harder to reach our net zero targets, unlock investment and support the growth of local supply chains. This report marks an exciting step towards unlocking the next 20-30GW of offshore wind pipeline – enough power for the equivalent of almost 20 million homes. Not only does it plot a course to bringing this new capacity to market by 2030, it sets out a number of important proposals to accelerate and de-risk the process for developers and maintain the attractiveness of the UK market for international investors.

There are exciting times ahead, both off our shores and within the onshore communities that stand to benefit from the continued success of UK offshore wind. As we continue to build Great British Energy, I look forward to working with industry and other partners for the benefit of all British people.

Juergen Maier
Chair, Great British Energy

"The UK's offshore wind industry has a long track-record of working together to rise to new challenges, and the shared depth of experience and expertise leaves us well-placed to face the future."

Julia Rose
Head of Offshore Wind Marine, The Crown Estate

Introduction

UK offshore wind is a success story on a global scale. Each turbine rotating off our shores represents decades of commitment, research, expertise and ingenuity which have combined to make the UK one of the most attractive markets for offshore wind in the world. And with each new turbine comes more investment into the UK economy, more jobs and more onshore opportunities for coastal communities.

At The Crown Estate, we're proud of the role we have played in supporting the growth of a sector that now produces enough renewable energy for half of all UK homes and is set to employ more than 100,000 people by the end of the decade.

Given this success, it is no surprise that offshore wind has become the cornerstone of the UK's drive to net zero. But with this comes the need to do more than ever before, and at a faster pace. This report sets out how seabed rights for 20-30GW of new offshore capacity could be brought to market before the end of the decade to support the UK's net zero and energy security ambitions. It looks at the prime areas of opportunity for new wind farms and considers how a mix of fixed, deep-water fixed and floating wind projects might be brought forward and developed over the coming years.

Being able to deliver against these ambitious targets means more than simply bringing new areas of seabed to market. It means challenging ourselves to consider how we could tackle some of the wider systemic challenges and support a move towards more predictable, coordinated offshore wind development, while enabling nature recovery amidst a changing climate.

If this sounds like a major undertaking, it's because it is. But the UK's offshore wind industry has a long track-record of working together to rise to new challenges, and the shared depth of experience and expertise leaves us well-placed to face the future.

Part of the solution lies with the development of a new Marine Delivery Routemap, with our early thinking on this published alongside this report. This exciting work, founded in partnership, builds on The Crown Estate's world-leading expertise and marine data capabilities to plot a course for a long-term vision for the competing demands on our seabed, while protecting and enhancing the marine environment. Further publications are planned as part of this work on other key sectors, such as carbon capture and storage (CCS) and minerals. We will also be taking a more detailed look at our approach to nature, including how we can continue working in collaboration with others to deliver restoration and recovery.

Continued policy support will also have an important role to play. For example, the Contracts for Difference regime has helped underpin the success of UK offshore wind, providing an investable and globally attractive route to market. This needs to continue to evolve to support our

growing ambition. And the recent announcement of the creation of Great British Energy and its new partnership with The Crown Estate will bring together investment, policy-making and offshore wind data and expertise in a way we haven't seen before. Alongside this, new legislation being considered by Parliament will modernise the way The Crown Estate can borrow and invest, unlocking new ways for us to play an even greater role in supporting the sector.

For our part, when it comes to leasing new areas of seabed for important new offshore wind projects, this report sets out an evolving approach that seeks to overcome some of the systemic challenges faced by developers. By providing greater certainty through the process, we can create a more predictable forward path for industry and in turn, retain the attractiveness of the UK market to global investors.

Alongside all of this, feedback and the views of our partners, stakeholders and industry are crucial to shaping the future of our approach to seabed leasing. This report therefore poses a number of important questions about our evolving approach – from identifying the most attractive sites for development to looking at how we can help advance the consenting process through things like up-front surveys and working more closely with the Energy Systems Operator (ESO) on early grid design.

We understand the scale of the challenges ahead. The feedback we receive on the discussion points set out in this report will be invaluable as we work together to ensure the UK's offshore wind industry continues to deliver for generations to come. Thank you.

Julia Rose
Head of Offshore Wind
Marine, The Crown Estate

Photo by Ben Barden Photography Ltd

A new approach to offshore wind

The UK's offshore wind market is one of the largest and most successful in the world, with more than 50 wind farms around the UK coastline at various stages of development, producing enough renewable energy to power half of all UK homes.

The UK's offshore wind pipeline currently stands at approximately 95GW, with a Government ambition to decarbonise the power system by 2030, including a radical increase in offshore wind capacity in the same timeframe. In March, National Grid ESO published a blueprint for a decarbonised electricity system, setting out the electricity network upgrades needed to deliver this.

Recent announcements by the UK Government, including the creation of Great British Energy and its partnership with The Crown Estate, offer an important platform to build momentum and provide confidence to meet longer term ambitions for offshore wind – whilst delivering in the context of nature and all other demands on the seabed.

We recognise that the marine environment is already under incredible pressure, with biodiversity loss affecting habitats and species along our coast and at sea. As an organisation focused on delivering lasting and shared prosperity for the nation, we acknowledge the vital need to match our ambition for offshore wind and energy security with our ambition for nature outcomes. Healthy and resilient ecosystems are fundamental for society and nature-based solutions have a critical role to play in our net zero future. Our approach for the next generation of offshore wind responds to this nature context and the risks to infrastructure deployment of not doing so.

As part of this report, we are sharing our early thinking on the 'what, when, where and how' for future seabed development, alongside potential associated enabling and de-risking activity, to support the offshore wind industry in meeting potential demand out to 2040. A core element of this includes planning strategically to consider how this investment can also support environmental outcomes.

Much of this new offshore wind capacity is expected to be in areas of the Celtic Sea, which lies off the coasts of South Wales and South West England, and North East England. Additional smaller areas of opportunity,

The UK Offshore Wind sector now produces enough renewable energy for half of all UK homes

Photo by Alison Pettitt | Nature-based solutions play a critical role in ensuring healthy and resilient ecosystems

that could accommodate smaller scale developments, lie off the coasts of North Wales, North West England, Lincolnshire and Yorkshire. The precise approach to development remains under consideration but is expected to include a mix of fixed and floating foundations. Further details on the spatial design and potential areas of opportunity are set out on pages 16-27.

We are considering how we could tackle some of the wider systemic challenges and support a move towards more predictable and coordinated offshore wind development. This ensures that offshore wind can play its part in reaching net zero targets whilst delivering financial, environmental, and social value for the nation.

These are set out in more detail on pages 28-32 but include potential steps such as:

- Drawing on our rich evidence and marine spatial modelling capabilities to play a more active role in identifying and surveying attractive and deliverable sites for future offshore wind, helping to accelerate and de-risk deployment.
- Exploring opportunities to support the consenting process through front-loading some of our activities (i.e. environmental surveys and analysis), securing statements of common ground from key stakeholders at a plan-level and/or anticipating other activities that could de-risk and accelerate the consenting process post-lease.
- Improving the coordination between the process of seabed leasing, energy infrastructure planning and grid connections, helping further accelerate the deployment of offshore wind, while considering other seabed users and the natural environment.

This report also sets out further detail on how The Crown Estate might play a more active role in investing to support and stimulate the infrastructure and supply chain needed to enable the future growth of offshore wind. This follows legislation currently being considered by Parliament, to modernise The Crown Estate's borrowing and investment powers, alongside the new partnership recently announced with Great British Energy. This is covered on pages 33-36, including details on initial areas of focus to help unblock strategic bottlenecks to speed up the delivery of offshore wind projects, in particular offshore wind ports and wider supply chain.

The views of stakeholders will be key as we progress our thinking and further develop our future leasing programme. This report poses a number of discussion points, summarised on pages 13-14, with further details of how to take part in this important conversation, and we are looking forward to hearing your views on these important matters.

The role of The Crown Estate

The Crown Estate is an independent organisation, sitting between the public and private sectors, with a purpose to create lasting value for the nation from its activities. When it comes to its role in managing the seabed around England, Wales and Northern Ireland, this means taking a holistic and long-term view of this vital resource, helping catalyse the UK's transition to net zero while playing an important role in stewarding the marine environment. By working in partnership with industry, governments and stakeholders, The Crown Estate has helped establish the UK as home to one of the most successful offshore wind markets in the world.

This also means we are well-placed to bring people together to find solutions to some of the shared systems challenges facing our increasingly congested shores. This includes convening partners to help solve key systems issues together such as supply chain, grid connection, consenting processes and delivering beneficial outcomes for the environment.

Since the first turbines appeared in UK waters some 25 years ago, The Crown Estate has developed its expertise and capabilities, becoming a world leader for spatial mapping. By combining these skills with new digital capabilities, we have been working with partners to digitally map the seabed resource needed to meet the long-term needs of vital industries, net zero commitments and nature recovery.

Safety First

We have a unique and special role in fostering an environment where everyone who works in, supports, or visits the marine environment can do so healthily and safely. This means ensuring the minimum of personal risk but also meeting expectations of an environment where they can thrive. We are committed to continued innovation and improvement and have made 'Safety First' a central tenet of our approach across our whole business, and our marine strategy.

More details on our Safety First approach are set out in our Marine Delivery Routemap which can be found here.

Photo by Ben Barden Photography Ltd | Turbine array at Rampion wind farm

Our remit

Our remit covers England, Wales and Northern Ireland, so we do not make proposals in this report for offshore wind provision in Scotland, although we continue to work closely with Crown Estate Scotland on areas of shared interest, such as transmission cable routes and sharing of valuable data which can help de-risk development.

Northern Ireland

Alongside the work reported here, we are working with Department for the Economy, the Department of Agriculture, Environment and Rural Affairs and other stakeholders across Northern Ireland to develop and execute the Offshore Renewable Energy Action Plan (OREAP)[1]. This is expected to put in place the policy and legislative frameworks to support future offshore wind leasing. We will be applying the insights and analysis from this report to help inform that work and envisage undertaking seabed leasing in Northern Ireland in support of OREAP at the appropriate time.

1 "Draft Offshore Renewable Energy Action Plan", Department for the Economy

Photo by Jason Hawkes

Data and evidence: our Whole of Seabed Programme

The Crown Estate's Whole of Seabed Programme combines our spatial mapping expertise, digital capabilities, an overview of seabed demands across sectors and nature, and inputs from our partners to digitally map the seabed resource needed to meet future objectives – supporting vital industries, net zero and nature recovery for the long-term. This modelling capability represents the most comprehensive and sophisticated approach to spatial mapping in our history and will be kept up to date as new data, evidence and information becomes available. The analysis covers a range of critical sectors including offshore wind, other types of energy generation, CCS, aggregate extraction, telecoms cabling and nature. Tailored approaches have been co-developed with key stakeholders to map opportunities for each sector, while considering all uses and interests in the marine space, including those beyond The Crown Estate's responsibilities, to promote co-location and minimise potential future conflicts.

Our data capability

With an increasingly constrained offshore environment, data, analysis and collaboration are fundamental to supporting accelerated growth in UK offshore sectors and building confidence in the UK market. The Crown Estate is committed to investing in and sharing pioneering research, data and digital capabilities to manage the seabed holistically and inform future delivery, in a way that works as part of the wider ecosystem – building confidence in the quality and sustainability of developments.

You can find out more in the section that starts on page 33.

You can find out more about our Whole of Seabed Programme here.

Photo by Keith Hiscock | Habitats protection is at the heart of our nature strategy

A Marine Delivery Routemap: working with offshore wind

The seabed and coastline are critical for net zero, nature and a wide range of marine sectors. As the sea space becomes increasingly congested, we must ensure we plan for the future of offshore wind in the context of nature and all sea users. Through our Whole of Seabed Programme, we are creating a unique picture of the anticipated demands on the seabed. It is this evidence base that underpins this next phase of working with our stakeholders to plot a course for the sustainable growth of marine industries, alongside the restoration and creation of marine habitats and the enablement of thriving communities.

We are using this insight to play our part in co-developing with stakeholders a Marine Delivery Routemap that provides a forward strategy for the marine space to deliver on net zero and nature recovery, build a thriving marine economy and benefit onshore communities.

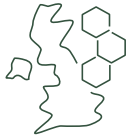
In embarking on this journey, we have set the following objectives:

- To catalyse the UK towards a net zero and energy secure future.
- To deliver a thriving marine environment and promote nature recovery.
- To optimise value from the marine space across sectors for the economy and communities.

It is envisaged that the Routemap will support:

Spatial pathways
Identifying 2050 spatial pathways to enable the best use of the marine space in order to meet policy objectives and user needs across sectors. This will provide stakeholders with long-term visibility on the key areas of opportunity for each sector, including opportunities for co-location, and support early resolution of competing demands.

Enabling investment
Providing forward visibility on where and when key enabling investments are needed (e.g. ports, supply chain, grid, nature). This can help underpin anticipatory investment needed and identify the opportunities these can create for impacted communities.



Seabed and coastal management
Informed by these pathways, developing forward plans which align the needs of industries, sectors, and the natural environment. For The Crown Estate, this means a timeline of leasing activity and investment for nature and infrastructure which it manages, while providing valuable long-term visibility for other users of the marine space.

This will all be underpinned by The Crown Estate's world-leading data and evidence. As we progress with the development of the Routemap, we will be able to identify in advance any gaps in this data across sectors, and how they can be addressed through research, shared forums and collaborations.

Through effective collaboration across users of the seabed and other interested parties, we have identified a number of benefits of a Routemap, including:

- ✓ **Optimise the use of marine space,** securing best outcomes for the economy, the environment and society.
- ✓ **Identify high-opportunity areas for biodiversity and nature,** supporting delivery of a thriving marine environment.
- ✓ **Provide visibility and certainty** to sea users across sectors on how the seabed will be used, giving market confidence.
- ✓ **Accelerate delivery and reduce costs across sectors:** for example, in energy, working with the ESO to find low-cost pathways for net zero with low consenting risk and which fit with the needs of nature and non-energy sectors.
- ✓ **Support economic development and communities** by identifying enabling investment needs and opportunities over the long-term (e.g. skills, infrastructure, ports, supply chain).

This report forms the first in a series of Marine Delivery Routemap publications. More on the overall approach and a link to the Routemap can be found here.

Technician aboard the Kommandor Iona, surveying areas of search

Discussion points

Through early analysis and engagement, we have developed our thinking on some key aspects of the approach to developing future offshore wind and bringing it to the market. These are distributed as discussion points throughout this report and are designed to underpin the next stage of a dialogue about our early thinking in terms of the 'what, where, when and how' for the future of offshore wind.

1 **Cross system coordination**

Forward delivery planning which works across all key marine sectors and nature for the marine space, i.e. the Marine Delivery Routemap, is critical to enhance safety, accelerate delivery, reduce consenting risks and spatial conflicts, and ensure that we make best use of scarce seabed.

2 **Future demand**

Our view is that there is a need to bring to market between 20-30GW of new offshore wind seabed rights in the waters off England and Wales by 2030, for delivery out to 2040[2].

3 **Leasing rounds**

Running successive leasing rounds in the period out to 2030 would deliver the best value and opportunity for developers. The timing and number of rounds, and the scale of each, remain under consideration.

4 **Locations**

We anticipate that the key multi-gigawatt (GW) opportunity for new leasing by 2030 will be in the Celtic Sea (off the south-western coasts of England and Wales) and in the North Sea (off the north east coast of England), with additional, more dispersed GW scale resource in other regions.

Further detailed spatial design and stakeholder engagement will refine these areas down through Areas of Search, refined Areas of Search, to final Project Development Areas (PDAs).

5 **Co-location**

Given an increasingly busy marine space, our view is that it is important to enable co-location in Areas of Opportunity through leasing design.

6 **De-risking and accelerating HRA, offshore surveys and consenting**

By bringing sites to market with a greater level of assurance, we can reduce potential stumbling blocks upfront and reduce the risk of attrition and delays in later development stages – accelerating projects, providing more certainty for investment, reducing project development costs and ultimately reducing consumer bills. This could be achieved by:

- Plan-level strategic environmental measures to ensure that future offshore wind takes full account of the UK's targets for the Marine Protected Area network.
- Undertaking pre-consent surveys.
- Developing options for additional upfront work to support consent ahead of sites moving to the market.

2 The focus of this report is new offshore wind leasing in the waters off England and Wales. There is potential for additional offshore wind leasing in Northern Ireland in support of the Offshore Renewable Energy Action Plan, and we will engage on this as plans progress.

7 Grid connections

By taking a systems-led approach we can provide more coordination between seabed development and transmission design and delivery, aligned with strategic planning processes for the energy sector. Working with Connections Reform, we will explore forward design of grid connections and applying for and entering into grid connection agreements for PDAs for novation to successful bidders.

8 Broad value

Our view is that we must harness the opportunities created by the delivery of offshore wind to enable net zero commitments, steward flourishing biodiversity and marine environments, create thriving communities and support economic growth. We are exploring how we can best achieve this through how we bring developments to market.

9 Technologies

Future offshore wind leasing will include a mix of sites that accommodate the development of fixed, deep-water fixed and floating sub-structures. Our long-term ambition is to give developers the flexibility to deploy the concept they consider most appropriate for a given site, noting that a tailored approach may be needed to ensure we foster growth and development of innovative foundation technologies, such as floating foundations.

10 Hydrogen

We recognise that offshore green hydrogen has significant potential, but we anticipate that there is unlikely to be a need for spatial design and leasing focused on this during the timeframes considered here. However, we are open to developers having the option to incorporate the production of green hydrogen in their development plans, where market arrangements and system plans align with this.

These are not final positions, and represent the next stage of dialogue with industry, partners, stakeholders and governments. We have compiled this report as part of our commitment to provide early visibility of our future offshore wind leasing intentions, in the context of a Marine Delivery Routemap. The Routemap aims to complement and inform key related marine spatial programmes - for example, the Marine Spatial Prioritisation (MSPri) programme in England, and Strategic Resource Areas (SRAs) in Wales - and forward plans for specific marine sectors. By providing a holistic view of the needs of all marine sectors and nature, the Routemap will also support the ESO's development of the Strategic Spatial Energy Plan (SSEP) and we are working together to ensure these programmes are closely aligned.

Seeking views

The views of stakeholders and partners are integral to this exercise. So we look forward to ongoing conversations as we progress our thinking and further develop our future leasing programme. As part of this, we will be undertaking regular engagement with the market, statutory and non-profit organisations, governments, sea users, and delivery partners. This will include supporting bi-lateral engagement with industry via trade bodies.

Alongside this report we will be issuing a questionnaire seeking feedback from existing and potential offshore wind develope[redacted]ho may be interested in bidding in a leas[redacted]a sole bidder or as part of a consorti[redacted]ate for completion by 4 October.

If you ar[redacted]ential developer or investor and wish [redacted]please apply by emailing a request [redacted]@thecrownestate.co.uk. Please note tha[redacted]ht to decline requests from other organisations to respond, at this time, noting that The Crown Estate will engage with other categories of stakeholder at appropriate times. You can also find this information in a Prior Information Notice on the Find a Tender website: www.gov.uk/find-tender.

A parallel questionnaire is being issued to key stakeholders (including statutory, non-profit organisations, governments, sea users and delivery partners) seeking feedback; alongside this, we are running an initial call for data and evidence to support our spatial design process.

Thank you for your continued support and engagement, which is invaluable as we work together to shape the long-term future of a resource on which we all rely.

Photo by Ben Barden Photography Ltd | Offshore wind technicians replacing sensors in a turbine nacelle

The future of offshore wind

Overview

Since the first turbines were installed off the Northumberland coast almost 25 years ago, the UK's offshore wind industry has flourished. Today, UK waters are home to more than 40% of all European offshore wind capacity. But just as important as delivering new, secure energy, the sector now also supports 32,000 jobs – a figure set to grow to more than 100,000 by 2030. Through its management of the seabed, and working in tandem with a strong government policy framework, The Crown Estate has played a key role in this success, helping create the right conditions for offshore wind to thrive. By working together to plot a course for the long-term growth of this critical industry, we can write the next chapter in this exciting story.

Design of future leasing rounds will be informed by views of the market and wider stakeholders, and they will support key energy and environmental policies, as has been the case for previous rounds. However, we intend to take a more strategic approach, working in the context of the Marine Delivery Routemap discussed above and seeking to 'design out' many of the systemic challenges arising from an increasingly busy seabed. Our future approach also acknowledges the challenges of introducing additional infrastructure into a marine environment already under pressure from a changing climate and suffering biodiversity loss. Achieving a net zero and climate resilient future requires us to realise the opportunity for offshore wind in a way that allows nature to flourish.

Discussion point 1

Cross system coordination: forward delivery planning which works across all key marine sectors and nature for the marine space, i.e. the 'Marine Delivery Routemap, is critical to enhance safety, accelerate delivery, reduce consenting risks and spatial conflicts, and ensure that we make best use of scarce seabed.

As detailed in the pages of this report, we propose that future offshore wind development by 2030 will:

1. Help to meet the UK's ambitions for future offshore wind demand out to 2040 - helping maintain a pathway to UK net zero.
2. Support development of a range of technologies that will deliver low-cost offshore wind over the long term.
3. Take a strategic approach to spatial design to support long-term cross-sector delivery and transmission infrastructure planning.
4. Include de-risking activities that not only accelerate sustainable deployment of offshore wind but also maximise the opportunities for beneficial outcomes for nature and recognise the needs of other users of the seabed.
5. Be designed in a manner which creates lasting financial, environmental and social value for the nation.

Additional leasing may be required beyond 2030 to enable further growth out to 2050, but this is out of scope of this report and is a topic we would come back to in due course.

Photo by Ben Barden Photography Ltd | Our Marine Delivery Routemap aims to unlock delivery of net zero and nature recovery goals

Meeting future demand for offshore wind

In order to maintain momentum to net zero by 2050 and provide necessary confidence to meet likely deployment ambitions for the mid-2030s and beyond, the time has come to consider plans for future offshore wind development.

Our long-term planning is based on external forecasts from organisations such as the ESO and the Climate Change Committee (CCC). Figure 1 shows that under net zero pathways in the 2024 Future Energy Scenarios report[3], 93-99GW of operational offshore wind could be needed by c.2040, and up to 103GW could be required by 2050[4]. Higher pathways published by the Climate Change Committee forecast that demand for UK offshore wind could reach 125GW-140GW by 2050[5].The UK's Offshore Wind Net Zero Investment Roadmap[6] referenced up to 125GW of offshore wind potentially being required by 2050. We use a mixture of these forecasts in our long-term planning to ensure that leasing acts as an enabler for the sector to meet policy and demand targets.

Discussion point 2

Future demand: our view is that there is a need to bring to market between 20-30GW of new offshore wind seabed rights in the waters off England and Wales by 2030, for delivery out to 2040.

3 "Future Energy Scenarios (FES)," National Grid ESO, accessed February 29, 2024.
4 CCC's scenarios are 65-140GW by 2050: "The Sixth Carbon Budget - Electricity Generation" Climate Change Committee, accessed 29 February 2024.
5 Reference: Sixth Carbon Budget, 9 December 2020.
6 "Offshore Wind Net Zero Investment Roadmap", Department for Energy Security and Net Zero, March 31, 2023.

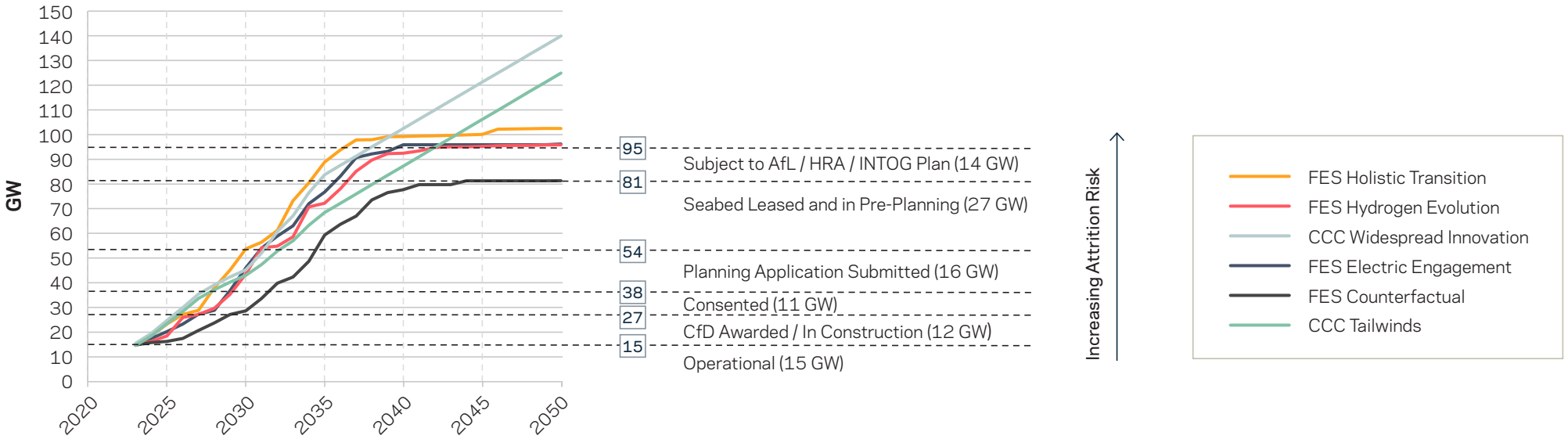
Figure 1 also shows that the current UK pipeline stands at approximately 95GW of capacity, which includes circa 15GW operational, circa 12GW under construction/ contracted, circa 11GW with consent granted, circa 16GW with planning applications submitted, circa 27GW in pre-planning, and circa 14GW of potential further capacity from leasing that has been announced, but for which seabed rights have not yet been awarded[7]. This includes potential capacity increases under consideration by The Crown Estate[8], and the capacity currently being offered to the market through Offshore Wind Leasing Round 5 in the Celtic Sea.

As with all major infrastructure projects, there is an increased attrition risk for developments that are at earlier development stages, therefore it is unlikely that all 95GW will be realised. Potential attrition in leased vs delivered capacity is an important factor when considering future leasing. However, potential attrition is not something that is represented in the Future Energy Scenarios (FES) or CCC numbers as these represent operational capacities needed to support the nation's transition to net zero.

Although there may be sufficient potential to meet short-term capacity targets from the current pipeline, additional leasing will be required to supplement the pipeline capacity for delivery by 2040 in order to maintain a cost-effective and deliverable pathway to net zero. Additional leasing can also help ensure the UK can meet its potential to export more clean electricity to continental Europe.

In light of this, having considered the risks across the current pipeline and the opportunities from new pipeline, our analysis has led us to an initial view that between 20-30GW of new offshore wind seabed rights should be brought to market in the waters off England and Wales by 2030, to meet potential demand for offshore wind out to 2040. The upper end of this range would provide more resilience against attrition in the project pipeline and for net zero scenarios with higher levels of offshore wind deployment – as well as greater optionality for lower-cost deployment.

Figure 1: Published UK future offshore wind pathways (solid lines) and capacities under agreement (dashed lines)[9]



7 Projects, leasing rounds and additional capacity subject to AfL and plan-level HRA or INTOG Sectoral Marine Plan.

8 "The Crown Estate Sets Out Plan to Unlock Enough New Offshore Wind Capacity to Power up to Four Million Homes", The Crown Estate, November 9, 2023.

9 Data correct as at 31 August 2024. Contract for Difference Allocation Round 6 results were published on 3rd September 2024, which will move approximately 4GW of offshore wind projects from 'Consented' to 'CfD Awarded / In Construction.

Offshore Wind Leasing Round 5 – a new chapter for UK offshore wind

In December 2023, The Crown Estate published details of Offshore Wind Leasing Round 5, which subsequently launched in early 2024. This latest leasing round is for three Project Development Areas (PDAs) in the Celtic Sea, off the coast of Wales and South West England, and is focused exclusively on the development of the UK's floating offshore wind capabilities.

Alongside establishing a new market for floating offshore wind, a key objective of Round 5 is driving wider social and economic benefits arising from new developments in the Celtic Sea. This is set out in more detail on page 37.

Round 5 also demonstrates the evolution of The Crown Estate's approach to leasing, with a number of up-front activities to help accelerate and de-risk the process for developers. This includes a multi-million-pound programme of marine surveys, up-front environmental assessment and working with ESO at an early stage to inform grid design.

In August 2024 we confirmed that the tender process had reached its next milestone (Invitation to Tender Stage 1) on schedule, and – thanks to groundbreaking collaboration with ESO – would be the first leasing round to come to market with an agreed plan for connecting the new wind farms to the energy grid.

The leasing process is due to proceed to an auction (Invitation to Tender Stage 2) in Spring 2025, with Agreements for Lease expected to be signed with winning bidders in Summer 2025.

Photo by Principle Power | Floating wind technology represents a new chapter for UK offshore wind

Route to market

We acknowledge that having a robust route to market is critical to successful project development.

There has been a relatively consistent and stable policy environment for offshore wind for more than a decade in the UK. However, it is evolving and a number of changes are either being implemented or are on the horizon, that will alter the policy framework moving forward, which we recognise could influence the risk profile for future investment.

Other structural changes are being actively considered through the Government's Review of Electricity Market Arrangements (REMA)[10] and the specifics of the Contract for Difference (CfD) scheme (such as how the scheme could be amended further to address price and volume risks associated with intermittent renewables). More generally, consideration is also being given to how renewable generators participate in the wholesale electricity market in the future, to ensure the overall system is optimised.

We are actively engaging with Government, and will continue to adapt our leasing approach to interact effectively with prevailing and new policies, in order to de-risk the route to market for projects and development.

Successive leasing rounds

One of our core aims is to provide the industry and wider stakeholders with forward visibility of a pipeline of future leasing rounds, with full consideration of other sectors and opportunities for nature – as part of the Marine Delivery Routemap. This will help enable early identification and efficient planning and resourcing of related activities, de-risking and investments. We want that pipeline visibility to drive investor confidence in upcoming development opportunities and unlock related anticipatory investment and value creation opportunities.

We believe the optimal approach to delivering that pipeline is to run successive leasing rounds in the period out to 2030 that collectively meet the future demand for offshore wind out to 2040. The precise timing and number of rounds, and the scale of each, remain under consideration at this stage, and will evolve as the leasing design progresses, with the aim to optimise deployment in support of supply chain considerations. We look forward to our engagement with stakeholders and the market as a key input into this.

Discussion point 3

Leasing rounds: running successive leasing rounds in the period out to 2030 would deliver the best value and opportunity for developers. The timing and number of rounds, and the scale of each, remain under consideration.

Locations

Successfully enabling this scale of capacity will require careful consideration of the marine space to ensure optimal locations are identified. Demand for space in the marine environment is accelerating and is predicted to at least double out to 2050[11]. Therefore, it is critical to consider future opportunities and development costs for offshore wind in the context of nature and other potential uses of the sea.

Approach to spatial design for future leasing

Our approach will analyse the best available data and evidence, including from our Whole of Seabed Programme, combined with extensive stakeholder engagement, to refine opportunities from a national picture, down to individual offshore wind PDAs. We believe that identification of PDAs by The Crown Estate, and offering these to the market through the leasing process (as we have done on Leasing Round 5), brings a number of advantages in supporting the sustainable deployment of offshore wind. Doing so allows The Crown Estate to incorporate a strategic approach to nature, avoiding areas identified as essential in supporting the most sensitive and vulnerable habitats and species, and take account of other sea users. We can also accelerate deployment by investing in transmission design and earlier offshore surveys, as well as undertaking plan-level HRA (see De-risking and Accelerating section on page 28).

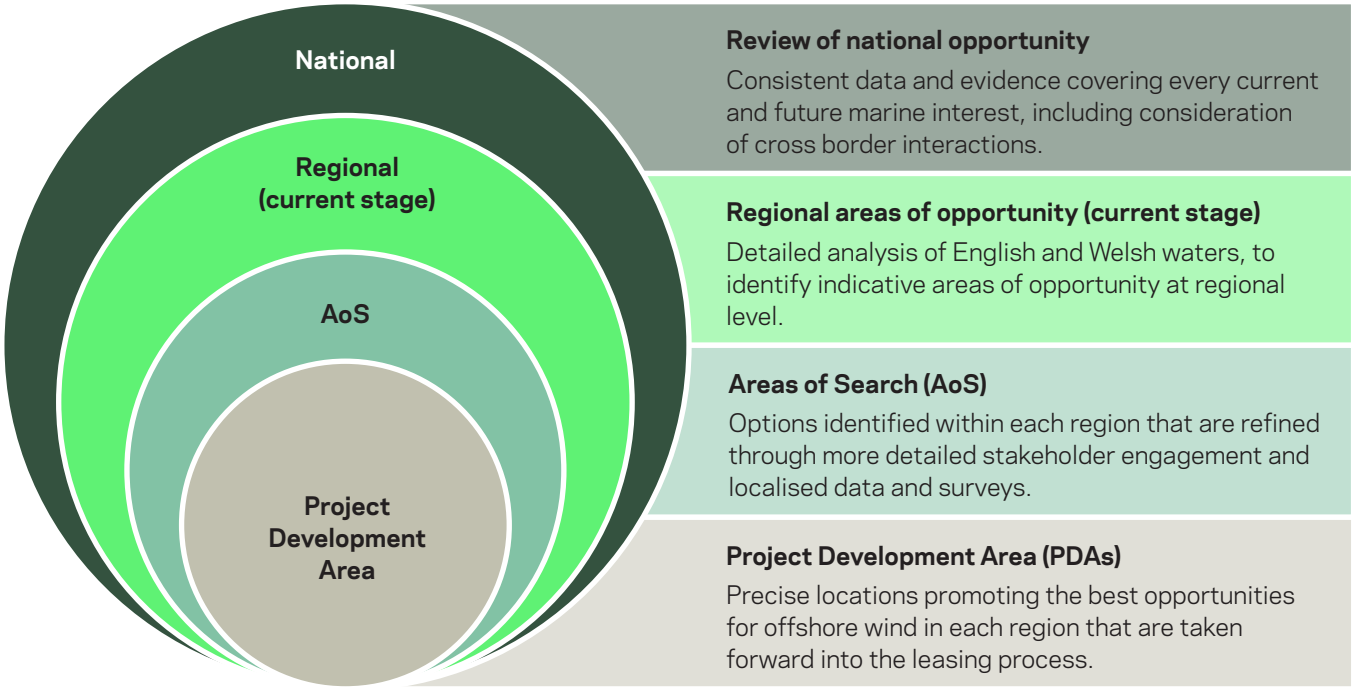
10 "Review of Electricity Market Arrangements (REMA): Second Consultation", Department for Energy Security and Net Zero, 12 March 2024.

11 For the sectors The Crown Estate manages (e.g. Offshore Wind, CCS, Cables, Minerals etc) the space needed is 2 times the current seabed area out to 2050, with further space needed for nature recovery and non-The Crown Estate sectors (e.g. Oil & Gas, Fishing, Defence, Shipping etc.).

Our regional analysis and engagement to date highlights the following key findings:

- There are substantial areas of seabed which have favourable technical characteristics for offshore wind development: high wind speed, relatively shallow seabed and proximity to shore. Consideration of other interests, however, shows that these areas are often also high value areas for nature including, but not limited to, the presence of Marine Protected Areas. They also coincide with areas of current activity and future opportunity for other sectors (e.g. shipping, fishing and nearshore leisure interests).
- While there are many opportunities for co-location (e.g. with other renewables, nature and CCS), critical decisions remain around overlaps between prime areas for sectors that need to be resolved as we refine areas for future offshore wind.
- The ESO recently published electricity network upgrade proposals[12] looking into the early 2030s, and beyond. However, further network upgrades are likely to be needed to support this scale of deployment, which is why we are committed to working closely with the ESO and National Grid Electricity Transmission (NGET) to support and inform network needs and delivery plans.

Project Development Areas are identified by working through the following steps:

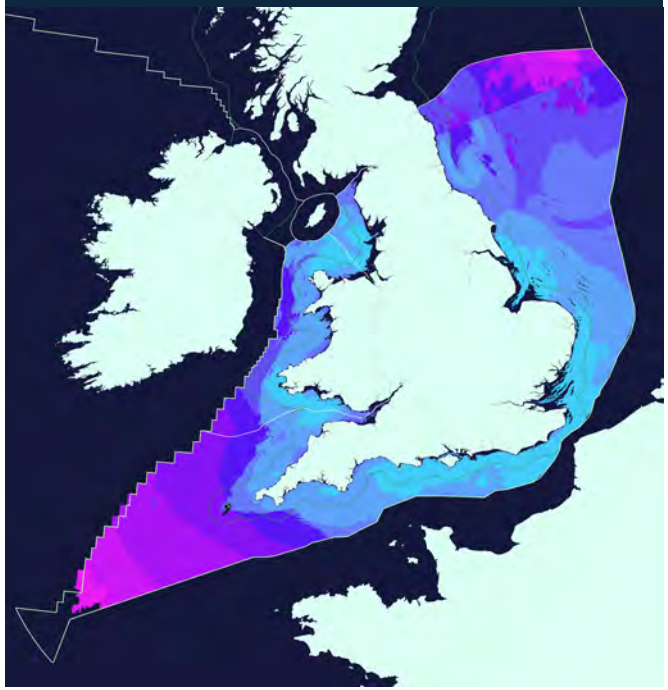


12 "Beyond 2030: A National Blueprint for a Decarbonised Electricity System in Great Britain," National Grid ESO, accessed 29 February 2024.

Figure 2: Draft maps showing the diversity of opportunity and interests

Levelised cost of energy

Levelised Cost of Electricity (LCOE) shows the relative cost to build, operate and de-commission an offshore wind farm.



LCOE
(blue cheaper, pink more expensive)

Exclusions

Exclusions provide a current view of barriers to the deployment of offshore wind; these result from physical, legal or safety considerations.

Exclusions
(shown in orange)

Suitability

Suitability is a measure of the combination and prioritisation of all other users, interests and environmental sensitivities (restrictions).

Suitability restrictions
(blue = less constrained, pink = more constrained)

To find out more information about the data used to create the maps presented above. Please see Appendix 1 of this report

Colleagues from The Crown Estate alongside the vessel used by Fugro for the 2023 geophysical survey

Following analysis of different scenarios to find a balance between economic factors, exclusions and suitability metrics as shown in Figure 2 on the previous page, three key indicative regional areas of opportunity have been identified in English and Welsh waters[13]: the North East, the South West (Celtic Sea), and more dispersed areas in Other Regions. These are shown in Figure 3 on the next page.

Within the North East and Celtic Sea regions, the contiguous areas of opportunity shown have been identified as the best areas for potential future development. The resource in Other Regions is more dispersed and distributed across the whole of this area.

There is significantly more space within all these areas of opportunity than will be needed to meet all net zero ambitions, meaning significant optionality exists. These areas of opportunity have been identified using our own modelling, drawing on understanding from previous leasing and engagement processes. The area of opportunity in the South West has also been informed by discussions with key government stakeholders.

Identification of more specific Areas of Search will commence shortly and will be the subject of extensive stakeholder engagement. The first stage of this engagement is the stakeholder questionnaire and call for evidence being issued to key stakeholders with this report.

13 Areas of opportunity in Northern Irish waters are currently being investigated in partnership with Department for the Economy, the Department of Agriculture, Environment and Rural Affairs and other stakeholders across Northern Ireland through OREAP, and so are not discussed further here.

Figure 3: Regional areas of potential opportunity for offshore wind in England and Wales

To enable additional capacity to be operational by 2040, based on the upper end of the GW ranges set out in this report, it is expected we would only need to lease a small proportion of each area of opportunity:

- Celtic Sea (up to 12% of Area of Opportunity)
- North East (up to 15% of Area of Opportunity)
- Other areas of dispersed opportunity (up to 2%)

The map shows indicative areas of opportunity for offshore wind in the waters off England and Wales, as identified in our Whole of Seabed analysis. These will be refined to Areas of Search and ultimately to precise Project Development Areas for leasing through further consideration of all marine sectors and nature, as part of the Marine Delivery Routemap.

Next steps will be fully informed by wide stakeholder engagement. Offshore wind leasing in the waters off Northern Ireland is being considered in parallel through the work under the Offshore Renewable Energy Plan.

Figure 4: Initial view of competition for future marine space

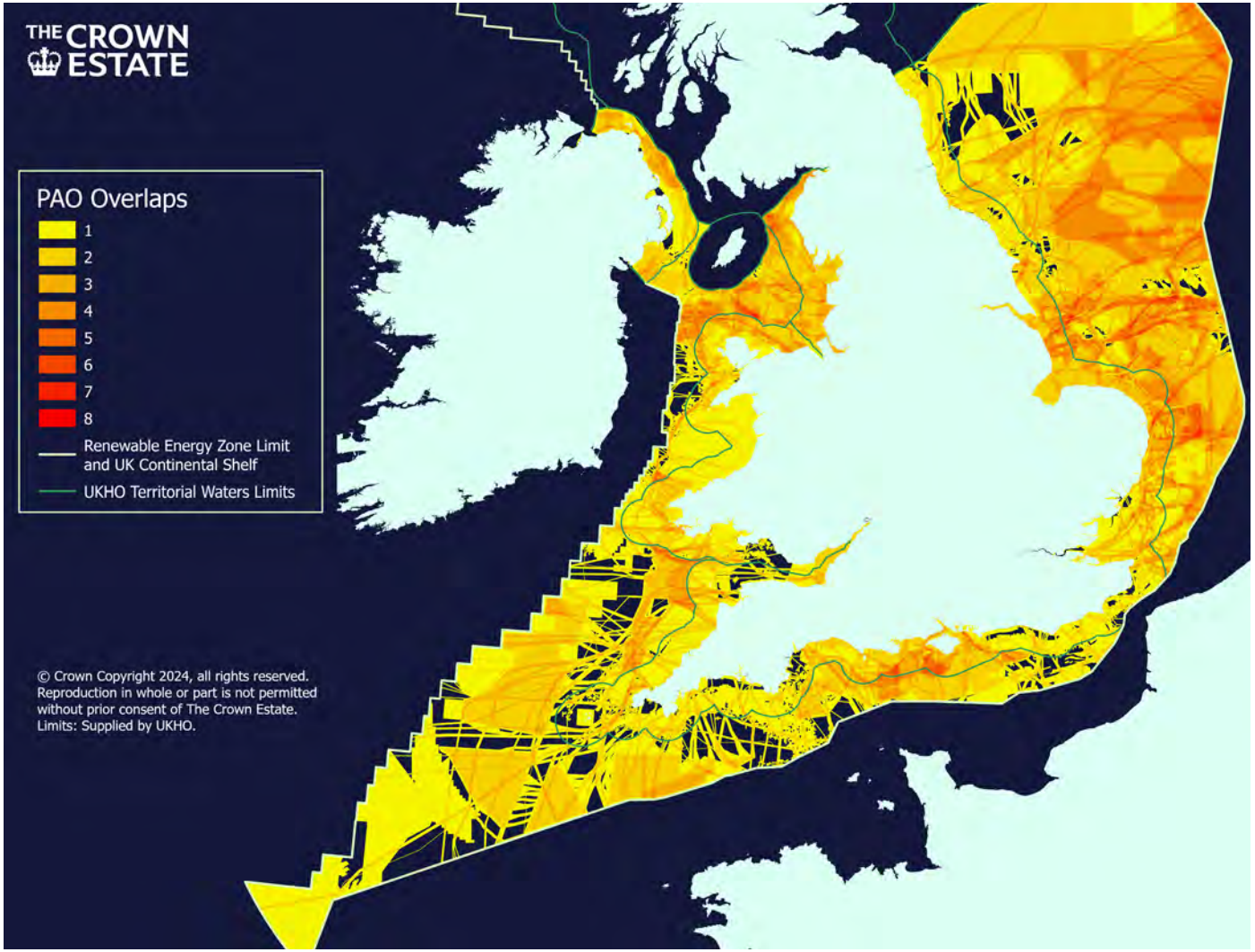


Figure 4 shows the overlaps between 'potential areas of opportunity' (PAOs) for marine sectors and highlights the growing competition for future space. In turn, it highlights the critical decisions around how the seabed is developed and used.

For example, the east has attractive areas for relatively low-cost future offshore wind development, but there is a lot of competition for space with environmental interests and other sectors (e.g. navigation, fisheries, defence, CCS, power cables, pipelines etc.) and areas designated to protect key environmental habitats and species. Therefore, early identification of co-location options and agreeing the best use of space are critical.

General characteristics of each regional area of opportunity

THE NORTH EAST

Spatial potential for circa 10-16GW additional capacity leased by 2030 and in operation from 2035 to 2040[14,15]:

- Broad region of opportunities for relatively deep water fixed, or relatively shallow water sub-structures.
- Moderate cost to construct and operate.
- Other sectoral current interests and future opportunities include marine navigation, fisheries, defence, power cables, CCS, oil and gas extraction and associated pipelines.
- Environmental interests include Marine Protected Areas, productive ocean fronts and the presence of mobile species (seabirds and marine mammals), with further work underway to better understand the context for these, including seabird foraging ranges at sea.
- To achieve the GW numbers above, we would need to lease approximately 8-15% of the area marked as 'North East area of opportunity' in Figure 3 by 2030.

THE CELTIC SEA

Spatial potential for up to 12GW, of which 4-10GW could be leased by 2030 and in operation from 2035 to 2040[14,15]:

- Further opportunities to deploy floating technology at scale in the Celtic Sea, alongside some smaller areas of deep water fixed opportunity.
- Higher cost to construct and operate, particularly in deeper waters further offshore.
- Moderate overlap with current interests and future sectoral opportunities including marine navigation, fisheries, defence, telecommunications cables.
- Like the North East, mobile species are present in the region as well as designated Marine Protected Areas. Further evidence is required to better understand the context for mobile species in this region.
- To achieve the GW numbers above, we would need to lease approximately 5-12% of the area marked as 'Celtic Sea area of opportunity' in Figure 3 by 2030.

OTHER REGIONS

Spatial potential for circa 2-8GW additional capacity leased by 2030 and in operation from 2035 to 2040[14,15]:

- Dispersed areas of single project scale opportunity in the Southern North Sea, English Channel, Welsh Waters and North West England.
- Shallower water suitable for fixed sub-structures.
- Lower cost to build and generally closer to onshore electricity demand.
- Overlap with current interests and future sector opportunities varies site to site but includes marine navigation, fisheries, defence, power and telecommunication cables, marine aggregates, CCS, oil and gas extraction, pipelines and civil radar.
- Environmental interests also vary site to site but include the same sensitivities found in other regions.
- To achieve the GW numbers above, we would need to lease up to 2% of the area marked 'Other regions containing dispersed areas of opportunity' in Figure 3, by 2030.

14 With the aim to bring to market between 20-30GW of new offshore wind seabed rights by 2030, these regional estimates capture wide ranges to allow for optionality. By undertaking the PDA refinement process as explained on p19 we will narrow down these estimates to ensure optimum locations are prioritized.

15 Subject to grid assessment.

Photo by Ben Barden Photography Ltd

Our initial analysis gives us confidence that these areas could support circa 20-30GW of new capacity operational by 2040, could allow new offshore wind developments to co-exist with other industries, and be delivered in a way that is sensitive to the nature context. The mid points of the GW ranges quoted above sum up to equal the mid-point in the overall capacity range (25GW). However, in quoting ranges, we are acknowledging that uncertainty remains. We will narrow this uncertainty through the detailed spatial design process, working closely with the ESO, NGET, delivery partners, sea users and environmental stakeholders to more fully understand the implications of different scenarios on onshore and offshore transmission network needs, other sectors, and nature. We will provide further details of our plans in due course.

As part of our early thinking on leasing design we are also considering how we might best enable opportunities for co-location of offshore wind with other uses of the seabed, such as nature restoration and CCS. For CCS in particular, we have established the Offshore Wind and Co-Location Forum to bring together partners to better understand the challenges, and find potential solutions, to co-location of both technologies. We are aware that co-location poses both benefits and challenges across all sectors and will consider these further as we develop our plans.

We will also continue to convene and partner with others through our Marine Delivery Routemap and will use our Whole of Seabed Programme to contribute to key spatial programmes, including the MSPri programme in England, SRAs in Wales, the SSEP with ESO, and statutory marine plans of the Marine Management Organisation (MMO) and the Northern Ireland Executive.

Discussion point 4

Locations: we anticipate that the key multi-gigawatt (GW) opportunity for new leasing by 2030 will be in the Celtic Sea (off the south-western coasts of England and Wales) and in the North Sea (off the north east coast of England), with additional, more dispersed GW scale resource in other regions.

Further detailed spatial design and stakeholder engagement will refine these areas down through Areas of Search, refined Areas of Search, to final Project Development Areas (PDAs).

Discussion point 5

Co-location: given an increasingly busy marine space, our view is that it is important to enable co-location in Areas of Opportunity through leasing design.

De-risking and accelerating

As we move forward, we are putting the foundations in place to provide greater targeted support to the UK's offshore wind market, helping it retain its status as one of the most attractive marine markets in the world. The recently-announced partnership with Great British Energy further strengthens this endeavour by bringing together the new body's ability to invest and develop critical strategic industrial policy with The Crown Estate's world-leading expertise in marine spatial planning and seabed leasing in supporting the growth in UK offshore wind. In addition, new borrowing and investment powers being considered by Parliament will further enhance The Crown Estate's own ability to accelerate and scale up our capabilities and provide targeted investment in the supply chain.

The global offshore wind industry is fortunate to benefit from a depth of expertise and experience built up over many decades across a wide range of organisations and sectors. This industry know-how will be central to its continued success, with The Crown Estate turning its attention to how it can better use its unique position to remove some of the systems-level and macro hurdles facing developers and support the accelerated deployment of new projects.

In part, this means moving our approach to seabed development towards a systems-level approach which better recognises, anticipates and explores some of the challenges that developers may be facing. This is underpinned by the proposed Marine Delivery Routemap, which will highlight, help address early, and de-risk issues over competition for sea space across a range of sectors, while maintaining a strong, proactive focus on nature restoration and recovery. In turn, the Routemap will enable the identification of the most attractive sites for future offshore wind, from a technical, economic and consenting perspective.

Discussion point 6

De-risking and accelerating HRA, offshore surveys and consenting: by bringing sites to market with a greater level of assurance, we can reduce potential stumbling blocks upfront and reduce the risk of attrition and delays in later development stages – accelerating projects, providing more certainty for investment, reducing project development costs and ultimately reducing consumer bills. This could be achieved by:

- Plan-level strategic environmental measures to ensure that future offshore wind takes full account of the UK's targets for the Marine Protected Area network.
- Undertaking pre-consent surveys.
- Developing options for additional upfront work to support consent ahead of sites moving to the market.

Photo by Jason Hawkes | Staging vessel and wind turbines

Optimising siting and surveys

Despite the rapid growth of offshore wind in UK waters, the time it takes to move from initial project conception through to the generation of new power can be up to ten years or more. Drawing on rich evidence and marine spatial modelling capabilities, The Crown Estate is well positioned to identify and survey attractive and deliverable sites for future offshore wind, helping to accelerate and de-risk deployment.

For example, by bringing sites to market with a greater level of assurance, we can eliminate potential stumbling blocks upfront and reduce the risk of attrition and delays in later development stages.

For Offshore Wind Leasing Round 5, we have already invested in surveys to inform early developer decision making and consenting, building on our early site identification and engagement with stakeholders. As we look to future leasing rounds, we are considering using surveys to inform technical characterisation, the plan-level HRA and identify sensitive environmental features to refine site selection. By better understanding early the spatial context and risks associated with the seabed being offered, we can reduce the timeline of development, accelerate delivery, take full account of the UK Government targets for the Marine Protected Area network, and deliver improved environmental outcomes.

This programme of surveys can also serve to reduce the costs and time for developers' design and consenting processes following the conclusion of the tender. In considering the potential for continuation of this approach for future rounds, we are exploring a range of options including geophysical, geotechnical, metocean and ecological surveys, and we will continue to engage with the market and key stakeholders to inform the scoping and timing of any such programme.

Photo by Ben Barden Photography Ltd | Gwynt y Môr wind farm with Snowdonia in the background

Supporting consent

Linked to this, one of the major challenges developers can face when progressing projects is the statutory consenting process, where increased uncertainty regarding the timeliness or likelihood of achieving consent can raise the risk associated with project decisions, such as those to do with early investments in supply chain, risking further delay to the deployment of offshore wind.

Building on our approach to optimising site selection through our world-leading spatial expertise and technical surveys, we are exploring opportunities for The Crown Estate to further front-load some of our activities (i.e. environmental surveys and analysis) to de-risk the consenting of future projects. We can further support consent through a range of actions, including reaching statements of common ground with key stakeholders at a plan level and anticipating other activities that could de-risk and accelerate the consenting process, post-lease.

This might include a range of actions aimed at streamlining the consenting process through building formal agreement with key stakeholders on critical issues, both pre and post leasing. This could extend to identifying, agreeing and implementing plan-level measures to avoid, minimise and balance environmental impacts (whether they be associated with HRA or key EIA topics) as well as other consenting considerations (e.g. interactions with other sector activity).

Working with key partners, such as Defra's Offshore Wind Enabling Action Programme, we plan to explore a variety of opportunities for de-risking consent. This could include spatial design, consideration of technical definitions or innovative mitigation, identification and application of environmental standards, providing plan-level environmental data for early stakeholder engagement and developer planning and strategic environmental compensation delivery, at a plan or sector level.

The delivery of strategic environmental compensation includes consideration of a variety of potential mechanisms which could include a Marine Recovery Fund to provide compensation across multiple projects, removing the need for project-specific compensation solutions. It might also include the potential for leasing areas for strategic compensation alongside those for development of generation and transmission assets, for example.

By taking a more strategic and systems-based approach to avoiding, minimising and balancing risks for projects, and embedding opportunities for environmental benefit across our leasing activity, we will deliver better outcomes for nature, identifying optimal sites and enabling reduced consenting and delivery timelines for sustainable offshore wind projects.

Greater certainty over grid connections

Offshore renewables are critical to net zero and are expected to provide around 50% of electricity generation by 2050. The Crown Estate is committed to ensuring there is sufficient pipeline to deliver this. However, ensuring that these critical future offshore wind projects can be connected in a timely manner is a major challenge, with planning bottlenecks for grid build-out and a long queue for grid connections.

By improving the coordination between the processes of seabed leasing, energy infrastructure planning and grid connections, there is a clear opportunity to further accelerate the deployment of offshore wind, while considering other sea users and the natural environment.

In December 2023, The Crown Estate and the ESO signed a Statement of Intent to begin a new chapter in our collaboration, which will be crucial in the development of future offshore wind leasing. The renewed agreement will see enhanced levels of information-sharing and programme alignment, to best enable future offshore development and energy infrastructure planning together.

This collaboration underpinned our approach to Offshore Wind Leasing Round 5, which recently became the first leasing round to come to market with an agreed plan for connecting the new floating wind farms to the UK's electricity grid.

Looking to the future, we will collaborate with the ESO to achieve new levels of coordination between seabed leasing and transmission design to accelerate the deployment of offshore renewable generation and infrastructure essential for successful delivery of net zero ambitions.

Building on the holistic network design of 2022, the ESO this year recommended further offshore and onshore electricity network upgrades that could integrate up to 86GW of offshore wind with a combined estimated capital cost of £112 billion[15]. Looking even further ahead, as we are with our future leasing plans, further network upgrades are likely. By planning further leasing and grid together, we can provide the best chance for projects and associated network upgrades to be deliverable and operational by 2040.

Our continued collaboration presents a number of benefits, in particular:

- The ability to plan areas for future offshore wind development in step with spatial energy planning and network design processes (SSEP and CSNP).
- In turn, earlier network designs will help inform and underpin anticipatory investment in the grid upgrades required to deliver new offshore wind capacity.
- Building on our experience with Round 5, we are exploring the potential to assist the securing of firm and timely grid connection agreements ahead of future auctions in the seabed leasing process, subject to the appropriate grid connection reforms.
- This partnership approach will enable a clearer pathway for the offshore wind and transmission networks industries out to 2040, increasing confidence and certainty.

15 £58 billion from ESO Beyond 2030 report Beyond 2030 | ESO (nationalgrideso.com) and £54 billion from ESO HND report download (nationalgrideso.com)

Discussion point 7

Grid connections: by taking a systems-led approach, we can provide more coordination between seabed development and transmission design and delivery, aligned with strategic planning processes for the energy sector. Working with Connections Reform, we will explore forward design of grid connections and applying for and entering into grid connection agreements for PDAs for novation to successful bidders.

Photo by Ben Barden Photography Ltd | A transmission substation at Gwynt y Môr wind farm

De-risking the supply chain

While the steps we have outlined above are designed to create greater assurance and streamline processes connected with offshore wind development, there is also a pressing need to support the growth of the supply chain required. This is particularly the case in areas such as the Celtic Sea region which are set to play a key role in the next chapter of the UK's offshore wind story, but which do not yet have an established supply chain.

In recent months we have seen two important steps towards transforming The Crown Estate's ability to further de-risk the supply chain. Firstly, our partnership with the newly created Great British Energy will bring together our long-term visibility of the demands on seabed and associated supply chain needs with the new body's ability to invest and help shape critical industrial policy.

Secondly, proposals currently being considered by Parliament to modernise The Crown Estate's ability to borrow will enable us to provide more targeted investment in the supply chain. Details of how this can further support initiatives such as our Supply Chain Accelerator are set out in the Investing to accelerate delivery section on page 33.

De-risking and accelerating summary

Our primary driver is to accelerate the deployment of offshore wind in a sustainable manner, and we believe that the measures above all have a potential material impact on our ability to achieve this objective. The scope, timing and sequencing of de-risking activities undertaken will have a material bearing on the timing of future leasing rounds, with a number of trade-offs to be considered. We welcome continued engagement on the options we have set out and will continue to share our thinking as it develops.

Photo by Ben Barden Photography Ltd | The Siemens Gamesa offshore wind turbine blade factory, Hull

Investing to accelerate delivery

As a company for the country, one of The Crown Estate's core objectives is to catalyse the UK's transition towards a net zero and energy secure future, and we are committed to investing to support this.

We are already investing in activities that will help de-risk future offshore wind projects, for instance through our activities to support Offshore Wind Leasing Round 5. This includes both plan-level strategic measures to ensure compliance with Marine Protected Area requirements, and investing in pre-consent site investigation surveys.

In addition, we recognise the need to accelerate delivery by investing in enabling infrastructure, most specifically in the development and construction of the necessary port and supply chain infrastructure that will accelerate offshore wind development and help the UK to capture even more of the economic benefits available through the energy transition.

The announcement by the UK Government to modernise The Crown Estate's investment powers and our partnership with Great British Energy will help to support this activity. The context is set out in more detail in the pages that follow.

Rotor blades about to be lifted, ready for being transported offshore

Signpost, Stimulate, Invest

Significant market evidence exists of the need for anticipatory capital investment to help address system barriers and to provide the enabling infrastructure to support deployment of offshore wind. For example: UK Governments Offshore Wind Manufacturing Investment Scheme (OWMIS); Ports for Offshore Wind; the Net Zero Opportunity (Crown Estate Scotland); Floating Offshore Wind Manufacturing Investment Scheme (FLOWMIS); RUK Industrialisation Roadmap 2040; Industrial Growth Plan (IGP); and Port and Manufacturing Investment Models (Offshore Renewable Energy Catapult, WSP), amongst others. We are undertaking three discrete activities to support this, which we are terming **Signpost, Stimulate, Invest**:

Signpost

This Future of Offshore Wind publication is the first stage in providing greater visibility of the long-term demand requirements for the potential scale and broad location of future fixed and floating offshore wind sites in UK waters, with up to 20-30GW of new leasing expected to come forward before 2030.

By identifying the future areas of development through our Marine Delivery Routemap, this provides an opportunity to more accurately review supply chain gaps and assess potential opportunities to stimulate and build out advance capacity in strategic locations to support future deployment. This should provide confidence to private capital of the benefits from investing in direct projects and the adjacent supply chain, as well as identifying the potential locations at a high level that could be the source of this future growth.

We have undertaken similar signposting exercises in more granular detail with our funding and publication of the Celtic Sea Blueprint, and co-funding of the Offshore Wind Industrial Growth Plan, both of which look to articulate the onshore supply chain needs to support delivery of Offshore Wind Leasing Round 5 (Celtic Sea Blueprint) and 2050 Offshore Wind targets (e.g. Industrial Growth Plan covering 2024-2035).

Stimulate

We recognise the importance of stimulating investment activity, which is why we have established the £50 million Supply Chain Accelerator fund with the explicit objective of helping catalyse the UK supply chain capacity and capability for offshore wind.

The first £10 million of the Supply Chain Accelerator was launched in May 2024 with a focus on supporting development expenditure for the core activities identified by the Celtic Sea Blueprint. This first wave of the Accelerator closed at the end of July 2024 and we are currently considering applications received. Further updates will be provided in due course, including details of further rounds of the Supply Chain Accelerator and potential themes.

Invest

There is a need for collective and upfront capital investment to address strategic bottlenecks and accelerate delivery, particularly in respect of enabling infrastructure (UK ports and supply chain). Our aim is that the additional 20-30GW of new development being brought to market before 2030, set out in this report, will provide a visible pipeline to allow investment capital to flow into some of these projects.

The Crown Estate has an ambition to commit capital into enabling infrastructure assets and we have the conviction and desire to invest alongside others in anticipation of this future pipeline. We welcome the decision by the UK Government in July 2024 to bring forward The Crown Estate Bill which will modernise our borrowing and investment powers and help to realise this ambition. This is explored further in the section that follows.

Investment focus areas: adjacent infrastructure to support offshore wind

The passing of The Crown Estate Bill will enable The Crown Estate to allocate £200m - £400m of capital over the short to medium term towards investments in enabling infrastructure assets that will allow the accelerated delivery of offshore wind projects.

We are focused on two specific areas for investment, unlocking strategic bottlenecks to speed up the delivery of offshore wind projects.

1. **Offshore wind ports:** investing in the expansion of UK ports and port-based activities to support the construction, assembly, integration and delivery of fixed/floating offshore wind.

2. **Offshore wind supply chain:** supporting the development and enhancement of the UK's offshore wind supply chain capability and capacity including the establishment of new or expanded manufacturing facilities and the establishment of associated R&D and training facilities. This can be at the early stage to fund development activity (through the Supply Chain Accelerator) but could also cover larger investments at the capital phase for more mature and well-established projects.

In addition, as part of The Crown Estate's recently announced partnership with Great British Energy, we are exploring further opportunities to invest in order to de-risk, keep pace and accelerate offshore wind projects in the development phase. We are evaluating this further with Great British Energy and UK Government and will be developing and sharing details on this in due course.

We recognise that there is significant revenue uncertainty and volatility in the initial years for some of these enabling infrastructure requirements. The Crown Estate has an established track-record, across its 260 years, of taking a long-term approach to creating lasting and shared prosperity, which means that we are prepared to accommodate short-term volatility in order to realise long-term value for the benefit of the nation.

We will be looking to secure long-term commercial returns as a co-investor working with aligned partners and to also generate wider impact from these investments including the potential to support jobs, catalyse urban and coastal regeneration, and drive economic growth as well as facilitate accelerated deployment of offshore wind.

In addition, The Crown Estate has geographic flexibility to invest into suitable offshore wind-adjacent infrastructure assets across England, Wales, Northern Ireland and Scotland. The passing of The Crown Estate Bill to modernise The Crown Estate's investment powers will also give us greater flexibility in and using different structures to deliver responsible financial returns from those investments.

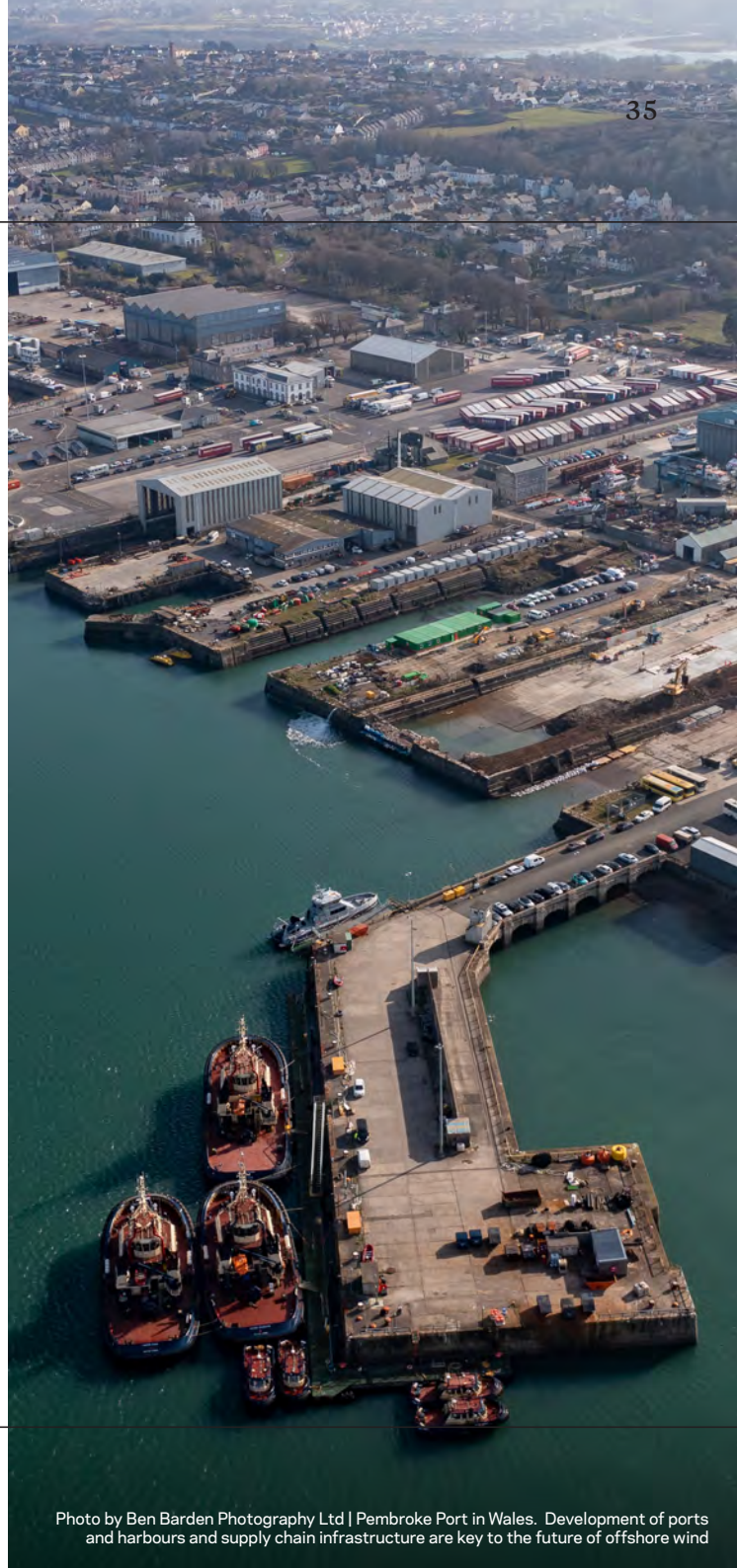


Photo by Ben Barden Photography Ltd | Pembroke Port in Wales. Development of ports and harbours and supply chain infrastructure are key to the future of offshore wind

Offloading blades from an installation supply vessel at a wind farm construction site

Next steps in our evolving investment approach

This publication sets out an early indication of The Crown Estate's evolving approach to investment, in particular our ambition to further support the accelerated deployment of offshore wind. In due course we will begin to engage with developers, land-owners, promoters and investors who wish to discuss specific projects or opportunities where we may be able to invest our capital.

It is anticipated that investment opportunities will be assessed against a set of yet to be determined criteria based on the potential they may offer in the context of The Crown Estate's strategic goals, and their investment characteristics of the specific opportunity.

Driving broad value

The Crown Estate's purpose is to create lasting and shared prosperity for the nation across all of our work. This means we are seeking to harness the opportunities created by the delivery of offshore wind to enable net zero, steward thriving biodiversity and marine environments, create inclusive communities and support economic growth.

Our approach to delivering such broad value will seek to use our systems-level, strategic perspective and convening power to collaborate with others and identify the best enabling activity or investment opportunities across key areas of the UK, to support sectors and places.

Building on the approach we have taken in Offshore Wind Leasing Round 5, this will include consideration of how best we can drive broader social and environmental value. As part of future leasing opportunities, we will continue to work closely with regional stakeholders, communities and industry clusters to develop our approach. This will include exploring how we can further catalyse activity and investment aimed at enhancing environmental and social value for the nation, whilst delivering cost-effective offshore wind and retaining the UK's position as a leading attractive market for offshore wind investment. We recognise the need to work with local partners to unlock onshore opportunities in support of offshore wind, and ensure these communities benefit from its long-term success. Together with engagement at an early stage of design, this will ensure that the highest value opportunities can be integrated into the leasing process.

Discussion point 8

Broad value: our view is that we must harness the opportunities created by the delivery of offshore wind to enable net zero commitments, steward flourishing biodiversity and marine environments, create thriving communities and support economic growth. We are exploring how we can best achieve this through our leasing design.

Photo by Ben Barden Photography Ltd | Ports, harbours and coastal communities stand to prosper through the further development of offshore wind

Identifying the opportunity

As part of our strategic approach, alongside Offshore Wind Leasing Round 5, The Crown Estate commissioned the Celtic Sea Supply Chain Blueprint[16]. Published in February 2024, the report identified the minimum infrastructure and supply chain capability required to deliver up to 4.5GW of floating wind in the Celtic Sea - highlighting opportunities for investment in plugging the capability gap - with the potential to create 5,300 jobs and £1.4bn of economic growth for the UK.

- In April [redacted] ore wind Industry Growth Plan[17] [redacted] ch sets out the potential 'made [redacted] ion from offshore wind, and the inv[redacted] required to secure this. This w[redacted] e sufficient capability exists to deli[redacted] projects, but also capture £25bn[redacted] e the pathway to growing the UK[redacted] than 100,000. The report, jointly-commissioned by OWIC, Renewable UK, The Crown Estate and Crown Estate Scotland, builds upon the Supply Chain Capability Analysis published in September 2023, which provided an evidence-based assessment of the products, services and infrastructure required to deliver the UK offshore wind portfolio out to 2040.

Social and environmental value

We intend to explore opportunities for The Crown Estate to deepen its support for communities and nature through building increased social and environmental value into future leasing programmes. We will seek opportunities for positive environmental outcomes, nature inclusive design, and sector decarbonisation alongside broader approaches for creating inclusive communities and supporting economic growth.

Supply Chain Accelerator

In February 2024, The Crown Estate announced a £10 million pilot fund with an initial focus on capturing some of the economic opportunities identified by the Celtic Sea Blueprint18 and supporting the UK supply chain. A further £40 million has been earmarked, which could be deployed over time to deliver on the wider Industrial Growth Plan. The initial Supply Chain Accelerator was launched in May 2024 - the submission window has now closed and proposals are currently under evaluation, with results due to be announced later in 2024.

Social and environmental value creation in Leasing Round 5

Offshore Wind Leasing Round 5 seeks to establish the next generation of floating offshore wind farms in the Celtic Sea. At up to 4.5GW it is set to be one of the biggest schemes of its kind in the world. Given the nascent nature of this technology and the absence of an established supply chain in the region, a key objective of the Celtic Sea Programme is to incentivise new onshore opportunities and create broader social and environmental value through the leasing process.

This means that Bidders are required to set out plans with clear commitments to delivering positive social outcomes aligned with core themes, such as new employment and skills, tackling inequality and diversity in the workforce, apprenticeships, volunteering and working with local communities. Bidders will also need to set out at an early stage how they intend to work with ports, which will be critical to the assembly and ongoing operation and maintenance of the new floating turbines. Successful Bidders will need to demonstrate how they will accelerate progress towards a net positive outcome for the environment and improved resilience of marine ecosystems.

The Crown Estate has also been clear that the leasing process is just one lever for driving these wider benefits, and ongoing collaboration between industry, onshore stakeholders and governments will be needed to truly realise the full potential of a new floating wind industry in the Celtic Sea.

16 "Supply Chain for Celtic Sea Floating Wind Farms Could Power 5,000 New Jobs and a £1.4bn Boost for the Economy," The Crown Estate, 22February 2024.
17 "Offshore Wind Industry Unveils Industrial Growth Plan to Create Jobs, Triple Supply Chain Manufacturing and Boost UK Economy by £25 Billion," 17 April 2024.

Technologies and innovation

Innovation has an important role to play in the development of the seabed and the energy transition, as the UK continues to find new ways to harness energy from our natural resources in a sustainable manner. As part of reviewing our approach to future leasing, we are interested in assessing the potential to bring forward innovation and new technologies. This could include, for example, the continued development of floating wind, the integration of floating solar or wave and tidal power generation technologies, introducing offshore hybrid assets into grid connection designs and the production of green hydrogen (see Green hydrogen section on page 41). To do this, we are considering the recommendations set out in the Industrial Growth Plan (IGP). It is apparent that despite early investment in some of these areas there remain challenges in commercialising new technologies for the market. For instance, the ambition to deploy and demonstrate new technologies at scale may at times be hampered by concerns about their bankability, and by the wider objective to drive down LCOE.

We will consider our role on this agenda and continue to deliver on our actions agreed within the IGP, including building on the lessons learned from previous leasing activity; noting this report and our wider Marine Delivery Routemap is identified as a key action to increase confidence in demand, thereby de-risking investments in supply chain and innovation. We recognise the criticality of working with others, and we will build on our existing partnerships with Government, industry, and actors such as ORE Catapult and SuperGEN ORE, as we seek to align our approach with the new IGP Delivery Body over the coming months.

Innovation is fundamental as we evolve our approach to leasing in order to support new technology development and to allow multiple technologies to access the seabed efficiently while supporting a thriving marine environment.

Three areas of current discussion are the relative mix of fixed and floating wind, and the production of green hydrogen and other complementary technologies.

Discussion point 9

Technologies: future offshore wind leasing will include a mix of sites that accommodate the development of fixed and floating sub-structures. Our long-term ambition is to give developers the flexibility to deploy the concept they consider most appropriate for a given site, noting that a tailored approach may be needed to ensure we foster growth and development of innovative foundation technologies, such as floating foundations.

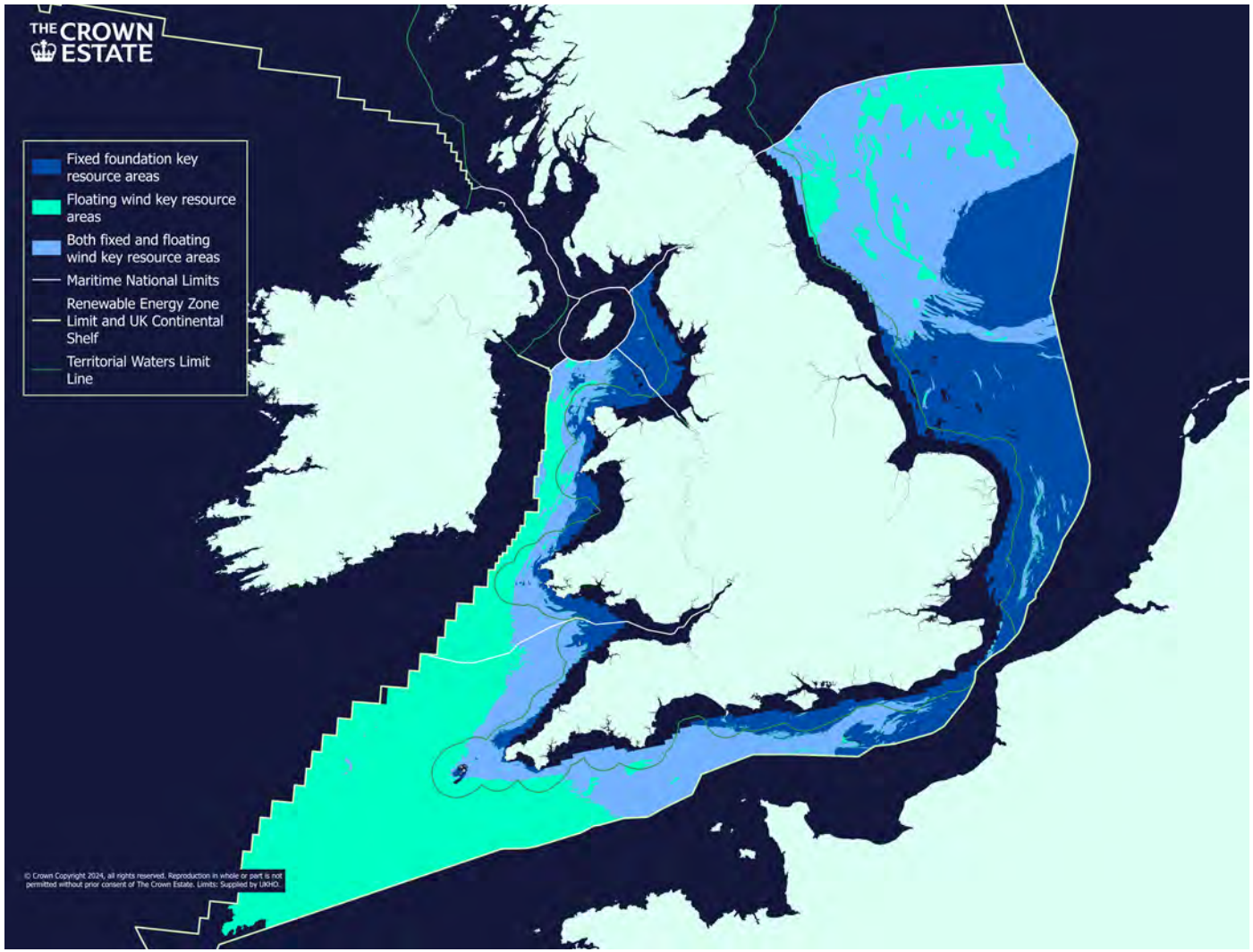
Photo by Sian Wilson | Future offshore wind could see greater integration of wave and power tidal generation technologies

Sub-structure technology

In 2020, The Crown Estate commissioned a report[18] that identified significant opportunities for both fixed and floating offshore wind in the waters off England, Wales and Northern Ireland. The report identified that fixed wind is expected to be able to be deployed in deeper waters than ever before, and floating wind will open up significant new areas of seabed to offshore wind deployment. Since publication, developing understanding of engineering solutions has led to a further increased maximum water depth for fixed sub-structures from 70 to 80m, as shown in Figure 5.

To satisfy future aspirations for offshore wind in a manner which is cost effective for the UK over the long term, there will be a need to develop offshore wind farms in a range of water depths and distances to shore. Our long-term ambition is therefore to move to an approach where we make available a mix of site types to enable the development of fixed and floating sub-structures, but give developers the choice to deploy the foundation concept they consider most appropriate and cost effective for each site, acknowledging that technology will develop over time and developers may have different approaches that would determine this choice. Due consideration will be given to technology choices in the coming rounds, to ensure we strike the right balance of flexibility for developers and foster growth and development of innovative foundation technologies, such as floating foundations.

Figure 5: Key offshore wind resource areas, Broad Horizons, 2020



18 "Broad Horizons: Key Resource Areas for Offshore Wind," The Crown Estate, 2020

Green hydrogen

Green hydrogen has a key role to play in the drive to net zero – helping to decarbonise a range of sectors (e.g. industry, transport) and harnessing the UK's strong wind and hydrogen storage resource. Significant opportunities exist for the development and production of green hydrogen produced by electrolysis and powered directly by offshore wind. This is an exciting and developing new area, but it remains in its early stages. Researchers assessing the comparative advantages of onshore and offshore electrolysis have reached different conclusions as to how these will develop over time[19],[20]. As the hydrogen market develops, the economics will become clearer. It is also too early to say how the development of this technology will feature in system level processes such as the SSEP.

In light of the above, we therefore do not consider that there is a need for spatial design and leasing focused solely on offshore green hydrogen production at this stage. However, we are open to developers having the option to incorporate green hydrogen production, either through onshore or offshore electrolysis, as a route to market in their development plans in the next rounds of offshore wind leasing, where market arrangements and system plans align with this. We see great potential in green hydrogen production powered by offshore wind which also uses the UK's strong offshore storage potential. We look forward to further dialogue, both on this proposed approach and how The Crown Estate can support the development of the sector. We will continue to keep this under review.

Other complementary technologies

We are following innovation and developments in the markets for other complementary technologies such as floating solar or wave and tidal power generation technologies with much interest whilst we evolve our approach for future leasing. We are exploring opportunities how we can support the development of these sectors and will continue to review our approach as these sectors continue to innovate and mature.

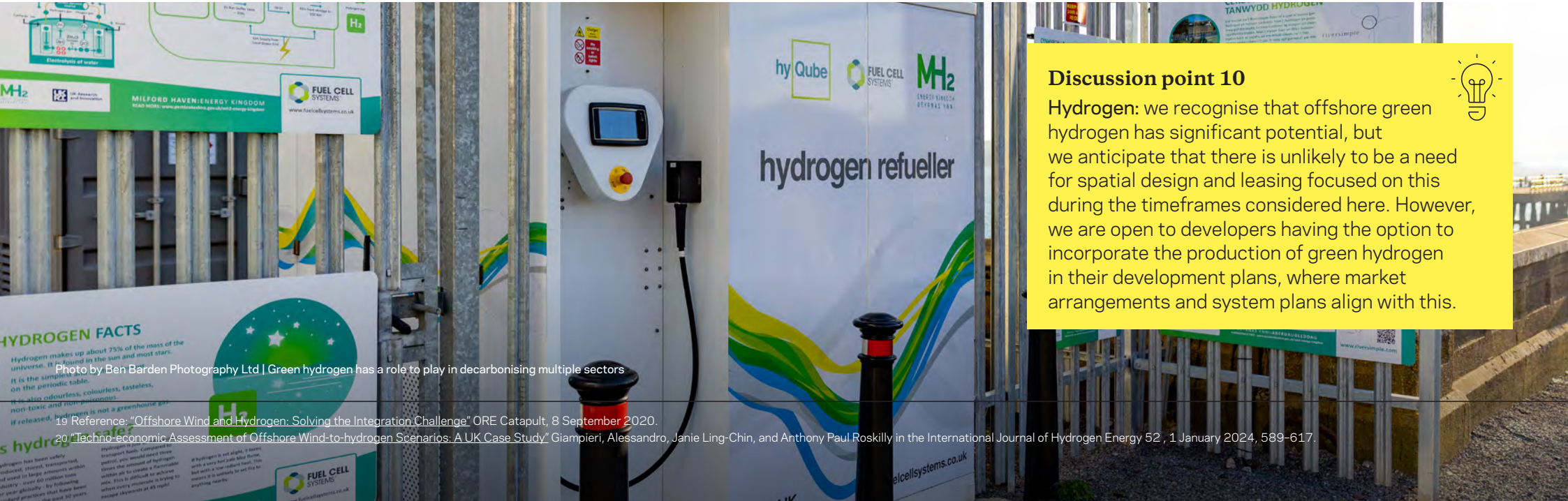


Photo by Ben Barden Photography Ltd | Green hydrogen has a role to play in decarbonising multiple sectors

Discussion point 10

Hydrogen: we recognise that offshore green hydrogen has significant potential, but we anticipate that there is unlikely to be a need for spatial design and leasing focused on this during the timeframes considered here. However, we are open to developers having the option to incorporate the production of green hydrogen in their development plans, where market arrangements and system plans align with this.

19 Reference: "Offshore Wind and Hydrogen: Solving the Integration Challenge" ORE Catapult, 8 September 2020.

20 "Techno-economic Assessment of Offshore Wind-to-hydrogen Scenarios: A UK Case Study" Giampieri, Alessandro, Janie Ling-Chin, and Anthony Paul Roskilly in the International Journal of Hydrogen Energy 52 , 1 January 2024, 589–617.

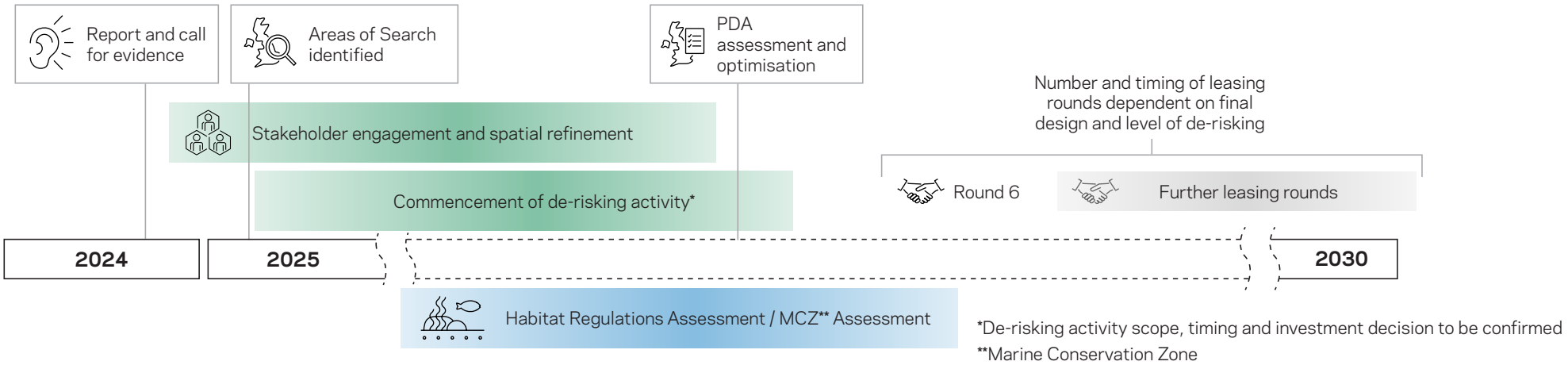
Next steps

In sharing our assumptions at this early stage, alongside our report on the Marine Delivery Routemap, we are presenting a vision of a more strategic approach to offshore wind development than ever before. Moving beyond a linear 'round-by-round' approach, we are looking more strategically and holistically at how we can enable the industry to play its part in delivering a sustainable energy transition for the country and supporting a thriving marine environment.

As set out, we are proposing our approach to future offshore wind to be closely informed by our Whole of Seabed Programme and our work with delivery partners and governments on the Marine Delivery Routemap. This was one of the key recommendations from the Electricity Networks Commissioner, Nick Winser, accepted as part of the Government's TAAP[22]. Likewise, the de-risking options in this report addresses recommendations made by the Offshore Wind Champion, Tim Pick, in his report, "Accelerating the deployment of offshore wind farms".

This is the next stage of the conversation. As illustrated in Figure 6, we will, upon publication of the report, commence extensive stakeholder engagement, whilst progressing to refine the spatial design assumptions for our future leasing rounds. We welcome your views on the discussion points raised in the report, and will take this feedback into consideration when scoping the de-risking activities which we aim to undertake ahead of future leasing rounds. This will inform the detailed programme for our next tender rounds, and we will continue to engage with the market as we refine timings and design assumptions.

Figure 6: Illustrative timelines, including potential de-risking activities



22 "Accelerating Electricity Transmission Network Deployment: Electricity Networks Commissioner's Recommendations", Department for Energy Security and Net Zero, 4 August 2023.

As discussed, the Routemap will complement and inform key related marine spatial programmes and forward plans for specific marine sectors. This Routemap series of publications will continue to expand, with future thinking to be shared in due course on our approach to nature, CCS, marine aggregates and other key marine sectors. A driving principle of our approach through all these will be to engage with sectors and stakeholders to test our assumptions and seek feedback on our proposals. In responding to this feedback, we will also seek to ensure that developers have an understanding of our likely requirements for our future leasing processes. As part of our broader approach, throughout the development of our future leasing programme, we will continue to seek the views of non-profit organisations, governments, sea users, and delivery partners on how we can work together to ensure our leasing programme supports biodiversity, nature recovery and the creation of broad environmental and social value.

We look forward to working with all stakeholders to refine our approach and develop a world-class programme that creates lasting and shared prosperity for the nation.

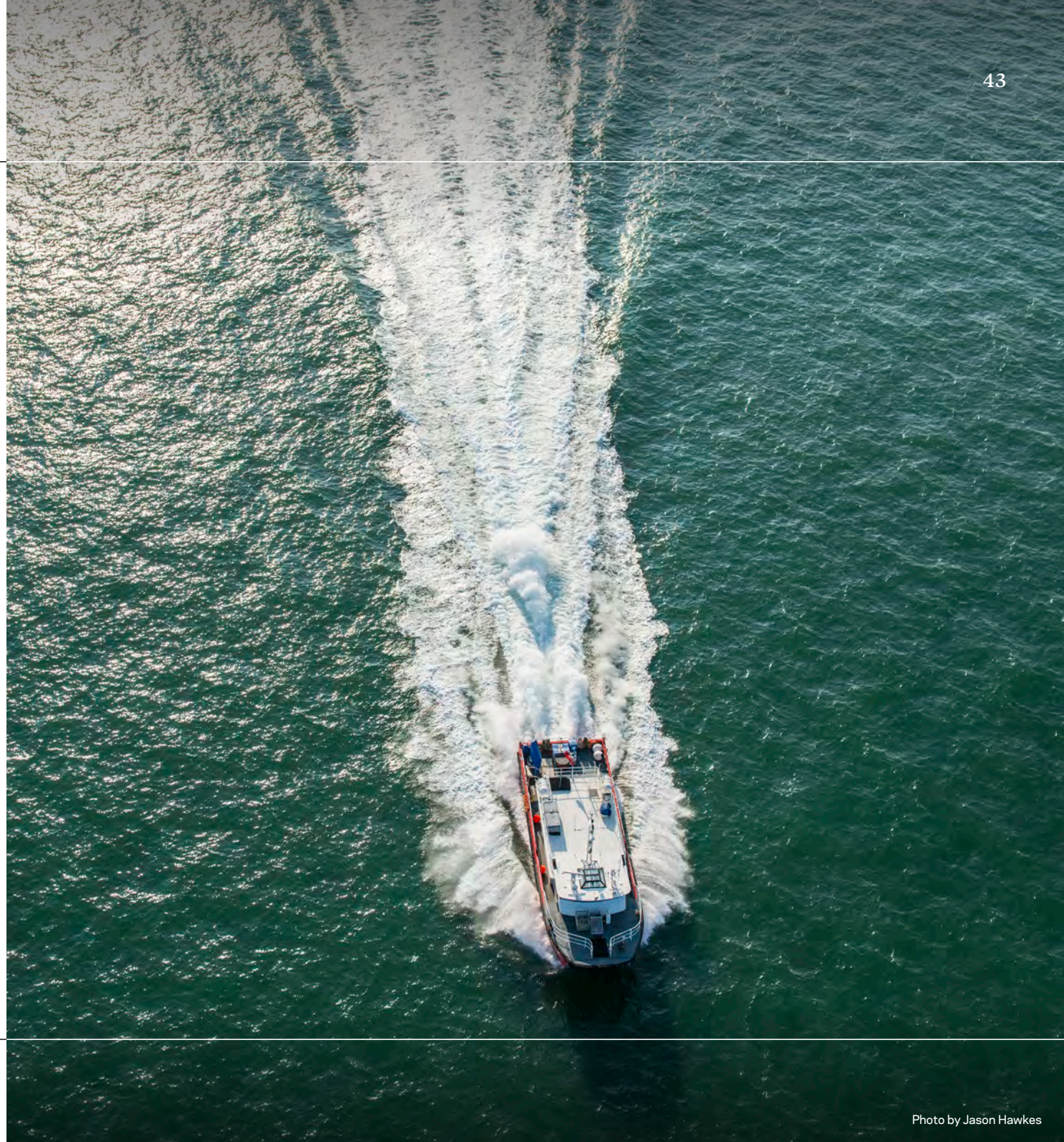


Photo by Jason Hawkes

About The Crown Estate

The Crown Estate has a diverse £16bn portfolio that includes urban centres and development opportunities; one of the largest rural holdings in the country; Regent Street and St James's in London's West End; and Windsor Great Park. We also manage the seabed and much of the coastline around England, Wales and Northern Ireland, playing a major role in the UK's world leading offshore wind sector.

We are a unique business established by an Act of Parliament, tasked with growing the value of the portfolio for the nation and returning all of our net profit to HM Treasury for the benefit of public spending. This has totalled £4bn over the last ten years.

Through our statutory purpose, The Crown Estate creates environmental, social and financial value both for now and into the long term. This includes:

- Playing a significant role in unlocking renewable energy for millions of homes through sectors such as offshore wind and creating opportunities for new technologies like CCUS and hydrogen to deliver the UK's energy security transition, resulting in thousands of jobs for communities across the UK.
- Supporting the sustainable transformation of land use in the UK through diversified, regenerative agricultural and environmental best practice alongside a thriving natural world.
- Becoming recognised as a centre of excellence for environmental and ecological best practice across the Windsor Estate.
- Identifying and creating opportunities for thriving and resilient communities across the country to support regeneration, housing and innovation.
- Ensuring London retains its global city status, by fostering a more vibrant, greener and inclusive destination for millions of visitors and businesses.

For further information please contact The Crown Estate Press Office:
www.thecrownestate.co.uk | 0845 241 2342

Photo by Jasper Carlberg

Appendix 1: Glossary and references

Glossary

AIS	Automatic Identification System
AoS	Area(s) of Search
CADW	the Welsh Government's historic environment service
CCC	Climate Change Committee
CCS	Carbon Capture and Storage
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CfD(s)	Contract(s) for Difference
CSNP	Centralised Strategic Network Plan
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation and Data Network
ESO	Energy System Operator
FES	Future Energy Scenarios
FLOWMIS	Floating Offshore Wind Manufacturing Investment Scheme
GW	Gigawatts
HRA	Habitats Regulations Assessment
IGP	Industrial Growth Plan
JNCC	Joint Nature Conservation Committee
km	kilometer
LCOE	Levelised Cost of Electricity
MCZ	Marine Conservation Zone
MCS	Marine Conservation Society
MMO	Marine Management Organisation
MNRs	Marine Noise Registries
MSPri	Marine Spatial Prioritisation
MW	megawatt
NATS	National Air Traffic Services
NE	Natural England
NIEA	Northern Ireland Environment Agency
NGET	National Grid Electricity Transmission
NGS	Natural Gas Storage
NM	nanometer
NRW	Natural Resources Wales
OREAP	Offshore Renewable Energy Action Plan
OREC	Offshore Renewable Energy Catapult
OSWMIS	Offshore Wind Manufacturing Investment Scheme
PAO(s)	Potential Area(s) of Opportunity
PDA(s)	Project Development Area(s)
PEXA	Military exercise areas and danger areas
REMA	Review of Electricity Markets Arrangements
RIO	Resource Identification and Optimisation tool
R&D	research and development
SACs	Special Areas of Conservation
SPAs	Special Protection Areas
SSSIs	Sites of Special Scientific Interest
SRA	Strategic Resource Area
SSEP	Strategic Spatial Energy Plan

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Appendix 2: Whole of Seabed Methodology

This symbol illustrates the quality assurance process, conducted to ensure outputs are reliable and that only high quality datasets have been used in the modelling process.

Definition and Data Sourcing

Define constraints and source high quality UK wide datasets (social, environmental and economic).

Modelling Potential Areas of Opportunity (PAOs)

Key Resource Areas
Identify where sectors can technically be deployed.

Exclusion Modelling
Exclude locations that contain interests which prevent offshore development ("hard constraints"). These are defined as areas where development is not possible generally due to existing rights, legislation, technical factors, infrastructure or health & safety.

Constraints Modelling
Analyse remaining locations for relative level of constraint posed to offshore development by all other competing activities or interests.

Cost Modelling
Integrate cost constraints into the modelling approach, e.g. consider levelised cost of energy (LCOE) for development (where available).

Potential Area of Opportunity (PAO) outputs
Incorporate spatial insights from previous spatial exercises and region-specific requirements. The output of this step of the process is then presented as a spatial map of the Potential Area of Opportunity (PAO), per sector.

Modelling Scenarios

Scenario Modelling
The scenario modelling informs a greater understanding of the potential distribution of sectors to meet 2050 demands, according to specific spatial rules, industry projections, policy targets and priorities. This process generates a wealth of insights and information that can be used to understand the implications of the successful delivery of sectors, impacts on the environment and societal and economic benefits.

Scenario Outputs
The output is the understanding of the potential distribution of sectors and trade-offs per scenario. Results demonstrate whether a scenario has met the demand requirements as well as prioritisation and co-location implications. This process is iterative, and as more data is fed into the process, scenario outputs will change and develop over time.

Evaluation and Analysis

We generate a wealth of statistics alongside each scenario output. We use these to form insights based on individual scenarios as well as them collectively. This process consolidates our understanding of the spatial outputs, helping us to identify where challenges are being identified through the analysis as well as where we should investigate further and aim to iterate and improve aspects of the analysis.

Stakeholder Engagement

We will continue to engage with government, industry and other key marine stakeholders throughout the process, to ensure that we include the best available data, evidence and analysis rules in the Programme.

The full Whole of Seabed methodology is published here.

Appendix 3: Future Offshore Wind report – map data

This appendix provides an overview of the data used to create the Exclusion and Suitability maps presented within this report.

Datasets used in the Exclusions Map (shown in column 2 of Figure 2)

The model used to create the Exclusions Map was created with The Crown Estate's Resource Identification and Optimisation tool (RIO), an advanced mapping and analysis capability developed by The Crown Estate.

'Exclusions' are defined as areas where development is not possible generally due to existing rights, legislation, technical factors, infrastructure or health & safety. The model identifies hard constraint areas where development is not possible and these are excluded from further consideration. These excluded areas may also include relevant buffer distances around sensitive features.

The list of exclusions in the table below are informed by previous engagement undertaken with stakeholders in February 2022 through the Celtic Sea Floating Offshore Wind Leasing Round 5 programme, as well as informed through engagement with stakeholders via the MSPri programme in May 2023.

The datasets included in the model as exclusions are as follows:

Exclusion Model

Dataset	Source Organisation	Buffer	Notes
12NM from shore in Welsh Waters	The Crown Estate		Aligned with Welsh Government Resource Area identification
6NM from shore in English Waters	The Crown Estate		Development of future offshore wind inshore recognised as infeasible
Abandoned Wells	North Sea Transition Authority	250m	Existing infrastructure would preclude development.
Active Cables Infrastructure	The Crown Estate	250m	Current legal agreement / infrastructure.
Active Pipelines Infrastructure	The Crown Estate	250m	Current legal agreement / infrastructure.
Aggregates Tender Round sites	The Crown Estate		Ongoing leasing process
Aquaculture Agreements	The Crown Estate		Current legal agreement / infrastructure
Cables Agreements	The Crown Estate		Current legal agreement / infrastructure
HPMAs	Natural England	1km	Highly Protected Marine Areas
Inshore Traffic Zones	UK Hydrographic Office		IMO routeing measures designated to maintain safety at sea.
International boundary buffer	The Crown Estate	2.5km	Buffer to avoid directly abutting international waters
Leasing Round 5 Project Development Areas	The Crown Estate	5km	Ongoing leasing process
MCMS Navigational Dredging	Marine Management Organisation		Navigational conservation and maintenance
Meteorological Equipment Agreements	The Crown Estate		Current legal agreement / infrastructure
Minerals and Aggregates Agreements	The Crown Estate	1km	Current legal agreement / infrastructure
Minerals Capital and Navigation Agreements	The Crown Estate		Current legal agreement / infrastructure
Natural Gas Storage Agreements	The Crown Estate		Current legal agreement / infrastructure
Navigation AIS – high density	EMODnet		Safety grounds

Dataset	Source Organisation	Buffer	Notes
Oil and Gas Agreements (infrastructure inside 12NM)	The Crown Estate		Current legal agreement / infrastructure
Open Disposal Sites	Cefas		Navigational conservation & maintenance
Outfall Leases	The Crown Estate	250m	Current legal agreement / infrastructure
PEXA danger areas[23]	Ministry of Defence		Defence requirements
Pilot Boarding Areas	UK Hydrographic Office	2NM	Safety grounds
Pipelines Agreements	The Crown Estate		Current legal agreement / infrastructure
Platform Helicopter Safety Zones – 500m	North Sea Transition Authority		Safety grounds
Protected Wrecks Exclusion Zones	English Heritage, CADW, Historic Scotland, Northern Ireland Government		Legislative protection
Shipping routes between Traffic Separation Schemes	The Crown Estate		Safety grounds
Suspended Wells	North Sea Transition Authority	500m	Legal requirement for abandonment procedures to be carried out. Existing infrastructure would preclude development
Tidal Stream Agreements	The Crown Estate		Current legal agreement / infrastructure
Traffic Separations Schemes & Deep Water Channels	UK Hydrographic Office	2NM	Safety grounds
Nuclear Power Stations	EDF	1NM	Safety grounds
Wave Agreements	The Crown Estate		Current legal agreement / infrastructure
Wind Agreements	The Crown Estate	5km	Current legal agreement / infrastructure

23 A subset of danger areas and firing ranges were included as exclusions, as advised by the MOD via the Marine Spatial Prioritisation Programme.

Datasets used in the Suitablity Map (shown in column 3 of Figure 2)

The Suitability Model combines the outputs of the Exclusion model above with a Restriction Model. Built using RIO, this model is used to analyse all economic, social and environmental interests in the marine space that are not 'hard constraints'.

For analysis purposes these are termed 'restrictions' and defined as all other activities or sensitivities which require consideration alongside offshore wind development but offer potential for co-existence.

Each res[redacted]prioritised (weighted) accordi[redacted]k that offshore wind develop[redacted]o the users or sensitivities, based o[redacted]ack gathered over the past 15 [redacted]ently as part of the MSPri program[redacted]he weightings and resulting heat-ma[redacted] demonstrate the extent that co-existence may or may not be possible between other economic, social and environmental sensitivities and offshore wind.

The datasets included in the model to represent soft constraints are as follows:

Restriction Model

Dataset	Source Organisation	Buffer
2021 Aggregates Tender Round Sites	The Crown Estate	
Anchorage Areas	UK Hydrographic Office	
Bathing Beaches	MCS	1NM
Carbon Storage 1st Round Provisional Licence Areas	North Sea Transition Authority	
Carbon Storage Licences	North Sea Transition Authority	
CCS Agreements	The Crown Estate	
Civil Radar Interference	NATS	
Closed Disposal Sites	Cefas	
Designated Feature Risk Layers (mobile species)	The Crown Estate	
Evaporites Agreements	The Crown Estate	
Fish Spawning and Nursery Grounds	Cefas	
Fisheries Areas of Importance	Marine Management Organisation	
Harbour Authority Areas	UK Hydrographic Office	
Leisure Vessel AIS intensity	EMODnet	
Licensed Field Determination Areas	North Sea Transition Authority	
MCZs & MNRs	JNCC, NE, NRW, NatureScot, NIEA	
Navigation AIS Density	EMODnet	
Oil & Gas Platform Helicopter Safety Zones	The Crown Estate	
Out of Service Cables Infrastructure	The Crown Estate	250m
Out of Service Pipelines Infrastructure	The Crown Estate	250m
Petroleum – 2nd & 3rd Term Licences	North Sea Transition Authority	
Petroleum – Initial Term Licences	North Sea Transition Authority	
PEXA areas[24]	Ministry of Defence	
Ramsars (European)	JNCC, NE, NRW, NatureScot, NIEA	
SACs (European)	JNCC, NE, NRW, NatureScot, NIEA	
SPAs (European)	JNCC, NE, NRW, NatureScot, NIEA	
SSSIs	JNCC, NE, NRW, NatureScot, NIEA	
Visibility from Coast	The Crown Estate	
World Heritage Sites	English Heritage, CADW	
Wrecks - unprotected	UK Hydrographic Office	50m

24 A subset of danger areas and firing ranges were included as exclusions, as advised by the MOD via the Marine Spatial Prioritisation Programme.

Analysis used in the Regional Opportunity Map (Figure 4)

This was created through analysis of the suitability model as well as consideration of development costs (Levelised Cost of Electricity - LCOE), shown in column 1 of Figure 2.

This analysis was undertaken as part of The Crown Estate's Whole of Seabed Programme and identifies future locations for offshore wind to area that have lower negative interactions with other interests and users of the marine space.

As the potential locations of future offshore wind are refined, there will be opportunity for stakeholders to flag further datasets for consideration.

Further detail on the Whole of Seabed, data and analysis will be provided as we move through the more detailed spatial design process for future offshore wind. This will include testing and refinement through stakeholder engagement as we transition from the regional opportunity identified in this report through Areas of Search to Project Development Areas that will be offered to market. General updates on the Whole of Seabed Programme, which covers all sectors leased by The Crown Estate and future usage of the seabed in English, Welsh and Northern Irish waters can be found on the following website page: Marine | The Crown Estate.

Correct as of September 2024, unless otherwise stated.

Photo credits

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THE CROWN ESTATE

Sky News Article – ‘Cornwall fishermen fear for livelihoods as offshore wind farms pose 'greatest change' the industry has faced’, 1 January 2025

‘Cornwall fishermen fear for livelihoods as offshore wind farms pose 'greatest change' the industry has faced.

David Stevens, from the Cornwall Fish Producers Organisation, says the proposals for the area where he fishes would "close down around 60% to 70%" of the waters.

Fishermen in Cornwall fear proposals for mass offshore wind farms could destroy their businesses and pose the "greatest change" the fishing industry has ever faced.

The Crown Estate - which owns much of the country's seabed - has published plans for what it calls "areas of opportunity" for offshore wind farms in waters off the North East and the Celtic Sea around South Wales, Devon and Cornwall.

It insists a maximum of 15% of North East and 12% of Celtic Sea zones may be leased to offshore wind companies.

But David Stevens from the Cornwall Fish Producers Organisation told Sky News fishermen fear they will be squeezed out of already busy waters.

He said: "This is probably the greatest change to our fishing patterns and businesses we're ever going to encounter, we're going to be squeezed out of the way, that's our greatest fear, by all these wind farms all of a sudden taking up ground that we traditionally fish."

He added: *"I've looked at the proposals to the south where I work and it would completely close down around about 60% to 70% of the area I work. So my business plan - it's gone out of the window."*

Mr Stevens said this is not about the fishing industry being against green energy, adding: "I am all in favour of renewable energy – it's definitely the way to go forward. But there needs to be a balance between energy security for the country and food security for the country

"We're the fishermen, we're out providing the food source, that is also, is it not, as important as energy, we're humans we need heat, we need food, we need shelter."

The Crown Estate told Sky News offshore wind has a "critical" role to play in supporting the UK’s energy transition.

It said: "The seabed is subject to a wide range of competing and complementary demands, which is why we have set out our initial thinking on how, and where, the future deployment of offshore wind might be possible, taking into account the needs of different sectors - including fishing - and the natural environment”.

It says it will continue to seek opinions from marine stakeholders.

Offshore wind is not the only green initiative causing concern amongst coastal communities in the South West.

Several seaweed farms are planned around Cornwall - covering 600 hectares of coastline.

The product could provide alternatives to plastic - but campaigners say consultation over the farms has been insufficient and worry ropes used could cause a risk to marine wildlife.

Barnaby Kay is from the group Save Our Bays.

He said: *"There is a South West sea-grab in terms of the applications of large scale seaweed farms.*

"For instance, the [seaweed] harvest period coincides with spawning for mackerel and various other fish and they're likely to spawn around the seaweed and on the seaweed and at that point it's harvest and so all that ecosystem will be pulled out."

Locals say they were not consulted about the farms and have criticised the Marine Management Organisation (MMO) which issues licences.

An MMO spokesperson told Sky News it must follow a "clear consultation process" and take an "evidence-based approach" and that it takes into account all responses.

The Liberal Democrat MP for North Cornwall, Ben Maguire, said the details of all green proposals must be looked at carefully.

He said: *"We need to bring our communities together along this journey, make sure they have input into it, make sure their views are heard, and make sure their feedback is collected in a valid way and that policy makers in the government listen to those local resident's concerns."*

ANNEX 2

Crown Estate Marine Lease – Mark Up of Proposed Changes

CROWN ESTATE ~~SCOTLAND~~

and

[ ]

LEASE
of
Rights for Wind Farm Site upon Bed of the Sea at [ ]

Contents

Clause

LEASE BETWEEN:

(1) **CROWN ESTATE SCOTLAND** (in Gaelic, Oighreachd a' Chrùin Alba) established as a body corporate in terms of the Crown Estate Scotland Order 2017 (previously carrying on business under the name of Crown Estate Scotland (Interim Management), (in Gaelic, Oighreachd a' Chrùin Alba (Stiùireadh Eadar-amail)) and renamed in terms of the Scottish Crown Estate Act 2019), having its principal office at Quartermile Two, 2nd Floor, 2 Lister Square Edinburgh EH3 9GL and acting in exercise of the powers conferred on it by the Scottish Crown Estate Act 2019 on behalf of Her Majesty The Queen (and its successors **the Landlord);** and

(2) **[ ]** (the **Tenant**).

WHEREAS:

The parties have agreed to enter into this Lease to permit the Tenant to construct an offshore wind farm on the Site in accordance with the Specification prepared by the Tenant in respect of the Tenant's Works;

NOW WITNESSES as follows:

1 Definitions and Interpretation

1.1 In this Lease unless the context otherwise requires:

Acceptable Covenant means an entity with either:

(a) BBB- or higher with Standard & Poor's Rating Group (a division of the McGraw-Hill Group of Companies, Inc.) or Baa3 or higher with Moody's Investor Services Inc. (or, if either cease to exist, an equivalent credit rating from another internationally recognised credit rating agency); or

(b) Net Assets in excess of [*20 x indemnity cap sum*] POUNDS (£[ ]) Sterling (indexed annually upwards only);

Aquaculture means the farming and/or growing of aquatic organisms including (but not limited to) fish, molluscs, crustaceans and aquatic plants;

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Authority means an authority whether statutory public local European international or otherwise government department or agency or a court of competent jurisdiction;

Break Event means where the Tenant's Works or part of them have been destroyed or damaged by an Insured Risk and a funder has elected in accordance with the provisions of a direct agreement between the funder and the Landlord that the insurance monies will be applied in repayment of amounts owing under the funding agreement between the funder and the Tenant rather than in reinstating the Tenant's Works or the part of them damaged or destroyed;

Break Fee means the sum calculated in accordance with Clause 6.4

Cable Corridor means [ ]

Cap means £[ ] ([ ] POUNDS)] *[Note: to be calculated for each project based on potential CES losses]* Sterling as increased by Indexation;

Commencement Date means [ ];

CDM Regulations means the Construction (Design and Management) Regulations 2015;

Change of Control means a change in the Control of the Tenant;

Control has the meaning given in section 450 of the Corporation Tax Act 2010;

Conduit means a pipe drain sewer channel gutter cable wire or other conduit for the passage or transmission of water soil gas oil air smoke electricity communications information light or other thing and all ancillary structures and equipment in on or under the Site;

CPS means the Contracted Position Statement accepted by the Landlord in terms of the Option Agreement contained in Schedule Part 11;

Data means primary data, observations and metadata gathered and stored by or on behalf of the Tenant in relation to meteorological, aural, biological, sea user and geotechnical, geophysical, bathymetric, oceanographic, sedimentological, cultural and heritage investigations and monitoring on the Site or surrounding areas;

Development means the installation by or on behalf of the Tenant upon the Site of an offshore wind farm including (without limitation) wind turbine generators, cables between them, substation(s) energy storage equipment and supporting platforms and structures and ancillary structures and having an installed carrying capacity of not less than and no more than that specified in the Specification;

EML Consultant means a firm of insurance advisers of international repute with experience of the offshore wind industry jointly appointed by the Landlord and the Tenant in accordance with Schedule Part 5;

EML Study means a study performed by the EML Consultant pursuant to the terms of this Lease;

Estimated Maximum Loss means the estimated maximum loss arising from the worst-case credible scenario that could be expected to affect the Tenant's Works as determined in accordance with Schedule Part 5;

Force Majeure means fire storm tempest other exceptionally inclement weather conditions war hostilities rebellion revolution insurrection military or usurped power civil war labour lock-out strikes local combination of workmen and other industrial disputes riot civil commotion disorder decree of Government delay by a local authority or statutory undertaker in carrying out work in pursuance of its statutory obligations or failure by such authority to carry out such work or if the tests and procedures required to demonstrate that the Specified Works are capable of commercial operation cannot be carried out as a result of the Supply Cables not being connected or fully operational or any other cause or circumstance provided that in the case of any of the foregoing events, the event:

a) adversely affects the completion of the installation of the Specified Works; and

b) cannot be reasonably avoided or provided against by the Tenant or its contractors or professional team.

Funder means a bank or other financial institutions providing funding to the Tenant to implement the Development;

Generator Cables means the Conduits owned by the Tenant in on or under the Site for the passage of electricity generated by each of the Turbines to an offshore substation or other point of connection to the Supply Cables;

Implementation Date means the date the Tenant commences the installation of the Specified Works;

Index means the Consumer Prices Index (CPI) (or any identical index published under a different title) published by the Office of National Statistics or any successor body upon which the duties in connection with such an index devolve;

Indexed shall have the meaning given to it in clause 9;

Indexation shall have the meaning given to it in clause 9;

Insolvency Event means, with respect to the Tenant or any Security Provider, that it:

a) is dissolved (other than pursuant to a consolidation, amalgamation or merger);

b) becomes insolvent or is unable to pay its debts or fails or admits in writing its inability generally to pay its debts as they become due;

c) makes a general assignment, arrangement or composition with or for the benefit of its creditors;

d) institutes or has instituted against it, by a regulator, supervisor or any similar official with primary insolvency, rehabilitative or regulatory jurisdiction over it in the jurisdiction of its incorporation or organisation or the jurisdiction of its head or home office, a proceeding seeking a judgment of insolvency or bankruptcy or any other relief under any bankruptcy or insolvency law or other similar law affecting creditors' rights, or a petition is presented for its winding-up or liquidation by it or such regulator, supervisor or similar official;

e) has instituted against it a proceeding seeking a judgment of insolvency or bankruptcy or any other relief under any bankruptcy or insolvency law or other similar law affecting creditors' rights, or a petition is presented for its winding-up or liquidation, and, in the case of any such proceeding or petition instituted or presented against it, such proceeding or petition is instituted or presented by a person or entity not described in paragraph d) above and:

    i) results in a judgment of insolvency or bankruptcy or the entry of an order for relief or the making of an order for its winding-up or liquidation; or

    ii) is not dismissed, discharged, stayed or restrained in each case within thirty (30) Working Days of the institution or presentation thereof;

f) has exercised in respect of it one or more of the stabilisation powers pursuant to Part 1 of the Banking Act 2009 and/or has instituted against it a bank insolvency proceeding pursuant to Part 2 of the Banking Act 2009 or a bank administration proceeding pursuant to Part 3 of the Banking Act 2009;

g) has a resolution passed for its winding-up, official management or liquidation (other than pursuant to a consolidation, amalgamation or merger);

h) seeks or becomes subject to the appointment of an administrator, provisional liquidator, conservator, receiver, trustee, custodian or other similar official for it or for all or substantially all its assets (other than, for so long as it is required by law or regulation not to be publicly disclosed, any such appointment which is to be made, or is made, by a person or entity described in paragraph (d) above);

i) has a secured party take possession of all or substantially all its assets or has an execution, attachment, sequestration or other legal process levied, enforced or sued on or against all or substantially all its assets and such secured party maintains possession, or any such process is not dismissed, discharged, stayed or restrained, in each case within thirty (30) Working Days thereafter;

j) causes or is subject to any event with respect to it which, under the applicable laws of any jurisdiction, has an analogous effect to any of the events specified in paragraphs a) to i) above; or

k) takes any action in furtherance of, or indicating its consent to, approval of, or acquiescence in, any of the foregoing acts

Intra Group Reorganisation means a Change of Control as a result of an intragroup reorganisation of the direct or indirect shareholders of the Tenant which has been intimated in writing to the Landlord;

Insured Risks means fire lightning explosion earthquake aircraft and other aerial devices dropped from them riot civil commotion storm impact by vessels subsidence landslip heave malicious damage terrorism and mechanical breakdown and such other risks as the Tenant may insure against and such other risks as the Landlord may reasonably require the Tenant to insure against;

Legal Obligation means an obligation imposed by or under or a requirement of any of the following (in so far as it relates to the Site or to their occupation or use or to the Tenant's Works or to the exercise of the Rights or to any substance or article upon in under or over the Site but irrespective of the person on whom such obligation is imposed or such requirement is made):

(a) any present or future international convention or other international obligation or present or future legislation (whether an Act of Parliament European Union legislation or otherwise); or

(b) any statutory instrument by law regulation direction order requirement notice plan code of practice or guidance note made under or pursuant to any of the matters referred to in clause (a) or by any Authority; or

(c) any of the matters referred to in Schedule Part 1; or

(d) any condition of a Necessary Consent;

Necessary Consents means:

(a) all consents licences permissions orders exemptions and approvals required from any Authority (and shall include for the avoidance of doubt all assessments which may be required to be undertaken before the issue of any of the foregoing); and

(b) those matters specified to be Necessary Consents in Schedule Part 3.

Net Assets means the fixed and current assets less the aggregate of the liabilities of the relevant entity based on financial statements prepared in accordance with the appropriate accounting policies and practices and as evidenced by its latest externally audited accounts;

Non-Statutory Decommissioning Programme means a programme for decommissioning activities for the removal of any equipment to be installed by the Tenant during the term of any Lease on Scottish Crown Estate Property and the restoration of any seabed and/or foreshore which does not fall within any Statutory Decommissioning Programme

OFGEM means the Office of the Gas and Electricity Markets Authority in the United Kingdom (or its successor Authority);

OFTO means:

(a) the offshore transmission system owner appointed and licensed by OFGEM to acquire or (as the case may be) install and own the Supply Cables forming part of the offshore electricity transmission system; or

(b) the Tenant where it has elected (in accordance with the relevant regulations and/or OFGEM guidance or policy) to install the Supply Cables forming part of the offshore electricity transmission system and it has notified the Landlord of such election.

[OFTO Works means the [Substation and ancillary structures equipment and Conduits (excluding Generator Cables) within the Substation Site] and] [●] Supply Cable(s) within the Designated Area together with any ancillary works owned and operated by the OFTO ***– note: to be adjusted to reflect requirements***]

Oil and Gas Works means any pipelines platforms wellheads or other works for the exploration for or exploitation of oil and gas in respect of which the consents of the Secretary of State required under a licence issued pursuant to the Petroleum Act 1998 have been given;

Option Agreement means the option agreement dated [ ] made between the Landlord and the OFTO;

Plan means the plan attached to this Lease in Schedule Part 8;

Renewable Energy Zone means an area designated by an Order in Council made pursuant to Section 84(4) Energy Act 2004 within which the rights to which Section 84 Energy Act 2004 applies are exercisable, including any modification to the boundaries of that area as may from time to time be made by legislation or as may from time to time otherwise arise;

Rent means either (i) the Output Rent ascertained and payable as provided in Part 4 of the Schedule or (ii) from the Review Date, the Revenue Rent in the event of the Landlord so electing in terms of paragraph 7 of Part 4 of the Schedule;

REZ Site means that part of the bed of the sea within the Site which from time to time lies within a Renewable Energy Zone and references to the REZ Site include reference to any part of it which accommodate the Tenant's Works and Generator Cables together with any supporting structures or platforms for any supply transmission equipment;

Rights means the rights set out in Part 1 of the Schedule;

Scottish Crown Estate Property means any interest in land to which section 90B(5) of the Scotland Act 1998 applies;

Security Document means a guarantee or other form of credit support provided by the Tenant in a form as determined by the Landlord acting reasonably which may take the form of:

(i) a guarantee from a guarantor, or guarantors, with an Acceptable Covenant; and/or

(ii) a letter of credit or bond from a bank, financial institution or other organisation with an Acceptable Covenant;

and reference to Security Document shall include any permitted substitute security for the Tenant's obligations under this Lease;

Security Provider means a guarantor or any other bank, financial institution or other organisation with an Acceptable Covenant, providing security under any Security Document;

[Substation means the substation from time to time on the Substation Site;]

Site means the area shown for identification shaded pink on the Plan and more particularly described in the attached co-ordinates contained in Schedule Part 9 accommodating the Specified Works and references to the Site include reference to any part of it [but excluding for the avoidance of doubt the Sub-station Site ***– note: include only if lease and OFTO lease granted simultaneously***];

Specification means the specification prepared by the Tenant of the Tenant's Works attached to this Lease in Schedule Part 10;

Specified Works means *inter alia* [ ] Turbines together having a projected annual output of [ ] megawatt hours, scour protection material, energy storage equipment, substations and supporting structures and platforms, anemometry equipment, sub-structures, Generator Cables and Conduits within the Site (but excluding the Supply Cable(s)), the Specified Works being more particularly described in the Specification;

Statement of Commitment means a statement in the form contained in Schedule Part 8 (*Statement of Commitment*);

Statutory Decommissioning Programme means a decommissioning programme applicable to the Tenant's Works approved by the Secretary of State under the Energy Act 2004 including any modifications or conditions which the Secretary of State may from time to time specify;

[**Substation Site** means the part of the bed of the sea shown coloured [ ] on the Plan and references to the Substation Site includes references to any part of it]

Supply Cables means Conduits, substations and ancillary equipment owned by the OFTO for the passage or transmission of electricity generated by the Tenant's Works or otherwise required for the operation of the Tenant's Works (but excluding the Generator Cables);

Tenant where the context admits includes the Tenant's successors in title as tenant under this Lease;

Tenant's Works means the Specified Works, all renewals or replacements of them and all alterations or additions to them;

Term means a term of sixty (60) years commencing on (and including) the Commencement Date;

Termination of the Term means Termination of the Term of this Lease by expiry re-entry notice surrender or otherwise;

Territorial Limit means the seaward limit from time to time of the territorial seas adjacent to Great Britain;

Terrorism Estimated Maximum Loss means the estimated maximum loss arising from the worst-case terrorist scenario that could be expected to affect the Tenant's Works as determined in accordance with Part 5 of the Schedule;

Turbine means a wind turbine generator including (without limitation) foundations and/or other method of attachment to the seabed, tower and blades.

VAT means value added tax or other similar tax and unless otherwise expressly stated all Rent and other sums payable by the Tenant under this Lease are exclusive of any VAT charged or chargeable and the Tenant shall pay such VAT in addition to and at the same time as the sum in question;

Working Day means any day except Saturday Sunday and bank or other public holidays in Scotland and England;

Works Completion Date means the date on which occurs the satisfactory completion of such procedures and tests as from time to time constitute usual industry standards and practices to demonstrate that the whole of the Tenant's Works are capable of commercial operation.

1.2 The expression "alteration" when used in respect of the Tenant's Works includes (without limitation) removal of the Tenant's Works or any part of them.

1.3 The expression "decommission" when used in respect of the Tenant's Works has the meaning given in section 104 Energy Act 2004.

1.4 Words importing one gender include other genders.

1.5 Words importing the singular include the plural and vice versa.

1.6 References to persons include bodies corporate and vice versa.

1.7 Obligations of a party comprising more than one person are obligations of such persons jointly and severally.

1.8 Undertakings by the Landlord or implied on behalf of the Landlord are with effect from the date on which the Site ceases to form part of Scottish Crown Estate Property such undertakings shall be deemed to be made by the person from time to time who owns the Site and all liability on the part of Her Majesty and Her Successors or the Landlord in respect of any such undertakings shall cease as from such date.

1.9 An undertaking or obligation of the Landlord is made separately with Her Majesty and Her Successors and the Landlord and any person charged with the management of Scottish Crown Estate Property and the person from time to time that owns the Site.

1.10 An undertaking by the Tenant not to do something shall be construed as including an undertaking not to permit or knowingly to suffer it to be done by any other person.

1.11 A consent or approval to be given by the Landlord is not effective for the purposes of this Lease unless it is in writing and signed by or on behalf of the Landlord.

1.12 Reference to a statute directive or regulation includes any amendment modification extension consolidation or re-enactment of it and reference to any statute or directive includes any statutory instrument regulation or order made under it for the time being in force.

1.13 References to numbered clauses and schedules are references to the relevant clause or schedule to this Lease and references in any schedule to numbered paragraphs are references to the numbered paragraphs of that schedule.

1.14 The clause headings do not affect the construction of this Lease.

2 Demise

2.1 In consideration of the Tenant paying the Rent in accordance with the provisions of Part 4 of the Schedule the Landlord hereby grants and the Tenant accepts this Lease of the Site ***[Note: If the site is wholly within the REZ Site then only Rights are granted]*** and the grant of the Rights from the Commencement Date for the Term

2.2 EXCEPT AND RESERVING the matters set out in Part 2 of the Schedule.

2.3 TO HOLD the Rights to the Tenant for the Term.

2.4 SUBJECT TO:

2.4.1 the public rights of navigation and fishing;

2.4.2 the matters referred to in Part 3 of the Schedule;

2.4.3 the rights of states or their nationals under rules of international law; and

2.4.4 all other rights, servitudes, easements, wayleaves and quasi easements, licences, exercisable over the Site.

2.5 This Lease is warranted by the Landlord from fact and deed only and the Tenant will have no claim against the Landlord or Her Majesty in respect of any loss or damage caused by the exercise of any of the rights hereby reserved and the Landlord does not warrant that the Rights and the Site may lawfully be used or are otherwise suitable for any purpose authorised under this Lease.

3 Tenant's Obligations

The Tenant undertakes to the Landlord to observe and perform the obligations in this clause 3.

3.1 **Rent and other payments**

3.1.1 To pay the Rent in accordance with the terms of this Lease without deduction or set off (so long as the Site forms part of the Scottish Crown Estate) to the Landlord by electronic transfer to any account nominated by the Landlord and notified to the Tenant.

3.1.2 To observe and perform such of the provisions contained in Schedule Part 4 as are expressed as obligations on the Tenant's part.

3.1.3 If any Rent or other sum becoming payable under this Lease by the Tenant to the Landlord remains unpaid for more than twenty one (21) days after becoming due (whether formally demanded or not) then the Tenant shall (if required but without prejudice to the Landlord's right of termination or any other right or remedy of the Landlord) as from the date on which it becomes due until the date of actual payment pay interest on it (as well after as before any judgement) at the rate of three per cent (3%) per annum above the base lending rate from time to time of the Royal Bank of Scotland plc (or such other bank as the Landlord nominates from time to time) or if such base rates cease to be published at any time such other comparable rate of interest as the Landlord designates and the interest shall be deemed to be part of the Rent and recoverable in like manner as rent in arrears but shall not itself bear interest.

3.1.4 To pay all existing and future rates taxes assessments impositions duties charges and outgoings whatsoever payable whether by the owner or occupier in respect of the Tenant's Works or the exercise of the Rights except for taxes (other than VAT) payable by the Landlord on the receipt of the Rent or on any dealing with the Landlord's heritable interest as proprietor of the subjects of this Lease.

3.1.5 To pay and indemnify the Landlord against:

(a) all VAT which is chargeable on the Rent or any other sum payable by the Tenant under this Lease upon receipt of a valid VAT invoice addressed to the Tenant; and

(b) all VAT incurred in relation to any costs or expenses which the Tenant is obliged to pay or in respect of which it is required to indemnify the Landlord under the terms of this Lease save where such VAT is recoverable or available for set off by the Landlord as input tax.

3.2 **Installation of Specified Works**

3.2.1 To use reasonable endeavours to procure that the Specified Works are designed using the reasonable skill care and diligence expected of appropriate professional designers experienced in designing projects of a similar size scope and complexity having due regard to the industry's knowledge and standards at the time of design and installation of the Specified Works.

3.2.2 To give to the Landlord at least seven (7) days prior written notice of the Implementation Date.

3.2.3 To obtain each Necessary Consent required for the installation and operation of the Specified Works as soon as it is required and to give all notices required to be given in connection with it.

3.2.4 To ensure that the Works Completion Date occurs by the sixth (6th) anniversary of the Commencement Date notwithstanding any event of Force Majeure.

3.2.5 To provide the Landlord, within fifteen (15) Working Days of receipt by the Tenant, with copies of the results of any tests carried out by or on behalf of the Tenant, its contractors and any OFTO that confirms that the Tenant's Works have been constructed satisfactorily in accordance with the Necessary Consents and the Specification.

3.2.6 In the event that any test carried out by the Tenant pursuant to clause 3.2.4 evidences that the Tenant's Works are not in accordance with the Necessary Consents and the Specification or are substandard or defective, the Tenant shall at its sole cost comply with the reasonable recommendations of the Landlord to remedy such defects or to ensure that the Tenant's Works comply with the Specification.

3.2.7 To notify the Landlord in writing immediately the Works Completion Date occurs and to provide the Landlord with such evidence as the Landlord may reasonably require to prove it occurred on the date notified.

3.2.8 As soon as reasonably practicable to provide to the Landlord a copy of any notice which must be given by any Authority before the operation of the Specified Works may lawfully commence and not to commence the operation of the Specified Works before such notice is given.

3.2.9 To provide to the Landlord from time to time on reasonable written request details of the consultants and contractors engaged by the Tenant and the principal suppliers of goods and services to the Tenant and the principal sub-contractors having design responsibility in connection with the Specified Works.

3.2.10 To provide to the Landlord as soon as reasonably practicable after the Works Completion Date plans and co-ordinates showing the location of the Specified Works as installed.

3.3 **Alterations**

3.3.1 Not to construct install erect fix or place on in over or under the Site any building erection structure works Conduit or materials except:

(a) the Specified Works;

(b) any renewal or replacement of the Specified Works (in materially the same form and layout); and

(c) any alteration or addition to the Tenant's Works in accordance with clause 3.3.2.

3.3.2 Not to make any alteration or addition to the Tenant's Works unless:

(a) the alteration/addition comprises the alteration or addition of Turbines and ancillary equipment structures and Conduits within the Site;

(b) the Tenant has obtained all Necessary Consents for the alteration/addition;

(c) the alteration/addition will not result in a reduction in the output capacity of the Tenant's Works below that stated in the definition of Specified Works other than:

(i) a temporary and unavoidable reduction while the alteration/addition is carried out;

(ii) a reduction (either temporary or permanent) in order to comply with a Legal Obligation or a proper health and safety requirement which cannot otherwise reasonably be complied with; or

(iii) the removal of Tenant's Works in respect of which clause 3.6.3 applies;

(d) the Tenant has submitted to the Landlord detailed plans and specifications showing the proposed alteration/addition; and

(e) the Tenant has obtained the Landlord's consent to carry out the alteration/addition (such consent not to be unreasonably withheld or delayed).

3.3.3 To comply with the provisions of clauses 3.2.1, 3.2.3, 3.2.4, 3.2.8 and 3.2.10 (mutatis mutandis) in respect of any renewal or replacement of the Specified Works or any alteration or addition to the Tenant's Works in so far as applicable.

3.3.4 Not to place affix or display any sign advertisement notice flag poster or other notification whatsoever within the Site except for such warning or other notices relating to the operation or use of the Tenant's Works as may either be required under any Legal Obligation or may be approved by the Landlord (such approval not to be unreasonably withheld or delayed).

3.4 **CDM Regulations**

3.4.1 The Tenant warrants that it has the competence to perform the duties imposed on a client by the CDM Regulations.

3.4.2 To comply with the provisions of the CDM Regulations in respect of the Tenant's Works including without limitation all requirements relating to the provision and maintenance of a health and safety file and to provide on request to the Landlord a copy of the health and safety file and any documents within it.

3.4.3 To supply all information to the Landlord that the Landlord reasonably requires to comply with the Landlord's obligations (if any) under the CDM Regulations.

3.4.4 Prior to commencing any Tenant's Works to confirm in writing to the Landlord who is to be the client for the purposes of the CDM Regulations in respect of those Tenant's Works which the parties agree, for the avoidance of doubt, shall not be the Landlord.

3.5 **Seabed Provisions**

3.5.1 Not to dig extract or remove any sand stone beach shingle or other minerals or mineral substances from the Site except in so far as is reasonably necessary for the installation of the Specified Works permitted under this Lease and the exercise of the Rights.

3.5.2 Not to cause waste spoil or destruction on the Site except in so far as is reasonably necessary for the installation of the Specified Works permitted under this Lease and the exercise of the Rights.

3.5.3 As soon as reasonably practicable following any disturbance of the seabed within the Site in the installation of the Specified Works permitted under this Lease or the exercise of the Rights to restore the same to a safe and (allowing for the presence of the Specified Works) proper condition and in accordance with all Legal Obligations.

3.5.4 Not to damage or interfere with the Supply Cables and Conduits referred to in Schedule Part 2.

3.6 **Repair**

3.6.1 To keep the Site and the Tenant's Works in good and safe repair and condition.

3.6.2 To keep the Tenant's Works properly maintained and in good working order.

3.6.3 The Tenant shall not be liable to comply with clauses 3.6.1 and 3.6.2 in respect of any part of the Tenant's Works which has broken down or been damaged to the extent that and for as long as it remains the case that it would not be economic in the reasonable opinion of a prudent operator of a project of similar size scope and complexity to the Tenant's Works to replace or repair the part of the Tenant's Works which is broken down or damaged taking into account the remainder of the design life of that part of the Tenant's Works, the unexpired residue of the Term and any notice given by the Tenant under clause 6 **Provided That**:

(a) the Tenant shall not be relieved from liability by this clause 3.6.3 to the extent that the breakdown or damage is a consequence of any failure by the Tenant to comply with its obligations under this clause 3.6 prior to the date of breakdown or damage; and

(b) the Tenant shall remain liable to keep any part of the Tenant's Works to which this clause 3.6.3 applies in safe repair and condition.

3.7 **Legal Obligations**

3.7.1 At the Tenant's own expense to observe and comply with all Legal Obligations and not to do or omit to do in relation to the Tenant's Works or the exercise of the Rights anything by reason of which the Landlord may incur any liability under a Legal Obligation whether for penalties damages compensation costs or otherwise.

3.7.2 To do all works and things and to bear and pay all expenses required or imposed by any Legal Obligation and to use all reasonable endeavours to obtain all Necessary Consents required from time to time in order to install or operate the Tenant's Works.

3.7.3 If the Tenant receives from an Authority formal notice of a Legal Obligation forthwith to produce a copy to the Landlord and if such Legal Obligation is in the Landlord's reasonable opinion contrary to the Landlord's interests (but without prejudice to the requirements of clause 3.7.1 and 3.7.2) to make such objection representation or appeal against such Legal Obligation as the Landlord reasonably requires but at the Landlord's cost (except where such notice arises from the act neglect or default of the Tenant in which event any objection representation or appeal shall be made at the Tenant's cost).

3.7.4 Not to do or omit to do anything which may cause any Necessary Consent which has been obtained for the installation or operation of the Tenant's Works to be modified or revoked without the consent of the Landlord (which shall not be unreasonably withheld or delayed).

3.7.5 Following the Termination of the Term (unless a new lease is granted to the Tenant) the Tenant shall at any time if so required by the Landlord use reasonable endeavours (subject to reimbursement of the Tenant's reasonable and proper costs of doing so) to procure that any Necessary Consent for the installation and operation of the Tenant's Works (which does not automatically enure for the benefit of the Site) is transferred (in so far as it is transferable) to or is reissued or amended to be in favour of any person to whom a lease or option agreement is granted by the Landlord in respect of the Site.

3.7.6 Clauses 3.7.4 and 3.7.5 shall remain in full force and effect notwithstanding the Termination of the Term.

3.8 **Use and Operation**

3.8.1 After the Works Completion Date to keep the Tenant's Works in operation for the purpose of generating electricity at all times during the Term except:

(a) insofar as the Tenant is prevented from doing so by an event or circumstance which is beyond its reasonable control including (without limitation) unsuitable weather conditions and safety reasons;

(b) to the extent that temporary cessation of operation is necessary to carry out any inspection testing maintenance alteration repair enhancement or renewal of the Tenant's Works in accordance with the terms of this Lease;

(c) in respect of any part of the Tenant's Works to which clause 3.6.3 applies;

(d) to the extent and for such time only as National Grid - Electricity System Operator (or any successor organisation) requests the Tenant to cease or constrain the generation of electricity by the Tenant's Works; or

(e) during the period reasonably required by the Tenant to decommission the Tenant's Works immediately prior to Termination of the Term;

Provided That in the circumstances set out in clauses 3.8.1(a) and (b) the Tenant shall use all reasonable endeavours to bring the Tenant's Works back into operation as soon as reasonably possible

3.8.2 Not to use the Site or exercise the Rights for any purpose except the installation of the Tenant's Works permitted under this Lease and the generation and storage of electricity by the Tenant's Works.

3.8.3 Not to do any act or allow any substance or article to remain on in under or over the Site or to exercise the Rights in a manner which:

(a) may be or become or cause a danger nuisance (other than a nuisance which is not actionable by reason of statutory authorisation) damage or injury to the Landlord or any other person or premises; or

(b) may cause pollution or harm to the environment or human health (except in so far as such pollution or harm is lawful by reason of the Necessary Consents for the purpose).

3.9 **Diversion**

To observe and perform the Tenant's obligations in respect of any diversion of any Generator Cables required under paragraphs 3 and 4 of Schedule Part 2.

3.10 **Alienation**

3.10.1 Not to assign or grant a charge over the whole or part of the Tenant's interest in the Lease and not to sublet part with or share the possession of or grant any licence in respect of the whole or part of the Tenant's interest in the Lease nor hold the Lease on trust for any other person;

3.10.2 Not to assign the whole of the Tenant's interest in the Lease without the consent of the Landlord such consent not to be unreasonably withheld or delayed provided that:

(a) the Landlord shall not be regarded as unreasonably withholding its consent if it withholds it on the ground of any of the circumstances set out in clause 3.10.4; and

(b) the Landlord shall not be regarded as giving its consent subject to unreasonable conditions if it gives its consent subject to any of the conditions set out in clause 3.10.5.

3.10.3 The provisos in clause 3.10.2 (a) and (b) shall operate without prejudice to the entitlement of the Landlord to withhold its consent on any other ground or grounds where such withholding of consent would not be unreasonable or to impose any further or subsequent condition or conditions upon the grant of consent where the imposition of such condition or conditions would not be unreasonable

3.10.4 The circumstances referred to in clause 3.10.2(a) are:

(a) where in the reasonable opinion of the Landlord the proposed assignee is not of sufficient financial standing to enable it to comply with the Tenant's obligations under this Lease and a valid Security Document is not agreed to be provided to the Landlord from an agreed Security Provider; and

(b) the proposed assignee is not resident in the United Kingdom or in a jurisdiction where reciprocal enforcement of judgements exists.

3.10.5 The conditions referred to in clause 3.10.2(b) are:

(a) that prior to the assignation the Tenant pays all arrears of Rent and other sums made payable under this Lease;

(b) that the proposed assignee executes and delivers an undertaking to the Landlord in such form as the Landlord may reasonably require to pay the Rent and observe and perform the covenants and the other provisions of this Lease to be observed and performed by the Tenant;

(c) that, where the proposed assignee is not incorporated in the United Kingdom, the proposed assignee procures a legal opinion letter from a firm of solicitors in the relevant jurisdiction addressed to and approved by the Landlord (acting reasonably) and provides to the Landlord an irrevocable address for service in the United Kingdom for notices under this Lease and proceedings with solicitors or other agents approved by the Landlord (acting reasonably);

(d) that all Necessary Consents for the installation and operation of the Tenant's Works are transferred or granted to the proposed assignee on or before the completion of the proposed assignation; and

(e) where the Landlord requires, the provision of a suitable Security Document.

3.10.6 Not to grant a charge over the whole of the Tenant's interest in this Lease without the consent of the Landlord such consent not to be unreasonably withheld provided that the consent of the Landlord shall not be required for a charge over the whole of the Tenant's interest in the Rights in favour of a reputable bank or other reputable and substantial financial institution provided that any chargee exercising a power of sale (or otherwise dealing with the Rights) shall be subject to the same terms and conditions relating to underletting or assignation as are set out in this clause 3.10.

3.10.7 Within one (1) month from their respective dates to send to the Landlord copies of all assignations of the Tenant's interest in the Lease, orders of court and other instruments affecting the devolution of this Lease or the Term and charges over it.

3.10.8 Any Change of Control (other than an Intra Group Reorganisation which has been notified to the Landlord in writing) of the Tenant is prohibited without the Landlord's prior written consent which shall not be unreasonably withheld or delayed. In deciding whether or not to grant their consent the Landlord shall have regard to the following factors (considered individually and collectively):

(a) the impact of the Change of Control on the ability of the Tenant to timeously and safely progress the Development and the ability of the Tenant to comply with its obligations under this Lease in a timely and safe manner;

(b) the selection process and factors taken into account by the Landlord in deciding to award the Option Agreement to the Tenant, including any special factors attributable to any shareholder whose ownership share of the Tenant will be reduced as a result of the Change of Control;

(c) the impact of the Change of Control on the financial resources available to the Tenant to enable it to perform its obligations under this Lease;

(d) whether the Change of Control would have an adverse effect on the capacity of the Tenant or otherwise available to the Tenant to enable it to perform its obligations under this Lease;

(e) whether the Change of Control would have an adverse effect on the experience and capability of the Tenant or otherwise available to the Tenant to enable it to perform its obligations under this Lease;

(f) whether the Tenant is in breach of its obligations under this Lease or any ancillary documents thereto;

(g) that the entity taking on Control has delivered a Statement of Commitment to the Landlord validly signed by an officer of the relevant entity; and

(h) such other material factors (not specified above) that may reasonably appear to the Landlord or are identified by the Tenant to be relevant at the time which may positively or negatively impact on the Landlord's assessment as to whether or not to grant consent to the Change of Control.

3.10.9 The Tenant may (but without prejudice to the other provisions of this Lease), permit any OFTO to carry out activities on the Site in connection with the transmission of electricity by the OFTO Works and the interface of the OFTO Works and the Tenant's Works including, without limitation, any of the following activities for those purposes:

(a) installing, using, commissioning, maintaining, inspecting, accessing, removing, operating, modifying, altering, repairing and decommissioning equipment comprising part of the OFTO Works on the Site; and

(b) providing services to the OFTO

but that subject to any such activities being carried out in accordance with the terms of the relevant interface agreement between the Tenant and the OFTO and no relationship of landlord and tenant being created or allowed to arise.

3.10A **Under-letting of parts for the purposes of Aquaculture**

1. Notwithstanding any other provision of this Lease including (but not limited to) clauses 3.8 and 3.10, this clause 3.10A shall have effect.

2. The Tenant may underlet part or parts of the Site for the purposes of Aquaculture in accordance with this clause 3.10A and with the consent of the Landlord (such consent not to be unreasonably withheld or delayed).

3. In the exercise of its consenting powers pursuant to clause 3.10A.2, the Landlord shall have regard to relevant policy measures promoting and otherwise dealing with co-existence and co-location as they apply to offshore windfarms.

4. The Tenant must not underlet part of the Site at a fine or premium.

5. In relation to any underlease granted by the Tenant, the Tenant must:

   a. not vary the terms of the underlease nor accept a surrender of the underlease without the consent of the Landlord (such consent not to be unreasonably withheld or delayed); and

   b. enforce the tenant covenants in the underlease and not waive any of them.

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3.11 **Indemnity**

3.11.1 To indemnify and keep the Landlord indemnified against all actions proceedings claims and demands brought or made and all proper costs and expenses (including reasonable legal fees and expenses) and all losses damages and liabilities incurred suffered or arising directly or indirectly in respect of or otherwise in connection with:

(a) the grant of this Lease

(b) the exercise or purported exercise of the Rights;

(c) the installation existence or use of the Tenant's Works;

(d) the state of repair and condition of the Site and the Tenant's Works;

(e) any act neglect or default of the Tenant or anyone deriving title through or under the Tenant or anyone exercising the Rights with the express or implied authority of such persons;

(f) any breach of any covenant or other provision of this Lease to be observed and performed by the Tenant; or

(g) any Tenant's Works remaining on in or under the Site and/or the Cable Corridor after the Termination of the Term (whether or not in breach of clause 3.16 and whether or not the Tenant has been negligent) including (without limitation) any removal or disposal of those Tenant's Works pursuant to clause 10.3.2.

3.11.2 The following provisions apply to clause 3.11.1:

(a) clause 3.11.1 shall not apply to the extent that any such actions proceedings claims and demands are brought or made or any losses damages costs expenses and liabilities are incurred or suffered as a consequence of the breach by the Landlord of its obligations under this Lease or the negligence of the Landlord or its servants agents and contractors;

(b) the Landlord shall take reasonable steps to mitigate its losses in respect of which it claims an indemnity under clause 3.11.1;

(c) the Landlord shall not make any admission of liability nor compromise or settle any actions proceedings claims and demands in respect of which it claims an indemnity under clause 3.11.1 without first notifying the Tenant and having due regard to the Tenant's timely representations;

(d) the Tenant may with the consent of the Landlord (which shall not be unreasonably withheld) conduct on the Landlord's behalf any proceedings in respect of which the Landlord claims an indemnity under clause 3.11.1 in which case:

(i) the Tenant shall give full indemnity and security to the Landlord in relation to all costs expenses damages and liabilities incurred suffered or arising from such proceedings; and

(ii) the Tenant shall act so as to minimise any liability or other adverse effects on the Landlord;

(e) clause 3.11.1 shall remain in full force and effect notwithstanding the Termination of the Term; and

(f) the Landlord shall not be entitled under clause 3.11.1 to an indemnity in respect of the Landlord's loss of use loss of contracts and/or any other indirect loss of the Landlord but this limitation shall not apply to any other person's losses and shall not limit any other right or remedy of the Landlord apart from clause 3.11.1.

3.11.3 Notwithstanding the other terms of this Lease, the Tenant's liability to the Landlord but only in respect of actions, proceedings, claims and demands brought or made and all proper costs or expenses and all losses, damages and liabilities incurred suffered or arising directly or indirectly as referred to in clause 3.11.1 (a) to (f) shall not exceed the sum of [ ] POUNDS (£[ ]) Sterling (as indexed annually), in aggregate, exclusive of all if any VAT which shall be payable in addition if applicable but declaring that the Tenant's liability to the Landlord shall not be limited in any way in respect of:

(a) death or personal injury caused by the Tenant's negligence or that of its directors, officers, employees, advisors, agents, consultants or contractors (including sub-contractors); and

(b) Fraud or fraudulent misrepresentation by the Tenant or its officers or employees; and

(c) any liability which cannot be excluded or limited by any laws and regulations.

3.11.4 Clauses 3.11.1 and 3.11.2 shall remain in full force and effect notwithstanding the Termination of the Term for a period of 5 years after the Termination of the Term.

3.12 **Costs**

3.12.1 To pay and indemnify the Landlord against all proper (and in the case of clause 3.11.1(a) reasonable) fees charges disbursements costs and expenses connected with incidental to consequent upon and (where appropriate) in proper contemplation of:

(a) an application for the Landlord's consent (whether or not the consent is given or the application is withdrawn) unless such consent is unlawfully withheld or is subject to an unlawful qualification or condition because it is unreasonable or otherwise;

(b) the inspection of the Site in accordance with paragraph 1.3 of Schedule Part 2 (where such inspection reveals a breach of the Tenant's covenants in this Lease) and the superintendence of any works required to remedy any breach of the Tenant's obligations under this Lease;

(c) the recovery of arrears of Rent or other sums payable under this Lease; or

(d) the enforcement of any obligation of the Tenant under this Lease.

3.12.2 Clause 3.12.1 shall remain in full force and effect notwithstanding the Termination of the Term.

3.13 **Insurance**

3.13.1 To effect and maintain the following insurances:

(a) insurance of the Tenant's Works against destruction or damage by the Insured Risks in a sum equal to or in excess of the Estimated Maximum Loss (as Indexed) and Terrorism Estimated Maximum Loss (as Indexed) in accordance with normal insurance practice for offshore wind farms from time to time, approved by the Landlord (acting reasonably); and

(b) third party and public liability insurance in respect of the Tenant's Works and the exercise of the Rights in the sum of £25,000,000, or in such other sum as the Landlord may from time to time reasonably require, in respect of each and every occurrence (except for pollution and product cover which may be on an annual aggregate basis if unavailable on an each and every occurrence basis), on terms in accordance with normal insurance practice for offshore wind farms from time to time.

3.13.2 The insurances required by clause 3.13.1 shall:

(a) be with an insurer holding a credit rating of at least A- with Standard & Poor's Rating Group (or an equivalent credit rating from another internationally recognised credit rating agency):

(b) name the Landlord as co-insured;

(c) contain waiver of subrogation, separate policy provision and non-vitiation endorsements in a form acceptable to the Landlord (acting reasonably); and

(d) be on terms in accordance with normal insurance practice for offshore wind farms from time to time (including the level of any deductible) approved by the Landlord (acting reasonably).

3.13.3 The Tenant shall not be obliged to insure under clause 3.13.1(a) if and to the extent that such insurance is not available in the European insurance market on commercially reasonable terms or is only available at uneconomic rates.

3.13.4 To produce to the Landlord upon request from time to time (but no more frequently than once every twelve (12) months) a copy of or full details of each policy of insurance and evidence that each policy is in force.

3.13.5 Except to the extent clause 3.6.3 applies, if the Tenant's Works or any part of them are damaged or destroyed by an Insured Risk to apply for and use reasonable endeavours to obtain all Necessary Consents to reinstate the Tenant's Works and as soon as reasonably practicable after they are obtained to apply the insurance monies received under the policy of insurance in reinstating the Tenant's Works with all reasonable speed making up any shortfall out of its own resources.

3.13.6 To pay to the Landlord the premium and other costs which the Landlord may incur in effecting and maintaining any insurance which the Tenant fails to effect or maintain in accordance with the provisions of this clause 3.13.

3.13.7 To observe and perform the terms of any insurance policy effected pursuant to this clause 3.13 and all requirements from time to time of the insurers and not to do or fail to do anything which shall or may cause any such policy to be void or voidable or any monies payable under it to be irrecoverable.

3.14 **Health and Safety Reporting**

3.14.1 In this clause 3.14 the following expressions shall have the following meanings:

Health and Safety Incident means any incident which is reportable under this Lease at clause 3.14.2;

Health and Safety Requirements means all applicable health and safety obligations of the Tenant deriving from Legal Obligations and this Lease.

HSI Notification means the form of notification set out at Schedule Part 6 to this Lease.

RIDDOR Reportable Incident means a Health and Safety Incident giving rise to reporting requirement under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013;

Serious Incident means any fatal RIDDOR Reportable Incident or Health and Safety Incident which involves serious threat to life, harm or damage to the environment or property including but not limited to vessel collisions, structural collapses, explosions or fires, releases of flammable liquids and gases, hazardous escapes of substances.

Incident Reporting

3.14.2 The Tenant shall notify the Landlord of the following incidents occurring at the Site using the HSI Notification as follows:

(a) in relation to a non-fatal RIDDOR Reportable Incident within one (1) month; and

(b) in relation to a Serious Incident as soon as reasonably practicable and, in any event, within forty-eight (48) hours.

3.14.3 The Tenant shall co-operate with the Landlord's reasonable written requests for information relating to any Health and Safety Incident at any time, save that the Tenant shall in no event be required to disclose any documentation or other information which is subject to legal privilege.

3.14.4 In the event of a Serious Incident occurring:

(a) the Tenant must comply with its reporting obligations pursuant to Clause 3.14.2(b);

(b) the Tenant shall notify the Landlord in the event that it proposes to release a press/public statement in connection with the same and shall provide a copy to the Landlord for information or in the event that it is not practicable to notify the Landlord in advance the Tenant shall notify the Landlord as soon as reasonably practicable following release of the press/public statement;

(c) the Landlord shall notify the Tenant in the event that it wishes to release a press/public statement in connection with the same and shall provide a draft copy in advance of release to the Tenant for review and approval and the Landlord shall not be entitled to so release a press/public statement without the prior written approval of the Tenant (not to be unreasonably withheld or delayed) save where the Landlord considers acting reasonably and in good faith, that a press/public statement urgently requires to be made and that the approval of the Tenant may not be obtained timeously.

3.15 **Encroachments**

To use reasonable endeavours to prevent all encroachments and unlawful acts on the Site which may prejudice the Landlord's title to them and if any claim is made to the Premises or to any right profit or easement in or out of or affecting them forthwith to give notice of it to the Landlord and not to admit or acknowledge it in any way whatsoever**.**

3.16 **Decommissioning**

3.16.1 Prior to the Termination of the Term:

(a) to decommission the Tenant's Works and to restore the Site in accordance with the Statutory Decommissioning Programme; and

(b) if and to the extent that the Statutory Decommissioning Programme does not apply to any element of the Tenant's Works, to remove those Tenant's Works (unless the Landlord agrees otherwise in writing) in accordance with the Non-Statutory Decommissioning Programme

in both cases in accordance with all Legal Obligations;

3.16.2 On the Termination of the Term to deliver up the Site to the Landlord in good and safe order and condition in accordance with the Tenant's covenants in this Lease; and

3.16.3 To comply with the provisions of the Statutory Decommissioning Programme and all other Legal Obligations relating to the Tenant's Works which continue to apply after the Tenant has complied with clause 3.16.1 (including (without limitation) those relating to post decommissioning monitoring maintenance and management of the Site) and this obligation shall continue in full force and effect after the Termination of the Term for as long as any such provision of the Statutory Decommissioning Programme or Legal Obligation continues to apply.

3.17 **Data**

3.17.1 If the Landlord, acting in good faith, considers that it would be beneficial to the development of the offshore wind energy industry in Scotland, the Tenant shall provide the Data to the Landlord.

3.17.2 The Data shall be provided as follows:

(a) in reports provided at such intervals as the Landlord may from time to time reasonably require (but no more frequently than annually) the first report during the Term to contain Data gathered since the Commencement Date and the subsequent reports to contain Data gathered since the previous report;

(b) the Data shall be provided in each report in any format which the Landlord reasonably require from time to time and which:

(i) uses appropriate standards and protocols for data (including metadata) handling and archiving;

(ii) is in digital format which can be transmitted electronically;

(iii) can be entered into geographical information systems; and

(iv) is either geographically or library referenced;

and for the avoidance of doubt the Tenant acknowledges and agrees that it has no interest or right (including copyright and database rights) in any format or database in which Data is put stored or processed whether by the Tenant pursuant to its obligation under this clause 3.17, by the Landlord.

3.17.3 Subject to clause 4.4 the Tenant grants to the Landlord (and shall procure all necessary third party consents to enable it to do so) a perpetual non-exclusive right and licence to use and make publicly available for any purpose or in any manner or form Data provided to them pursuant to this clause 3.17.

3.17.4 This clause 3.17 shall remain in full force and effect notwithstanding the Termination of the Term in respect of Data gathered in connection with monitoring carried out in connection with the Tenant's obligations under clause 3.17.3.

3.18 **Bribery**

The Tenant shall comply and use all reasonable endeavours to ensure that any person employed by or acting on behalf of the Tenant or any of their representatives comply, whether with or without the knowledge of the Tenant, with all the requirements of the Bribery Act 2010 and any form of Guidance issued in respect of the Bribery Act 2010.

3.19 **Disposal Premium**

The Tenant shall pay any Disposal Premium (as defined in the Option Agreement) that falls due after the Commencement Date all in terms of the Option Agreement.

4 Landlord's Obligations

4.1 The Landlord undertakes to the Tenant that the Landlord shall not:

4.1.1 exercise the rights reserved in paragraph 1.2 of Schedule Part 2 to install Conduits other than to an OFTO in respect of the Supply Cables;

4.1.2 carry out or grant any licence or consent for the dredging or removal of minerals within the [Site/REZ Site]; or

4.1.3 install or permit the installation of any wind farm within a distance of five (5) kilometres from the boundary of the Site

without the consent of the Tenant (such consent not to be unreasonably withheld or delayed). [***note: to be discussed if phased projects***]

4.2 Clause 4.1 shall not apply to the exercise of any right granted pursuant to the matters referred to in Schedule Part 3.

4.3 The Landlord undertakes to the Tenant that they will not do or fail to do anything which shall or may cause any policy of insurance maintained under clause 3.13.1(b) to be void or voidable or any monies payable under it to be irrecoverable.

4.4 The Landlord undertakes to the Tenant not to disclose any Data relating to wind resource provided under clause 3.17 to any third party for a period of three (3) years after the date on which that Data was gathered except:

4.4.1 to employees of the Landlord and to government departments agencies or other government bodies and their respective employees;

4.4.2 to national repositories for data provided that any such repository does not publish or distribute the Data in its entirety or only uses the Data in aggregation with other data for the production of charts or for the purposes of research and keeps the source of the Data confidential;

4.4.3 as required by law or parliamentary questions;

4.4.4 where, in the absolute discretion of the Landlord, disclosure is required under the Freedom of Information (Scotland) Act 2002 (**FOISA**), or the Environmental Regulations (Scotland) 2004 (**EIRs**) and the Tenant acknowledges and agrees that the Landlord may, acting in accordance with the codes of practice (**Codes**) issued and revised from time to time under Section 60 of the FOISA and regulation 18 of the EIRs, disclose such data either in certain circumstances as described in the Codes, without consulting the Tenant, or following consultation with the Tenant and taking its views into account in accordance with the Codes;

4.4.5 in so far as already in the public domain through no default of the Landlord; or

4.4.6 as agreed by the Tenant;

and where disclosure is made under clause 4.4.1 or 4.4.2 the Landlord shall notify the person to whom the information is disclosed of the confidentiality of the information and shall take reasonable steps to ensure that such person observes the restrictions on disclosure in this clause 4.4.

4.5 The Landlord covenants with the Tenant that it shall compensate the Tenant for any actual direct loss, costs and expenses (including any liability for loss of income incurred by the Tenant as a result of the Landlord requiring an OFTO to divert any Supply Cables (which at the time of the diversion are actually transmitting electricity generated by the Tenant's Works or otherwise required for the operation of the Tenant's Works) or any part of such Supply Cable (and which loss could not have been reasonably avoided or is not too remote) with the Tenant taking all reasonable and appropriate steps to mitigate against such loss.

4.6 Clause 4.5 shall not apply where the Landlord requires an OFTO to divert any Supply Cables or any part of a Supply Cable which, at the time of the diversion, are not actually transmitting electricity generated by the Tenant's Works nor otherwise required for the operation of the Tenant's Works.

4.7 The Landlord's obligations under this clause 4 shall cease upon Termination of the Term.

5 Termination on default

5.1 The Landlord may at any time after the occurrence of any of the following events exercise any of the rights set out in clause 5.3:

5.1.1 if any Rent remains unpaid twenty-one (21) days after it is due (whether formally demanded or not);

5.1.2 if any undertaking or provision in this Lease which is to be observed or performed by the Tenant is not observed or performed;

5.1.3 if the Works Completion Date has not occurred by the sixth (6th) anniversary of the Commencement Date whether or not the Tenant is in breach of any covenant or provision in this Lease and whether or not there is or has been an event of Force Majeure;

5.1.4 the occurrence of an Insolvency Event in respect of either the Tenant or any Security Provider;

5.1.5 any Disposal Premium (as defined in the Option Agreement) that may become due in terms of the Option Agreement after the Commencement Date remains unpaid twenty- one (21) days after it is due (whether formally demanded or not); or

5.1.6 any Security Document ceases to be valid, binding and enforceable for any reason or, if applicable, the Security Provider ceases to hold an Acceptable Covenant and the Tenant has not procured a replacement Security Document in accordance with clause 8 within thirty (30) Working Days.

5.2 the Tenant, or any person employed by or acting on behalf of the Tenant (whether or not with the Tenant's knowledge), has offered or given or agreed to give to any person any gift or consideration of any kind as an inducement or reward for doing or refraining from doing or for having done or refrained from doing any action in relation to the obtaining or complying with the Tenant's obligations under the Lease or any other contract with the Landlord.

5.3 Subject to the terms of clause 5.4 of the Lease, the Landlord may at any time after the occurrence of the events detailed in Clause 5.1.1 to 5.1.5 bring this Lease to an end on giving written notice to that effect to the Tenant whereupon the Lease shall cease and terminate (but without prejudice to any rights and remedies of the Landlord in respect of any arrears of Rent or any antecedent breach of this Lease and the continuing operation of any provision of this Lease which is expressed to continue to apply or remain in force and effect after or notwithstanding termination of the Lease) but which irritancy is hereby declared to be contractual and not penal and will not be purgeable at the Bar.

5.4 In the case of the occurrences detailed at Clauses 5.1.2 to 5.1.5 the Landlord will not be entitled to terminate the Lease as aforesaid unless it will have first given written notice of the breach to the Tenant and each Security Provider and to every creditor in any then existing standard security or floating charge (so far as the grant of such standard security or floating charge has been notified to the Landlord) affecting the Lease prescribing a time which is reasonable in the circumstances (such circumstances not including the financial position of the Tenant) within which such breach must be remedied and the Tenant (or any such creditor or Security Provider) will have failed to remedy the breach within the time prescribed in the notice and declaring that where the breach is the failure to pay any sum of money, a reasonable time will be a period of not less than fifteen (15) Working Days and that in the case of a breach of clause 5.1.2 will be not less than three (3) months and (b) in the case of the Tenant going into liquidation or suffering an administrative receiver, receiver or an administrator to be appointed the Landlord will allow the liquidator or administrative receiver, receiver or administrator (as the case may be) and any such creditor as aforesaid a period of one year in which to dispose of the Tenant's interest in the Lease and will only be entitled to terminate the Lease if the liquidator or administrative receiver, receiver or administrator or such creditor as the case may be will have failed to dispose of the Tenant's interest at the end of the said period provided always that the liquidator or administrative receiver, receiver or the administrator or such creditor as the case may be will accept in probative writing within one (1) month of the date of appointment or of such creditor's entry into possession of the Site and implement full responsibility for payment of the Rent (whether due in respect of a period occurring before or after the date of liquidation or receivership or administration or entering into possession as the case may be) and for the performance of all other obligations of the Tenant under the Lease from the date of liquidation or receivership or administration or the date of such creditor's entry into possession as the case may be to the date of disposal or termination of the Lease including settlement of any arrears of the

rents and the performance of any outstanding obligations which may subsist at the date of liquidation or receivership or administration or such creditor's entry into possession as the case may be and will if requested by the Landlord find caution for such payment and performance in an amount acceptable to the Landlord. And it is hereby declared that the Landlord will deal with any request for consent to assign the Lease made by such liquidator, administrative receiver, administrator or creditor as the case may be in the same manner as if the request had been made by the Tenant. The provisions relating to a liquidator, administrative receiver or administrator hereinbefore narrated will apply mutatis mutandis to a trustee in sequestration and a trustee under a trust deed for the benefit of creditors if the Tenant is an individual or individuals or a partnership or an unincorporated body.

6 Tenant's Right of Termination

6.1 The Tenant may terminate this Lease after the Works Completion Date and after a Break Event occurs on not less than twelve (12) months and not more than five (5) years written notice given to the Landlord within twelve (12) months after the Break Event occurs and specifying the date on which the Tenant intends this Lease to terminate (**Intended Date of Termination**).

6.2 The Tenant may terminate this Lease on or at any time after the 22nd anniversary of the Works Completion Date but in any event before the 37th anniversary of the Works Completion Date by serving on the Landlord not more than 5 years and not less than 2 years written notice which may be served on or at any time after the 20th anniversary of the Works Completion Date but must always be served before the 35th anniversary of the Works Completion Date specifying the proposed date of termination (**Intended Date of Termination**) but such Intended Date of Termination shall never be earlier than the 22nd anniversary of the Works Completion Date.

6.3 This Lease shall only terminate as a result of notice given by the Tenant under clause 6.1 or 6.2 on the date specified in the notice as the Intended Date of Termination if on that Intended Date of Termination the Tenant has:

6.3.1 paid all Rent due under this Lease up to (and including) the Intended Date of Termination;

6.3.2 complied with clauses 3.16.1 and 3.16.2 in all material respects;

6.3.3 given vacant possession of the Site to the Landlord; and

6.3.4 in respect of any termination of this Lease pursuant to Clause 6.2, the Tenant has paid (in cleared funds) the Break Fee to the Landlord on or before the Intended Date of Termination.

6.4 Any Break Fee under this Lease shall be calculated in accordance with the following formula:

BF = (5-N) x Minimum Rent

Where

BF = Break Fee

N = Notice Period; and

Minimum Rent = means the net present value of the annual rent calculated and based upon the Rent payable by the Tenant in the Generation Period immediately preceding the date of the notice served by the Tenant pursuant to clause 6.2 assuming that the Output is twenty five per cent (25%) of the Minimum Output (as defined in Schedule Part 4) and which may be expressed as (Rent for that Generation Period x 4) with such aggregate sum being discounted by five per cent (5%) per annum per year of Minimum Rent

calculated pursuant to this Clause 6.4 and payable by the Tenant pursuant to Clause 6.3.4. Schedule Part 7 (*Break Fee – Worked Example*) provides worked examples showing how the Break Fee will be calculated

6.5 If a valid notice is given by the Tenant under clause 6.1 or 6.2 and this Lease does not determine on the Intended Date of Termination specified in the notice because of the Tenant's failure to comply with any of the conditions set out in clause 3 then:

6.5.1 the Tenant may determine this Lease on giving written notice to the Landlord at any time after the Intended Date of Termination specifying a revised intended date of termination (**Revised Intended Date of Termination**) (which notice is not required to be of any particular length) but this Lease shall only determine as a result of notice given by the Tenant under this clause 6.5.1 if on the Revised Intended Date of Termination the Tenant has paid all Rent due under this Lease up to the Revised Intended Date of Termination and has complied with the conditions set out in clauses 6.3.2 and 6.3.3; and

6.5.2 the Landlord may terminate this Lease with immediate effect on giving written notice to the Tenant at any time after the Intended Date of Termination specified in a notice given by the Tenant under clause 6.1 or 6.2.

6.6 The Landlord may in its absolute discretion waive compliance with all or any of the conditions or obligations set out in clause 6.2 but unless otherwise expressly agreed in writing such waiver shall not release the Tenant from liability to comply with the relevant condition or obligation.

6.7 Upon termination of this Lease under this clause 6 the Term shall cease and determine but without prejudice to either party's rights and remedies in respect of any antecedent breach by the other of this Lease and the continuing operation of any provision of this Lease which is expressed to continue to apply or remain in force and effect after or notwithstanding Termination of the Term.

6.8 Any notice given under this clause 6 shall be irrevocable.

6.9 Time is of the essence in respect of this clause 6.

7 Landlord's Right of Termination for Oil and Gas Works

7.1 The Landlord may at any time and from time to time during the Term terminate this Lease in respect of the Site or any part or parts of it by giving reasonable prior written notice to the Tenant specifying the Site or the part or the parts of it in respect of which the notice is given.

7.2 The Landlord shall not give notice under clause 7.1 unless the Secretary of State for the purposes of the Petroleum Act 1998 has requested the Landlord to determine this Lease in respect of the Site or the part or parts of it specified in the notice because the Site or the part or parts of it specified in the notice are required for Oil and Gas Works or rights are required over the Site or the part or parts of it specified in the notice in connection with Oil and Gas Works.

7.3 If notice is given under clause 7.1 in respect of the whole Site then upon the expiry of that notice this Lease shall determine but without prejudice to the rights and remedies of the Landlord in respect of any antecedent breach by the Tenant of its obligations under this Lease.

7.4 If notice is given under clause 7.1 in respect of a part or parts of the Site then upon expiry of that notice:

7.4.1 this Lease shall terminate in respect of the part or parts of the Site specified in the notice;

7.4.2 this Lease shall from that date take effect as if the part or parts of the Site specified in the notice were no longer part of the Site and/or REZ Site (as the case may be); and

7.4.3 such termination shall be without prejudice to:

(a) the rights and remedies of the Landlord in respect of any antecedent breach by the Landlord of its obligations under this Lease in respect of the part or parts of the Site specified in the notice; and

(b) the continuing operation of this Lease in respect of the remainder of the Site.

7.5 The Tenant shall comply with the obligations under clauses 3.16.1 and 3.16.2 in respect of the Site or such part or parts of it as are specified in a notice given under clause 7.1 prior to the expiry of that notice.

7.6 Except as provided in clause 7.7 termination under this clause 7 does not give rise to any abatement of the Rent or liability of the Landlord to pay compensation to the Tenant for such termination.

7.7 Upon termination of this Lease in respect of a part or parts of the Site pursuant to a notice given under this clause 7 the Minimum Output shall be reduced by such proportion as shall be fair and reasonable (if any) having regard to the proportion of the Tenant's Works which the Tenant is required to remove as a consequence of that notice and the proportion of the Tenant's Works remaining.

7.8 Any difference arising between the Landlord and the Tenant as to the reduction in the Minimum Output pursuant to clause 7.7 may be referred by either the Landlord or the Tenant on notice to the other for determination by an independent electrical engineer acting as an expert as provided in clause 10.2 and who shall be nominated by the Landlord and approved by the Tenant (such approval not to be unreasonably withheld) or in default of agreement be nominated by the President of the Institution of Engineering and Technology or other acting chief officer for the time being on the application of either the Landlord or the Tenant.

7.9 The Tenant shall enter into such deeds and documents as the Landlord may reasonably require to give effect to any notice given under clause 7.1.

8 Replacement Security Document

8.1 On each anniversary of the Commencement Date the Tenant shall (if requested by the Landlord) deliver evidence in a form satisfactory to the Landlord (acting reasonably) that the Security Provider continues to have an Acceptable Covenant.

8.2 If a Security Document ceases to be valid, binding or enforceable for any reason or the Security Provider ceases to have an Acceptable Covenant then the Tenant shall provide the Landlord with a replacement Security Document (which shall be subject to a maximum value or cap on liability no less than the Cap) within thirty (30) Working Days of any Security Document ceasing to be valid, binding or enforceable or the Security Provider ceasing to have an Acceptable Covenant.

9 Indexation

9.1 Where in this Lease an amount is to be increased by **Indexation** or **Indexed** the amount shall be that amount multiplied by (CPI1 ÷ CPI2), where:

CPI1 is the higher of:

(a) the value of the Index published in respect of the month two (2) months prior to the relevant calculation date; and

(b) the highest value of the index published after the date of this Lease; and

CPI2 is [***to be the same as CPI2 in the Option Agreement***]

9.2 If the reference base used to compile the Index changes after the date of this Lease the figure taken to be shown in the Index after the change is to be the figure that would have been shown in the Index if the reference base current at the date of this Lease had been retained.

9.3 If after the date of this Lease:

9.3.1 the Index ceases to be published; or

9.3.2 it otherwise becomes impossible to operate the formula in clause 9.1 by reference to the Index

the Landlord and Tenant shall consult together with a view to agreeing an alternative index or method of adjusting the amounts stated to Indexed which as closely as possible gives effect to the purpose and intent of the parties as set out in this Agreement but in the event of any failure to agree or if any other dispute or difference arises between the Landlord and Tenant with respect to the calculation of the amounts stated to Indexed either party may require the matter to be determined by an expert to be appointed either by agreement between the parties or, in the absence of agreement, by the President of the Royal Institution of Chartered Surveyors (or the next senior officer).

10 Miscellaneous

10.1 Except where and to the extent that any statutory provision prohibits the Tenant's right to compensation being reduced or excluded by agreement the Tenant shall not be entitled on quitting the Site to claim any compensation from the Landlord on any ground.

10.2 If there is any dispute or matter in this Lease expressed to be referable to an expert for determination:

10.2.1 the relevant expert shall be instructed to accept written representations and counter representations within such time as he shall direct as being reasonable having regard to the nature of the dispute or matter and the need for its timely resolution and in any event shall be instructed to seek to reach his decision within twenty eight (28) days (or such further time as he shall determine to be reasonable having regard to the nature of the dispute or matter) of his appointment;

10.2.2 the costs of the reference to the relevant expert and of his determination (including his own fees and expenses the fees and expenses of any other professional consulted in accordance with clause 10.2.3 and the costs of the Landlord and the Tenant) shall lie in his award;

10.2.3 the relevant expert shall be entitled to seek the opinion of another professional of an appropriate different experience and qualification if he shall be concerned that he lacks relevant or sufficient experience or expertise;

10.2.4 the relevant expert shall be required to give reasons for his decision and his decision will be final and binding save in case of manifest error; and

10.2.5 if a relevant expert shall die or otherwise be incapable of resolving the dispute either the Landlord or the Tenant may request (in default of agreement) a replacement person and the foregoing will apply.

10.3 The following provisions apply in respect of the Tenant’s Works:

10.3.1 the Tenant’s Works are the property of the Tenant and shall remain the property of the Tenant notwithstanding Termination of the Term; and

10.3.2 where any of the Tenant’s Works remain on in or under the Site and/or the Cable Corridor after the Termination of the Term (whether or not in breach of clause 3.16) the Landlord may (save where prohibited by a Statutory Decommissioning Programme) in its absolute

discretion retain remove and dispose of those Tenant's Works as it sees fit without any liability whatsoever to the Tenant and without prejudice to the Landlord's rights and remedies in respect of any breach by the Tenant of clause 3.16 and the continuing operation of clause 3.11.

10.4 The Landlord shall incur no liability to the Tenant by reason of any approval given to or inspection made of the Tenant's Works or any drawing plan or specification of them nor shall any such approval or inspection in any way relieve the Tenant from its obligations under this Lease.

10.5 Any notice must be in writing and will be properly given if sent by Recorded Delivery or Registered post in the case of a notice by the Tenant to the Landlord addressed to them at Quartermile Two, 2nd Floor, 2 Lister Square, Edinburgh EH3 9GL (or at such other address as the Landlord may from time to time intimate in writing to the Tenant) and in the case of the Tenant and any Security Provider to its registered office or last known place of business if such registered office or last known place of business is Scotland, England or Wales or otherwise and in the case of the Security Provider only to any agent specified in the relevant Security Document declaring that all notices will be deemed to be received at the same time two (2) Working Days after posting and any omission to send by recorded delivery or registered post will not be pleadable where the notice has received an acknowledgement.

10.6 Nothing contained or implied in this Lease gives the Tenant the benefit of or the right to enforce or prevent the release or modification of any covenant agreement or condition relating to other premises.

10.7 It is not intended that any third party shall be entitled to enforce any term of this Lease pursuant to the Contracts (Rights of Third Parties) (Scotland) Act 2017.

11 Supply Chain and Contracted Position Statement

Supply Chain

11.1 In order to maximise efficiencies in the supply chain (whether on a local or national basis) required for the construction and subsequent maintenance and operation of the Tenant's Works to be constructed in terms of this Lease, the Tenant (whether alone or in partnership with other offshore wind farm developers) shall

11.1.1 use reasonable endeavours to engage with and meet regularly local and national business forums relevant supply chain organisation(s) and relevant economic development agencies with a view to ensuring their requirements for the efficient facilitation of the construction and subsequent maintenance and operation of the Tenant's Works are understood by such forums and organisations and to inform them of progress, concerns and opportunities regarding their region or companies which they account manage; and

11.1.2 advertise all opportunities for sub-contractors and suppliers in a way which ensures suppliers for which the opportunities may be relevant, are aware of procurement activities related to the Development.

11.2 Where applicable, the Tenant shall provide the Landlord with all Supply Chain Plan information at the time it is submitted as part of the Contract for Difference eligibility process.

Contracted Position Statement

11.3 Within two (2) weeks of every 2nd anniversary of the Commencement Date until the 6th anniversary thereof, the Tenant shall provide the Landlord with a written report on the delivery of the CPS Commitments contained within the CPS and thereafter the Tenant

shall provide such written report every five (5) years commencing on the 10th anniversary of the Commencement Date.

11.4 The report referred to in clause 11.3 shall be in a form approved by the Landlord and which aligns with other relevant supply chain measures across the UK, such as supply chain plans linked to Contracts for Difference (as defined in Schedule Part 4) and the Offshore Wind: Sector Deal published by the Department for Business, Energy & Industrial Strategy on 7 March 2019.

11.5 The Landlord may publish information from the report referred to in clause 11.3 as the Landlord considers appropriate.

12 Proper Law

12.1 This Lease shall be governed by and construed in accordance with the Laws of ~~Scotland~~ England and Wales insofar as they apply to Wales and the Site is to be regarded as if it were incorporated in the body of a county of ~~Scotland~~Wales.

12.2 The Tenant irrevocably agrees for the exclusive benefit of the Landlord that the courts of ~~Scotland~~ England and Wales shall have jurisdiction over any claim or matter arising under or in connection with this Lease and that accordingly any proceedings in respect of any such claim or matter may be brought in such courts. Nothing in this clause shall limit the right of the Landlord to take proceedings against the Tenant in any other court of competent jurisdiction, nor shall the taking of proceedings in any one or more jurisdictions preclude the taking of proceedings in any other jurisdiction or jurisdictions, whether concurrently or not, to the extent permitted by the law of such other jurisdiction or jurisdictions.

13 Further Assurance

The Parties agree that each shall and shall use reasonable endeavours to procure that any third party shall execute such documents and perform such acts as may be required to implement the OFTO regime or any equivalent replacement regime.

14 Direct Agreement

14.1 The Landlord acknowledges that the Tenant may require funding from a Funder to implement the Development and in arranging such finance a Funder may require, as a condition of the availability of that finance to enter into a direct agreement with the Landlord to cover (without limitation) the following principal matters:

14.1.1 an acknowledgement by the Landlord of any security taken by the Funders over the Tenant and its assets (including over the Lease);

14.1.2 an obligation to give notice to the Funder in the terms of clause 5.1 of the Lease;

14.1.3 an obligation on the Landlord not to take any action to wind up, appoint an administrator or sanction a voluntary arrangement (or similar) in relation to the Tenant without first giving a prescribed period of notice to the Funder;

14.1.4 a step in right (without giving rise to any express or implied assignment) to allow the Funder to ensure that the obligations of the Tenant are complied with as to prevent any circumstances arising under which the Landlord could seek to determine) the Lease; and

14.1.5 provisions regulating the application of insurance proceeds in the event that all or part of the Tenant's Works is destroyed or damaged which provisions will permit the Funder to recalculate financial ratios and conduct other economic tests (in respect of which the Funder will take account of the Landlord's reasonable representations) relating to the fundamental financial viability of the Development and fundamental ability of the Development to meet debt service after the occurrence of a major insurable event and will further provide that if the specified economic tests are not satisfied, then any insurance proceeds received in respect of such insurable event shall be applied in

repayment of amounts owing under any funding agreements rather than reinstatement of the relevant part or parts of the Tenant's Works.

14.2 The Landlord further acknowledges that they will act in good faith (at the cost and expense of the Tenant) to negotiate such a direct agreement where reasonably requested by the Tenant.

15 Consent to Registration

The parties hereto consent to registration hereof for preservation and execution: IN WITNESS WHEREOF these presents consisting of this and the …. preceding pages together with the Schedule attached are executed as follows:

They are subscribed for and on behalf of Crown Estate Scotland

At……..
On ……
By
….....Authorised Signatory
….....Full Name
before this witness
….....Witness Signature
….....Witness Full Name
….....Witness Address
……
And they are subscribed for and on behalf of the said [ ]
At……..
On ……
By
….....Director Signature
….....Director Full Name

….....Witness
….....Full Name
….....Witness Address
……

This is the Schedule referred to in the foregoing Lease by Crown Estate Scotland in favour [ ] of the wind farm site on seabed at [ ]

Schedule Part 1 - Rights

1 The following rights are granted to the Tenant:

1.1 the exclusive right to install use operate inspect maintain repair renew and remove Tenant's Works within the Site together with such ancillary rights as may be necessary to enable the Tenant to comply with its obligations under this Lease in respect of the Site;

1.2 the rights granted under paragraph 1.1 in respect of the REZ Site shall not exceed the rights exercisable by virtue of any Order or Orders in Council from time to time made pursuant to Section 84(4) Energy Act 2004 designating the Renewable Energy Zone in which the REZ Site is located;

1.3 to install Generator Cables and to use inspect maintain repair renew and remove Generator Cables from time to time laid by the Tenant on in under or over the Site and to divert any Generator Cables from time to time laid by the Tenant where entitled to do under this Lease; and

1.4 to connect any Generator Cables to any transmission or substation equipment within the Site and to inspect maintain repair renew and remove any such connection for the purposes of carrying out any routine maintenance or repair work.

Schedule Part 2 - Exceptions and Reservations

1 The following are excepted and reserved to the Landlord and all others from time to time authorised by the Landlord (including, without limitation, any OFTO) or otherwise entitled:

1.1 all mines minerals and mineral substances within the Site;

1.2 the right to install and use (without interruption or interference save for routine maintenance or repair work) within the Site one or more substations (or supporting platforms including the footings of any such platform to accommodate any substation) and Supply Cables and any required Conduits for the purposes of transmitting electricity generated by the Tenant's Works or by any other wind farm or otherwise and to connect into and use any Conduits belonging to the Tenant and to use connect into inspect maintain repair renew and remove any such substations, Supply Cables and Conduits (not forming part of the Tenant's Works); and

1.3 the rights to:

1.3.1 enter the Site to exercise the rights referred to in paragraphs 1.2, 1.3.2 and 1.3.3;

1.3.2 inspect the Site and the Tenant's Works; and

1.3.3 carry out scientific research within the Site.

1.4 the right to install works on the seabed outside the Site in such manner as it sees fit irrespective of whether the works affect or diminish the light air or wind which may now or at any time be enjoyed by the Site or the Tenant's Works subject only to the Landlord complying with the obligations under clause 4 (where relevant) provided that the Landlord will not install or suffer or permit the installation of any wind farm within an area of 2.5 km from the boundary of the Tenant's Works as shown on the plan provided pursuant to clause 8.1 of the Option Agreement (the **Exclusion Zone**) and where there is to be an adjacent wind farm the Landlord shall procure that a similar exclusion zone be included for such wind farm so that the total exclusion zone is 5 km provided further that this exclusion shall not apply where the Landlord, the Tenant and any relevant third party agree an alternative arrangement which would permit such use of the Exclusion Zone.

2 The rights granted under paragraphs 1.1 and 1.3 of Schedule Part 1 are subject to the following:

2.1 the right of the Landlord to carry out and grant leases licences and consents for the carrying out of works on in over or under the Site are subject only to the Landlord complying with the obligations under clause 4 (where relevant);

2.2 the rights of the Landlord under paragraph 3;

2.3 the Tenant complying with its obligations under clauses 3.2, 3.3 and 3.5; and

2.4 where the relevant works are not carried out by or on behalf of the OFTO for the purpose of accepting and transmitting electricity generated by the Tenant's Works, the Landlord shall pay to the Tenant reasonable compensation for any loss of income which the Tenant sustains as a direct consequence of such works and which could not have reasonably been avoided

2.5 The Landlord's rights under paragraph 3 of this Part of the Schedule

3 The Landlord may from time to time upon giving at least twelve (12) months' notice to the Tenant:

3.1 require the Tenant to divert any or all Generator Cables and Conduits within the Site to such alternative position or positions within the Site as the Landlord may reasonably require; and/or

3.2 require the OFTO to divert any or all Supply Cables and Conduits within the Site (and the Cable Corridor) to such alternative position or positions within the Site (and the Cable Corridor) as the Landlord may reasonably require; and/or

3.3 require the OFTO to alter the position of the Site (and the Cable Corridor) and divert the Conduits and Supply Cables within it to such alternative positions within the Site (and the new Cable Corridor) as the Landlord may reasonably require.

4 Where the Landlord exercises its rights under paragraph 3:

4.1 the Tenant shall carry out the diversion required under paragraph 3 prior to expiry of the notice given under paragraph 3; and

4.2 the Landlord shall pay to the Tenant the costs and expenses reasonably incurred by the Tenant in carrying out such diversion under paragraph 3 and reasonable compensation for any loss of income which the Tenant sustains as a direct consequence of any such diversion and which could not have reasonably been avoided.

5 The exceptions and reservations under paragraph 1 are subject to the following terms:

5.1 in exercising the rights under paragraph 1.3 and/or 1.4, the Landlord shall take all reasonable steps not to interrupt the operation of the Tenant's Works and shall make good any damage caused to the Tenant's Works in the exercise of the rights as soon as reasonably practicable and to the reasonable satisfaction of the Tenant or if the Tenant shall reasonably require the Tenant may after giving written notice to the Landlord make good the damage to the Tenant's Works caused by the exercise of the rights under paragraph 1.3 or 1.4 and the Landlord shall reimburse the Tenant for all reasonable costs and expenses incurred by the Tenant in making good the damage to the Tenant's Works;

5.2 when exercising the right under paragraph 1.3.2, the Landlord shall where it is reasonably practical to do so take reasonable steps to enable the Tenant to provide a representative in whose presence the inspection is to be carried out;

5.3 when exercising the right under paragraph 1.3.2, the Landlord shall where it is reasonably practical to do so engage for the purpose one of the contractors on the approved list of contractors from time to time supplied by the Tenant to the Landlord or (where it is not practicable to do so or no list is provided) use all reasonable endeavours to engage a contractor experienced in offshore wind farm developments for the purpose;

5.4 the Landlord shall exercise the rights under paragraph 1.3.3 in accordance with a method statement which has been approved by the Tenant (such approval not to be unreasonably withheld); and

5.5 where the rights referred to in paragraph 1.3.1 are exercised in respect of a Conduit installed pursuant to a consent under clause 4.1.1 then the terms of the consent shall apply in place of paragraph 1.2.

Schedule Part 3 - Title Matters

Part 1

The following are licences and leases granted by the Landlord where the Landlord have given undertakings to obtain the consent of the licensee/tenant specified below or where agreement with an existing tenant or licensee (in a form reasonably acceptable to the Landlord (acting reasonably) is required to allow co-location of uses or rights (each such consent being a Necessary Consent for the purpose of this Agreement):

Date	Tenant/Licensee	Works

Part 2

The following are licences and leases granted by the Landlord where no consent need be obtained from the licensee/tenants specified below before the Specified Works are carried out in the vicinity of the works specified below:

Date	Tenant/Licensee	Works

Part 3

The following are works that are not authorised by the Landlord to the extent that they lie outside the Territorial Limit of the United Kingdom but of which the Landlord are aware and in respect of which consent from the owners and/or operators of such works may need to be obtained:

[ ]

Schedule Part 4 - Rent

1 **Definitions and Interpretation**

In this part of the Schedule:

Contract for Difference means a Contract for Difference which is entered into pursuant to a direction made by the Secretary of State under Section 10 of the Energy Act 2013 (or any replacement support scheme which may be receivable by the Tenant);

Fee means the sum of £1.07 (Indexed on the Commencement Date and each anniversary of that date thereafter);

Forecasted Output means the anticipated Output in megawatt hours of electricity that may be generated by the Tenant's Works in each Forecast Year (or part thereof);

Forecast Year means each year of the Term commencing on 1 April

Generation Certificate means a certificate signed by a duly authorised officer of the Tenant addressed to the Landlord certifying for the relevant Generation Period:

1. the Output; and

2. the Output Rent payable

Generation Date means the date on which the Tenant's Works or any part of them first commence to generate and export electricity;

Generation Period means a period of 3 months commencing on (and including) 1 January, 1 April, 1 July and 1 October in each year provided that:

1. the first Generation Period shall be the period commencing on (and including) the Generation Date up to following first following 1 January,1 April, 1 July or 1 October; and

2. the last Generation Period shall be the period commencing on (and including) the last 1 January, 1 April, 1 July or 1 October during the Term up to the Termination of the Term;

Minimum Output means (subject to paragraph 4 [●] [***Note: this will be seventy per cent (70%) of the annual Projected Output fixed under clause [8.5 and 8.6] of the Option Agreement***] megawatt hours as revised from time to time under paragraph 4;

Output means the greater of:

1. either the amount in megawatt hours of Loss Adjusted Metered Output (as reported by Elexon) generated by the Tenant's Works during the relevant Generation Period or, where there is no Contract for Difference receivable by the Tenant in respect of the Tenant's Works, the amount of Net Electrical Output during the relevant Generation Period; and

2. twenty-five per cent (25%) of the Minimum Output;

Net Electrical Output means the amount in megawatt hours of electricity generated by the Tenant's Works during the relevant Generation Period less the amount in megawatt hours of electricity generated by the Tenant's Works but used by the Tenant in the operation of the Tenant's Works;

Output Rent means, for each Generation Period the sum calculated by the formula:

R = Fee x Output

Output Rent Commencement Date means the date forty eight (48) months after the Commencement Date

Payment Date means (subject to paragraphs 2.3 and [*link to review if reviewed*]) the date fourteen (14) days after the end of each Generation Period;

Records means all meter readings and other documents and records (including computer tapes discs and other storage systems) which are or ought in the reasonable opinion of the Landlord to be kept by the Tenant or its predecessors in title for the purpose of ascertaining the Output or that are or may in the reasonable opinion of the Landlord be relevant for that purpose;

Review Date means the date of the end of the Generation Period in which the thirtieth (30th) anniversary of the Commencement Date occurs

2 Output Rent

The Output Rent shall be ascertained and paid as provided in this paragraph 2;

2.1 From the Commencement Date, the Tenant shall pay to the Landlord rent in the sum of £1 per annum (if demanded).

2.2 From the earlier of (i) the Generation Date and (ii) the Output Rent Commencement Date up to (but excluding) the Review Date, the Tenant shall pay the Output Rent for each Generation Period in arrears on the Payment Date immediately following the relevant Generation Period.

2.3 The following provisions apply to the calculation and payment of the Output Rent for the last Generation Period (whether at expiry or earlier termination of this Lease or the Landlord electing to review the rent in accordance with paragraph 7):

2.3.1 where the first and/or last Generation Periods are not a period of three months (3), the Minimum Output shall be the figure which bears the same proportion to the figure stated in the definition of Minimum Output above (as revised from time to time under paragraph 4) as the number of days in the first and/or last Generation Periods (as the case may be) bears to 91.25; and

2.3.2 for the last Generation Period (where it is not a period of three (3) months), the Payment Date shall be the last day of that Generation Period.

3 **Certificates and Records of Output**

3.1 The Tenant shall notify the Landlord immediately that the Generation Date has occurred and provide such evidence as the Landlord may reasonably require to prove that it occurred on the date so notified.

3.2 On or before each Payment Date the Tenant shall deliver to the Landlord a Generation Certificate for the Generation Period which has just ended.

3.3 The Tenant warrants to the Landlord that each Generation Certificate will be true and accurate in all respects.

3.4 The Tenant shall maintain the Records fully and accurately throughout the Term and shall make them available for inspection at all reasonable times by an employee of the Landlord.

3.5 The Landlord may at its discretion cause an audit of the Records to be made by a professionally qualified person appointed by the Landlord and if it is established by such

audit that the Output for any Generation Period or the Gross Revenue for any Period has been understated then the cost of the audit shall be borne by the Tenant.

3.6 If it shall appear from any such inspection or audit or from any other circumstances that any further Output Rent for a Generation Period (or the Revenue Rent if applicable in terms of paragraph 7 below) for any Period is payable then such Output Rent shall be paid by the Tenant on demand and for the purpose of clause 3.1.3 of the foregoing Lease, such further Output Rent (or Revenue Rent if applicable) shall be deemed to have been due on the Payment Date (or Revenue Rent Payment Date if applicable) immediately following the Generation Period for which such further Output Rent (or Period for which such further Revenue Rent if applicable) should have been paid.

3.7 If any dispute or question shall arise between the Landlord and the Tenant with respect to the amount of the Output Rent (or Revenue Rent), either of them may by notice to the other require the matter in dispute to be determined by an independent chartered accountant acting as an expert as provided in clause 10.2 and who shall be nominated by the Landlord and approved by the Tenant (such approval not to be unreasonably withheld) or in default of agreement be nominated by the President of the Institute of Chartered Accountants of Scotland or other acting chief officer for the time being on the application of either the Landlord or the Tenant

4 **Increase in Minimum Output**

4.1 If and each time the Tenant carries out any alterations or additions to the Tenant's Works the Minimum Output shall be revised in accordance with this paragraph 4.

4.2 The Minimum Output figure used in calculating the Rent for each Generation Period commencing after the carrying out of the alteration or addition shall be the Minimum Output figure applying immediately prior to the carrying out of those alterations or additions or (if greater) seventy per cent (70%) of the anticipated annual electricity production of the Tenant's Works following the carrying out of the alteration or addition expressed in megawatt hours.

4.3 The Tenant shall provide to the Landlord such evidence and analysis of that evidence of the anticipated annual electricity production of the Tenant's Works following the carrying out of the alterations or additions to the Tenant's Works as the Landlord reasonably requires.

4.4 Any difference arising between the Landlord and the Tenant as to the anticipated annual electricity production of the Tenant's Works following the carrying out of the alterations or additions may be referred by either the Landlord or the Tenant on notice to the other for determination by an independent electrical engineer acting as an expert as provided in clause 10.2 and who shall be nominated by the Landlord and approved by the Tenant (such approval not to be unreasonably withheld) or in default of agreement be nominated by the President of the Institute of Engineering and Technology or other acting chief officer for the time being on the application of either the Landlord or the Tenant.

4.5 This paragraph 4 does not apply to any removal of the Tenant's Works or part of them required pursuant to clause 3.16.

5 **Late Ascertainment of Output Rent (or Revenue Rent if applicable)**

Where the Output Rent or Revenue Rent applicable to any Generation Period or Period (as applicable) is not ascertained before the relevant Payment Date or Revenue Rent Payment Date (as applicable), interest shall be paid on any Output Rent or Revenue Rent Payment Date (as applicable) payable in accordance with clause 3.1.3 of the foregoing Lease from the due date until actual receipt by the Landlord.

6 **Forecasted Output**

6.1 At least eighteen (18) months prior to the date on which, in the Tenant's reasonable opinion the Generation Date will fall, the Tenant shall provide to the Landlord a written estimate of the Forecasted Output calculated on a month to month basis for the period commencing on the anticipated Generation Date to the following 31 March;

6.2 On or prior to 1 August in every year throughout the Term commencing in the year the Generation Date is forecasted to occur in terms of paragraph 6.1, the Tenant shall provide to the Landlord a written estimate of the Forecasted Output calculated on a month to month basis for the immediately following Forecast Year (or part thereof in the final year of the Lease if applicable).

7 **Rent Review**

7.1 In this paragraph 7:

Base Rent means the average of the Output Rent payable by the Tenant in the 5 calendar years immediately preceding the Review Date (apportioned on an annual/daily basis if necessary for any such year) as agreed between the Landlord and the Tenant or in the event of dispute with respect to the calculation of the Base Rent either of them may by notice to the other require the matter to be determined by an independent chartered accountant acting as an expert as provided in clause 10.2 and who shall be nominated by the Landlord and approved by the Tenant (such approval not to be unreasonably withheld) or in default of agreement be nominated by the President of the Institute of Chartered Accountants of Scotland or other acting chief officer for the time being on the application of either the Landlord or the Tenant

Base Rent Commencement Date means in the event of the Landlord electing to review the Rent in accordance with this paragraph 7, the Review Date;

Base Rent Payment Dates means [ ], [ ], [ ] and [ ] [*insert dates every 3 months starting on the Review Date*] commencing on the Base Rent Commencement Date;

Certificate means, in relation to each Period, a certificate of Gross Revenue for that Period;

Gross Revenue means the gross income received or receivable by Tenant during the relevant Period for the electricity generated by the Tenant's Works and/or at the Site including but not limited to income received from (i) a Contract for Difference or any replacement support scheme which is received by the Tenant in respect of the Tenant's Works from time to time and/or (ii) the sale of electricity, (less any sum which the Tenant is obliged to pay to (a) the relevant counterparty under a Contract for Difference or (b) any other party under any replacement support scheme which is received by the Tenant in respect of the Tenant's Works from time to time) (iii) in the event of cessation of or constraint on the generation of electricity by the Tenant's Works (either partial or complete) as a direct consequence of the Tenant complying with a request made by National Grid Electricity Transmission plc or their successors ("NGET") to cease or constrain the generation of electricity by the Wind Farm in accordance with NGET's or their foresaids' role in procuring balancing services or equivalent replacement or similar

scheme that provides income to the Tenant, any income received by the Tenant to the extent directly attributable to the cessation or constraint on the generation of electricity by the Tenant's Works as a result of such request by NGET or their foresaids less (a) any VAT and (b) the cost of any electricity imported to the Tenant's Works and (iv) the storage of electricity at the Site;

Gross Revenue Certificate means a certificate prepared by the Tenant or auditors of the Tenant and furnished by the Tenant to the Landlord specifying the amount of and giving all relevant details of the Gross Revenue and the Revenue Rent payable in respect of the relevant Period which certificate shall contain all reasonably necessary information as the Landlord and his professional advisors may reasonably require to enable the Landlord to cross check and calculate the Gross Revenue and the Revenue Rent payable and how same has been attained and calculated;

Period means each year of this Lease, starting on the Base Rent Commencement Date, except that the last Period shall start on the relevant anniversary of the Rent Commencement Date and end on the last day of this Lease;

Revenue Rent means, for each Period, the greater of (i) £1 and (ii) two per cent (2%) of the Gross Revenue for the relevant Period, less the Base Rent paid for that Period;

Revenue Rent Payment Date means the date [20] Working Days after the end of each Period;

Records means all documents and records (including computer tapes discs and other storage systems) which are or ought in the reasonable opinion of the Landlord to be kept by the Tenant or its predecessors in title for the purpose of ascertaining the Gross Revenue or that are or may in the reasonable opinion of the Landlord be relevant for that purpose.

7.2 At least six (6) months prior to the Review Date the Tenant shall provide to the Landlord a statement setting out the Tenant's projection of the Revenue Rent ("Revenue Rent Statement") containing such information as is reasonably required by the Landlord to allow the Landlord to reach a decision as to whether to continue to receive the Output Rent or to change to the Revenue Rent. The Tenant shall act reasonably and diligently in preparing such Revenue Rent Statement.

7.3 Within three (3) months of the Review Date (or if later within three months of receipt by the Landlord of the Revenue Rent Statement) the Landlord shall give written notice to the Tenant as to whether it elects to receive the Output Rent or the Revenue Rent in respect of the period from the Review Date for the remainder of the Term. In the event that the Landlord does not give written notice to the Tenant as aforesaid, provided that the Tenant has provided the Revenue Rent Statement timeously, the Landlord shall be deemed to have elected to continue to receive the Output Rent for the remainder of the Term.

7.4 If the Landlord has elected (or is deemed to have elected) to receive the Revenue Rent from the Review Date then the Tenant shall pay the Base Rent quarterly in advance in equal instalments on the Base Rent Payment Dates commencing on the Base Rent Commencement Date.

7.5 Within twenty (20) Working Days of the end of each Period the Tenant shall provide a Gross Revenue Certificate to the Landlord and if the Revenue Rent for the relevant Period exceeded the Base Rent then the Tenant shall pay to the Landlord a sum which represents the amount by which the Revenue Rent exceeded the Base Rent for relevant Period within forty (40) Working Days of the end of the relevant Period. Any payments received or receivable by the Tenant following termination of the Lease will be treated as having been received in the last year of the Lease and the Tenant shall account to the Landlord for any additional Revenue Rent arising as a result of such payments.

7.6 The Tenant warrants to the Landlord that each Gross Revenue Certificate will be true and accurate in all respects.

8 **Miscellaneous**

8.1 Time shall not be of the essence for the purposes of this Part of the Schedule unless otherwise expressly stated.

8.2 The provisions of this Part of the Schedule shall continue to apply notwithstanding the expiry or earlier termination of the Lease

8.3 All figures stated in this Part of the Schedule are exclusive of VAT which shall, if appropriate, be payable in addition thereto in exchange for a valid VAT invoice.

Schedule Part 5 - Determination and Review of Estimated Maximum Losses

2 Initial Estimated Maximum Losses under this Lease

(a) Within fourteen (14) days of the Commencement Date the Tenant shall appoint an EML Consultant to perform an EML Study in order to derive the Estimated Maximum Loss and the Terrorism Estimated Maximum Loss. The Tenant shall deliver the completed EML Study to the Landlord.

(b) The appointment of an EML Consultant and any EML Study delivered by the EML Consultant will not discharge the Tenant's obligations under paragraph 1(a) unless the identity of the EML Consultant and his terms of appointment have been approved by the Landlord (such approval not to be unreasonably withheld).

(c) In performing the EML Study the EML Consultant shall be required to:

(i) act impartially;

(ii) have due regard to the Tenant's Works and the location of the Tenant's Works;

(iii) use the "as low as reasonably practicable principle";

(iv) have due regard to "Sue and Labour", "Removal of Wreck" and "Vessel Costs"; and

(v) include all ancillary costs, professional fees and VAT.

(d) The Estimated Maximum Loss and Terrorism Estimated Maximum Loss as derived from an EML Study shall be final and binding upon the Tenant and the Landlord save in the case of manifest error or fraud.

(e) The cost of appointing the EML Consultant under this paragraph 2 shall be borne solely by the Tenant.

(f) Following a determination under this paragraph 2, the Estimated Maximum Loss and Terrorism Estimated Maximum Loss for the purposes of clause 3.13.1(a) shall be the amount so determined by the EML Consultant.

3 Reviewing the Estimated Maximum Losses

(a) On one occasion during each five (5) year period during the Term, either party may by notice to the other propose that an EML Consultant is appointed to perform a further EML Study to assess the Estimated Maximum Loss and Terrorism Estimated Maximum Loss at that time.

(b) Any notice under paragraph 2(a) shall propose the identity of the EMC Consultant and the terms of appointment of the EMC Consultant.

(c) Within thirty (30) days of such request (save where there is a dispute concerning the identity and/or terms of the appointment), the Tenant shall appoint the EML Consultant to perform a further EML Study. In performing that EML Study the EML Consultant shall be required to act in the same manner as that set out in paragraph 1(c)(i) to paragraph 1(c)(v) (inclusive).

(d) The Estimated Maximum Loss and Terrorism Estimated Maximum Loss as derived from that EML Study shall be final and binding on the Landlord and the Tenant, save in the case of manifest error or fraud.

(e) The cost of appointing the EML Consultant shall be borne by the Party which requested that the EML Study be performed.

(f) Following a determination under this paragraph 2, the Estimated Maximum Loss and Terrorism Estimated Maximum Loss for the purposes of 3.13.1(a) shall be adjusted to the amount so determined by the EML Consultant.

Schedule Part 6 - Form of HSI Notification

Details of business or undertaking notifying the incident

Legal name of business:		
Name of site:		
Business address:		
Contact phone number:	**Work hours:**	**Mobile:**
Business email address:		

Incident details

Incident type

This is to notify of :	☐	**Serious Incident**	☐ **Non-fatal RIDDOR Reportable Incident**

Provide a brief explanation of the type of incident (i.e. fall from height, vessel collision):

Incident date, time and location

Date of incident:	**Location of incident:**
Time of incident:	

Description of the incident Please provide as much detail as possible

Do you propose to release a press/public statement in connection with the incident?
☐ **Yes** ☐ **No**

Notifier's details

☐ **Mr**	☐ **Mrs**	☐ **Miss**	☐ **Ms**	**First Name:**	**Last Name:**

Position at workplace:		**Contact phone number:**	
Email:			

Is this the person that should be contacted for further information?
☐ **Yes** ☐ **No If no, please provide the name and contact details of the appropriate person should further information be required**

☐ **Mr**	☐ **Mrs**	☐ **Miss**	☐ **Ms**	**First Name:**	**Last Name:**

Position:		**Contact phone number:**	

Schedule Part 7 - Break Fee Worked Example

We set out below two worked examples of how a payment will be calculated following the service of a break notice under a lease and in accordance with the following formula:

Any Break Fee under this Lease shall be calculated in accordance with the following formula:

BF = (5 - N) x Minimum Rent

Where:

BF, N and **Minimum Rent** have the definitions given to them in Clause 6.

Examples:

1. If five (5) years notice is served then the break fee will be nil because:

BF = (5-5) x Minimum Rent

BF = 0 x Minimum Rent

2. If less than five (5) years notice is given, then a break fee will apply:

Assuming Minimum Rent (on an annual basis) at the point the Break Notice is served is £2,000,000 then, applying a five per cent (5%) discount rate yields the following Break Fees:

Notice Period (Years)	Break Fee (NPV)	Comment
5	£0	See 1. above.
4	£1,904,762	5-4 = 1 years Minimum Rent, discounted at 5% p.a.
3	£3,718,821	5-3 = 2 years Minimum Rent, discounted at 5% p.a.
2	£5,446,496	5-2 = 3 years Minimum Rent, discounted at 5% p.a.
1	£7,091,901	5-1 = 4 years Minimum Rent, discounted at 5% p.a.
0	£8,658,953	5-0 = 5 years Minimum Rent, discounted at 5% p.a.

Schedule Part 8 - Plan

Schedule Part 9 - Co-ordinates

Schedule Part 10 - Specification

Schedule Part 11 - Contracted Position Statement

Schedule Part 12 - Statement of Commitment

Dear Sirs

Statement of Commitments re: [ ] ("**the Development**")

We,
[•] [name, company no. (if applicable) and registered office of organisation] refer to the abovementioned Development and now confirm the following to Crown Estate Scotland:

1. We are aware of, and are willing to participate in the Development which is the subject of this letter. A brief summary of our proposed involvement in the Development is [•];

2. Insofar as information provided in this letter relates to this organisation, we are aware that Crown Estate Scotland are acting in reliance on this information in assessing whether or not to consent to our proposed involvement and confirm that it is comprehensive, accurate and up to date; and

3. The acceptance of our involvement in this Development does not present a reputational risk to Crown Estate Scotland in that neither this company/organisation nor any office holder or person with powers of representation, decision or control within this company/organisation have been convicted of any of the types of unlawful conduct described in full in Appendix 1 to this letter. If at any time this company/organisation or any office holder or person with powers of representation, decision or control within this company/organisation is convicted of an offence under replacement/amendment legislation to that listed in Appendix 1, we understand that this requires to be disclosed to Crown Estate Scotland;

Yours faithfully,

Signed for and on behalf of [•] [name of company/organisation] by:

Please formally sign for and on behalf of your organisation here and provide full details of signature to confirm how your company/organisation is bound by this letter as shown at Appendix 1.

Template Letter Appendix 1 – Reputational confirmation

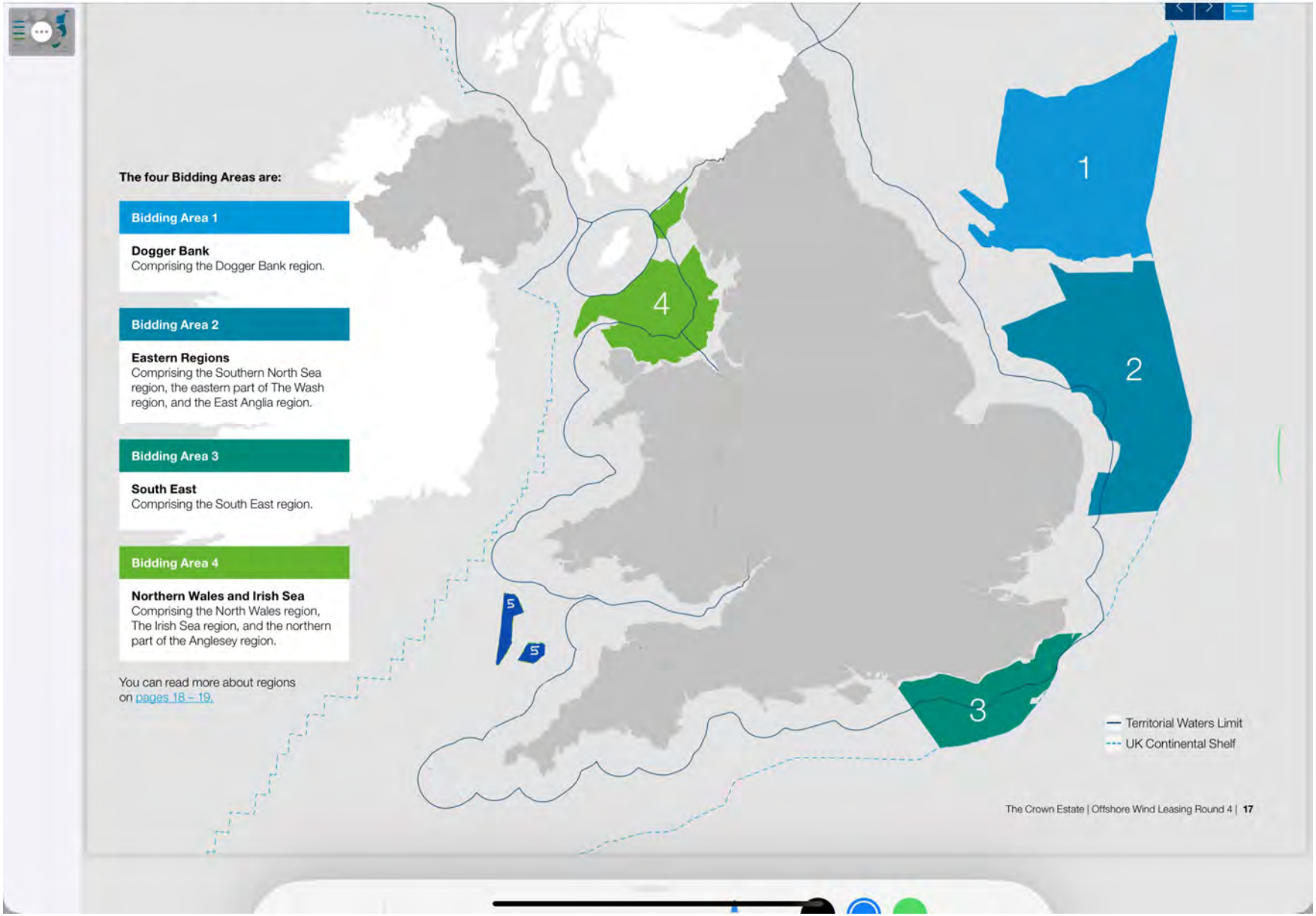
i) Conspiracy relating to participation in a criminal organisation or an offence relating to involvement in/directing serious organised crime (Criminal Justice and Licensing (Scotland) Act 2010);
ii) Corruption (within the meaning of the Public Bodies Corrupt Practices Act 1889 or the Prevention of Corruption Act 1906)
iii) Bribery or corruption (within the meaning of the Criminal Justice (Scotland) Act 2003)
iv) Bribery (within the meaning of the Bribery Act 2010)
v) Cheating the Revenue
vi) Common law fraud
vii) Common law theft/ fraud
viii) Fraudulent trading (within the meaning of the Companies Acts 1985/ 2006)
ix) Fraudulent evasion (within the meaning of the Customs and Excise Management Act 1979 or the VAT Act 1994)
x) Offence re: taxation (Criminal Justice Act 1993)
xi) Common law uttering (Scots law term for fraud)
xii) Common law attempting to pervert the course of justice
xiii) Offences under Counter-Terrorism Act 2008

xiv) Money laundering (within the meaning of the Proceeds of Crime Act 2002)
xv) Proceeds of criminal conduct (within the meaning of the Criminal Justice Act 1988)
xvi) Human trafficking (Human Trafficking and Exploitation (Scotland) Act 2015)
xvii) Proceeds of drug trafficking (Drug Trafficking Act 1994)

Any other offence that is set out as an exclusion ground in the Directive 2014/24/EU of the European Parliament and of the Council on public procurement or any subsequent legislation which replaces that.

ANNEX 3

Crown Estate Bidding and Project Areas for Round 4 and Bidding Areas for Round 5



The four Bidding Areas are:

Bidding Area 1

Dogger Bank
Comprising the Dogger Bank region.

Bidding Area 2

Eastern Regions
Comprising the Southern North Sea region, the eastern part of The Wash region, and the East Anglia region.

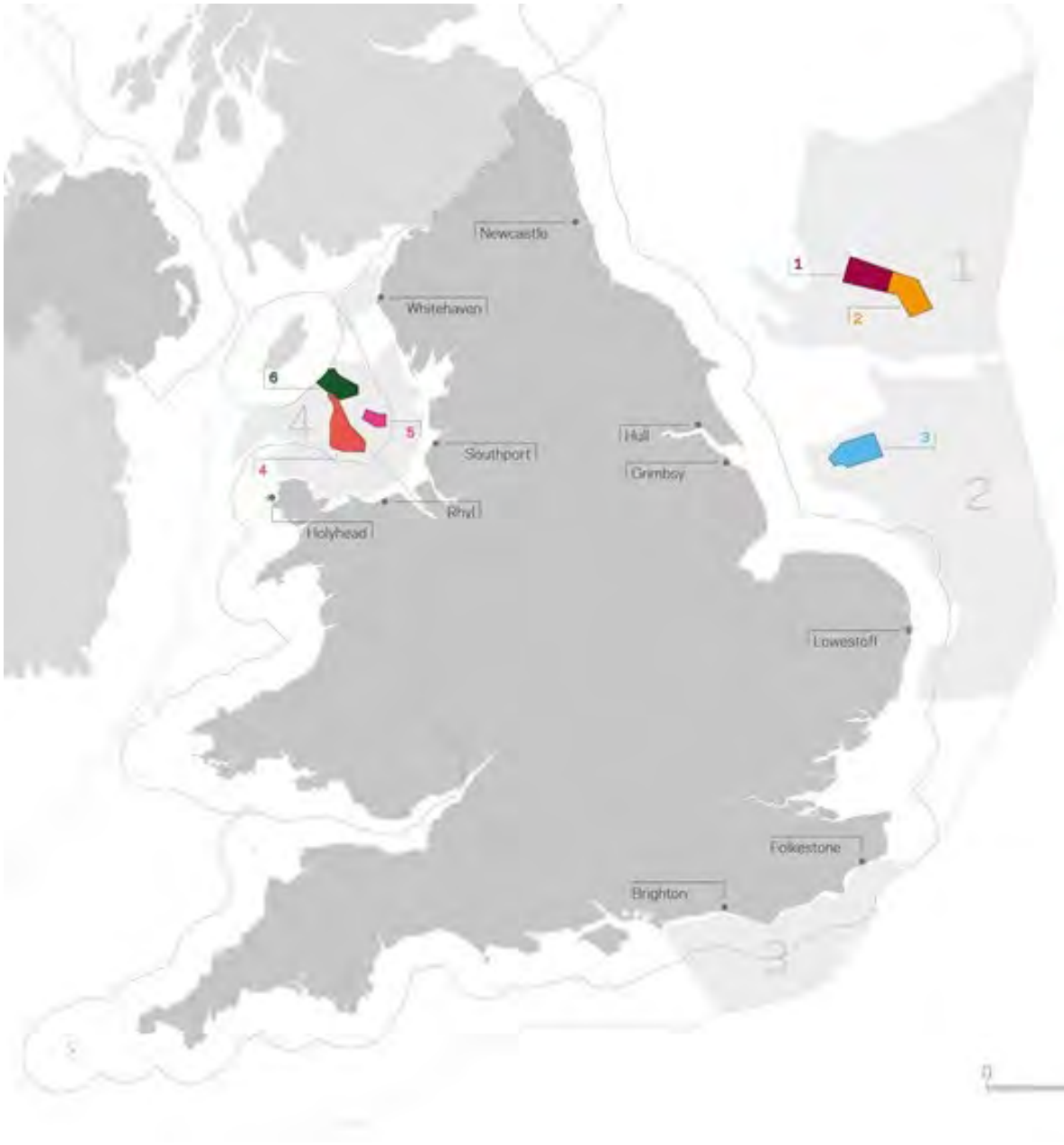
Bidding Area 3

South East
Comprising the South East region.

Bidding Area 4

Northern Wales and Irish Sea
Comprising the North Wales region, The Irish Sea region, and the northern part of the Anglesey region.

You can read more about regions on pages 18 – 19.



Offshore Wind Leasing Round 4

THE CROWN ESTATE

Offshore Wind Leasing Round 4 projects

1. Dogger Bank South (West) - RWE Renewables
1500 MW capacity
2. Dogger Bank South (East) - RWE Renewables
1500 MW capacity
3. Outer Dowsing - TotalEnergies and Corio Generation, a portfolio company of the Green Investment Group
1500 MW capacity
4. Mona - Consortium of EnBW and BP
1500 MW capacity
5. Morecambe - Morecambe Offshore Windfarm Ltd, a joint venture between Cobra Instalaciones y Servicios, S.A. (Cobra) and Flotation Energy Ltd.
480 MW capacity
6. Morgan - Consortium of EnBW and BP
1500 MW capacity

The four seabed Bidding Areas

- Dogger Bank
- South East
- Eastern Regions
- Northern Wales & Irish Sea

Territorial Waters Limit — UK Continental Shelf

0 100 200 300 400

kilometres

ANNEX 4

Aquaculture & Blue Growth The Crown Estate Perspective, November 2023

Aquaculture & Blue Growth The Crown Estate Perspective

Aquaculture for a Thriving Future

November 2023

THE CROWN ESTATE

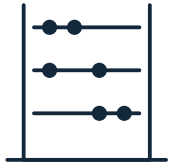
THE CROWN ESTATE

Dating back more than 260 years, The Crown Estate is a unique business with a diverse portfolio that stretches across the country

THE CROWN ESTATE

Established by The Crown Estate Act of 1961

As an independent commercial business with accountability to Parliament.



Return our net revenue profit to the Treasury

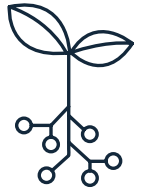
>£3bn generated in the last 10 years for public spending

Active owners and managers of land and seabed

We seek to leverage our scale and convening power to make a meaningful difference.

With a new purpose

To create lasting and shared prosperity for the nation



And an ambitious approach

Guided by our purpose and informed by major trends impacting our business, we seek to create broad financial, environmental and social value for our stakeholders, customers and the nation.

About TCE Marine: As custodian of the marine environment TCE leads the sustainable development of the seabed to deliver value for the nation

OUR PAN-SECTORAL VIEW

Energy
Offshore wind
Energy conversion
Marine energy

Storage
CCUS
Hydrogen
Natural gas

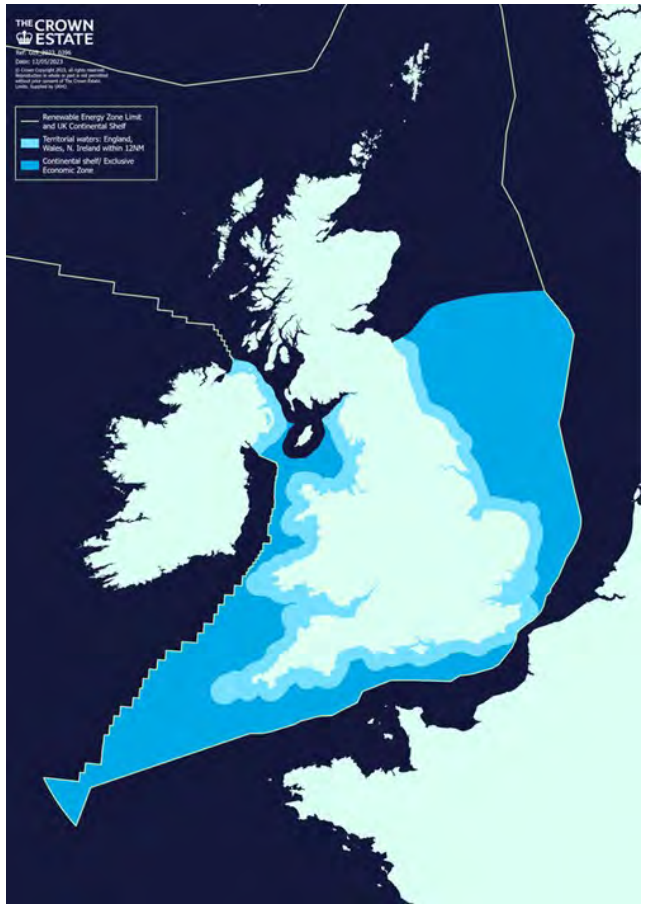
Infrastructure
Power & Telco Cables
Pipelines

Minerals
Reclamation
Aggregate dredging
Marine mining

Coastal
Ports and harbours
Aquaculture
Leisure

Habitats
Habitat creation
Biodiversity
Nature recovery

OUR OFFSHORE AND ONSHORE FOOTPRINT



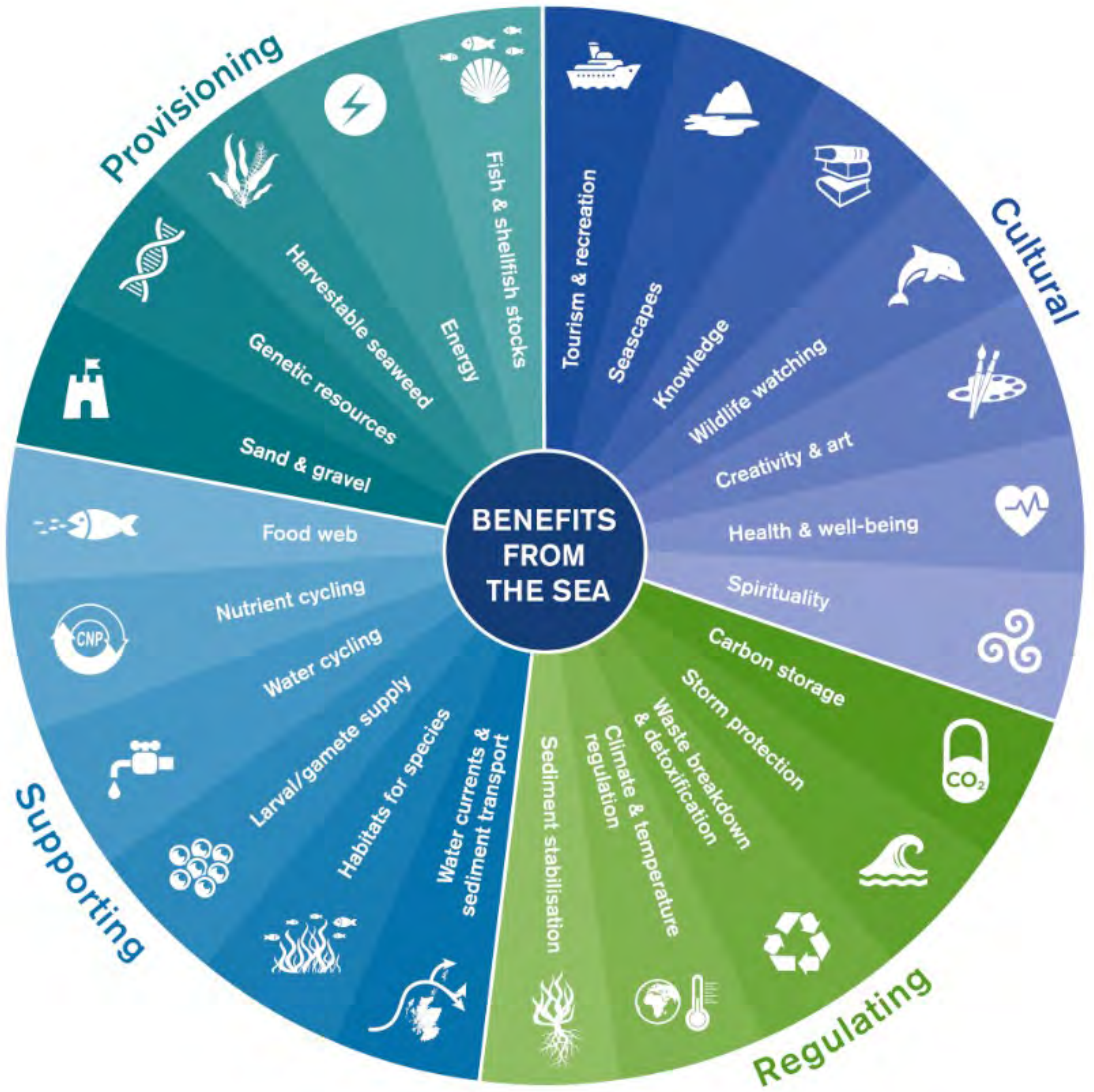
OUR CAPABILITIES

- ✓ Our deep **expertise and experience** (incl. multi-sector knowledge, data & spatial insight)
- ✓ Our **ability to look across sectors** (e.g. energy, minerals, nature) balancing competing and complementary demands
- ✓ Requirement and purpose to **deliver greatest value for the nation**
- ✓ **Statutory independence** and our ability to take an objective **long-term view**
- ✓ Our **power to convene** and partner with others to bring the marine vision to life

NB. TCE has complete control over activities in territorial waters. TCE has purpose-limited rights covering the continental shelf, these permit the management of certain activities but TCE's control is not exhaustive.

Valuing our Natural Assets

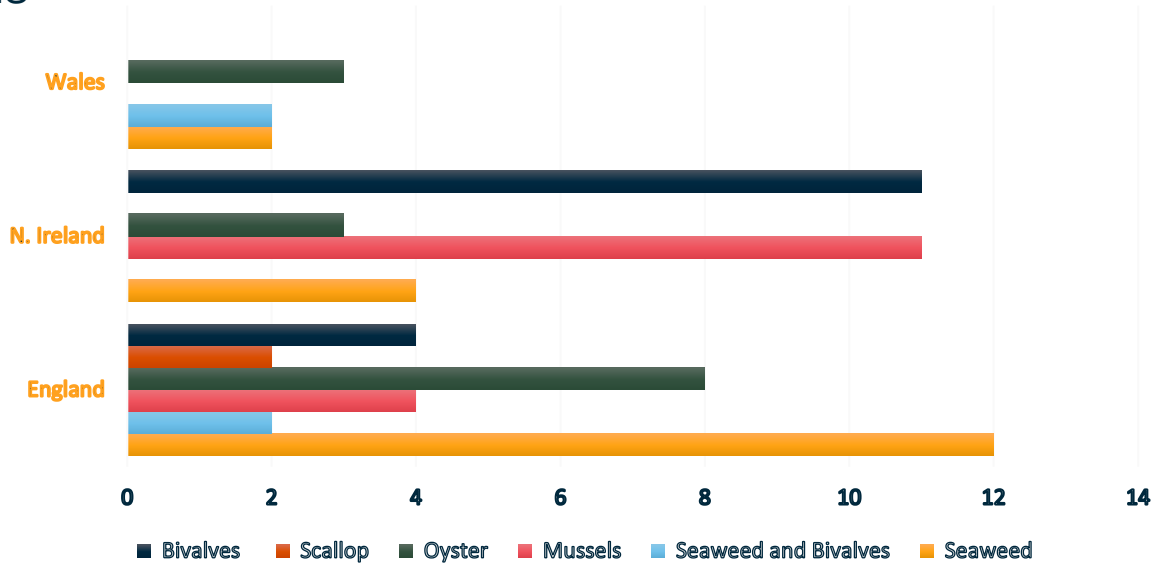
- Work is underway (by ourselves and others) to map and assess the natural capital value of the different areas of The Crown Estate seabed and foreshore
- Huge variety of habitat types delivering associated ecosystem services
- Linked to separate work on understanding Whole Life Carbon and other social and environmental impacts associated with marine sectors
- Supporting the definition and scope of a roadmap to guide a whole-systems approach to sustainable marine management, including delivery of the nation's net zero and nature recovery goals
- Underpinned by robust and trusted data and evidence to improve strategic decision making
- Creating better balance for competing demands on the seabed and space for blue growth



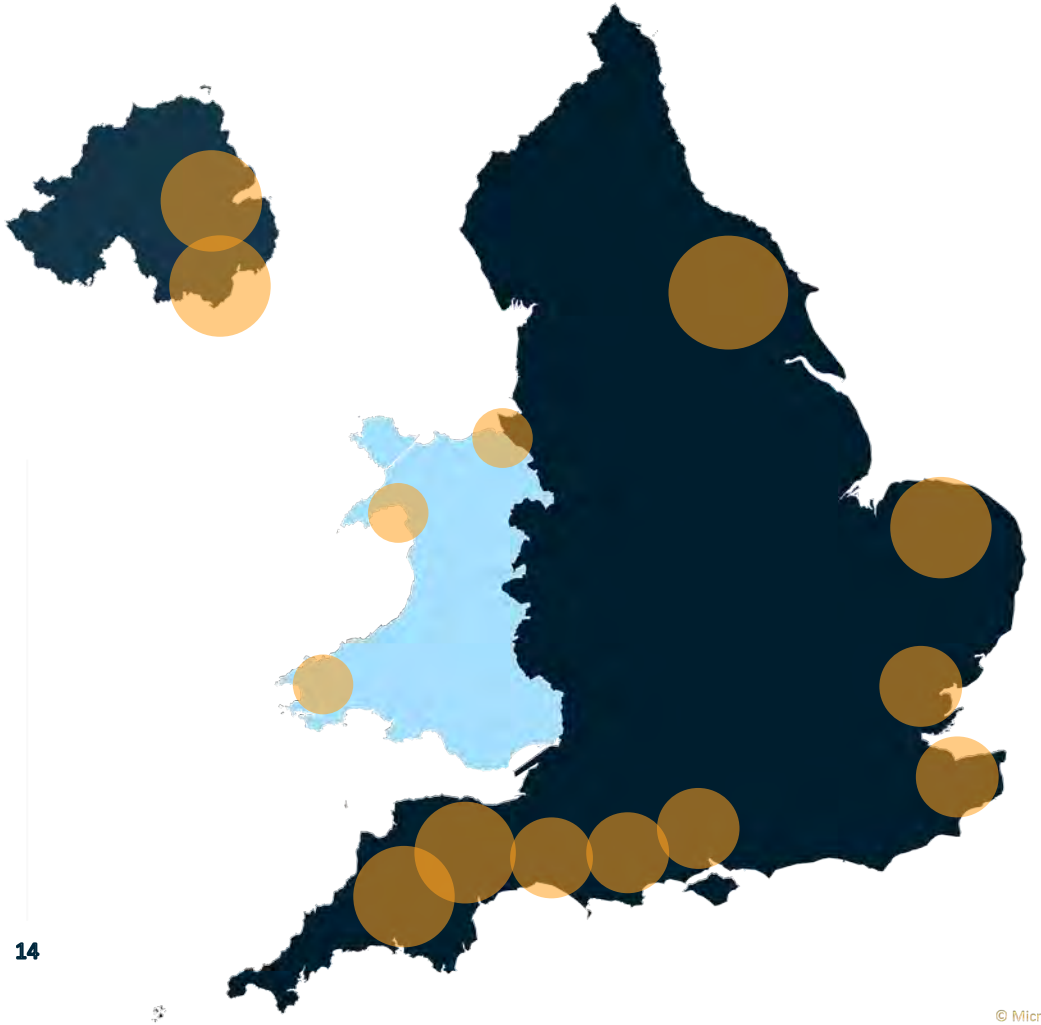
Source: Nature Scot

Aquaculture Activity Update

- Aquaculture activity in England, Northern Ireland and Wales has been on a steady growth trajectory for some years.
- The majority of projects are located in near/inshore waters around England; loughs in Northern Ireland and growing number around the coast of Wales
- Growing interest in deeper water/offshore options



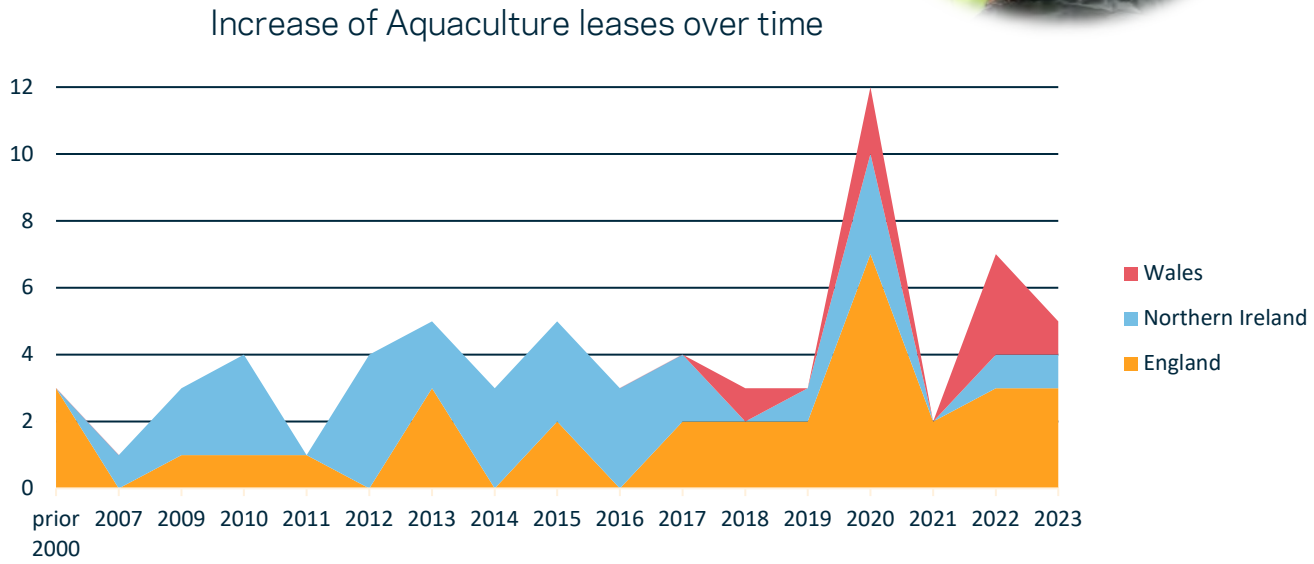
Current Aquaculture leases (seaweed, shellfish, multi-tropic) in England, Northern Ireland and Wales



Aquaculture Activity Update

- Mix of shellfish and seaweed aquaculture – no finfish operations
- Increasing enquiries and applications for seabed access for aquaculture activities – growing demand from industry
- High interest in seaweed – range of approaches
- Changing nature of activities –looking towards multi trophic aquaculture, blending in ecosystems services revenue potential and natural capital market opportunities

Expanding and diversifying sector, delivering multi-value outcomes



Challenges & Opportunities

Growing recognition of biodiversity benefits associated with aquaculture activity

Increasing interest in avoided emission opportunities linked to product alternatives

Diversification of sector attracting new entrants–bringing innovation, investment and job opportunities

Renewed focus on co-location and co-existence opportunities –both within and between sector activities

Empirical evidence quantifying ecosystem service benefits currently limited –along with standardized approach to data capture

Many products still in 'test and development' phase, yet to scale – associated supply chain limitations and clear offtake markets

Skills and capacity limitations across all areas. Need to develop training pipeline of and highlight transitional opportunities

Marine space increasingly constrained – demands on seabed continue to grow. Competing priorities in a finite space.

Unlocking Potential For Blue Growth

- TCE is working to help address barriers and accelerate progress
- Understanding what can be achieved where – and what this looks like within the context of other maritime activities
- Building data and evidence to understand how best to accelerate progress, adapt approaches and monitor outcomes
- Addressing barriers to growth – mapping, skills, finance, supply chain, etc.
- Evolving TCE policy to prioritise the right activities in the right locations, in the right way
- Creating space for 'learning through doing' and building consensus around an adaptive approach (i.e. not letting perfect be the enemy of the good)

Building data, evidence and digital tools

Develop new leasing and participation models

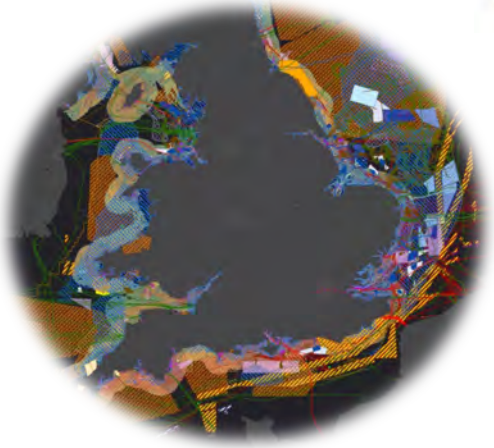
Investing to accelerate, unlock and resolve barriers

Addressing Barriers – Projects & Process

- Improving mapping to better understand key resource areas for aquaculture activity – help focus opportunities
- Supporting research to improve data around ecosystem services and environmental benefits e.g. SuMMeR CDT PhD seaweed farming and ecosystems services
- Developing new licence/lease products to support evolving/emerging sector activities e.g. trial licence, multi-revenue stream licence
- Testing new concept approaches to explore routes to market e.g. AEZ
- Engaging with policy and statutory bodies to simplify and streamline where possible

Additive.earth™

University of Exeter



Marine Biological Association

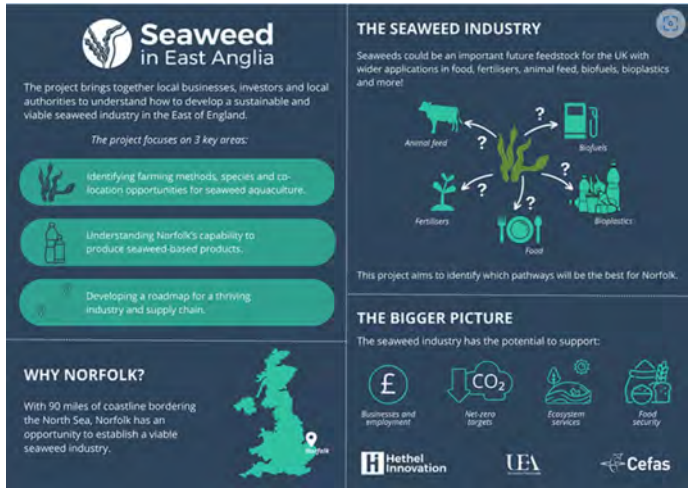
Sustainable Management of Marine Resources
SuMMeR Centre for Doctoral Training

UNIVERSITY OF PLYMOUTH

Foreshore and estuary ownership map

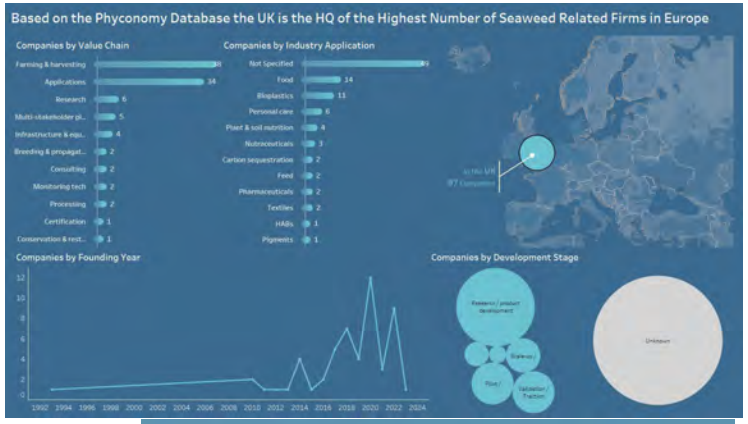
Collaboration & Partnership

- Contributing to industry led projects e.g. Seaweed in East Anglia, Sea the Value
- Co-funding WWF, Hatch, MEP study on The Future Value of Seaweed Farming in the UK
- High-Integrity Marine Natural Capital Markets Roadmap work (Finance Earth, Pollination, Blue Marine Foundation, Crown Estate Scotland, Esmée Fairburn)
- Supporting funding bids for innovative and exploratory co-location projects
- Engaging with projects linking habitat restoration supply chain opportunities to aquaculture infrastructure e.g. nursery facilities



OffshoreWind IndustryCouncil

Pathways to Growth (P2G)



SEA THE VALUE
MARINE BIODIVERSITY BENEFITS FOR A SUSTAINABLE SOCIETY

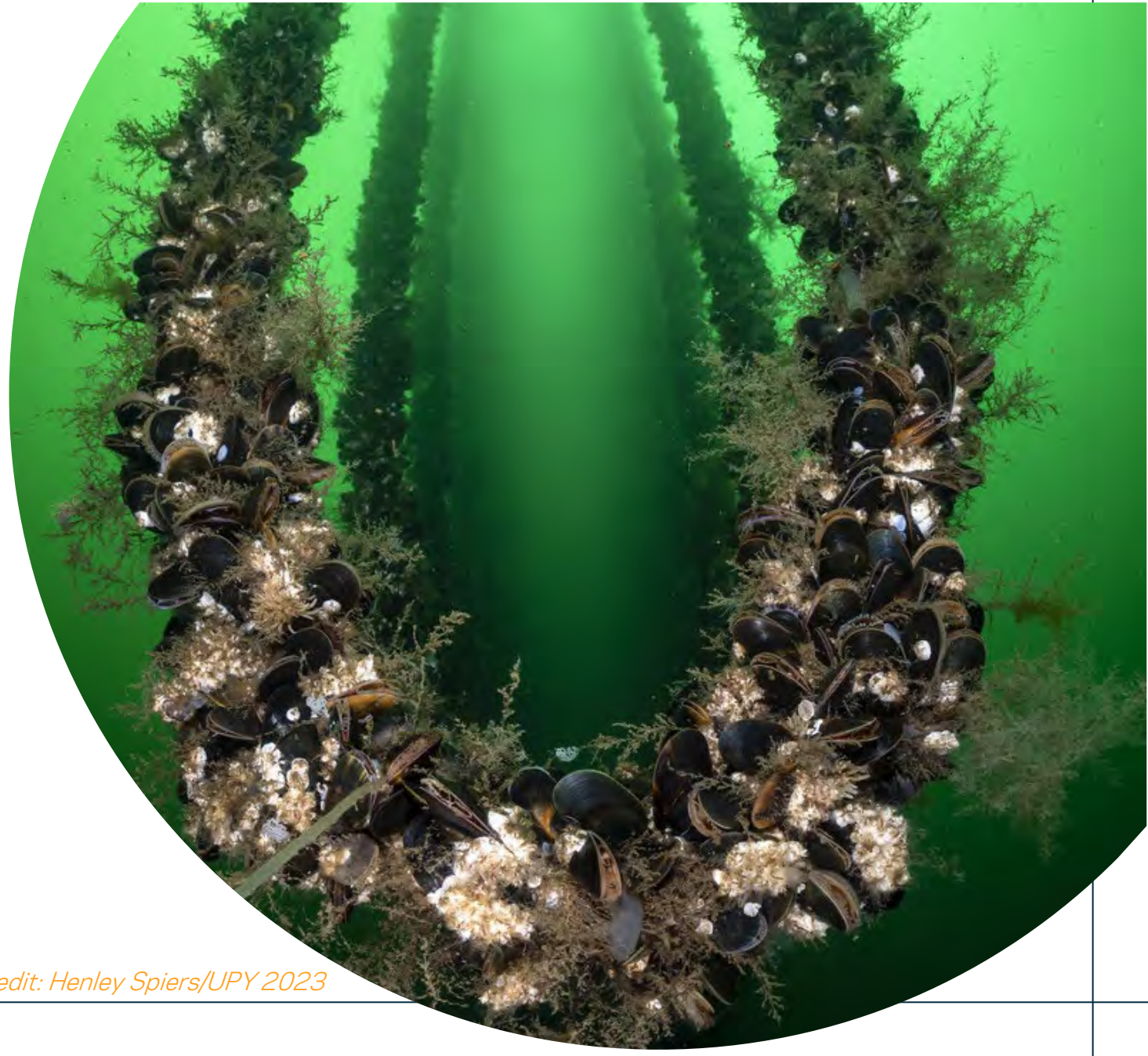
WWF

MEP MACALISTER ELLIOTT & PARTNERS LTD

HATCH Innovation Services

Next Steps - Blue Futures

- Industry engagement and representation – better data, more access and information
- Continue making space for aquaculture - TCE WoS programme & engagement with statutory marine planning process
- Further development of seabed access options
- Additional research areas
  - Skills & transitional opportunities
  - Circularity
  - Deployment infrastructure review
- Support co-location opportunities –seabed optimisation etc
- Convene, catalyse & champion!



Credit: Henley Spiers/UPY 2023

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THE CROWN ESTATE

ANNEX 5

CEFAS – A review of the potential for co-existence of different sectors in the Welsh Marine Plan Area, April 2020

Centre for Environment Fisheries & Aquaculture Science

Cefas

World Class Science for the Marine and Freshwater Environment

Welsh National Marine Plan

A review of the potential for co-existence of different sectors in the Welsh Marine Plan Area

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V8.0	EM, FM	24/02/20	Draft after AJ review
V9.0	EM, FM	02/03/20	Draft after RM review
V10.0	EM, AM, FM	25/03/20	Integrate comments WG/NRW
V11.0	EM, AM, FM, AG	03/04/20	Integrating 2 additional sectors as requested and addressing comments WG

Executive Summary

The Welsh marine environment encompasses a diversity and abundance of species, habitats and ecosystems. These natural assets provide valuable resources that are of major importance to enhance coastal populations' well-being and contribute to present and future social and economic development and prosperity. The Welsh National Marine Plan (WNMP) envisions to achieve the sustainable management of natural resources in the Welsh seas through an integrated, evidence and plan-led approach which takes into account the cumulative effects of the multiple use of the marine space (social, economic and environmental) whilst balancing different interests and ecosystem resilience. This is in order to access, enhance and sustainably use the natural resources of Wales and, in so doing, protect the future generations, whilst boosting the long-term economic and social welfare of coastal communities as also anchored in the Environment (Wales) Act 2016 and the Wellbeing of Future Generations (Wales) Act 2015.

The overall aim of this report was to enhance the evidence base regarding social and economic constraints and opportunities for the focal sectors of marine aggregates, aquaculture and energy-low carbon: wave and tidal stream energy (which can also be applied to other sectors/activities). This report has been organised around three core tasks:

1. A desk-based review of available evidence at international, UK and national (Welsh) scales, regarding social and economic constraints and opportunities for the focal sectors of strategic importance for the development of the Welsh marine area (marine aggregates, aquaculture and energy-low carbon: wave and tidal stream energy). This was followed by a desk-based review of possible co-existence opportunities and constraints between the focal sectors and other relevant maritime sectors/activities[1].

2. Production of summary tables for potential interaction in the WNMP area, within focal sectors and between focal sectors and other maritime sectors/activities. The tables have been combined with mapping of spatial overlap, and discussion about the spatial (and temporal) overlaps in relation to future planning considerations.

3. A review of policies from Plans/Frameworks at national and local levels together with legislative and policy considerations, all of which have potential relevance to the focal sectors. This task supplemented the evidence review and interaction appraisal.

The overview of the available evidence (Welsh, UK as well as international) on the potential opportunities or constraints resulting from sectoral interaction from a socio-economic angle, provided in Section 3, has been accompanied by mapping of spatial overlaps to facilitate future planning and engagement. General recommendations and recommendations based on the sector interactions have been made. These recommendations aim to inform ongoing planning

[1] The other sectors reviewed in this report include tourism and recreation (including sea angling); fisheries; ports and shipping; energy – low carbon: offshore wind; subsea cabling; and other constraining sectors e.g. military practise areas.

discussions and suitable resource areas for the planning authority to consider for future investment to support the Sustainable Management of Natural Resources (SMNR).

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1 Introduction

Over 60% of the population of Wales live and work around the coast. The total value of the economic activity within the plan area in 2015 was estimated to be over £2 billion of Gross Value Added (GVA) (Welsh Government, 2015a). The direct employment contribution, in the same year, of the maritime sectors was 31,000 jobs whilst the indirect contribution was 56,000 jobs (Welsh Government, 2015a). The positive effects of the marine environment are not limited just to the economic benefits but encompass wider social aspects, such as physical health, mental health and social well-being. Marine and coastal areas are one of the drivers of the Welsh economy and contributors of societal wellbeing (Bell et al., 2015; White et al., 2013).

Use of the marine and coastal areas have increasingly become contested over the last decades due to the increase of people living in coastal zones and the growing importance of maritime industries (e.g. low carbon energy sector) (Barragán and de Andrés, 2015; Schupp et al., 2019). The rising demand for marine and coastal zone use requires identification of priorities and objectives for the spatial and temporal use of marine and coastal environments, whose goal is to balance and coordinate competing and/or conflicting needs. Thus, marine planning is needed to both reduce the potential conflict between different users as well as assess trade-offs between environmental, social and economic impacts of activities occurring either at the same time, or within the same area (Eggenberger and Partidário, 2000; Kyvelou and Ierapetritis, 2019).

In this context, the Welsh National Marine Plan (WNMP) (Welsh Government, 2019a) - the first marine plan for Wales - represents the beginning of a planning process to support and promote the sustainable management of natural resources in Welsh inshore and offshore regions, through economic, social and ecological objectives. As part of WNMP implementation, The Welsh Government is undertaking work to develop a greater understanding of sector-specific opportunities and constraints in the context of the Resource Areas (RA)[2], including environmental, social and economic considerations.

This project contributes to the understanding of socio-economic considerations with respect to three focal sectors (1) Marine aggregates; (2) Aquaculture; and, (3) Energy – Low Carbon: Tidal stream and Wave energy. Evidence has been collected using literature applicable to Wales, UK and internationally. The evidence base feeds into a systematic appraisal of likely spatial interaction between the WNMP focal sectors and other sectors/activities mentioned in the WNMP i.e. Tourism and Recreation (including recreational sea angling); Fisheries; Ports and Shipping; Energy – Low Carbon: offshore wind and tidal range energy; Subsea Cabling; and, other potentially constraining sectors e.g. military practice areas (defence).

[2] A Resource Area (RA) is a spatially defined broad area that describe the spatial distribution of a particular resource that is, or has the potential to be, used by sector activity (in terms of technical feasibility) (Welsh Government, 2019, p. 15).

To help visualise the areas of potential conflict between and within sectors, maps have been produced with examples of identified spatial constraint (or conflict). Environmental considerations are also a critical component of planning and decision-making process, but they are being assessed in a separate project, in line with Welsh Government's commitments and obligations.

To supplement the evidence review and interaction appraisal, an overview is provided in section 5 of relevant plan policies (national to local levels) related to the focal sectors. A summary and recommendations for future research needs can be found in section 6.

2 Method

2.1 Evidence review

A review of the evidence base (primary and secondary literature), in which potential co-existence (a component of opportunities) as well as incompatibility (constraints) for the each of the focal sectors with all other sectors was undertaken. The focal sectors considered in this report are (1) Marine aggregates, (2) Aquaculture and (3) Energy - Low carbon: Tidal stream and Wave energy.

Two search strategies were adopted to identify literature for this review: keyword search and the 'snowball' approach. The keyword search engines were initially identified, starting from Google as a broad search engine to keep the search open to include, for example, government and industry reports. Then the search was narrowed down to more specific academic search engines, such as Google Scholar, Mendeley, Scopus and ScienceDirect. Once the search tools were selected, input keywords were derived from our research objectives (e.g. co-existence, co-location, constraints, marine space, case studies, pilot projects, social acceptance, social perceptions economic impact etc.) and used in combination with both the focal sectors and the other relevant sectors. With the snowball method, the search is based on relevant references or comments found in published articles or reports about the research topic subject to review. Literature available at international, UK and national (Welsh) scale was searched and reviewed to assess co-existence opportunities and potential constraints between the categorised focal marine sectors and other sectors in terms of potential social or economic outcomes.

This review builds in large part upon and expands - where possible - the work published by the Marine Management Organisation (MMO) in 2013 ("*Evaluation of the potential for co-location of activities in marine plan areas*") and in 2014 ("*Social Impacts and Interactions Between Marine Sectors*"), providing more recent examples of social and/or economic impacts of marine sectoral interaction.

The current review of sectoral interactions does not include interaction with certain sectors, such as surface water & wastewater treatment & disposal, and dredging and disposal, due to the lack of targeted evidence in the literature of the interaction of these sectors with any of the focal sectors highlighted in the WMNP.

Furthermore, it should be noted that although some sectors (e.g. subsea cable and telecommunications) are not presented as specific sections in the review, they are part of the assessment. This is in the case that interaction with the focal sectors occurs through other key marine industries. For example, a potential area for marine aggregate extraction may overlap with an existing low carbon energy array and associated cable route.

2.1.1 Spatial interaction appraisal for WNMP focal and non-focal sectors

2.1.2 Defining spatial co-existence and constraints

Co-existence is defined in the WNMP as: "*multiple developments, activities or uses can exist alongside or close to each other in the same place and/or at the same time*" (Welsh Government, 2019, p. 26). Therefore, spatial conflict (constraint) can be considered as the inability of two or more activities to take place in the same spatial area and/or occur at the same time.

The WNMP defines co-location as "*a subset of co-existence and is where multiple developments, activities or uses co-exist in the same place by sharing the same footprint or area*" (Welsh Government, 2019a). The term 'footprint' applies to some or different parts of the marine environment i.e. the sea surface, the water column and the seabed. It also depends on the structures/activities concerned (MMO, 2013a). The 'footprint' of a structure is either the footprint of the structure(s) itself, or that of the safety zone surrounding the structure, where such a zone is applicable. The 'footprint' of mobile activities is essentially the area covered by the activity e.g. the area of a ship or a ship plus the equipment it is towing (MMO, 2013a).

With an understanding of co-existence, it has been possible to identify literature of interest and gauge the potential interaction of the focal sectors and other marine sectors/activities.

2.1.3 Identifying spatial co-existence and constraints

The WNMP identifies a diversity of sectors/activities operating in Welsh waters. Whilst some of these may interact other combinations may not. Therefore, we applied 'screening' using the following questions about the likelihood of spatial interaction, and co-existence (or co-location) between the focal sectors and other marine sectors/activities (Appendix 1):

- Q1. Are the activities likely to interact (marked as possible, likely or unlikely)? If so, how do they interact?
- Q2. Can the structures/activities physically co-exist in space, recognising activities could occur in the same space yet at different times (marked as possible, likely or unlikely)?

Q1. Are the activities likely to interact (marked as possible, likely, unlikely)? If so, how do they interact?

To answer this question, the GIS layers in the Wales Marine Planning Portal[3] were initially reviewed and then additional mapping work performed in ArcGIS, for evidence of spatial intersection both between sectors as well as between sectors and the resources upon which the focal sectors depend. The GIS data used was a mixture of publicly available shapefiles e.g. downloadable from The Lle Geo-Portal and data made available for the project by Welsh Government and project partners.

Q2. Can the structures/activities physically co-exist in space, recognising activities could occur in the same space yet at different times (possible, likely, unlikely)?

Having considered the likelihood of interaction, the second question investigated is whether the structure/activity could physically co-exist. Answering the questions involved making several assumptions:

- Use of the spatial footprint approach for structures/activities that occur in or atop/along the seabed, in the water column and at the sea surface.
- Focussing only on the potential constraints and opportunities during the operation and maintenance phase of an activity/development.
- Using activities/infrastructure that sit within the marine plan sector, to ensure a full range of activities/infrastructure are captured.
- Consideration of temporal sequencing of the activities/sectors which could enable existence in the same space but at different times.

Answering the questions involved expert knowledge of the project team, primary and secondary literature regarding co-existence of maritime activities and utilising the interaction of available shapefiles for sectors of the WNMP and associated resources. The results have been compiled into tables demonstrating the following:

(i) Within focal sector comparison; and,
(ii) Cross-sector analyses.

Details of the type and source of GIS data layers used in the mapping (Section 4) are summarised in Appendix 2. The derivation of the Resource Areas (RAs) for the Welsh National Marine Plan is outlined by The Welsh Government (2019).

Having summarised information, mapping in ArcGIS 10.5 was undertaken to help with the visualisation of spatial co-existence (or lack thereof). The available ArcGIS shapefiles for focal sector RA (and other sectors), were overlaid and clipped using the ArcGIS geoprocessing tool, to generate areas of intersection. The resulting maps for combinations of sectors indicate where spatial co-existence is potentially limited and hence may need consideration in determining future use of the RAs.

[3] https://lle.gov.wales/home?lang=en [Last access: 06/04/2020].

3 Review of sector-sector interactions: co-existence opportunities and constraints

3.1 Co-existence opportunities and constraints between focal marine sectors

The review of available information sources (n = 76, literature and internet sources) highlighted the lack of local (Welsh) scale specific information on sector-sector interactions. Less than 8% of sources reviewed were Welsh, as compared to 41% at national (UK) scale and 51% at international scale. The following review and assessment of co-location and co-existence opportunities and potential constraints between the focal marine sectors in Welsh water is therefore regarded as low to medium confidence on the basis of approximately 50% of the sources being UK and Wales specific.

3.1.1 Marine aggregates and low carbon energy: wave and tidal stream energy

The marine aggregate industry in Great Britain is one of the largest and most developed sectors globally producing between 15 to 20 million tonnes of sand and gravel yearly (Bide et al., 2016; The Crown Estate, 2017). A large part (about 80%) of all marine aggregate sales in England and Wales are used as concrete aggregate. The construction industry in Wales accounts for 3% or £5.5 billion of the total value of construction in Great Britain (MPA, 2018). The sector is driven by infrastructure demands (22% of the total output), followed by new house building and commercial building (18% and 17% of the total output respectively). In the wider Great Britain, infrastructure accounts for 12% of total construction output. Marine-dredged sands and gravels are also used for coastal defence and beach replenishment projects (MPA, 2018; Newell and Woodcock, 2013).

Sand and gravel extraction activities are organized through a leasing process managed in the UK by The Crown Estate. This process spatially accommodates marine aggregate needs with those of other marine sectors and looks to minimise or mitigate the risk of conflicts (MMO, 2014). There is growing momentum for low carbon energy (tidal stream and wave energy), as demonstrated by the primary role of the sectors in the WMNP. It appears likely these two sectors could compete for sea space with the aggregate industry in the Welsh marine area. As such, the possible conflicts originating from the spatial/temporal overlap with aggregate dredging operations should be minimised for these sectors to co-exist. It is possible that sectoral developments define the sequence and timing in which activities will occur. This means that if there is an area which is potentially suitable for both sand and gravel extraction and low carbon energy development, the aggregate extraction process should ideally take place first. Once the extraction area can be surrendered, the wave or tidal stream energy arrays could be developed over the same area; this will allow for the two activities to co-exist efficiently.

Despite the potential for the marine aggregate extraction industry to compete for the use of the space with the low carbon energy sector in the Welsh marine area due to the

expected increasing contribution of renewables to the energy mix, at present no evidence of sector-sector incompatibility was found.

3.1.2 Marine aggregates and aquaculture

Spatial co-existence of marine aggregates with aquaculture is not expected. There is no expectation for the aggregates sector to overlap in the future with aquaculture developments since the two activities are not compatible. This is supported by the lack, at present, of robust evidence available through literature, either for the Welsh marine area or at UK and international level.

3.1.3 Aquaculture and low carbon energy: wave and tidal stream energy

There is potential for the aquaculture and low carbon energy sectors to be combined. On the one hand, employment in aquaculture is important for several coastal communities across the UK (MMO, 2013b). In 2012, enterprises in the aquaculture sector generated a total revenue of approximately £590 million and employed over three thousand people (Jennings et al., 2016). Latest economic figures show that aquaculture in Wales generated a production valued about £3m/1.700t in total in 2017 (T. Ellis, Cefas, *pers. comms*. 23.07.2019). Thus, the aquaculture sector has the potential to contribute to the sustainable growth of the Welsh marine economy and help coastal communities diversify their activities, whilst reducing pressure on fish stocks and supporting food security (European Commission, 2012; Jennings et al., 2016). The importance of aquaculture goes beyond its socio- economic value and incorporates cultural benefits stemming from aquaculture operations. This includes knowledge transfer to future generations and opportunities for new scientific research and education (Hasselström et al., 2018).

On the other hand, low carbon marine energy is an emerging sector. The UK's marine energy industry can play a significant contribution to national economic development. According to the Marine Energy Council (2019), around 1,700 people are currently employed in the marine energy sector in the South West, Wales and Scotland. A report recently published by ORE Catapult[4], states that tidal stream energy could generate by 2030 a net cumulative benefit to the UK economy of £1.4 billion, becoming a source of significant job creation. It is anticipated that a successful transition towards a low-carbon economy will create approximately 4,000 new jobs, many of which will be in regional economies whereas the wave energy sector is expected to create around 8,000 new jobs by 2040 (Smart and Noonan, 2018).

Combined marine activities, such as aquaculture and renewable energy systems, will allow for a more efficient use of the marine space whilst reducing competition between different users. Nonetheless, the sustainable development plans for the integration of aquaculture installations with the low carbon energy industry necessitate an integrated assessment of a combined utilization of either the inshore or offshore sea space which

[4] Ore Catapult is the UK's leading technology innovation and research centre for offshore renewable energy. Source: https://ore.catapult.org.uk/about-us/ [Last access: 26.03.2020].

encompass environmental, social and economic considerations. Possible synergies between the low carbon energy sector and aquaculture development have been identified in recent years by researchers and practitioners (Aquatera, 2014; Welsh Government, 2015b), which include:

- Reduction of operating costs by using the same vessel to transfer personnel, feed, equipment etc. to and from the shared infrastructure. Lower operating costs will likely increase the competitiveness, efficiency and long-term profitability of the aquaculture sector.

- Additional costs savings can be achieved if the two interacting sectors are able to share anchor or supporting structures.

Where the facilities are located offshore, the aquaculture farm may potentially share the power supplied by the offshore low carbon renewable infrastructures (in-field power supply). According to Toner and Mathies (2002), the overall positive view the public has of low carbon renewable energy, perceived as an environmentally friendly sector, may play a crucial role in improving the image of aquaculture.

With regards to impacts of wave energy converters[5] and finfish aquaculture sites using cage structures, several pilot projects already exist. For example, in 2013 at the Isle of Muck, Scotland, a pilot project was established to test an offshore wave energy converter array (WaveNET) as a means of powering offshore aquaculture installation as well as to assess the appropriate wave energy converter sizes. This was developed by Albatern, a Scottish wave energy device developer, in collaboration with Marine Harvest Scotland.

Figure 3.1: WaveNET 6S Array off the Isle of Muck, Scotland and SQUID Series-6 Generating Unit

WaveNET arrays (Figure 3.1) are flexible floating structures made of units which react to the motion of the waves to generate electricity[6]. The project aimed to identify and meet

[5] **Wave energy converters** were classified in the report published by SARF (2013) into one of eight different categories: attenuators, surface point absorbers, oscillating wave surge, oscillating water column technologies, overtopping devices, submerged pressure differential, bulge wave technology and rotating mass devices.
Tidal stream energy converters include instead (SARF, 2013): horizontal axis turbines, vertical axis turbines, Reciprocating Hydrofoils, the Venturi Effect devices, tidal kite and the Archimedes Screw.

[6] Description of WaveNet device: http://albatern.co.uk/wavenet/works/ [Last access: 28/02/2019].

the power requirements of offshore aquaculture installations[7]. As anticipated by Black and Hughes (2017), the energy price is likely to play an important role on future aquaculture trends. The project demonstrated that Wave NET is a secure system that can work commercially on an operating remote fish farm and the risk for the cages is minimal[8] (Dalton et al., 2019).

Another study to assess the impact of wave energy converters on an adjacent aquaculture cage installation was conducted in Portugal (Silva et al., 2018). The results of the simulation-based research based on the impact of different types of wave converters, indicate that the wave farm - whilst producing energy - simultaneously attenuates the impact of waves propagation, thus sheltering the fish farm and reducing the likelihood of damage (Silva et al., 2018). Malta and Cyprus provide other examples where aquaculture sites use wave energy devices to provide power for intensive finfish aquaculture installations (Depellegrin et al., 2019).

Currently, there are no marine finfish farms in Welsh waters. As mentioned in this report already, new offshore technologies are being developed and tested in Scotland. These could make offshore fish farming in Wales feasible in the not too distant future. Indeed, sustainable finfish farming is discussed in the WNMP, which states the goal for the aquaculture sector is "*to facilitate the development of sustainable aquaculture in Welsh waters, including promoting innovative finfish, shellfish and marine algal businesses and associated supply chains*" (Black and Hughes, 2017, p. 80).

Wave Dragon[9], Seaweed Energy Solutions (SES)[10] and BELLONA foundation[11] are working together on a combined wave and aquaculture project to be deployed in Welsh waters. The project brings together an array of wave energy converters (WEC) of a design created by the Wave Dragon, combined with a seaweed farm. The latter will benefit from calmer waters behind the wave devices and access to power for storm submergence[12], which will increase the operational days and thus make kelp production feasible in exposed waters.

Once processed, seaweed can be sold as a high value raw material for food and health products, cosmetics, animal feed markets and biofuel (Dalton et al., 2019). Furthermore, the co-existence of wave devices and seaweed farms is expected to benefit from a smoother licensing process, due to the multiple use of the marine space as well as from the perceived, positive public perception (Dalton et al., 2019). Outputs and evaluations from the combined project were, however, not available at the time of writing.

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[7] Source: Albatern WaveNet Device - http://grebeproject.eu/wp-content/uploads/2017/09/Wave-Energy-Albatern-WaveNet-Scotland.pdf [Last access: 16/12/2019].

[8] Source: Ibid.

[9] Wave Dragon39 is a private Danish/UK based company working towards the commercialisation of wave energy converter (WEC) technology to extract electricity directly from ocean waves.

[10] Seaweed Energy Solutions (SES) 40 is a Norway-based seaweed innovation and business development company.

[11] Bellona Foundation is an independent environmental NGO that aims to mitigate challenges of climate change through identifying and implementing sustainable environmental solutions.

[12] Source: Marine Investment for the Blue Economy - https://maribe.eu/wave-aquaculture/ [Last access: 06/04/2020].

3.2 Co-existence opportunities and constraints between focal sectors and other key marine sectors

3.2.1 Marine aggregates and low carbon energy: wind energy

There are opportunities for co-existence between marine aggregates and offshore wind farms (OWFs). For example, the Round 3, Zone 5 OWF development zone off the East Anglian coastline was planned with consideration of the licensed aggregates extraction areas, to ensure adequate space for both sectors to develop (MMO, 2014). In the same way, following the selection of a landfall site for the Hornsea Offshore Wind Farm at Horseshoe Point, the inshore and offshore cable route corridors were identified taking into account dredger transit routes from The Crown Estate and the British Marine Aggregates Producers Association (BMAPA) around licensed dredging areas (SMart Wind, 2013).

The Marine Aggregate Levy Sustainability Fund (MALSF) funded a project to design a tool aimed at assessing whether spatial conflicts exist between aggregate extraction areas and other uses of the marine space (Newell and Woodcock, 2013). The tool was tested in the Outer Thames to analyse the trade-offs between marine aggregate extraction and other activities taking place in the area, including offshore renewables. It was estimated that the spatial conflict between the renewable energy sector and licensed aggregate sites could result in losses for the renewable energy sector. The losses ranged from £2.9 to £4.8 million over 15 years owing to electrical energy not being produced. Moreover, the economic shortfall was expected to have a knock-on impact on employment; it was anticipated there would be 15 jobs lost during the OWF construction phase. However, no information was given on the jobs or profit generated by marine aggregates in this area (Dick et al., 2011, as cited in Newell and Woodcock, 2013).

The marine aggregate extraction sector and the offshore wind industry may have a mutual interest in exploiting the same resource area. From the perspective of the marine aggregate industry, a major drawback of spatial overlap with renewable energy infrastructure, is the area no longer being available for aggregate extraction in the medium-term, due to the presence of the foundations, turbines and cables (Eftec, 2011 as cited in MMO, 2014). There may also be impacts associated to decommissioning[13] or partial decommissioning of offshore wind installations. In fact, in case of a partial decommissioning, any infrastructure left in place (e.g. cables or foundations) may limit the potential future use of the site for other uses, such as aggregate extraction (Smyth et al., 2015).

Offshore energy developments are also likely to limit the safe passage of dredge vessels through areas occupied by infrastructure. Dredging vessel displacement may lead to increased steaming distances/times and in the case of aggregates, production will be

[13] Decommissioning refers to all the operations associated to the removal or making safe of offshore infrastructure at the end of its useful life.

moved to a more distant licensed area which translates into higher costs (e.g. additional fuel) as well as reduced revenues to the marine aggregate sector (MMO, 2014).

An example of spatial overlap between the renewable energy sector and marine aggregate extraction, where a solution to accommodate both parties was not reached, can be seen with Gwynt y Môr OWF. The area licensed for aggregate dredging was indeed amended to accommodate the wind farm (npower renewables, 2005 as cited in MMO, 2014).

3.2.2 Marine aggregate and low carbon energy: tidal range energy

Significant tidal range resources have been identified in the north of Wales from north eastern Anglesey to the Dee estuary and along the southern coast from St Davids to the Severn estuary[14] (Welsh Government, 2019). The primary technology is tidal lagoons which work by utilising the tidal height difference to generate electricity. They effectively create a lagoon area either free standing within the body of an estuary or incorporated with the shoreline. They have not yet been used commercially anywhere in the world; however, they have been considered as an alternative to what is considered to be the more environmentally damaging tidal barrages (Gill, 2011).

Interaction with marine aggregates activity should be minimal given the proposed location of tidal range lagoons being close to shore and the majority of marine aggregate resource is further offshore. The spatial scale of lagoons (of the order of a few 100 km^2) and ability to adjust location within the tidal resource areas, means that positioned corrected they should allow passage of vessels (i.e. marine aggregate dredgers and support vessels).

3.2.3 Marine aggregates and shipping

Several licenced extraction areas in UK are located within or close to busy shipping lanes. Existing shipping lanes need to be properly considered during both the licensing of marine aggregate areas and with respect to ports where cargoes will be delivered. Tillin et al. (2011 as cited in MMO, 2014), report that collisions and or accidents between dredging and commercial vessels are usually prevented through communication with the shipping industry at all stages of licensing and the subsequent associated operations. Hence, risk of collision is regarded as unlikely to arise in areas with high levels of shipping activity (Tillin et al., 2011 as cited in MMO, 2014).

3.2.4 Marine aggregates and fisheries

Once licensed, marine aggregate extraction can spatially co-exist with other marine sectors, which do not involve deployment of fixed in infrastructure in the same area, e.g. shipping and fisheries, by zoning the licence area into Active Dredge Zones (ADZ). The ADZ

[14] Source: https://www.marineenergywales.co.uk/marine-energy-in-wales/the-resource/ [Last access: 02/04/2020].

are usually specific to a licensed area as a result of a licence condition, or as a voluntary initiative introduced by the operator[15]. There can be dredging at any time in the limits of the ADZ, whilst parts of the seabed and sea space of the licence area can be accessible to other maritime users. The ADZ are intended to minimise spatial conflict with other sea users, as well as minimise environmental impacts and effective resource management. As such, co-existence can be viewed as a possibility for the aggregate licence areas that are new but occur in an environment of existing activities. Moreover, the production and distribution of charts with regional Active Dredge Areas (ADA) contributes to minimising spatial conflict with other sea users, as well as minimising environmental impacts and effective resource management.

Feasibility of co-existence between marine aggregate extraction and fisheries depends on the long-term effects of sand and gravel dredging on fisheries activities (MMO, 2013a). In the short term, however, co-existence is possible if such activities do not occur at the same time. Thus, it is expected that fishing with either mobile or static gears can continue outside of the active extraction periods.

Cooperation between the aggregate industry and local fishermen can arise through informal arrangements between the interested sectors, i.e. through mutual consultation and local stakeholders' knowledge. A necessary pre-condition for the arrangement to work is that both parties voluntarily agree to comply to a set of pre-determined guidelines (MMO, 2013a).

Fisheries displacement, as suggested by Kyvelou and Ierapetritis (2019), has to be addressed through intelligent and innovative cooperative ways; such as the arrangements established by the East and South Coast Dredging-Fishing Liaison Committees. Such arrangements allow the two activities to operate within the same space at different times and represent an example of cross-sectoral cooperation. These measures include (MMO, 2013a):

- The communication of the active dredge zone to allow fishing access to the wider licence area;
- Measures to allow aggregate extraction to take place within International Maritime Organization (IMO) Traffic Separation Schemes; and,
- Establishing buffer distances for existing cable infrastructure to ensure fishing gear and cable infrastructure are not damaged.

Hence, marine aggregate dredging co-existing in the same space with fishing activities, as long as they do not take place at the same time. However, if this is not the case then marine aggregate production displaces fishing and this can increase social tension and reduced community cohesion. A study carried out by Cooper (2005) indicates that perceived risk of damaged static gears (nets and pots) may cause fishermen to avoid

[15] Source: https://bmapa.org/issues/other_sea_users.php [Last access: 06/04/2020].

certain areas around aggregate extraction sites, hence may lead to increased fishing pressure on alternative grounds adjacent to the dredging site.

An additional concern for fishermen relates to alterations of the seabed topography resulting from sand and gravel extraction, that may affect the migration routes of crabs and lobsters as well as flat fish movement (Cooper, 2005; Posford Duvivier Environment and Hill, 2001). This may impact the catch rate and, ultimately, fishers' revenues. However, alterations in flat fish movement patterns or abundance due to dredging activities are not supported by scientific evidence (Cefas, *pers. Comm.*).

It is also anticipated that increased demand for aggregate products can lead to larger quantities extracted for longer periods of time, which can result in conflict with the fishing sector in cases where extraction activities limit the activities of the fishing vessels (MMO, 2013a). Dick et al. (2011, as cited in Newell and Woodcock, 2013) applied a tool for the assessment of social and economic impacts associated with a proposed extraction site and other activities. The study quantified the costs to local fishermen of exclusion, if their activities overlap with extraction of sand and gravel in the Outer Thames Estuary site. The assessment estimated the present value (PV) of aggregate extraction to be between £22.4 - £35.0 million over a 15-year period. The PV of fisheries over the 15-year licensing period was estimated to be between £27,000 and £81,000. The figures may change if sensitivities are tested. In this case, after there was agreement for the inclusion of a 1 km buffer area to account for the impact on sediment transport, the PV of fisheries in the study area increased to £131,000 over the same period.

Licensing an area for extraction of marine sand and gravel is likely to affect employment as well. Dick et al. (2011, as cited in Newell and Woodcock, 2013) deduced that 22 people would benefit from direct employment in the area under investigation and, equally, direct employment would be also positively impacted from the support of 28 indirect jobs. Effects on fisheries employment at the site appear to be marginal, with less than a single job lost as a direct consequence of dredging and extraction activities.

3.2.5 Marine aggregates and recreational activities

Dredging for sand and gravel interacts with a range of recreational activities which span from recreational angling to scuba diving and sailing (MMO, 2014; Newell and Woodcock, 2013). Sea angling, for instance, may occur in areas coinciding with aggregate extraction. For example, the Overfalls, a site that lies approximately 18 km east of the southern part of the Isle of Wight, was acknowledged to provide an important habitat for various fish species of importance for local anglers. Prior to designation, it emerged that the site was near three aggregate extraction sites and coincided with an aggregate application site. This overlap raised concerns amongst sea anglers about the possible impact of sand and gravel extraction on their catches. After consultation, The Crown Estate chose to not licence aggregates extraction from the Overfalls area for 21 years following designation in January 2016 (MMO, 2013a).

In the Outer Thames Estuary example (mentioned above), it was anticipated that extraction activities may cause displacement of recreational sea anglers, albeit economic

losses were not quantified as data relating to participation were available only at high level (Dick et al., 2011, as cited in Newell and Woodcock, 2013).

Marine aggregates extraction could diminish the view of a pleasant landscape/seascape of residents if dredgers operate close to the shore (Custódio et al., 2019; Gentry et al., 2019). Recreational use of the area can equally be impacted negatively where dredging operations disrupt the activities of recreational anglers or divers, e.g. if the activity occurs near to a wreck diving site.

3.2.6 Marine aggregate and defence sector

With reference to the defence sector, military practices in Wales cover approximately 37% of the Welsh Zone (Judd and Wood, 2018), hence sectoral interaction with any other sector is likely. Marine aggregate dredging includes the implementation of fixed infrastructure. Therefore, any new development needs to be approved by the Minister of Defence (MoD) as it might be considered to create navigational risks and potentially obstruct defence activities (Welsh Government, 2019, pp. 85–87). Hence, marine aggregate dredging is likely to be constrained by the defence sector. At present, however, evidence is lacking from literature, either specific to the Welsh context or at UK or international level with regards to the impact of actual or potential sector-sector interaction.

3.2.7 Low carbon energy: wave and offshore wind energy

The UK has the largest operating offshore wind capacity in the world (The Crown Estate, 2017). In September 2019, The Crown Estate launched the fourth round of Offshore Wind Leasing. The seabed areas made available to the market in Round 4, known as Bidding Areas, are: the Dogger Bank Bidding Area, the Eastern Regions Bidding Area, the South East Bidding Area, and Northern Wales and Irish Sea Bidding Area. Designating more areas for OWF development requires optimal decision making over the use of the space, especially in the offshore waters of the Northern Wales and Irish Sea[16]. The Crown Estate - after the completion of the plan level Habitats Regulations Assessment (HRA) to evaluate the potential impact of proposed wind farm extensions in 2017 – has also granted seven project extension applications, which included the extension to the existing Gwynt y Môr Offshore Wind Farm[17].

The Welsh Government is actively involved in the development of marine energy technologies and pre-commercial projects. The Pembrokeshire Demonstration Zone (PDZ), a 90km^2 area of sea leased from The Crown Estate by Wave Hub Ltd and located

[16] Source: https://www.thecrownestate.co.uk/en-gb/media-and-insights/news/2019-the-crown-estate-launches-the-uk-s-first-major-offshore-wind-leasing-round-in-a-decade-opening-up-the-opportunity-for-at-least-7gw-of-new-clean-energy/ [Last access: 18/12/2019].

[17] Source: https://www.thecrownestate.co.uk/en-gb/media-and-insights/news/2019-28-gw-of-offshore-wind-extension-projects-to-progress-following-completion-of-plan-level-habitats-regulations-assessment/ [Last access: 19/03/2020].

between 15 and 21 kilometres off the south Pembrokeshire coast[18], has been expanded to include a floating offshore wind demonstration project (Carbon Trust, 2018).

The analysis of co-location of wave energy converters and offshore wind turbines into a single renewable energy farm has been undertaken in Italy (Azzellino et al., 2019). The researchers use a spatial planning approach to identify optimal locations for future wind-wave energy infrastructures, in a context of existing human-driven pressures (e.g. commercial shipping, mariculture activities, cable routes, etc.) and environmental factors (e.g. designated marine protected areas). This is within a sea area around Italy, including the Adriatic Sea, Ligurian Sea, Tyrrhenian Sea, and partially the Ionian, Sardinia Sea, as well as the northern part of the Strait of Sicily. The study identified a weak correlation in local and temporary conditions of wind and wave, which may, nonetheless, be exploited for efficient joint production of low carbon renewable energy. The results of the wind-wave climatic analysis indicate that appropriate conditions occur in the western and southern part of the study area, in both coastal and offshore deep waters. Additionally, where there is the potential for development of combined wind and wave energy installations, the approach enabled the identification of optimal sites and sites with a low cumulative human impact (Azzellino et al., 2019).

Assessing the benefits of combining wind energy with wave energy at various locations around Ireland, it was shown that wave and wind resources are very low correlated on the South and West Coast, where the waves are dominated by the presence of high energy swells generated by remote westerly wind systems (Fusco et al., 2010). This means that the co-location of wind and wave farms, at these locations, allows the achievement of a more reliable, less variable and more predictable electrical power production. Similar, results were shown along the California coast where offshore wind resource is high. Aggregating offshore wind and wave energy farms generate less variable power output than a wind or wave farm operating separately (Stoutenburg et al., 2010). Considering the feasibility of joint exploitation of wave and offshore wind power in the Statfjord field in the North Sea, positive outcomes resulted mainly from the reduction of capital investment costs and increased power production (Muliawan et al., 2013).

3.2.8 Low carbon energy: wave/tidal stream energy and tidal range energy

The low carbon energy resources along the Welsh coastal and offshore waters is estimated to be able to supply 6.4 GW of power[19]. This significant resource is available via wave, tidal stream and tidal range power. As tidal stream power comes from the movement of water, whereas the tidal range power comes from the difference in tidal height, these resources are spatially separate in Welsh waters (Welsh Government, 2019). There is overlap in terms of resource on the south coast off Porthcawl and to Penarth, however tidal range resource is focussed to a specific location close to shore where a tidal lagoon can be constructed. Tidal stream devices, on the other hand, are

[18] Source: https://www.marineenergywales.co.uk/marine-energy-in-wales/demonstration-zones/pembrokeshire-demonstration-zone/ [Last access: 19/03/2020].

[19] Source: https://www.marineenergywales.co.uk/marine-energy-in-wales/the-resource/ [Last access: 02/04/2020].

discrete and relatively small structures which can be deployed within the water column. Hence, there is clear opportunity to have both operating in coastal waters, if located appropriately.

For wave devices, the identified wave resource in Welsh waters is confined to the south west coastal and offshore waters. There is therefore very little spatial overlap with the identified tidal range resource and therefore little opportunity for co-existence or conflict.

3.2.9 Low carbon energy: wave/tidal stream energy and shipping

Literature regarding interactions between wave and tidal stream energy and other sectors is scarce. Offshore low carbon renewable developments could interfere with other uses of the sea causing hazards to shipping. Associated social impacts include loss of potential future employment due to interaction with these sectors, and which could constrain development opportunities of renewable energy arrays (MMO, 2013a).

The presence of structures above, on or below the sea surface poses a risk to all vessels through collision or snagging of vessel lines with structures and their moving parts while the vessel is either underway or anchoring (The Scottish Government, 2013). For offshore renewable developments, it is the outer structures that are most exposed to shipping collision related to vessels navigating in restricted visibility, or those with inadequate bridge watch keeping, or vessels adrift and/or not under command. However, any development would be identified on a chart and appropriately marked with buoyage as a hazard. The effectiveness of these controls relies on vessels monitoring up to date charting information and maintaining an effective watch whilst at sea (The Scottish Government, 2013).

To minimise the danger posed by offshore renewable energy installations to navigation and communication of shipping and emergency rescue, renewable energy developers seeking consent for marine works must consider the latest marine guidance notes issued by the Maritime and Coastguard Agency (MCA)[20].

3.2.10 Low carbon energy: wave/tidal stream energy and fisheries

Renewable energy arrays have the potential to displace fishing activities due to lost or reduced fishing grounds and/or increase vessels density in the vicinity of the licenced area towards shore. As a result of fisheries displacement outside the renewables development, there is an increased risk of collision and subsequent safety issues and delays/restrictions on the extent of fishing activities (de Groot et al., 2014; MMO, 2014).

3.2.11 Low carbon energy: wave/tidal stream energy and defence

Any new development of the low carbon energy sector (wave/tidal stream energy) would encompasses fixed infrastructures, hence the Ministry of Defence (MoD) might oppose these new development due to generating potential navigational risks and obstruction to

[20] Source: https://www.gov.uk/government/collections/marine-guidance-notices-mgns [Last access: 26/03/2020].

the defence activities, respectively (Welsh Government, 2019, pp. 85–87). At present, however, evidence is lacking from literature, either specific to the Welsh context or at UK or international level with regards to the impact of actual or potential sector-sector interaction.

3.2.12 Aquaculture and low carbon energy: offshore wind energy

The idea of bringing together aquaculture installations and OWFs has gained considerable attention over the years not only in the UK, but also across other European countries, such as Germany, the Netherlands, France and Belgium. For a multi-use system to be economically advantageous, OWF developers need to maintain the energy output of an OWF at the maximum economic level, but also guarantee the overall commercial viability of offshore aquaculture (Michler-Cieluch et al., 2009), or add value through accounting for the ecosystem services provided by species like bivalves and macroalgae (Buck et al., 2018).

Naylor and Burke (2005) suggested targeting lucrative species for large-scale aquaculture operations or niche markets. Overall, increased efficiency could be achieve through shared logistics and infrastructures as well as restrictions for other types of activities to reduce the risk of collision with the shipping sector (Gimpel et al., 2015; Michler-Cieluch et al., 2009).

Buck et al. (2018) state that social acceptance of multi-use facilities, combining wind farms and aquaculture, may increase as a result of:

- the perceived footprint reduction of the two activities combined;
- the potential job creation opportunities; and,
- additional income, especially for more vulnerable sectors (e.g. inshore fisheries), through livelihood diversification and access to new markets.

However, co-existence is not immune from skepticism and may cause conflicts between the interested parties.

Various projects have investigated potential synergies between these two sectors (Griffin et al., 2015) and there are several examples of pilot demonstration projects, where wind farms and different aquaculture types have been co-located. Studies assessing co-location of aquaculture and wind farms have mainly investigated the feasibility of cultivating species like seaweed or bivalves (Buck and Langan, 2017). Whereas there is scarcity of available information on the possibility of co-locating finfish farms with OWFs (OECD, 2016, p. 135). Experiences of existing OWFs and aquaculture sites in the German North Sea, indicate that offshore operations and maintenance (O&M) can be five-to-ten times more expensive (Buck et al., 2017; Christie et al., 2014; Michler-Cieluch et al., 2009). Table 3.1 summarises constraints of mariculture and offshore windfarm operators during the O&M activities which make co-location of these two sectors more costly.

Survey results revealed that the main concerns expressed by OWF developers/operators and fishers in Germany, range from socio-cultural issues to policy issues, as well as issues of economic and technical feasibility (Michler-Cieluch et al., 2009).

The challenges of integrating aquaculture with energy production through a social lens requires differentiating between offshore[21] and inshore areas. Buck et al. (2018) argue this is due to differences in the types of activities and resource uses in the two areas, which entails different political as well as economic considerations. Conflicts between stakeholders over the use of the offshore space are likely to be addressed more readily by policy makers, since the actors involved are more powerful and influential than stakeholders operating inshore whose resources are more limited. Given these differences between these power relationships of stakeholders, Buck et al. (2018) conclude that co-location of aquaculture and offshore energy installations demands a different governance and management approach to nearshore co-location.

Table 3.1: Issues for Operation & Maintenance of large-scale offshore wind farms and offshore aquaculture.

OWF Aquaculture co location
Operation costs
Limited accessibility – weather windows
Distance to farm site
Higher offshore labor costs
Difficult logistics for operations and maintenance/ Difficult logistics for maintenance and harvesting
Reliability of the turbines/Reliability of culture devices
Uncertain regulatory and permit requirements

Mee (2006) investigated the possibility of combining finfish aquaculture and OWFs from the point of view of the stakeholders in the wind energy industry across the UK. Results of the telephone interviews and questionnaires show scepticism amongst stakeholders about the idea of co-location of OWFs with fish aquaculture because of several factors. For example, it was mentioned the possible conflicts with the local fishing community, problems with wind farm maintenance work and the specific environmental criteria which must be met for the co-location of these sectors within the same sea space. Additional concerns include issues regarding statutory approval, more health and safety burdens and restrictions to access the wind farms (Mee, 2006).

Dalton et al. (2019) confirm that OWFs stakeholders are hesitant to share space due to perceived added risks to health and safety as well as the large investments required for the business endeavour to be economically feasible. The “complex, fragmented and inconsistent” regulatory framework (Black and Hughes, 2017, p. 26) and the depth of information required for licence applications (Wood et al., 2017) may dissuade prospective investors.

[21] Offshore aquaculture is defined as: “*the transfer of farm installations from a sheltered environment to a more exposed location as well as the establishment of new aquaculture enterprises in exposed sites”* (Buck et al., 2018, p. 2).

Additionally, social acceptance of OWFs and aquaculture installations may be adversely affected by the presence of such structures (Ladenburg and Lutzeyer, 2012; Wood et al., 2017). This is especially if located adjacent to areas frequently visited by recreational boaters or if visible from land, due to the perceived negative impact on aesthetics. Negative impacts encompass also community harmony and local fishing industry (Firestone and Kempton, 2007). This is confirmed by the findings presented by Börger et al. (2015), where a welfare loss is expected as result of more visible wind farm turbines. Not surprisingly, welfare loss was higher for respondents in coastal locations but diminishing with increasing distance from the coast.

3.2.12.1 Bivalve aquaculture and low carbon energy: offshore wind energy

Research projects combining mariculture and OWFs in the German Bight started in 2001. Shellfish aquaculture industry in the North Sea was identified as a primary candidate for co-location within windfarms (Syvret et al., 2013). Buck et al. (2010) calculated costs and net returns of moving mussel cultivation close to German OWFs across four case scenarios. Results indicate that a baseline scenario with two full mussel plots, corresponding to 2,380 tons of consumption mussels per year and with investment into a new vessel, would generate net returns for an average 4-year period. This is approximately equal to 4.6 million euros.

Net returns were calculated to be four times higher in the case of farming mussels using existing equipment. Scenarios 3 and 4 explored mussel production as being less labour intensive. Scenario 3, however, included investment costs for the purchase of a new vessel and net returns of approximately 77.7 thousand euros. In contrast, scenario 4 did not anticipate the purchase of a vessels, thus returns were estimated to be higher at 1.5 million euros.

In Wales, a practical blue mussel cultivation trial was designed in 2010 by Deepdock Ltd. with assistance from Seafish (Sea Fishing Authority) at the North Hoyle Wind Farm site off Rhyl to investigate aquaculture co-location with OWFs. The OWF contains 30 monopiles in 10 meters of water (at low tide) and was constructed in 2003. The information provided in the final report prepared by Seafish shows that mussels grew well, but unexplainable mortality occurred at harvest which requires further investigation (Syvret et al., 2013).

This trial demonstrated that aquaculture activities could be carried out without a negative impact on wind farm operations. Further commercial-scale trials were recommended to both refine the technology to grow mussels offshore on fixed gear and assess environmental impacts and economic performance. Anticipated socio-economic benefits from co-locating aquaculture within OWFs include (Syvret et al., 2013):

- Job creation and employment opportunities;
- Potential for expanding seafood provision from UK waters;
- More space left in the see for other economic or recreational activities in the region; and,
- Knowledge and experience acquired through the trial to mitigate impact on local fishing grounds.

To our knowledge, no offshore co-location trial combining mussel farming and OWFs is going on currently in Welsh waters. The mussel aquaculture sector appears to have the greatest current potential to be combined with offshore wind arrays, and thus meeting economic, environmental and technical requirements (Jansen et al., 2016).

3.2.12.2 Seaweed aquaculture and low carbon energy: offshore wind energy

Seaweed demand in the UK has been met thus far by harvesting of wild resources. However, the anticipated rise in biomass use (Bosch et al., 2015) will increase the demand of seaweed biomass, which will likely be achieved by farming rather than natural harvest (Capuzzo et al., 2019). Furthermore, seaweed demand may increase as a result of the current consumers preferences in healthy food, food supplements, new protein sources and novel bioactive compounds, which has led to further research of the chemicals found in seaweeds (Buck and Langan, 2017; Capuzzo et al., 2019).

The seaweed sector is still in its infancy in the UK, yet the predicted increase in demand of high-value products is expected to generate new market opportunities in the UK and in Europe, especially for seaweed offshore cultivation. Studies looking into integration of seaweed aquaculture with offshore renewable energy arrays have been carried out, but currently a high level of uncertainty exists regarding operational aspects such as access to suitable onshore facilities and infrastructure for processing/transport to markets (Jansen et al., 2016; Linley et al., 2008).

Currently, offshore seaweed production in the North Sea is not economically profitable in the vicinity of an offshore wind farm. Results indicate that the seaweed production in the offshore wind farm would result in a loss of about US$24,000 per hectare per year (van den Burg et al., 2016). A sensitivity analysis was employed to assess how much seaweed price should rise to be profitable. The findings show that with a price of US $1,747/metric ton seaweed production becomes a profitable venture. The study presents some limitations; it is acknowledged that offshore cultivation of seaweeds is not common in the North Sea, hence there is uncertainty about some of the input parameters used for the economic modelling. Additionally, there could be possible costs savings due to expected synergies with offshore wind energy (van den Burg et al., 2016).

3.2.13 Aquaculture and low carbon energy: tidal range energy

For many years, lagoons have been linked with aquaculture in several parts of the world (e.g. extensively for centuries in the Mediterranean (Cataudella et al., 2015)). Being close to shore allows easy access and management of the resource area. The management of traditional aquaculture and capture fisheries activities in lagoons has been identified as a main instrument to maintain the ecological features of lagoons and to prevent the degradation of their sensitive habitats, both from an environmental and socio-economic point of view.

The aquaculture resource area in Welsh marine waters is extensive and overlaps with both the northern and southern tidal range resource areas. Furthermore, the predominant aquaculture in Wales is molluscs in shallow, nearshore waters. There is

therefore the potential for co-existence between lagoon-type aquaculture and marine energy (Buck and Langan, 2017), such as tidal range power lagoons.

3.2.14 Aquaculture and fisheries

Akyol et al. (2019) investigated the interaction between finfish aquaculture and fisheries activities, to ascertain conflicts stemming from the adverse social interactions. The study focussed on the perspective of both local fishermen and fish farmers. The researchers interviewed small-scale fishers, face to face, in 48 randomly selected fish farms, 28 fishery cooperatives, and 33 fishing ports, located close to aquaculture sites in the Aegean Sea. Results showed that about three-quarters of small-scale fishers had a problem with sea-cage fish farms, and almost half of the fish farmers had issues with small scale coastal fishers. The latter highlighted the main problems as the pollution caused by finfish farms, the space limitation for fishing, recreational fishers, and net damage caused, in particular by dolphins and monk seals.

Similar research, carried out in Portugal, investigated fishing communities' perceived impact of an finfish aquaculture pilot project off the Armona coast (Ramos et al., 2015). A total of fifty fishermen were interviewed and small-scale fishers claimed they were the most affected by the establishment of offshore aquaculture. A decrease in the available area for fishing was perceived as a negative effect of finfish aquaculture development together navigational disturbance associated to longer routes to reach fishing grounds which correspond to increased time at sea and fuel costs.

In another study, multi-use conflicts associated with finfish and shellfish aquaculture were investigated in Ireland and The Netherlands (Steins, 1998). The researcher claims, in line with the finding of Ramos et al. (2015), that the development of aquaculture in the Irish coastal zone resulted in a number of conflicts over the access to marine space, mostly associated with fishing grounds. In fact, several locally important shellfish, lobster and white fish grounds were allocated to aquaculture production and fishers felt they lost territory over aquaculture producers.

3.2.15 Aquaculture and tourism and recreation

Either inshore or offshore aquaculture developments may generate potential conflicts with stakeholders representing other key segments of the recreational sector.

Potential constraints may arise for inshore aquaculture due to competition for space and resources with recreational activities and coastal aesthetics (MMO, 2013a; Naylor and Burke, 2005). A study undertaken in Cyprus (Stephanou, 1999), suggested potential conflicts between aquaculture and tourism include:

- The tourism industry may compete for the use of land and sea space;
- Visual impacts of aquaculture installations close to the coastline;
- Navigational hazards between leisure boats and aquaculture structures; and,
- Conflict between aquaculture farms and other user groups e.g. recreational fishing, scuba diving.

Visual impacts can be a major barrier to social acceptance of the offshore installations (Ladenburg and Lutzeyer, 2012; Wood et al., 2017). Steins (1998) states that the Irish tourism industry perceives that finfish aquaculture conflicts with tourism development since aquaculture installations located in front of beaches and in scenic areas, are considered to clash with the natural character of Ireland's rural areas. Additionally, aquaculture development has restricted access to marine leisure activities, such as angling, sailing and windsurfing (Steins, 1998).

Conversely, there are examples from other European countries (Spain, Italy, Slovenia, Greece and Malta) where aquaculture and tourism can be harmoniously combined. So, for example, shellfish and finfish farmers take tourists to visit their farms for educational and recreational purposes, e.g. fishing and diving (Depellegrin et al., 2019). In other cases, however, fish farmers complained about the increase in recreational fisheries occurring due to small scale fishers getting tourism licenses to work as a charter for recreational fishers (Akyol et al., 2019).

3.2.16 Aquaculture and oil and gas energy

Research and trials are not only limited to the feasibility of combining aquaculture and renewable energy arrays, but encompass other offshore energy production structures, such as oil and gas platforms. In the Gulf of Mexico (GoM), for instance, trials of multi-use systems in offshore areas started in the 1990s (Kaiser and Chambers, 2017).

An economic feasibility study regarding the use of oil and gas structures in the GoM for aquaculture (Kaiser et al., 2011), concluded that co-location was not a cost-effective venture. The major hurdles encountered by the oil and gas operators were associated with liability and decommissioning of the structures (Kaiser et al., 2011). Average costs of decommissioning a four-pile platform in shallow waters lie between $US 1.5 and $US 2.5 million (Kaiser and Pulsipher, 2008). Liability can equally be a significant burden for both the aquaculture operator and the original owner of the platform, especially in cases where the platform is destroyed or severely damaged (Kaiser et al., 2011; Kaiser and Pulsipher, 2008).

Potential advantages envisaged for the aquaculture operators include opportunities for job creation and abated costs arising from the oil and gas platform, that will reduce the number of trips required to the offshore farm as a result of the increased farm supply vessel payload (Jin, 2008 as cited in Kaiser et al., 2011). The farm will also benefit from the 24 hours on-site surveillance and monitoring of offshore platforms, which constitutes a deterrent against vandalism and theft (Kaiser et al., 2011).

Attempts to combine offshore platforms and finfish aquaculture have also been investigated in in the Caspian Sea, Russia in 1987. Nonetheless, in this case the high operating costs led to the cessation of this venture at a very early stage (Buck and Langan, 2017).

3.2.17 Aquaculture and defence

Any new development within areas considered as strategic important for the defence sector needs approval of the Ministry of Defence (MoD). New developments which include fixed infrastructure which might create navigational risks and potentially obstruct defence activities may therefore be constrained within these areas. (Welsh Government, 2019, pp. 85–87). Thus, all the types of aquaculture which include fixed infrastructure (e.g. finfish, seaweed, bivalve -cage/rope-systems) can be considered as a likely constraint. Mussel bed relaying, which is currently the dominant form of aquaculture within Welsh waters (Hambrey and Evans, 2016), can be considered as compatible with defence activities, as long as they do not interfere with strategic defence interests. Hence, they are likely subject to temporal restrictions on access during operational test and military training periods (Welsh Government, 2019, pp. 85–87). At present, however, evidence is lacking from literature, either specific to the Welsh context or at UK or international level with regards to the impact of actual or potential sector-sector interaction.

3.3 Summary of key findings and marine planning considerations

The knowledge gathered through the evidence-based literature review suggests that there are resource areas in the Welsh waters where the concept of spatial and temporal multiple use of the sea can be sustainably developed. This could allow for the identified focal marine sectors and other sectors to co-exist or co-locate. It should be noted the majority of the studies presented in this review are desk-studies coming from a U.K. or international perspective; there is a limited availability of evidence produced for the Welsh context, hence in-country studies and more ad-hoc research and evidence are required.

Drawing on the literature review findings, the sectors which present greater opportunities for co-existence, in particular with respect to co-location, are aquaculture and offshore low carbon energy (OWFs mostly). This is given the case studies identified and investment into research and innovation of these sectors in recent years. This finding aligns with the objective of the WNMP and the sectors identified in the WNMP as sectors with the highest potential for sustainable development (Welsh Government, 2019a, p. 25).

From a socio-economic angle, the co-location in Welsh waters of shellfish and/or macroalgae aquaculture installations with low carbon energy arrays, present several advantages: lower operating costs and increased competitiveness of the commercial aquaculture sector. Additional societal benefits for Welsh coastal regions include additional jobs which are not restricted to farmers but encompass the wider community. For example, income diversification opportunities for small scale fishers (Syvret et al., 2013).

However, spatial co-existence between aquaculture resources and tidal stream and wave energy resources) in Welsh waters, at present, is considered unlikely, hence no conflicts between key stakeholders are currently expected.

Marine aggregate resources are widely distributed throughout Welsh waters and the sector is set to play a strategically important role in the Welsh economy. The demand for marine aggregates for infrastructure projects is expected to increase. Aggregate resources will also supply material for soft engineering defences (such as beach replenishment), and for coastal flood and erosion defence. It is expected that "*the use of offshore aggregates resources could support larger extraction licences with longer-term duration*" (Welsh Government, 2019, p. 76). This anticipated sectoral expansion will necessitate careful consideration of co-existence, by minimising possible spatial conflicts with other users of the maritime zone which may arise due to existing spatial and/or temporal occurrence, such as commercial fisheries, port and shipping routes, oil and gas platforms.

It should be noted that these sector-sector interactions do not just represent an opportunity for marine sectors and coastal communities to benefit from but also potential sources for conflicts. There is evidence at UK and international level that, for example if spatial interaction occurs between recreation, aquaculture and fisheries sector, conflict between interested parties is a possibility. As such, strategies and approaches should be developed that take into consideration the diverse interests of all parties involved and is aimed at reducing or mitigating them. Moreover, any new development which incorporates fixed structures and are envisioned in areas of importance for the defence sector are subject to approval of the Ministry of Defence, hence development might be constrained due to conflicting interests.

The relationship between society and the maritime environment has come to the forefront of international policy development and scientific research. In particular, the need to understand and account for the social as well as cultural components of this relationship has gained momentum in recent years in science (Lacroix et al., 2016; McKinley et al., 2019; Twomey and O'Mahony, 2019) and policy (e.g. WFGA). Evidence from marine planning documents and frameworks indicates that marine and coastal governance is developing globally towards more participatory, integrated and increasingly holistic approaches (Twomey and O'Mahony, 2019). At EU level, the "Roadmap for Maritime Spatial Planning: Achieving Common Principles in the EU" (European Commission, 2008) state that stakeholders should be involved at each stage of the marine spatial planning process, from the development of marine and coastal plans to the process of monitoring and review. This is key not only because of economic and environmental drivers but also to keep track of possible social impacts, thereby balancing different outcomes). Likewise, the WMNP consider early engagement with stakeholders, local communities and public authorities a requirement to facilitate opportunities for sector- sector co-existence or co-location, where possible (Welsh Government, 2019). Integrative, and participatory approaches are crucial to foster good governance for marine planning.

4 Spatial interaction appraisal for WNMP focal and non-focal sectors

The spatial extent of resources for the RA of focal sectors have been appraised for spatial interaction potential with a range of other sectors/activities within Welsh waters. For each focal sector, The Welsh Government has been working in consultation with a panel of expert stakeholders, on determining if there is a 'Case for Proceeding' to seek to develop strategic resource areas (SRA). The Case for Proceeding is intended to support the respective focal sector safeguarding policy and the implementation of the policy as appropriate.

Following the evidence review, the interaction between focal sectors and other marine activities have been systematically appraised for spatial interaction potential in terms of opportunities or potential constraints. The activities and definitions are in Appendix 1 and the focal sectors considered are listed as follows:

- Marine aggregates;
- Energy – Low Carbon: Wave energy;
- Energy – Low Carbon: Tidal stream (fixed and floating); and,
- Aquaculture for finfish (cages), shellfish (bottom cultivation, rope, trestles) and macroalgae (rope). Resources in the mapping distinguish between seabed resources. bottom cultivation of shellfish, and water column resources e.g. rope cultivation of shellfish.

The range of other sectors/activities considered are:

- Energy – Low Carbon: Tidal range energy;
- Energy – Low Carbon: Offshore wind energy;
- Energy – Oil and gas;
- Fisheries (mobile and static) – indicative only;
- Ports and shipping;
- Subsea cables;
- Surface water and wastewater treatment and disposal;
- Dredging and disposal;
- Defence; and,
- Tourism and recreation.

Due to the lack of published evidence regarding impacts of actual or potential sector-sector interactions, tidal range energy interaction with the focal sectors of marine aggregates, tidal stream energy and wave energy are not considered further. There is consideration (in Section 4.4) of aquaculture and tidal range energy interaction due to the potential risk of interaction for these sectors.

The appraisal has considered findings of the Evidence Review (Section 3), and the evidence and conclusions of the Case for Proceeding (Welsh Government, *in prep.*) for

each of the focal sectors of wave energy, tidal stream energy and aquaculture in Welsh waters.

Screening the long list of activities/sectors for potential spatial interaction, involved formulating and answering questions about the likelihood/ possibility of spatial interaction, and spatial co-existence between the focal sectors and other marine sectors/activities. The questions asked were:

Q1. Are the activities likely to interact (marked as possible, likely or unlikely)? If so, how do they interact?

Q2 Can the structures/activities physically co-exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?

During the screening work, there has been consideration of existing consenting/regulatory requirements that govern sectors/activities and hence which may affect the potential and likelihood of sectors interacting spatially. It is recognised that changes or updates to these consenting/regulatory requirements in the future, may change the interactions and could even enhance opportunities for co-existence and co-location of sectors/activities.

The outcomes of the screening exercise are shown in Table 4.1 to Table 4.6, with accompanying rationale. Likely or possible co-existence between activity is shown and the application of the criteria has been based on expert judgement and available evidence at the time of writing. References to locations and activities in Wales has been included for context. Future potential for co-existence has been factored in where appropriate. If co-existence is considered unlikely then the rationale has been provided.

It is recognised that sequencing/timing of the activities/sectors can influence co-existence potential (or lack thereof). It is possible that some activities can occur at different times yet in the same location. With available information, it has been possible to highlight temporal constraints as an issue in the following sections, but it has not been discussed comprehensively. This is mainly because of uncertainty over the timing of future activities as well as considering timing variations for existing/on-going activities.

To integrate the screening exercise with the outcome of the Evidence Review (Section 3) and help visualise spatial interactions (constraints or opportunities), we have included summaries and maps for each sector. These are for marine aggregate resources (Section 4.1 and Table 4.1); low carbon energy resources: tidal stream energy (Section 4.2 and Table 4.2) and wave energy resources (Section 4.3 and Table 4.3). Also, aquaculture seabed and water column resources, covering shellfish aquaculture on the seabed (Section 4.4.1 and Table 4.4), rope-based aquaculture (Section 4.4.2 and Table 4.5) and finfish aquaculture (Section 4.4.3 and Table 4.6). There are examples for intersection where spatial and temporal conflicts and constraints could arise and examples for co-existence for intersecting activities/sectors.

4.1 Marine aggregate resources

A summary of interaction appraisal for marine aggregates and other sectors is shown in Table 4.1.

Spatial co-existence of marine aggregates and tidal stream energy developments, and marine aggregate and wave energy development is considered unlikely (Table 4.1). The leasing of seabed areas is typically for one activity. Whereas fixed infrastructure of the tidal stream and wave devices and associated cabling, generally preclude safe aggregate extraction.

It is, however, recognised that the sequencing/timing of the activities can have a bearing on co-existence. For instance, if an aggregate resource is fully exploited in a licenced seabed area and the licenced area is relinquished then the seabed could be made available for wave or tidal stream infrastructure.

Mapping indicates areas off the north coast of Anglesey, off the Pembrokeshire coast and in the Inner Bristol Channel, where resources for marine aggregates and tidal stream

resources spatially overlap (

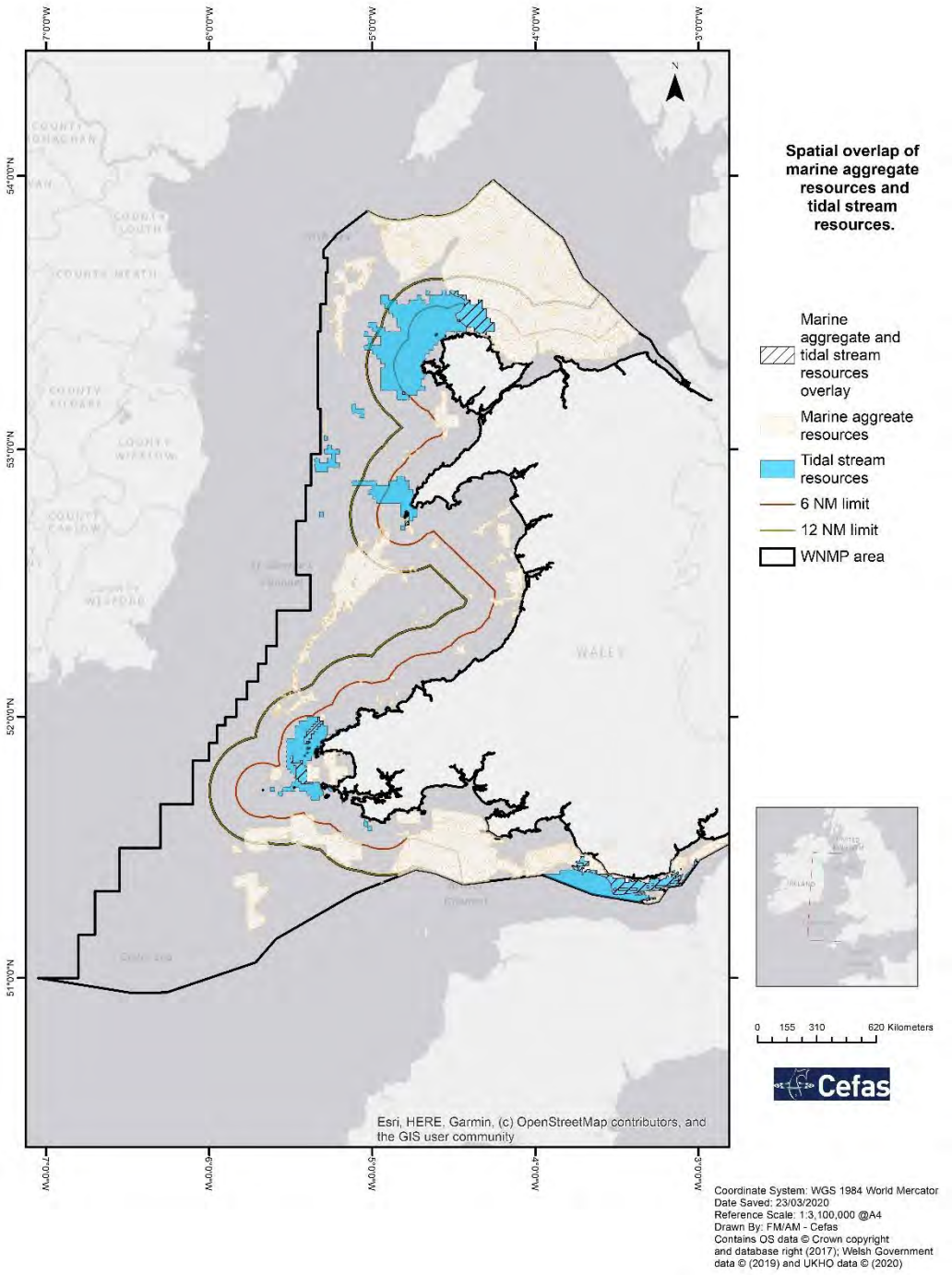

Figure 4.1). It is unlikely that these two sectors could temporally co-exist because floating or seabed mounted energy devices would effectively preclude access to the aggregate resource.

However, spatial and temporal management could be applied to sequence the activities of each sector. Such future planning would benefit from dialogue between the respective sectors and their associated regulators. Having these resource overlaps mapped (Figure 4.1) and considering the interactions (Table 4.1) will help to target this dialogue on

forward-looking, proactive and spatial planning. This resource overlap and sector interactions will also be important for the planning authority when developing criteria for the development of any SRA (and applying safeguarding policy) for these two sectors.

Areas to the west and south-west of Pembrokeshire are further identified on the maps as areas where marine aggregate and wave energy resources overlap (Figure 4.2). As for tidal stream energy, this could mean a potential issue for future use and so the same considerations apply in terms of forward-looking, proactive and spatial planning.

Spatial co-existence of marine aggregates with aquaculture is considered unlikely at present. This applies to resources for seabed-based aquaculture and water-column aquaculture e.g. rope grown seaweed. For safety and operational reasons, there is typically a separation of aggregate extraction in licensed areas and sites for aquaculture. Mapping indicates areas all around the Welsh coastline where marine aggregate resource and aquaculture on the seabed and/or in the water column resources overlap (Figure 4.3). Whilst the operational characteristics of the two sectors precludes co-existence at the same time, forward-looking, proactive and spatial planning approaches could be applied to consider options for sequencing activities within any area of resource overlap.

If the aquaculture sector in Welsh inshore and offshore waters were to expand, there could be opportunity for co-existence. This is given the flexibility in siting aquaculture locations relative to aggregate resource and extraction, to optimise spatial co-existence. Mapping resource overlap (Figure 4.3) and examining sector interactions (Table 4.1) will be important for the planning authority when developing criteria for the development of any SRA (and applying safeguarding policy) for these two sectors. It will also help facilitate dialogue between the sectors and their regulators.

With regards to the spatial overlap between focal sectors, the marine aggregate resources covers an area of ca. 9,675 km^2, of which ca. 4.45% (ca. 430 km^2) overlaps with tidal stream resources, ca. 9.8% (ca. 950 km^2) with wave energy resources, ca. 13.75% (ca. 1,330 km^2) with seabed aquaculture resources and ca. 29.2% (ca. 2,824 km^2) with water column aquaculture resources.

Spatial co-existence of marine aggregates with subsea cables is considered unlikely (Table 4.1; Figure 4.4). Currently for consenting, safety and operational reasons, aggregate extraction is usually separate from subsea cables, offshore wind farms and the associated cable routes (Figure 4.4). Physical interaction between the resource and cable infrastructure is typically avoided because of risks for operations and mechanical integrity (for the cables and dredgers). Mutually acceptable proximity limits and proximity agreements can be used by aggregate and subsea cable operators, on a case-by-case basis, to keep the activities/infrastructure separate and thus minimise spatial conflict[22]. Whilst the operational characteristics of the two sectors precludes co-existence simultaneously, forward-looking, proactive and spatial planning approaches could be

[22] Source: TCE and BMAPA Good Practise Guidance https://bmapa.org/documents/BMAPA_TCE_Good_Practice_Guidance_04.2017.pdf [Last access: 06/04/2020].

applied to consider options for sequencing activities within any area of resource overlap. Mapping resource overlap and examining sector interactions (Table 4.1), will be important for the planning authority when developing criteria for the development of any SRA (and applying safeguarding policy) for these two sectors. It will also help facilitate dialogue between the sectors and their regulators.

As discussed in section 3 and indicated in Table 4.1, there is potential for spatial co-existence of marine aggregates with several sectors, including commercial fishing and shipping (Figure 4.5 and Figure 4.6, respectively). This is achieved primarily through spatial zoning and mutual co-operation between sectors. This could mean an opportunity for optimising spatial co-existence and should be considered as part of the SRA determination process. Mapping resource overlap (Figure 4.5 and Figure 4.6) and sector interactions (Table 4.1) will be important for the planning authority when developing criteria for the development of any SRA (and applying safeguarding policy) for these sectors, and will help facilitate dialogue between the sectors and their regulators.

It is recognised in the summary in Table 4.1 and section 3.2, that marine aggregate resource will become available once the resource is extracted, hence there is a flexibility associated with the extraction history.

Due to its potential to create a navigational barrier, new marine aggregate dredging in Cardigan bay and off the south-west coast of Pembrokeshire would need permission from the Ministry of Defence (Figure 4.7).

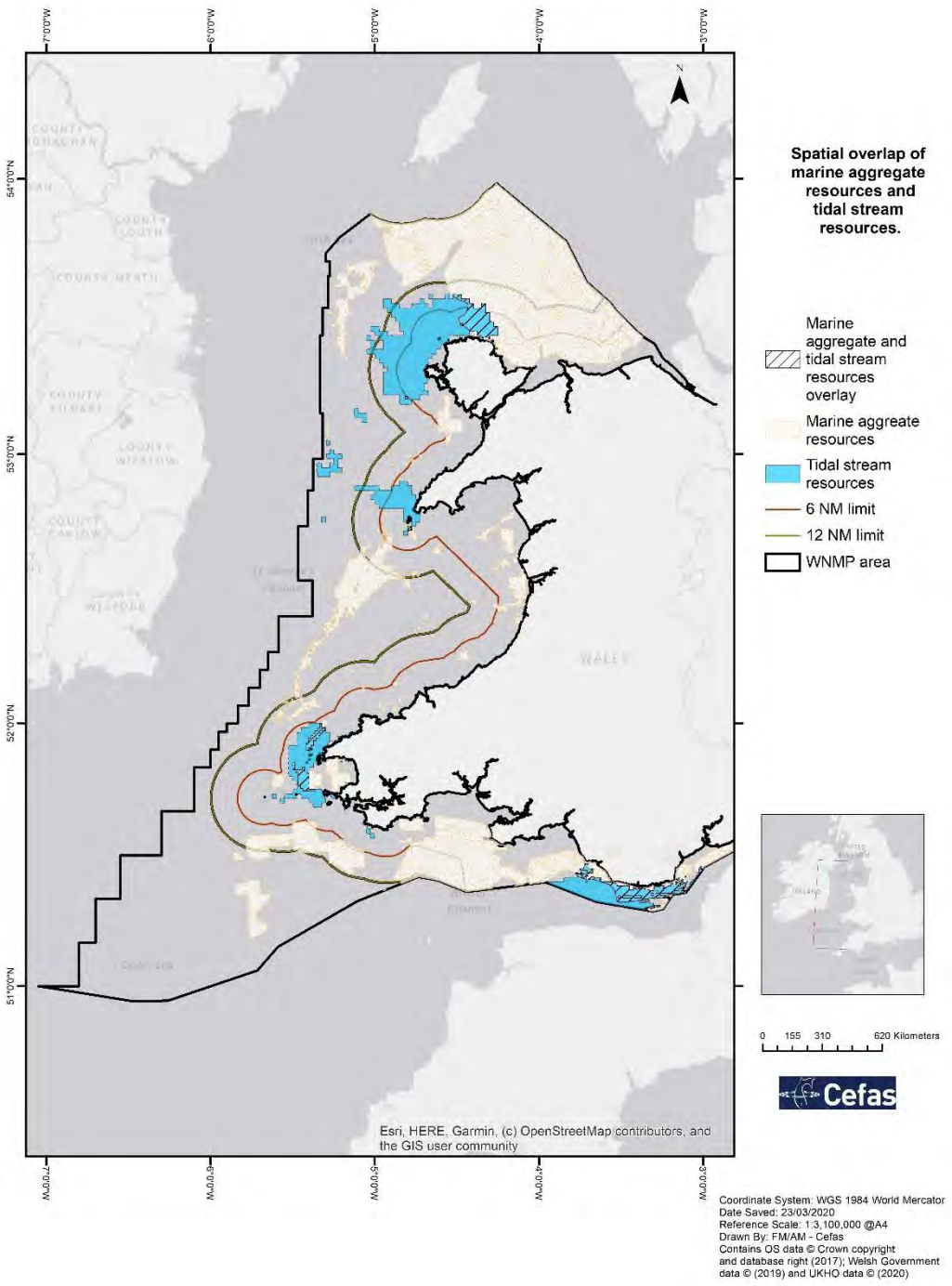

Figure 4.1: Spatial overlap of marine aggregate and tidal stream resources.

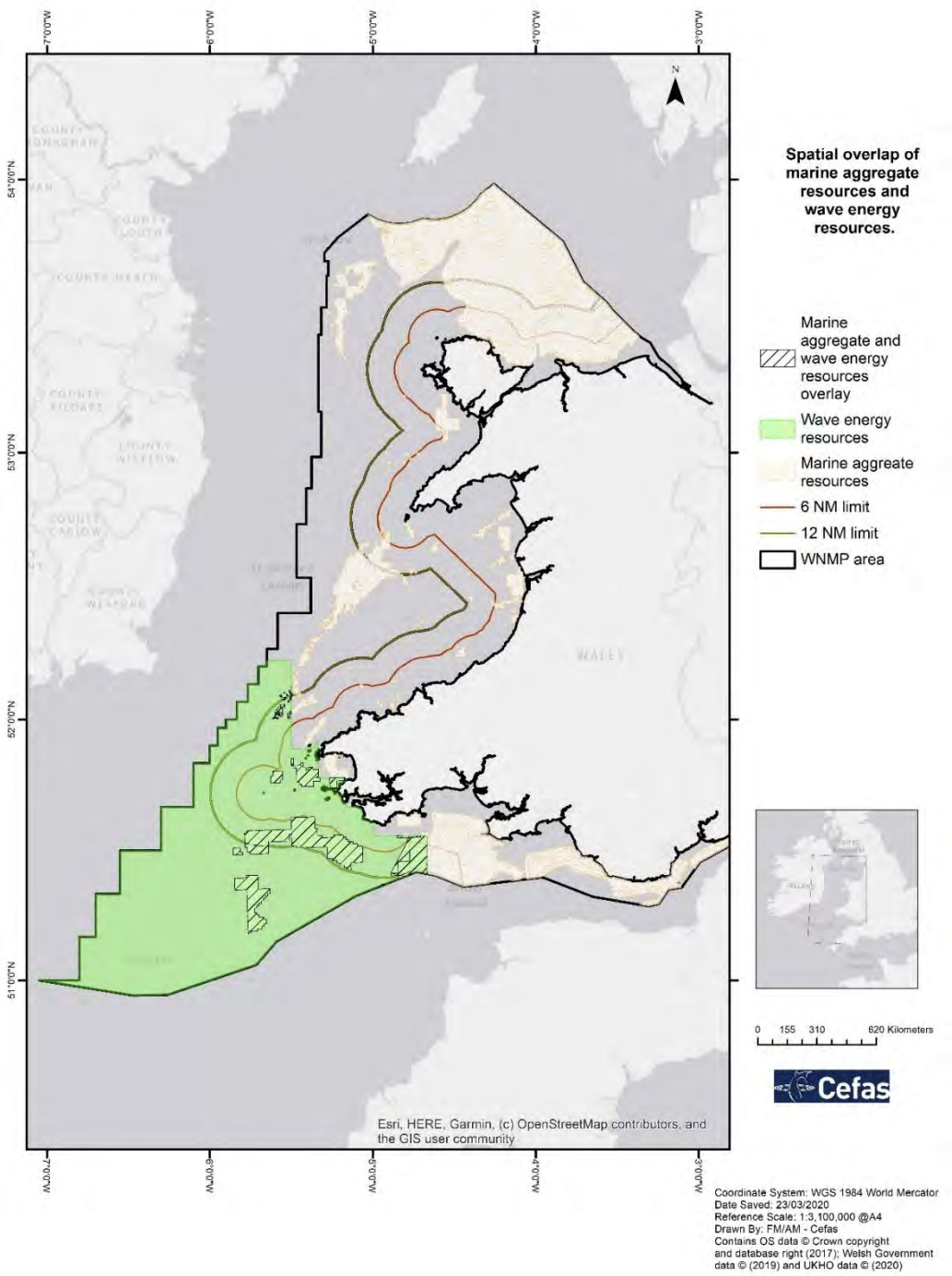

Figure 4.2: Spatial overlap of marine aggregate and wave energy resources.

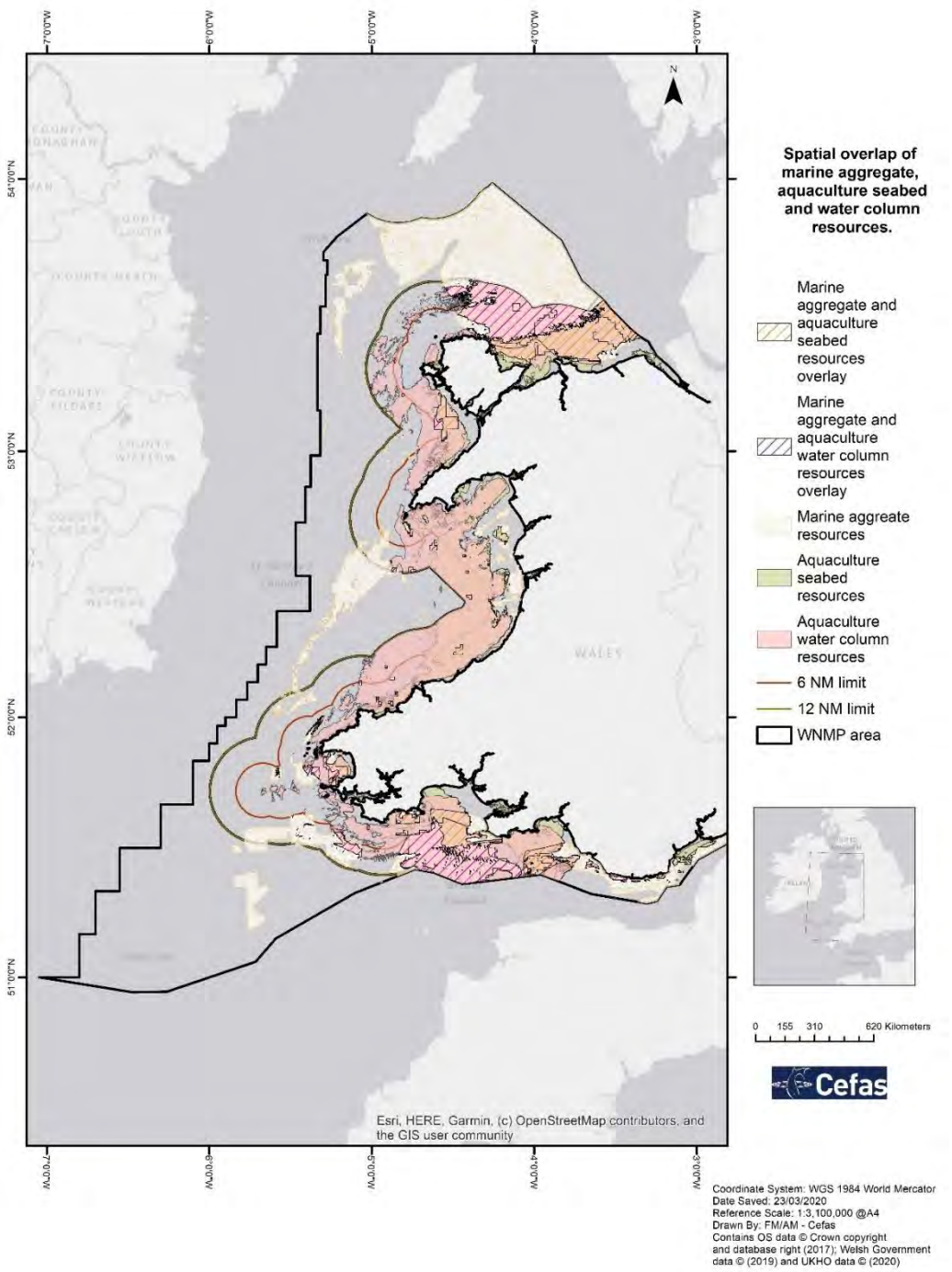

Figure 4.3: Spatial overlap of marine aggregate resources and resources for seabed and water column aquaculture.

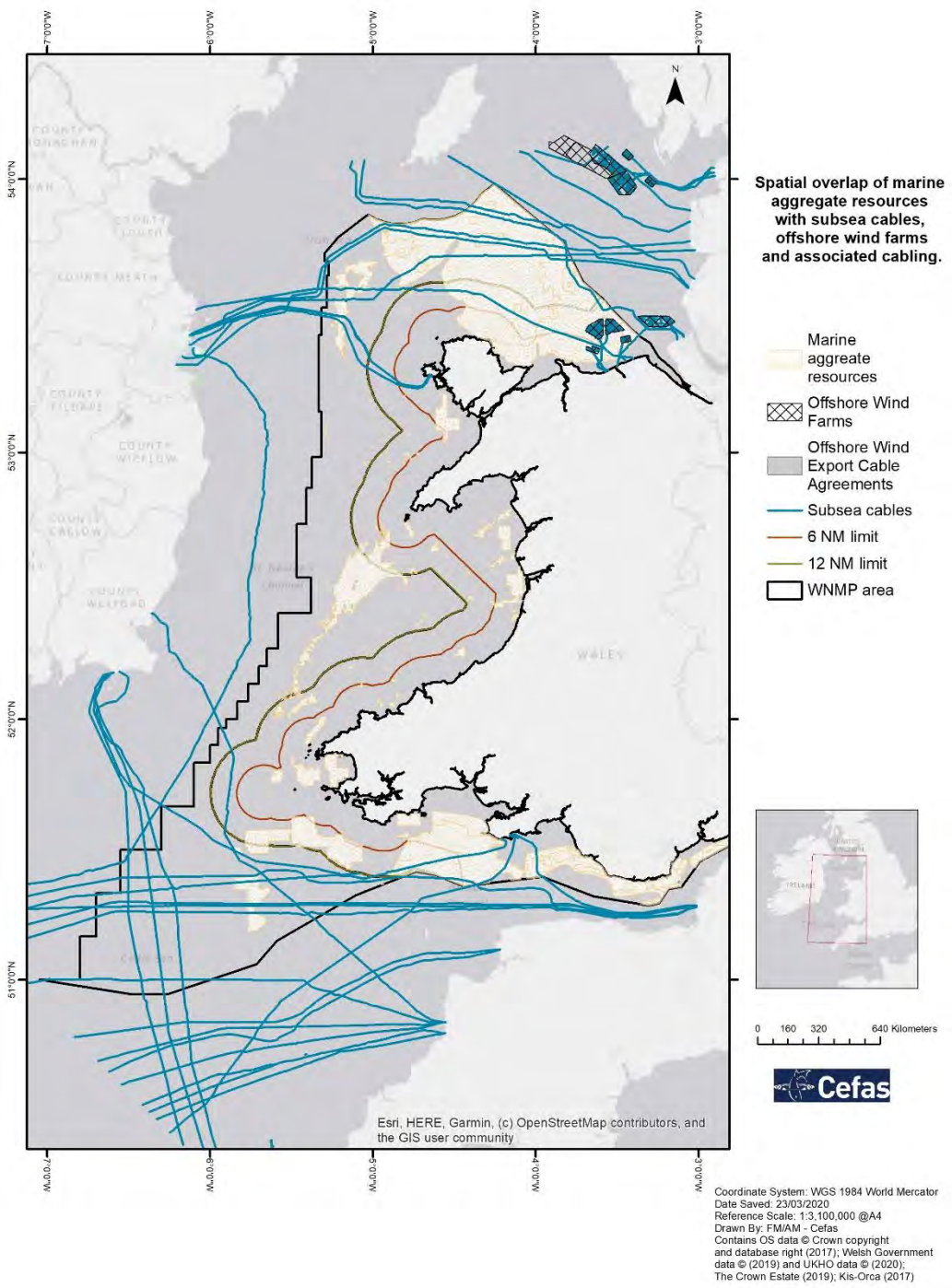

Figure 4.4: Spatial overlap of marine aggregate resources with subsea cables and with consented offshore wind farms (as of 2017) and associated export cabling.

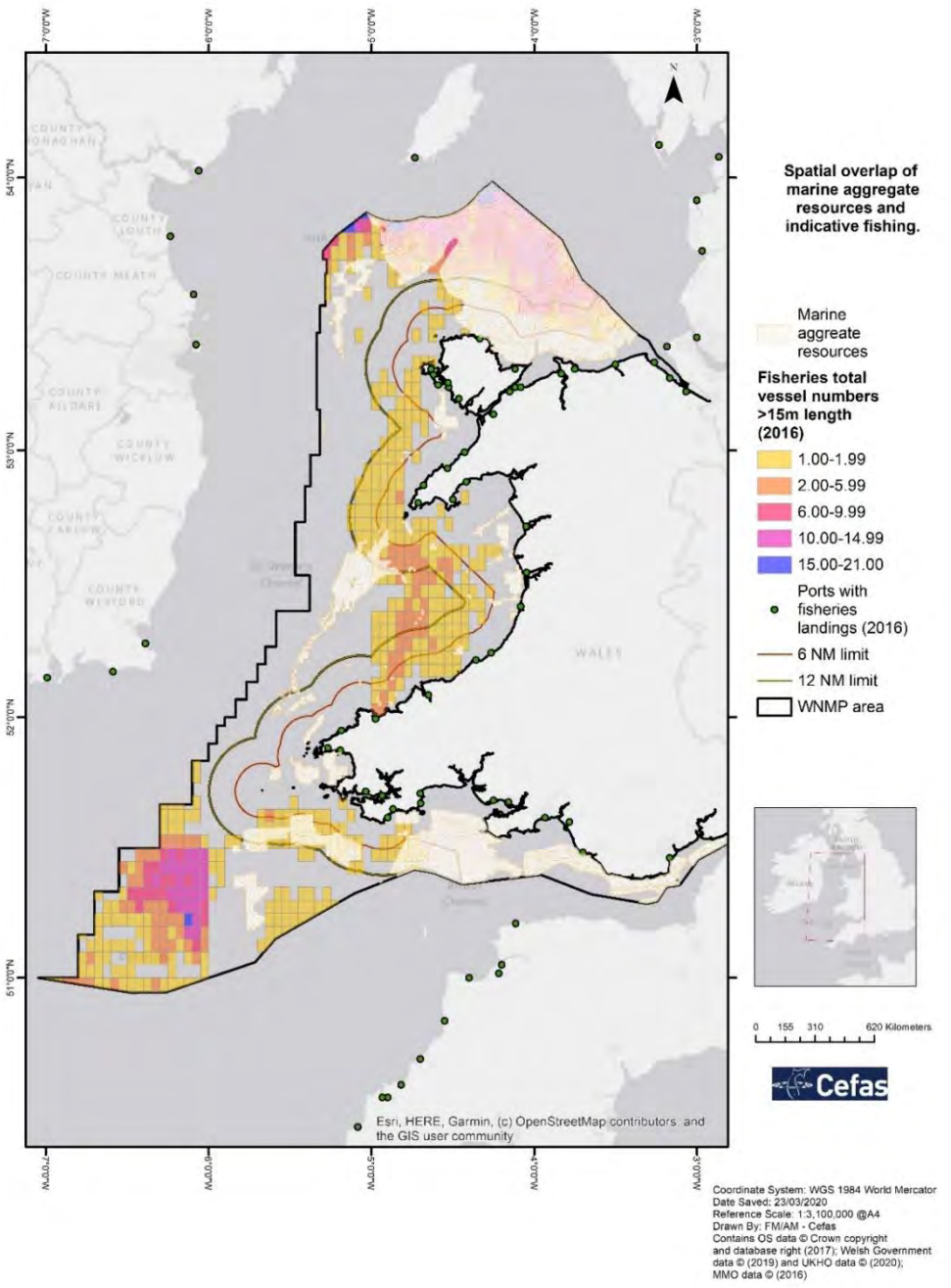

Figure 4.5: Spatial overlap of marine aggregate resources and fisheries[23].
The map is indicative only and shows ports with recorded landings (in 2016) and total vessel numbers (≥15m vessel length) recorded per ICES sub-rectangle[24].

[23] Fishing is considered a mobile activity that could occur in many locations within a given season/year, and over successive years. Data for the activity of vessels <15m, notably the inshore commercial fleet working in the 0-6NM limit, is not represented in the maps due to data availability and limitations. However, the inshore nature of the fisheries and associated vessel activity, are important considerations for spatial-temporal interaction with the focal and non-focal sectors discussed.

[24] There are recognised caveats in the process used to generate fishing activity data within ICES sub-rectangles around Wales and England. The process uses Vessel Monitoring System data and logbook data for recorded landings, to generate indicative fishing activity data.

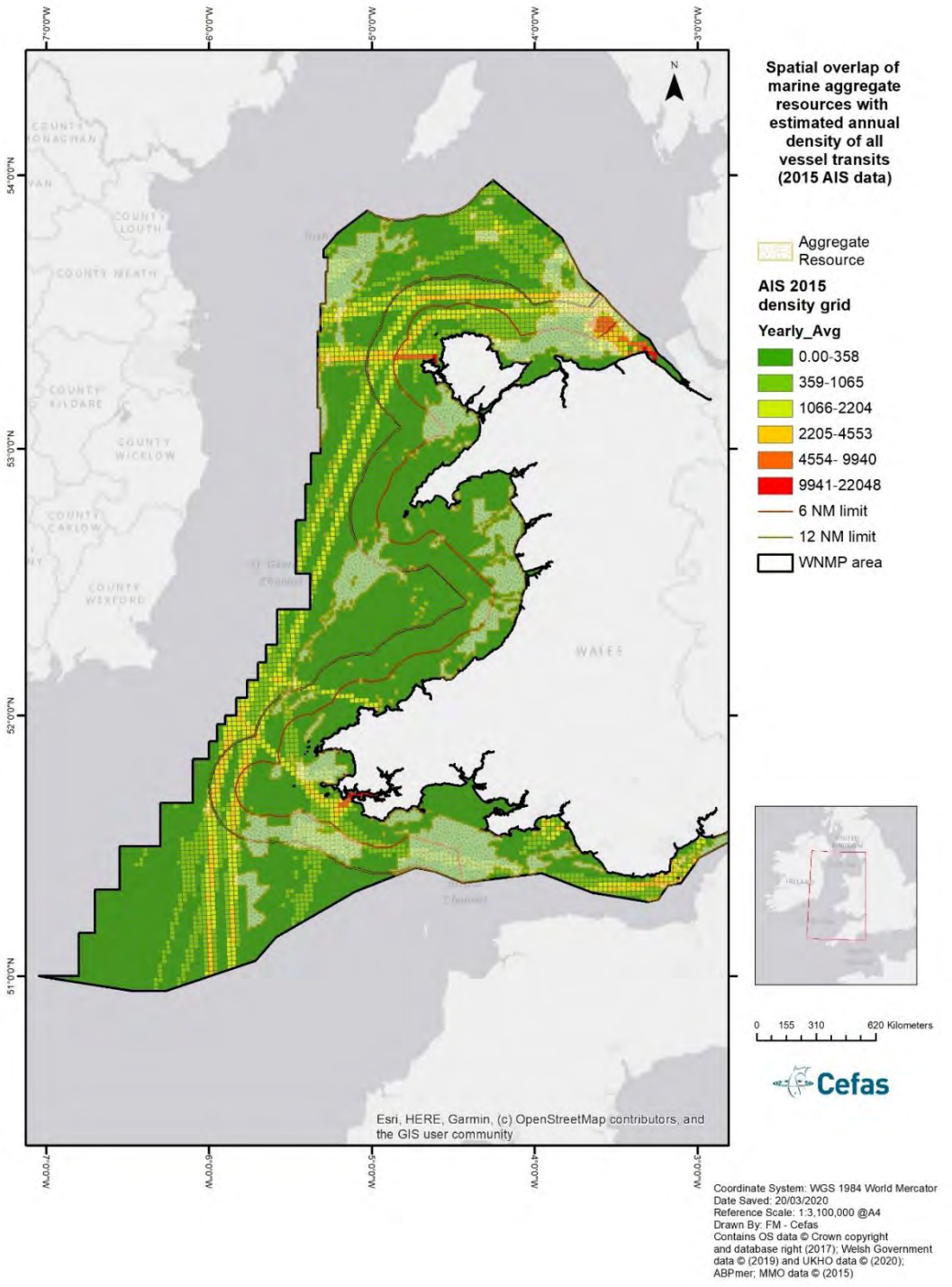

Figure 4.6: Spatial overlap of marine aggregate resources and shipping.

Shipping activity represented by estimated annual density of all vessel transits from Automatic Identification Systems data (available in 2015).

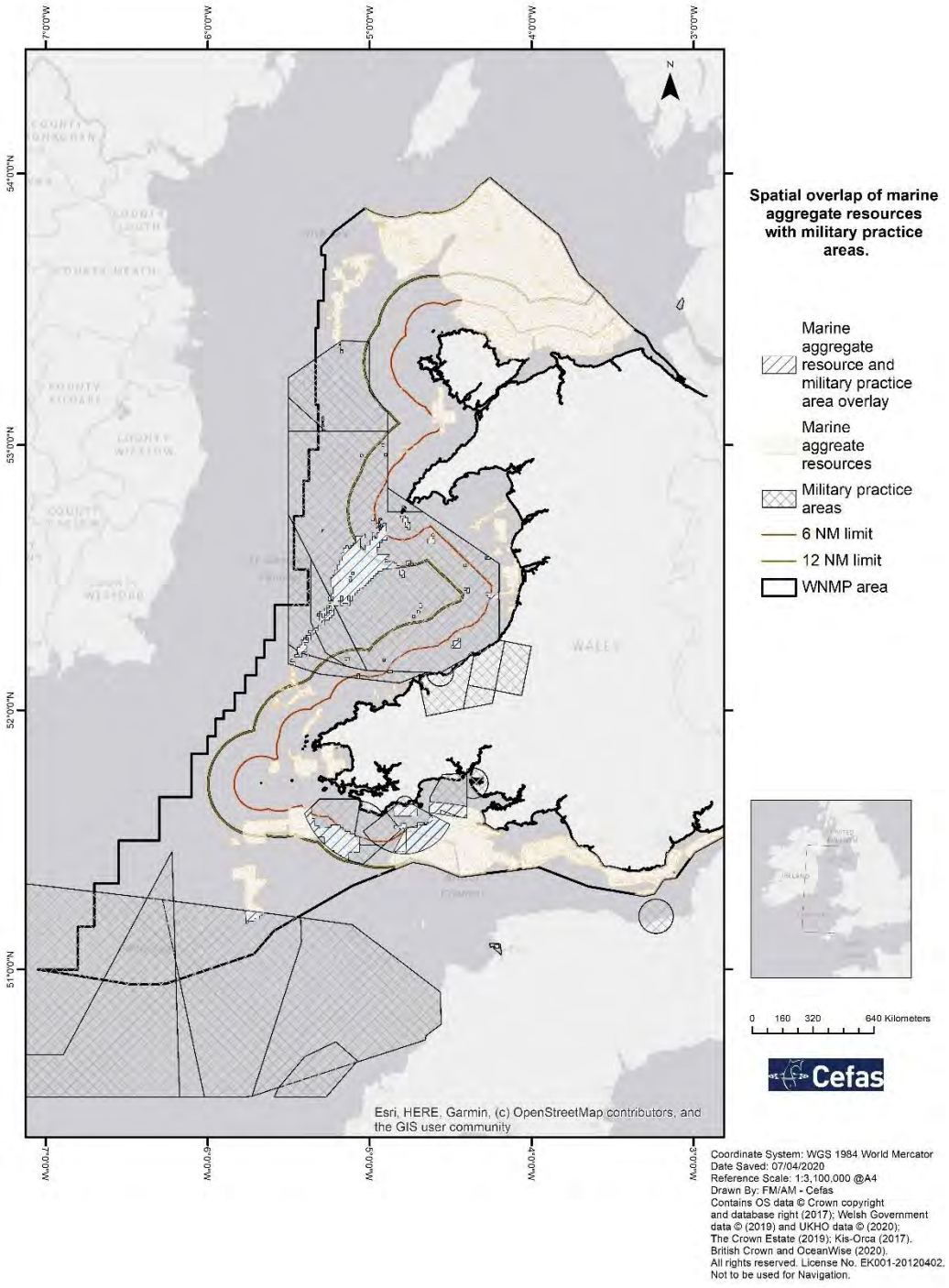

Figure 4.7: Spatial overlap of marine aggregate resources and military practice areas.

Table 4.1: Summary of marine aggregate interaction with other focal and non-focal sectors.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact spatially (possible, likely or unlikely)? If so, how do they interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space, yet at different times (possible, likely or unlikely)?[25]
Energy	Wave **Refer to Figure 4.2 for the indicative sector interaction map.**	**Possible**– Resources for aggregates and wave energy coincide to the south and south-west of Pembrokeshire.	**Unlikely** – Currently for consenting, safety and operational reasons, aggregate extraction is typically separate from wave devices and associated infrastructure, present on the sea surface/ water column.
	Tidal stream (fixed and floating) **Refer to Figure 4.1 for the indicative sector interaction map.**	**Possible** – Resources for aggregates and tidal stream energy coincide in several areas: north coast of Anglesey, south-west Pembrokeshire, Bristol Channel; off the coast of Cardiff round to Porthcawl.	**Unlikely** – Currently for consenting, safety and operational reasons, aggregate extraction is currently separate from tidal stream devices and associated infrastructure, present along or on the seabed, or in the water column.
	Wind turbines (fixed and floating)	**Possible** – Resources for aggregates overlap with wind energy resource areas around all of Welsh waters. Notably, existing OWF and proposed extensions sited off the North Wales coastline are adjacent to aggregate resource areas and licensed extraction areas.	**Unlikely** – Currently for consenting, safety and operational reasons, aggregate extraction is usually separate from fixed/floating turbines (and turbines together in a wind farm), where the structures exist at the sea surface, through the water column and with a base that can be atop or within the seabed (if not floating structure). However, if marine aggregates were to occur, cease and then the seabed area made available for wind energy, potential exists for occupation of same space at different times.
	Offshore wind farms (fixed and floating) **Refer to Figure 4.3 for the indicative sector interaction map.**		
	Oil and Gas (incl. submarine pipelines and other infrastructure)	**Likely** – Resources for aggregates off the North Wales coast, within Liverpool Bay, overlap with oil and gas infrastructure and petroleum licensing areas.	**Unlikely** – Consenting, safety and operational reasons including asset protection (oil and gas rounds), aggregate extraction separated from oil and gas structures atop the sea surface and pipelines/well heads etc on/along the seabed.
	Miscellaneous (incl. overhead power lines, power station, substations)	**Unlikely** – Marine aggregate extraction at sea, whereas the structures are coastal based.	**Possible** – Maritime occurrence of aggregate dredging and use of established navigational routes for vessel transits. Whereas miscellaneous structures present at the coast or not sited directly in footprint of the licensed area.

[25] Areas of marine aggregate resource will become available once the resource has been full exploited, hence there is flexibility in spatio-temporal associated with extraction history.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact spatially (possible, likely or unlikely)? If so, how do they interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space, yet at different times (possible, likely or unlikely)?[25]
Aquaculture	Bottom culture – shellfish **Refer to Figure 4.3 for the indicative sector interaction map.**	**Unlikely** – Aggregate resources overlap with resources for seabed aquaculture (shellfish bottom cultivation), in several areas: north-east Anglesey, off North Wales, south Pembrokeshire, and Carmarthen and Swansea Bay. However, interaction is unlikely since the activities typically each occupy a relatively small footprint.	**Unlikely** – Safety and operational reasons, aggregate extraction is usually separate from shellfish cultivated on the seabed. In the future if bottom culture of shellfish expands, there is considered to be flexibility in the location of the activity relative to marine aggregate resources.
	Cage culture – finfish **Refer to Figure 4.3 for the indicative sector interaction map.**	**Possible** – Aggregate resources overlap with resources for cage-based finfish cultivation in locations such as off the north coast and south-west of Anglesey, south Pembrokeshire, and Carmarthen and Swansea Bay.	**Unlikely** – Safety and operational reasons, aggregate extraction is usually separate from finfish culture in cages. Commercial finfish aquaculture in cages is not occurring in Wales at present. In the future if cage cultivation of finfish expands which could be offshore then there is considered to be flexibility in the location of the activity relative to marine aggregate resources.
	Rope culture – shellfish **Refer to Figure 4.3 for the indicative sector interaction map.**	**Possible** – Aggregate resources overlap with resources for rope culture of shellfish, for instance, off the north coast and south-west of Anglesey, south Pembrokeshire, and Carmarthen and Swansea Bay.	**Unlikely** – Safety and operational reasons, aggregate extraction is usually separate from shellfish rope culture. In the future if rope cultivation of shellfish expands potentially offshore, there is likely to be flexibility in the location of the aquaculture activity relative to marine aggregate to enable co-existence potential.
	Rope culture – seaweed **Refer to Figure 4.3 for the indicative sector interaction map.**	**Possible** – Aggregate resources overlap with resources for rope culture of seaweed, for instance, off North Wales coast, south-west of Anglesey, around the Llŷn Peninsula, south Pembrokeshire, Carmarthen and Swansea Bay and coastal to Cardiff.	**Unlikely** – Safety and operational reasons, aggregate extraction is usually separate from seaweed rope culture. In the future if rope cultivation of seaweed expands potentially offshore, there is likely to be flexibility in the location of the aquaculture activity relative to marine aggregate to enable co-existence potential.
	Trestle culture - shellfish	**Possible** – Aggregate resources overlap with resources for trestle-based shellfish cultivation within the Inner Bristol Channel, (coastal from Cardiff to Newport).	**Possible** – Spatial separation of aggregate extraction areas at sea and intertidal nature of trestle cultivation.
Fisheries	Mobile mid-water gear	**Likely** – Areas fished with mobile mid-water gear could coincide with suitable aggregate resources.	

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact spatially (possible, likely or unlikely)? If so, how do they interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space, yet at different times (possible, likely or unlikely)?[25]
	Refer to Figure 4.5 for the indicative sector interaction map for fisheries (based on 2016 fishing activity of >15m vessels, without division of activity by gear types).		**Likely** – But only where mobile fishing occurs outside of the Active Dredge Zones (ADZ) in licensed aggregate extraction areas.
	Mobile bottom gear	**Likely** – Possible that areas fished with mobile bottom gear coincide with suitable aggregate resources.	
	Static gear (pots, lines, nets etc)	**Likely** – Possible that areas fished with static gear could be where suitable aggregate Resources occur.	**Likely**– But only where static gear is placed outside of the ADZ in licensed aggregate extraction areas.
	Hydraulic dredging	**Likely** – Possible that areas fished with hydraulic dredging (mainly for bivalves) coincide with suitable aggregate resources.	**Likely** – But only where the hydraulic dredging occurs outside of the ADZ in licensed aggregate extraction areas.
	Rod and lining	**Likely** – Possible that areas fished commercially with rods and lines could be where suitable aggregate resources occur.	**Likely**– But only where the rod and lining occur outside of the ADZ in licensed aggregate extraction areas.
	Hand gathering	**Unlikely** –Hand gathering is primarily intertidal in contrast to the subtidal extraction of aggregate.	**Likely** – Spatial separation from aggregate extraction areas at sea and intertidal nature of hand gathering.
Ports and Shipping	Shipping - navigation routes **Refer to Figure 4.6 for the indicative sector interaction map.**	**Likely** – Aggregate resources coincide with vessel traffic routes including to/from Newport and Cardiff in the Bristol Channel, Swansea Bay, Pembroke/Milford Haven, Holyhead on the north Anglesey coast, and Liverpool port and Liverpool Bay.	**Likely** – Aggregate dredgers may utilise existing navigational routes to access a licensed area. However, statutory navigational measures and best practise measures in place whilst a dredger is active in the ADZ. Co-existence potential with navigational measures in place.
	Anchorage areas	**Likely** – Aggregate resources coincide with anchorage areas including off Cardiff and Newport, Bristol Channel.	**Unlikely** – Where anchorage areas are already present before marine aggregates, the potential for co-location on operational and safety grounds is limited.
Subsea cables	Cables and telecommunications **Refer to Figure 4.4 for the indicative sector interaction map.**	**Likely** – Aggregate resources coincide with subsea cable routes within the Inner and Outer Bristol Channel, and within inshore and offshore areas of Liverpool Bay.	**Unlikely** – Physical disturbance of seabed not compatible for the dredging activity or subsea cables. On safety and operational basis, proximity limits and proximity agreements utilised between aggregate and subsea cable

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact spatially (possible, likely or unlikely)? If so, how do they interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space, yet at different times (possible, likely or unlikely)?[25]
			operators. A separation of approximately 1 nm, is considered good practice[26].
Surface water and wastewater treatment and disposal	Intakes and outfalls, including licensed discharges	**Possible** – Aggregate resources coincide with coastal pipelines including from Cardiff and Newport.	**Possible** – Surface water and wastewater treatment and disposal developments usually coastal or inshore, hence minimal interaction with marine aggregate extraction. But future developments of the surface/wastewater infrastructure may need to ensure these are sited and with agreements to achieve co-existence with aggregate areas.
Dredging and Disposal	Designated disposal sites (Active)	**Likely** – Aggregate resources coincide with licensed disposal sites within Liverpool Bay, off the north-east Anglesey coast and within areas of the Bristol Channel.	**Unlikely** – Safety and operational reasons, including burial of and contamination of potential resource, mean that aggregate extraction is usually separated from designated dredging locations and disposal sites.
Defences	Military exercise areas/ammunition disposal sites **Refer to Figure 4.7 for the indicative sector interaction map.**	**Likely** – Aggregate resources coincide with Military Practise Areas in Cardigan bay, off the Llŷn Peninsula, off the south-west coast of Pembrokeshire and in Carmarthen Bay.	**Unlikely** – Safety and operational reasons, defence areas typically separate from the aggregate extraction. Future development for marine aggregates areas would need to be in dialogue with MoD, as per the WNMP defence sector policy.
Tourism and Recreation	Recreational Sea Angling (RSA)	**Possible** – Aggregate resources coincide with RSA undertaken from chartered vessels around seabed features/wrecks.	**Possible** – But likely only where the RSA occurs outside of the ADZ in licensed aggregate extraction areas.
	RYA marinas and sailing routes	**Possible** – Possible that sailing routes pass by or through resource areas. Unlikely for coastal based marinas unless directly adjacent to wharves.	**Possible** - But dredgers may utilise existing navigational routes to access a licensed area. However, statutory navigational measures and best practise measures in place whilst dredger is active in the ADZ, hence no immediate spatial co-existence. But outside of dredging, spatial interaction not present.
	Water sports (e.g. surfing, kite surfing, diving, rafting)	**Possible** – Possible use of the sea surface or water column for water sports. Although diving may be	**Possible** – Safety and operational reasons, aggregate extraction occurring in the ADZ. But outside of dredging the area could be available and accessed by water sports.

[26] Source: TCE and BMAPA Good Practise Guidance https://bmapa.org/documents/BMAPA_TCE_Good_Practice_Guidance_04.2017.pdf [Last access: 06/04/2020].

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact spatially (possible, likely or unlikely)? If so, how do they interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space, yet at different times (possible, likely or unlikely)?[25]
		affected by poor visibility if dredging results in high turbidity.	
	Shore based activity (e.g. coasteering, hiking, dog walking, kites)	**Unlikely** – Extraction occurring away from the shoreline and hence unlikely for the activities to intersect. However, landings made to wharfs along the coast e.g. Penryhn, Pembroke, Port Talbot, Swansea could mean the vessel traffic is visible to shore-based activities.	**Possible** – Spatial separation from active aggregate extraction areas at sea and activities on/by the shore. Also, dredgers transiting to/from licence areas and port, using established navigational routes, may be visible from shore.
	Wildlife watching - shore based	**Unlikely** – Extraction occurring away from the shoreline and hence unlikely for the activities to intersect. However, landings made to wharfs along the coast e.g. Pembroke, Port Talbot, Swansea could mean the vessel traffic is visible to shore-based activities.	**Possible** – Spatial separation from active aggregate extraction areas at sea and activities on/by the shore. Also, dredgers transiting to/from licence areas and port, using established navigational routes, may be visible from shore.
	Wildlife watching - boat based	**Possible** – Possibly with passage of wildlife boats through licensed areas, though not within ADZ whilst dredger present. Also, consider where dredging related operations, may not be conducive to the presence of wildlife of interest e.g. seabirds.	**Possible** – Safety and operational reasons, aggregate extraction occurring in the ADZ. But outside of dredging the area could be available and accessed by wildlife watching boats.

4.2 Low Carbon Energy: tidal stream resources

A summary of interaction appraisal for tidal stream and other sectors is shown in Table 4.2.

As mentioned in section 3.1.1, spatial co-existence of marine aggregates and tidal stream energy is considered unlikely, but the sequencing/timing of the activities has a bearing on co-existence potential. For instance, full aggregate exploitation in a licenced area, preceding the placement and operation of tidal stream infrastructure.

Mapping indicates an area off the west of Pembrokeshire where tidal stream and wave energy resources spatially overlap (Figure 4.8). It is unlikely that these two sectors could temporally co-exist in the same space, because floating or seabed mounted energy devices would effectively preclude access to each other. Whilst the operational characteristics of the two sectors precludes co-existence at the same time, forward-looking, proactive and spatial planning approaches could be applied to consider options for sequencing activities within any area of resource overlap.

Mapping indicates spatial overlap of resources for tidal stream energy and seabed and water column-based aquaculture resources (Figure 4.9). The sequencing/timing of the activities can have a bearing on co-existence potential and there is also the matter of regulatory changes to enable consenting of combined aquaculture and tidal stream energy developments, ideally operating on a commercial level.

Spatial and temporal management could be applied to sequence the activities of each sector (tidal stream, wave energy and aquaculture). Such future planning would benefit from dialogue between the respective sectors and their associated regulators. Having these resource overlays mapped (Figure 4.8 and Figure 4.9) and considering the interactions (Table 4.2) will help to target this dialogue on forward-looking, proactive and spatial planning. This resource overlap and sector interactions will also be important for the planning authority when developing criteria for the development of any SRA (and applying safeguarding policy) for these two sectors.

With regards to the spatial overlap between focal sectors, the tidal stream resources cover an area of ca. 2,164 km^2, of which ca. 19.9% (ca. 430 km^2) overlaps with marine aggregate resources, ca. 10.8% (ca. 233 km^2) with wave energy resources, ca. 1.26% (ca. 27 km^2) with seabed aquaculture resources and ca. 21.6% (ca. 466 km^2) with water column aquaculture resources.

As referenced in Table 4.2, there is potential for spatial co-existence of tidal stream energy with several other sectors, including subsea cabling and shipping (Figure 4.10 and Figure 4.11), tourism and recreation e.g. recreational sea angling and sailing (Figure 4.12). This could mean an opportunity for optimising spatial co-existence and should be considered as part of the SRA determination process. Mapping resource overlays (Figure 4.10 to Figure 4.12) and sector interactions (Table 4.2) will be important for the planning authority when developing criteria for the development of any SRA (and applying

safeguarding policy) for these sectors, and will help facilitate dialogue between the sectors and their regulators.

New tidal stream developments would need the permission of the Ministry of Defence if planned in the area off Llŷn Peninsula (Figure 4.13), due to its potential to create navigational hazards for military practices.

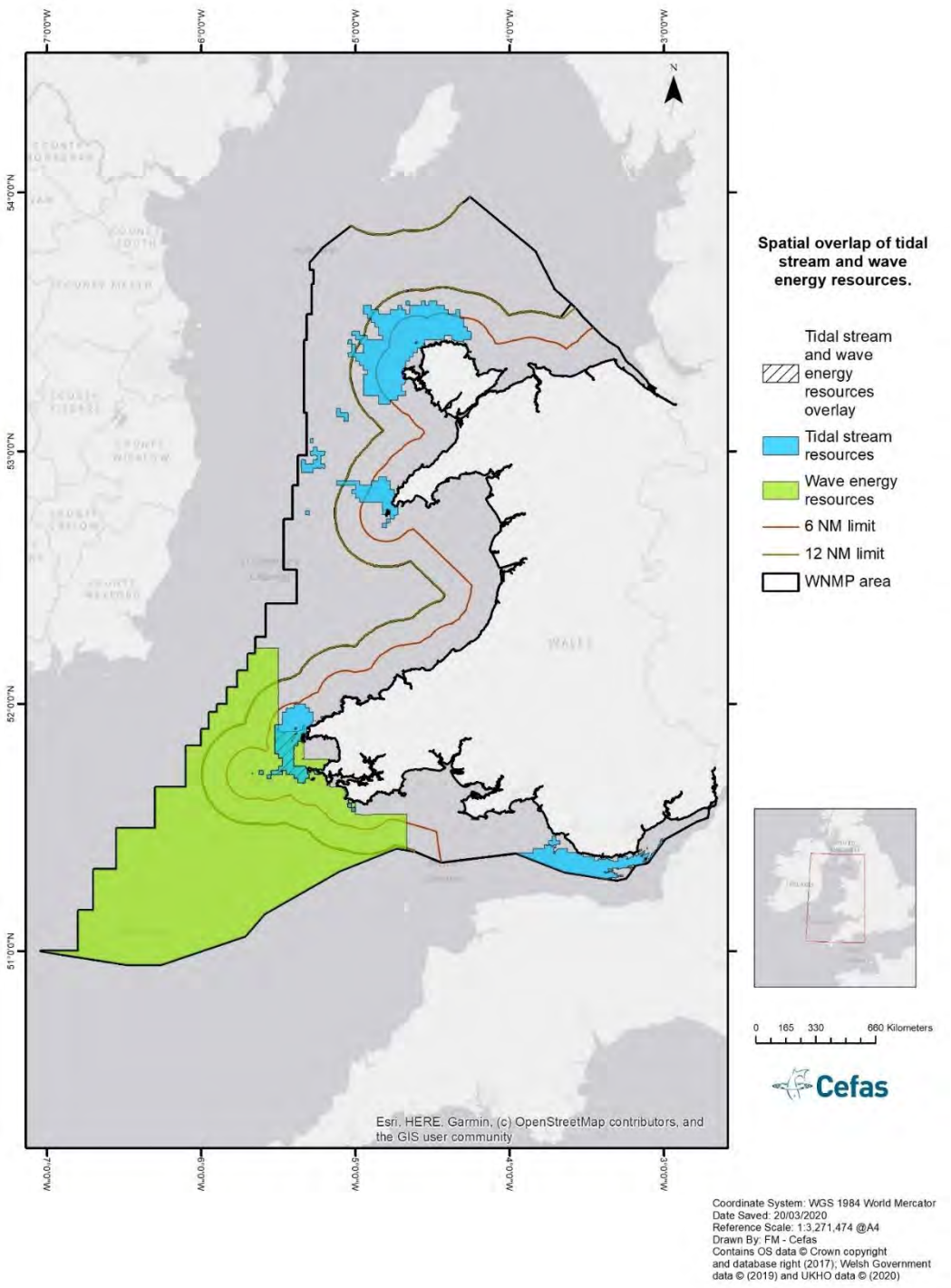

Figure 4.8: Spatial overlap of tidal stream and wave energy resources.

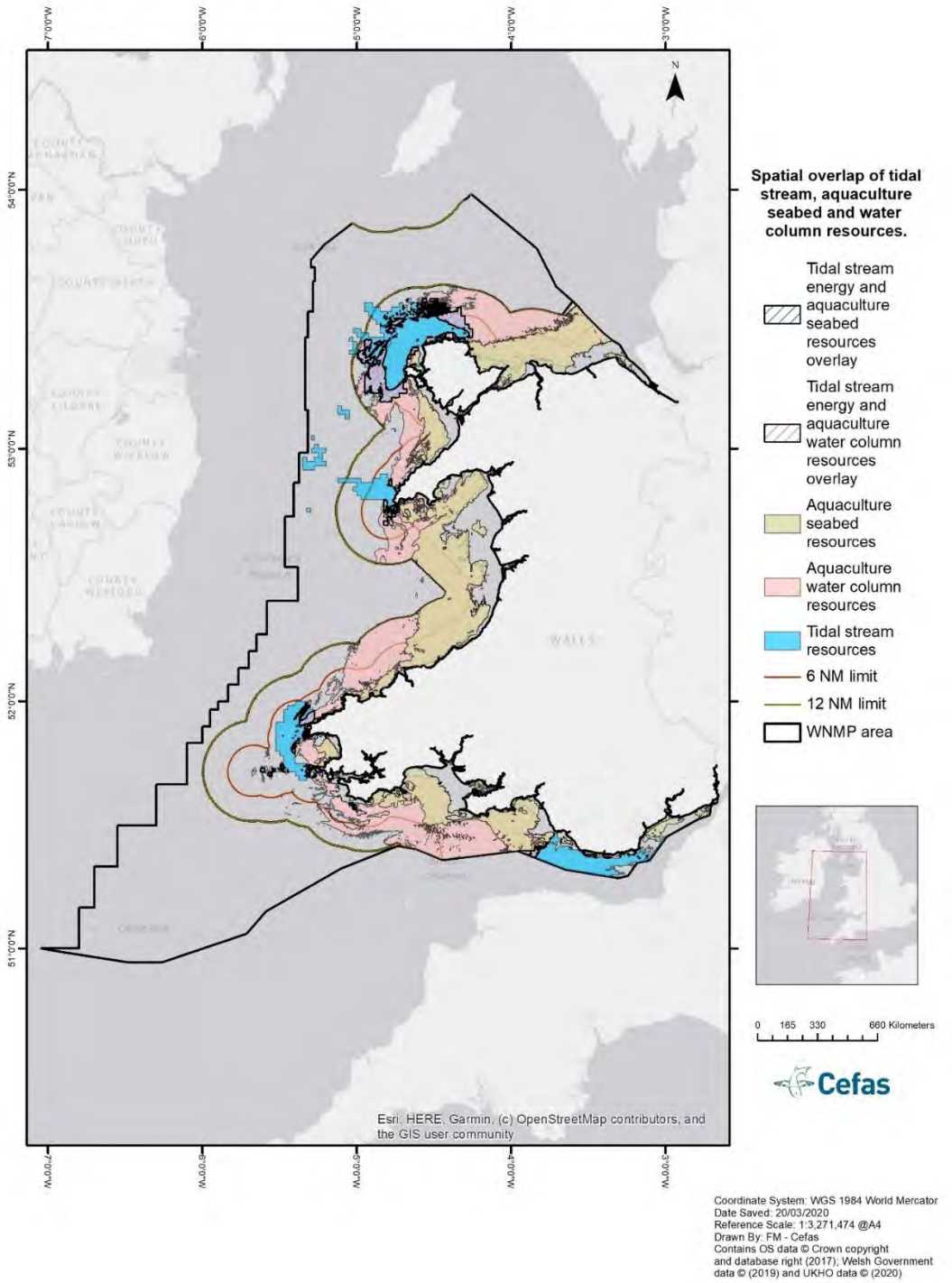

Figure 4.9: Spatial overlap of tidal stream energy and aquaculture (seabed and water column) resources.

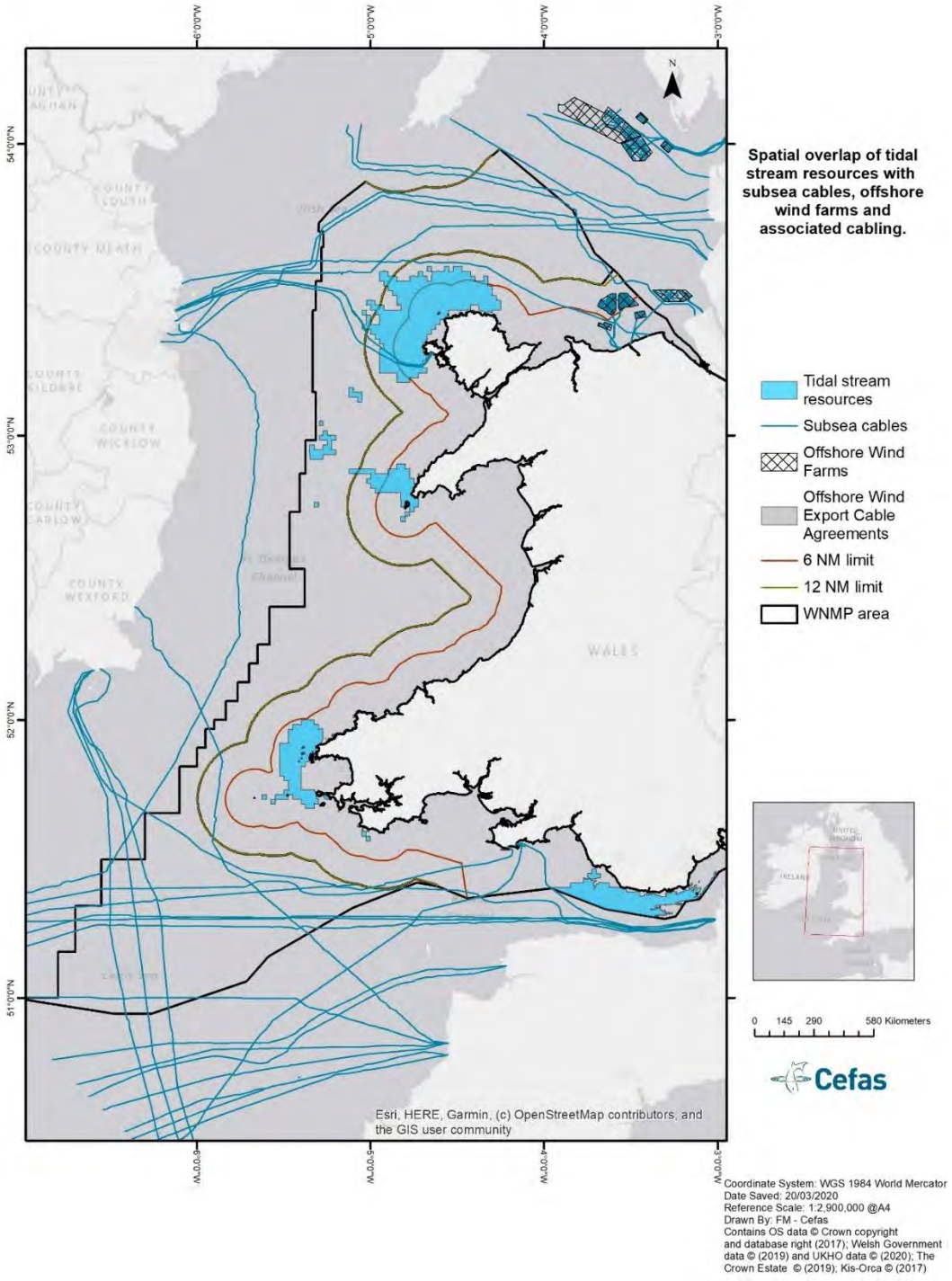

Figure 4.10: Spatial overlap of tidal stream resources and cables and with consented offshore wind farms (as of 2017) and associated export cabling.

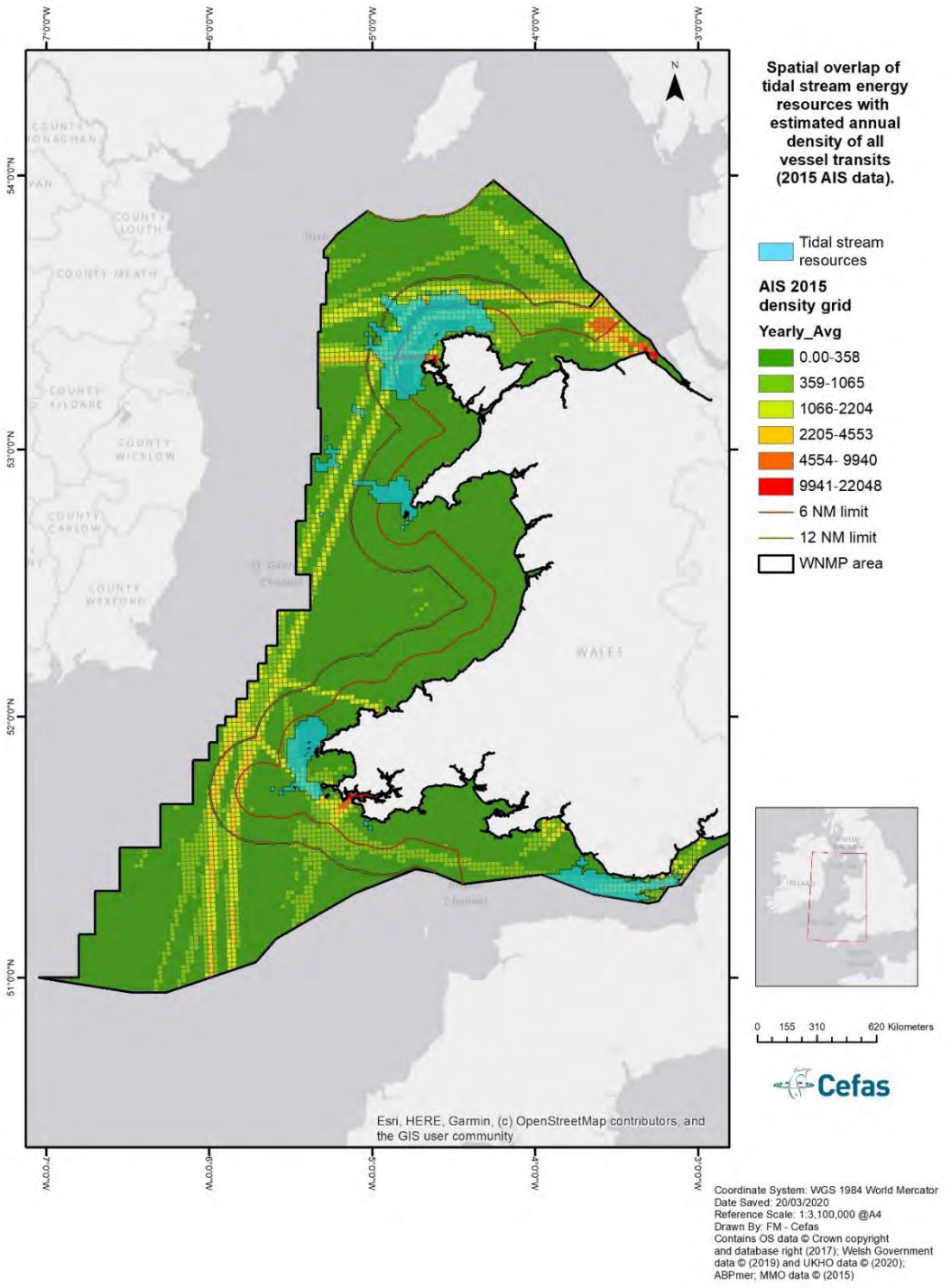

Figure 4.11: Spatial overlap of tidal stream resources and shipping.
Shipping activity represented by estimated annual density of all vessel transits from Automatic Identification Systems data (2015).

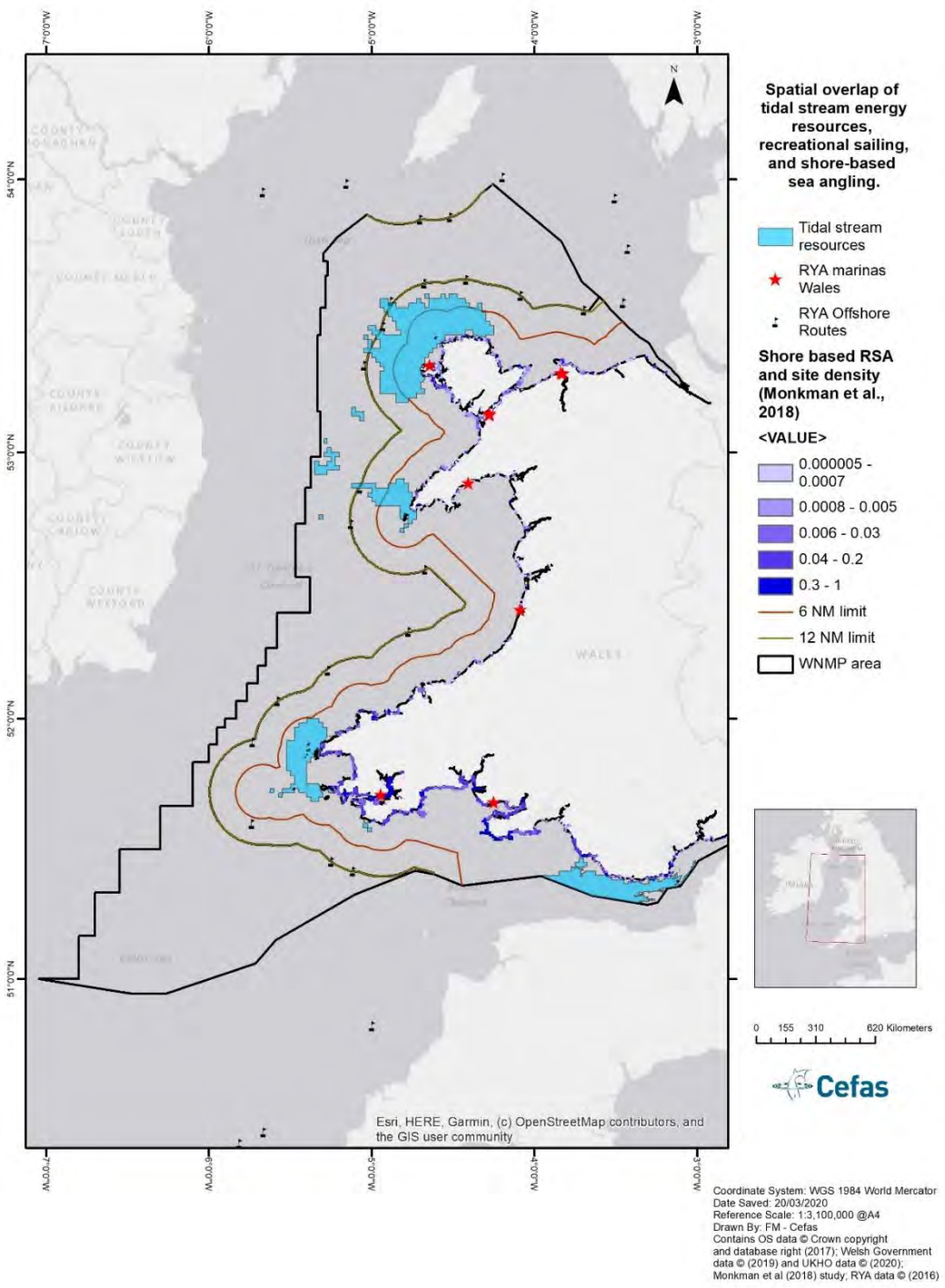

Figure 4.12: Spatial overlap of tidal stream energy and recreational activities.
Examples given for sailing and shore locations for recreational sea angling (source: Monkman et al., 2018).

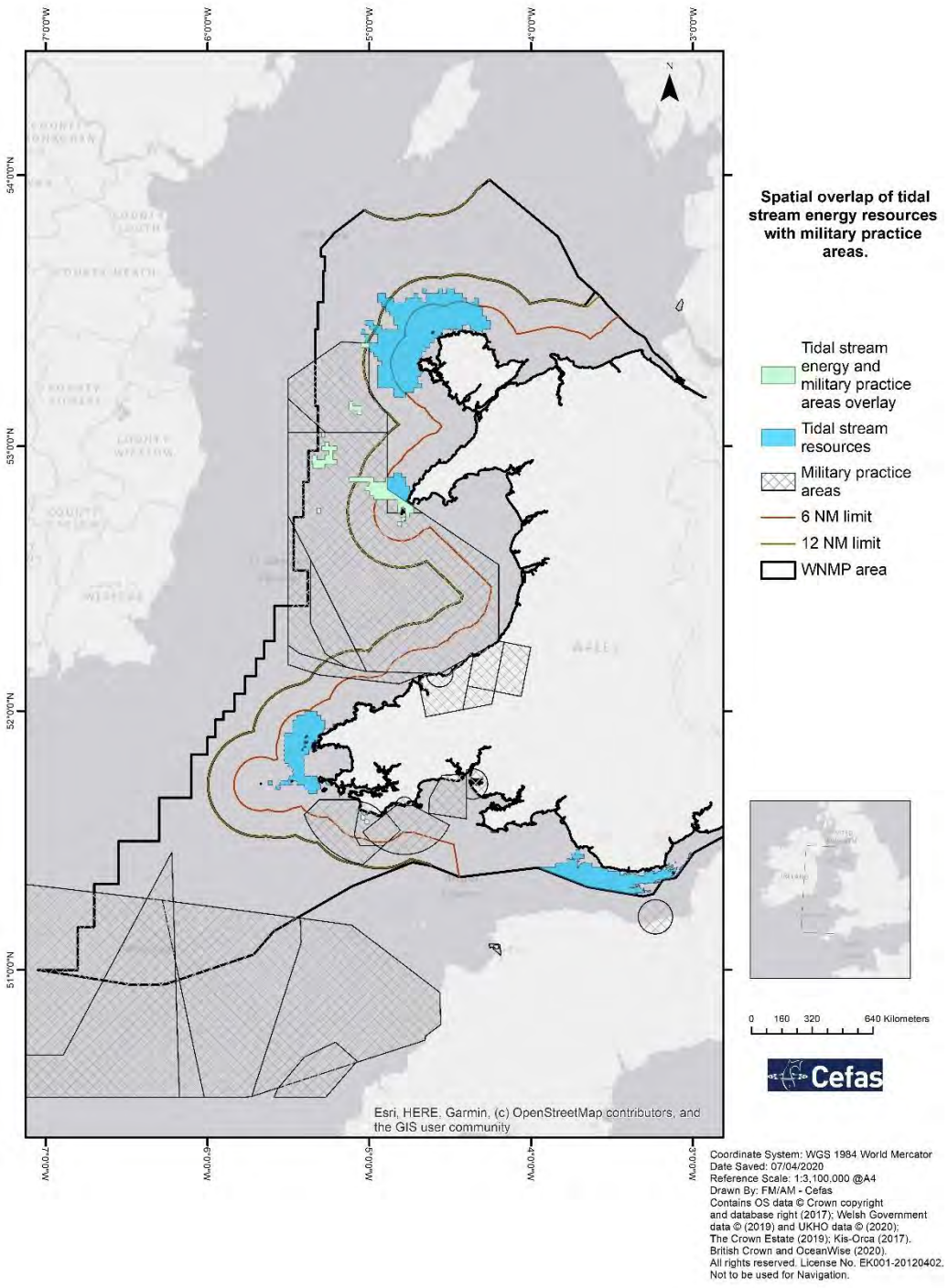

Figure 4.13: Spatial overlap of tidal stream energy and military practice areas.

Table 4.2: Summary of tidal stream energy interaction with other focal and non-focal sectors.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
Marine minerals	Marine aggregates	**Possible** – Tidal stream resources coincide with aggregate resources off north Anglesey, Pembrokeshire and within the Inner Bristol Channel.	**Unlikely** – Currently for consenting, safety, and operational reasons, licensed aggregate extraction spatially separate from tidal stream devices present on the sea surface/in the water column.
Energy	Wave energy **Refer to Figure 4.8 for the indicative sector interaction map.**	**Possible** – Tidal stream resources coincide with wave resources off the Pembrokeshire coast.	**Unlikely** – Currently for consenting, safety and operational reasons, spatial separation of tidal stream devices present along/on the seabed, or in the water column wave devices on the sea surface/in the water column.
	Wind turbines (fixed and floating)	**Possible** – Tidal stream resources overlap with wind energy resources off north Anglesey, around the Llŷn Peninsula, south Pembrokeshire, Carmarthen and Swansea Bay and coastal to Cardiff.	**Unlikely** – Currently for consenting, safety and operational reasons, tidal stream devices spatially separate from fixed/floating turbines (and turbines together in a wind farm) and wind farms.
	Offshore wind farms (fixed and floating)		
	Oil and Gas (incl. submarine pipelines and other infrastructure)	**Possible** – Petroleum licensing area off the Llŷn Peninsula intersect. However, otherwise overlap of tidal stream resources and existing oil and gas infrastructure is considered to be limited.	**Unlikely** – Safety and operational reasons, tidal stream devices usually spatially from oil and gas structures atop the sea. Proximity agreements/crossing agreements utilised by the operators where the device cables intersect pipelines.
	Miscellaneous (incl. overhead power lines, power station, substations)	**Possible**– Deployment of tidal stream device at sea whereas miscellaneous infrastructure predominantly at or on the shore.	**Likely** – Maritime occurrence of tidal stream devices, whereas miscellaneous structures present at the coast or in the case of substations (e.g. for operational renewable developments), tend not to be sited directly in footprint of the tidal stream devices or associated cabling.
Aquaculture	Bottom culture – shellfish **Refer to Figure 4.9 for the indicative sector interaction map.**	**Possible**– Tidal stream resources overlap with resources for seabed aquaculture (shellfish bottom cultivation), in locations such as off the Llŷn Peninsula, Pembrokeshire, and coastal sites in South Wales.	**Unlikely** – Safety and operational reasons, tidal stream devices (especially seabed anchored) are likely to be separate spatially from shellfish cultivated on the seabed.
	Cage culture – finfish	**Possible** – Tidal stream resources overlap with resources for cage-based finfish cultivation in	**Unlikely** – At present the chosen tidal stream regimes for devices are not considered optimal for caged fish farm operations (SARF, 2014).

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
	Refer to Figure 4.9 for the indicative sector interaction map.	locations such as off Anglesey, the Llŷn Peninsula, Pembrokeshire, and coastal sites in South Wales.	
	Rope culture – shellfish **Refer to Figure 4.9 for the indicative sector interaction map.**	**Possible** – Tidal stream resources overlap with resources for rope culture of shellfish, for instance, off Anglesey, the Llŷn Peninsula, Pembrokeshire, and coastal sites in South Wales near Cardiff.	**Possible** – Known examples of combining rope-based aquaculture and tidal stream energy are absent from Wales at present. However, there is scope for a potential co-location (multi-use of space) in the future.
	Rope culture – seaweed **Refer to Figure 4.9 for the indicative sector interaction map.**	**Possible** – Tidal stream resources overlap with resources for rope culture of seaweed, mainly off Anglesey.	
	Trestle culture - shellfish	**Unlikely** – Operational tidal stream devices at sea unlikely to interact with intertidal trestle cultivation.	**Possible** – Spatial separation from tidal stream devices at sea and intertidal nature of trestle cultivation.
Fisheries	Mobile mid-water gear	**Likely** - Where suitable tidal stream resources coincide with locations where mobile gears are fished.	**Unlikely** – Safety and operational reasons, tidal stream devices (notably seabed mounted) and associated anchors/lines, are likely to be kept spatially separate from grounds fished by mobile fishing gears.
	Mobile bottom gear		
	Static gear (pots, lines, nets etc)	**Likely** - Where suitable tidal stream resources coincide with locations targeted by fishers with static types of gears.	**Unlikely** – Safety and operational reasons, tidal stream devices (notably seabed mounted) and associated anchors/lines, likely to be kept spatially separate from grounds fished by static gear fishing gears. However, potential benefits from hard substrata of tidal stream devices as artificial reef for fauna to be considered.
	Hydraulic dredging	**Likely** – Where suitable tidal stream resources coincide with locations for hydraulic dredging (mainly for bivalves).	**Unlikely** – Safety and operational reasons, tidal stream devices (notably seabed mounted) and associated anchors/lines, likely to be spatially separate from hydraulic dredging operations.
	Rod and lining	**Likely** – Possible that areas fished commercially with rods and lines could have tidal stream resources.	**Unlikely** – Safety and operational reasons, wave devices (notably seabed mounted) and associated anchors/lines, likely to be spatially separate from rod and lining.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
	Hand gathering	**Unlikely** – Where hand gathering is primarily intertidal compared with the placement of tidal stream devices at sea.	**Unlikely** – Spatial separation from wave devices at sea and intertidal nature of hand gathering
Ports and Shipping	Shipping - navigation routes **Refer to Figure 4.11 for the indicative sector interaction map.**	**Likely** – Tidal stream resources coincide with vessel traffic routes including to/from Newport and Cardiff in the Bristol Channel, Swansea Bay, Pembroke/Milford Haven, Holyhead on the north Anglesey coast.	**Likely** – Vessels involved with construction and operations and maintenance of the devices, may utilise existing navigational routes and statutory navigational measures. Co-existence potential with measures in place.
	Anchorage areas	**Likely** – Tidal stream resources are considered to be adjacent to but not situated in anchorage sites.	**Unlikely** – Where anchorage areas are already present before tidal stream device deployments, the potential for co-location on operational and safety grounds is limited.
Subsea cables	Cables and telecommunications **Refer to Figure 4.10 for the indicative sector interaction map.**	**Likely** – Tidal stream resources to the north/north-west of Anglesey coincide with subsea cabling between Anglesey and Ireland.	**Likely** – A separation of approximately 1 nm is considered good practice between offshore renewable installations and subsea cable infrastructure. However, if the distance is <1 nm then proximity agreements/crossing agreements, utilised by the operators[27].
Surface water and wastewater treatment and disposal	Intakes and outfalls, including licensed discharges	**Unlikely** – On the basis of intakes/outfalls being distant from at sea tidal stream devices.	**Likely** – Surface water and wastewater treatment and disposal developments usually coastal or inshore, hence minimal interaction with tidal stream devices at sea. But future developments of the surface/wastewater infrastructure may need to ensure these are sited and with agreements to achieve co-existence with tidal stream developments.
Dredging and Disposal	Designated disposal sites (Active)	**Likely** – Tidal stream resources to the north/north-west of Anglesey coincides with a licensed disposal site.	**Unlikely** – Safety and operational reasons, tidal stream devices (notably seabed mounted) and associated anchors/lines, likely to be kept spatially separate from designated disposal sites.

[27] Source: European Subsea Cables Association (2016) Guideline No.6 – The Proximity of Offshore Renewables Energy installations & Submarine Cable Infrastructure in UK Waters. Online available: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwiSl5moxNToAhV2TRUIHcM3DE8QFjAAegQIBBAB&url=https%3A%2F%2Fwww.escaeu.org%2Fdownload%2F%3FId%3D123%26source%3Dguidelines&usg=AOvVaw3-Ny4ahHcAdGFxt76wunC7 [Last access: 06/04/2020].

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
Defences	Military exercise areas/ammunition disposal sites **Refer to Figure 4.13 for the indicative sector interaction map.**	**Likely** – Overlap of tidal stream resources off Llŷn Peninsula with an existing Military Practise Area.	**Unlikely** – Safety and operational reasons, defence areas usually kept separate from tidal stream devices. Future development for tidal stream areas would need to be in dialogue with the MoD.
Tourism and Recreation	Recreational Sea Angling (RSA) **Refer to Figure 4.12 for the indicative interaction map.**	**Possible** – RSA undertaken from chartered vessels around seabed features/wrecks, and islands, could overlap with tidal stream resources.	**Possible**- Boat-based RSA considered possible around devices, subject to accessibility and safety. Also, possibility of wave energy devices in the areas of suitable resource, could act as fish aggregating devices which may draw RSA to fish in the area.
	RYA marinas and sailing routes **Refer to Figure 4.12 for the indicative interaction map.**	**Possible** – Sailing routes overlap with tidal stream resources at sea. Unlikely overlap with coastal based marinas.	**Possible**- Devices and recreational sailing routes could co-exist, subject to safety measures e.g. device lighting and marking, safe clearance above devices for recreational craft. Also recognising the mobile nature of the recreational activity relative to the requirements for siting tidal stream devices (and arrays).
	Water sports (e.g. surfing, kite surfing, diving, rafting)	**Possible** – Possible use of the sea surface or water column for water sports, in proximity to tidal stream resources.	**Possible –** For safety and operational reasons, water sports are not likely to occur in the footprint of the devices but may occur around the device (and associated arrays for upscaled tidal stream energy in the future).
	Shore based activity (e.g. coasteering, hiking, dog walking, kites) Wildlife watching - shore based	**Unlikely** – Shore-based activities compared with tidal stream resources located at sea.	**Possible** – Activities on/by the shore would not directly in the footprint of the devices or arrays. Also, energy cables from the devices to shore would be buried and only affect shore activities and access, should they need to be accessed for repairs/maintenance.
	Wildlife watching - boat based	**Possible** – Tidal stream resources and boat-based tourism could overlap. Potential for boat-based tourism in proximity to the tidal stream devices, due to the device being of interest, attracting wildlife or through proximity to islands that are wildlife hotspots.	**Possible** – Devices (and future arrays of the devices) could co-exist with boat-based wildlife tourism. Though this is likely to be subject to safety measures e.g. device lighting and marking, safe clearance above devices for vessels. Boat-based tourism may also be flexible in locations and visited areas to accommodate tidal stream devices and arrays.

4.3 Low Carbon Energy: wave energy resources

A summary of interaction appraisal for wave energy and other sectors is shown in Table 4.3.

As mentioned in section 3.1.1, spatial co-existence of marine aggregates and wave energy is considered unlikely, but the sequencing / timing of the activities can have a bearing on co-existence potential.

Mapping (Figure 4.4) indicates an area off the west of Pembrokeshire where there is overlap of tidal stream and wave energy resources. Whilst the operational characteristics of the two sectors precludes co-existence at the same time, forward-looking, proactive and spatial planning approaches could be applied to consider options for sequencing activities within any area of resource overlap.

Mapping (Figure 4.14) indicates an area off the west of Pembrokeshire where there is overlap of wave energy resources and water column resources for aquaculture. There is currently limited evidence for spatial co-existence of wave energy and aquaculture of bivalves on the seabed and finfish. There is, however, a growing interest for combining wave energy devices and rope-based aquaculture, as demonstrated through the recent Maribe H2020 project (Dalton et al., 2019). Nonetheless, the sequencing / timing of the activities for wave developments and aquaculture may have a bearing on co-existence potential. There is also the matter of regulatory changes to enable consenting of combined aquaculture and wave energy developments.

With regards to the spatial overlap between focal sectors, the wave energy resources covers an area of ca. 9,731 km^2, of which ca. 9.8% (ca. 950 km^2) overlaps with marine aggregate resources, ca. 4.4% (ca. 233 km^2) with tidal stream energy resources, ca. 0.32% (ca. 31 km^2) with seabed aquaculture resources and ca. 5.7% (ca. 552 km^2) with water column aquaculture RA.

Combining wave energy and offshore wind could be a potential co-existence opportunity, with recognition of both the synergies and challenges posed by the integration of the energy infrastructure (Pérez-Collazo et al., 2015).

As referenced in Table 4.3 and Table 4.2, there is potential for spatial co-existence of wave energy with several other sectors, including subsea cabling (Figure 4.15), shipping (Figure 4.16) as well as tourism and recreation. Examples are provided for recreational sea angling from shore and sailing (Figure 4.17). This could mean opportunities for encouraging spatial co-existence. Mapping resource overlap (Figure 4.15 to Figure 4.17) and sector interactions (Table 4.3) will be important for the planning authority when developing criteria for the development of any SRA (and applying safeguarding policy) for these sectors, and will help facilitate dialogue between the sectors and their regulators.

New wave energy projects off Pembrokeshire, in the Outer Bristol Channel (Figure 4.18) would need permission from the Ministry of Defence due to potentially creating a navigational hazard for military practices.

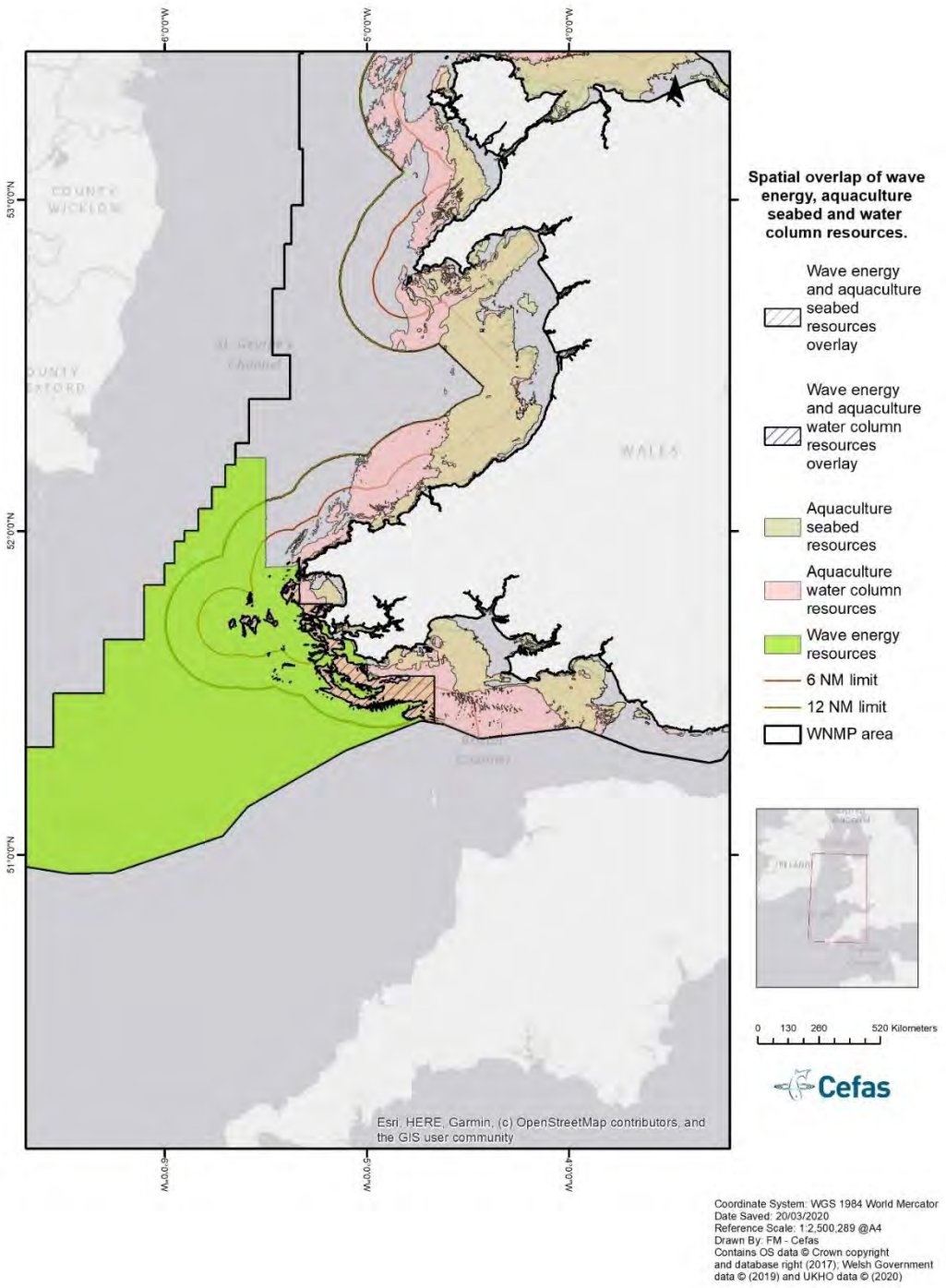

Figure 4.14: Spatial overlap of wave energy resources and aquaculture (seabed and water column) resources.

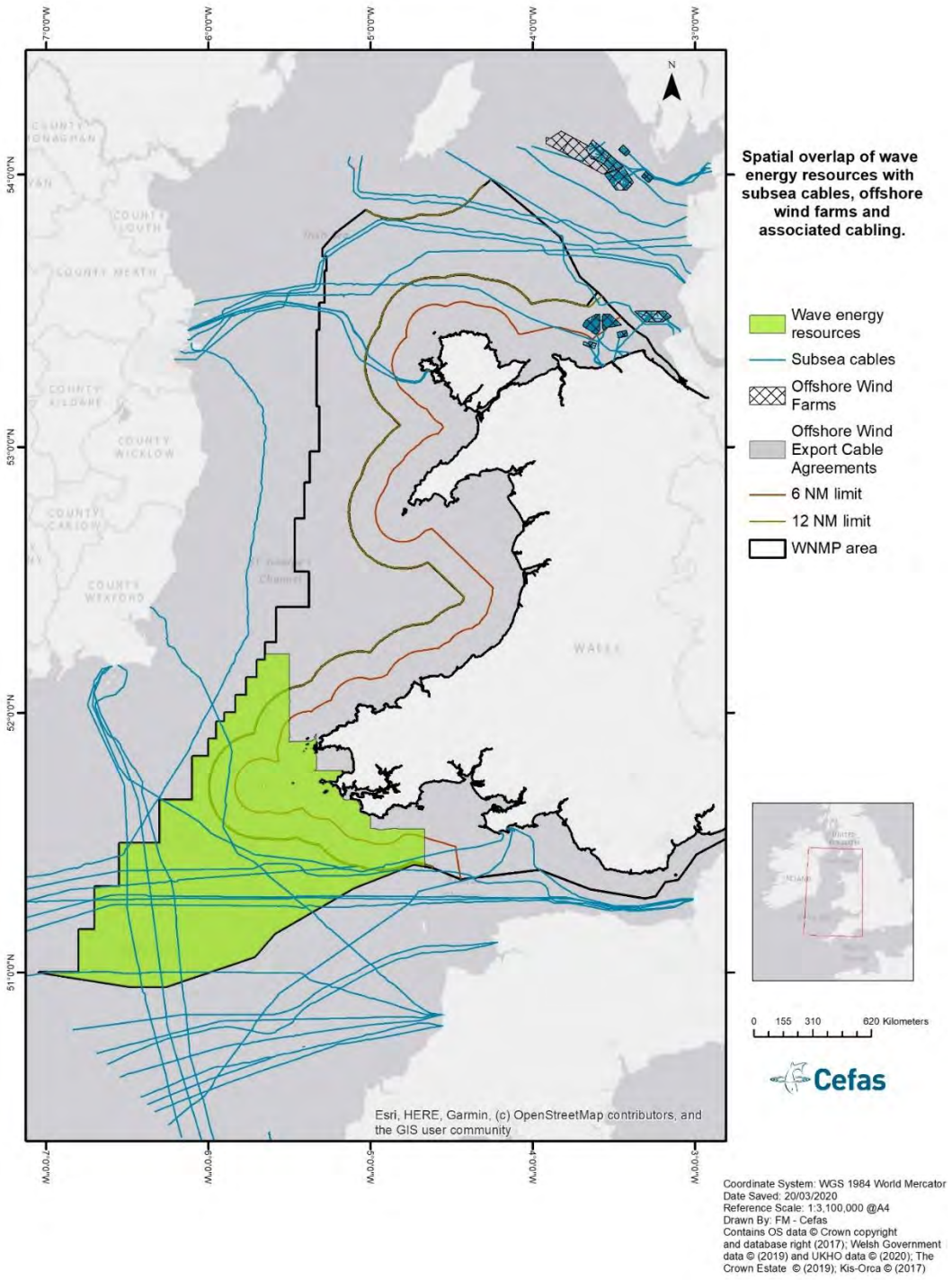

Figure 4.15: Spatial overlap of wave energy resources and subsea cabling.

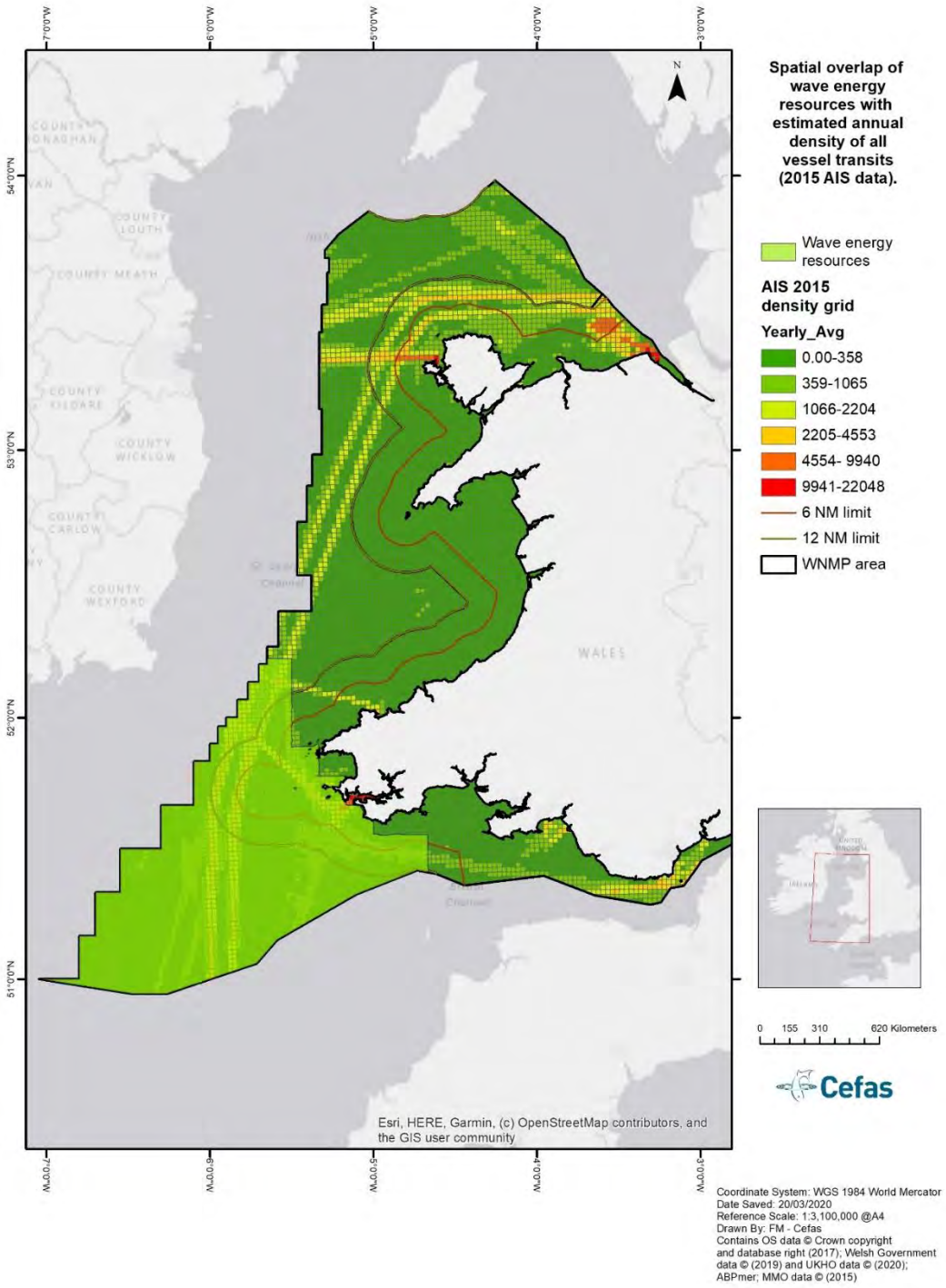

Figure 4.16: Spatial overlap of wave energy resources and shipping.
Shipping activity represented by estimated annual density of all vessel transits from Automatic Identification Systems data (2015).

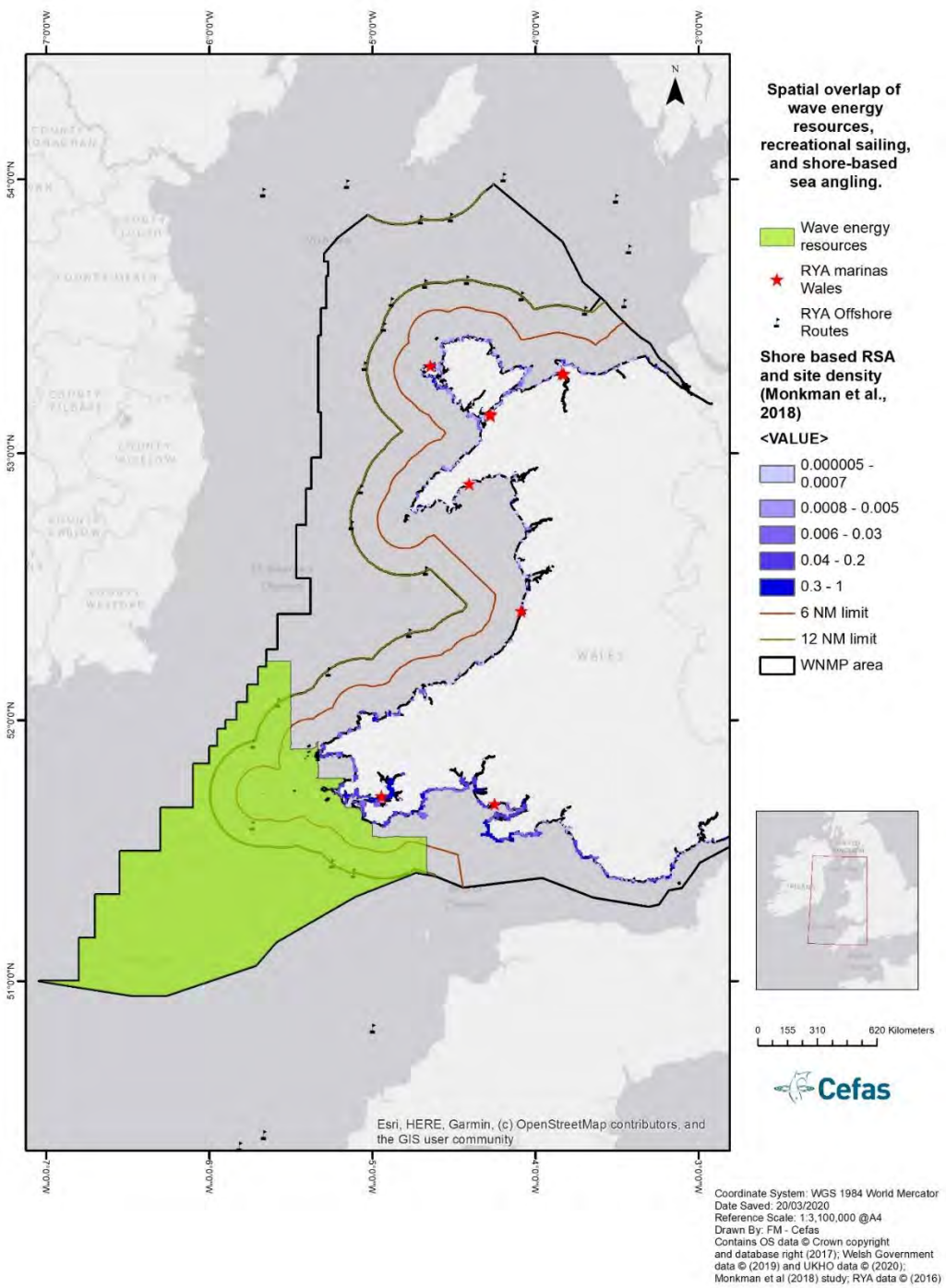

Figure 4.17: Spatial overlap of wave energy resources and recreational activities.
Examples given for sailing and shore locations for recreational sea angling (source: Monkman et al., 2018).

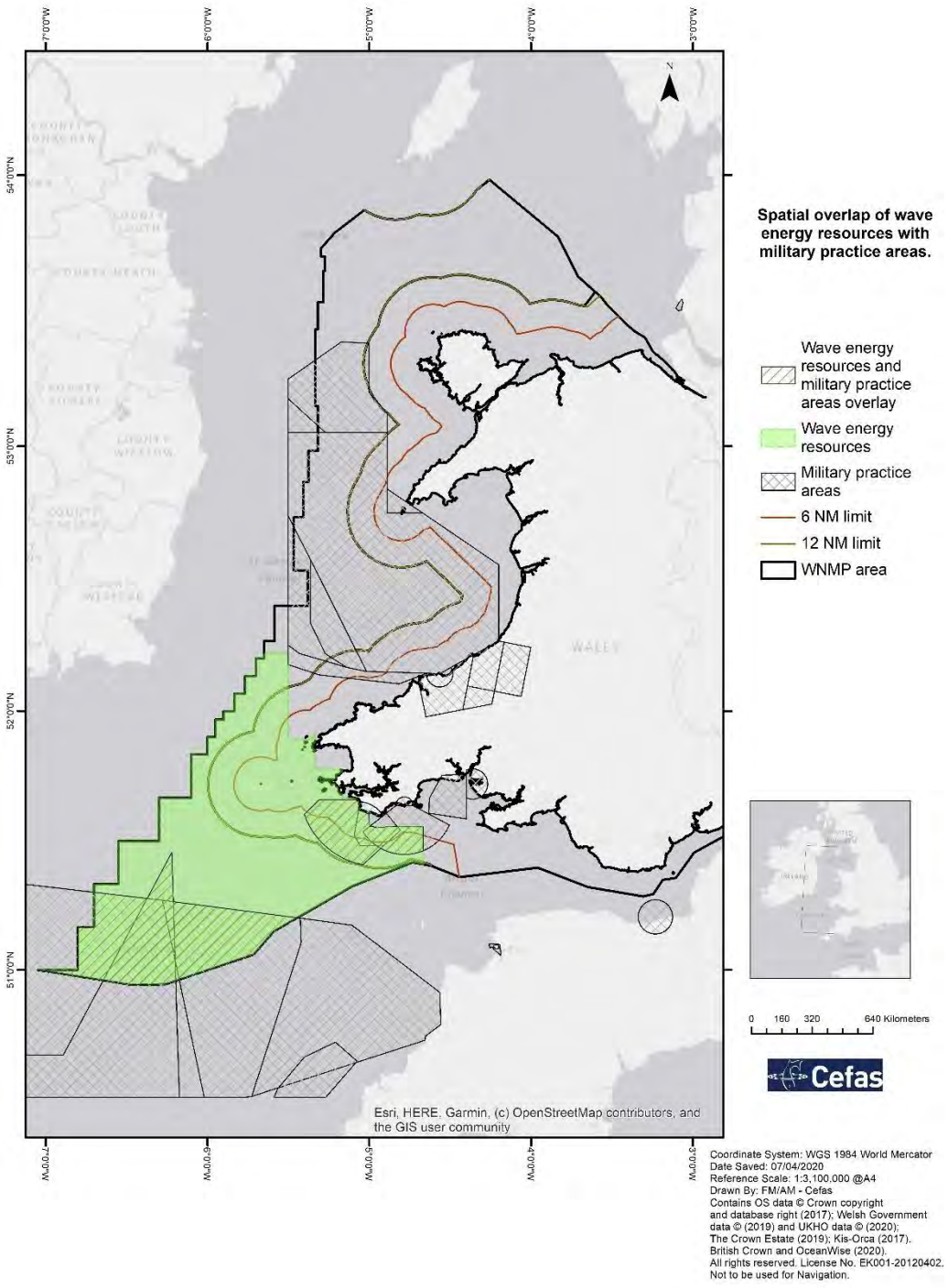

Figure 4.18: Spatial overlap of wave energy resources and military practice areas.

Table 4.3: Summary of wave energy interaction with other focal and non-focal sectors.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
Marine minerals	Marine aggregates	**Possible** – Wave energy and aggregate resources overlap off the coast of Pembrokeshire.	**Unlikely** – For consenting, safety and operational reasons, licensed aggregate extraction spatially separate from wave devices present on the sea surface/ water column
Energy	Tidal stream (fixed and floating)	**Possible**– Wave energy and tidal stream resources overlap off the coast of Pembrokeshire, located in the Outer Bristol Channel.	**Unlikely** – For consenting, safety and operational reasons, spatial separate of wave devices on the sea surface/water column and tidal stream devices present along or on the seabed, or in the water column.
	Wind turbines (fixed and floating) Offshore wind farms (fixed and floating)	**Possible** – Wave energy resources overlap with wind energy resource off Pembrokeshire, located in the Outer Bristol Channel.	**Possible** – Currently for safety and operational reasons, wave devices spatially separate from fixed/floating turbines (and turbines together in a wind farm) and wind farms. But in the future, potential exists for co-location of wave devices and wind farms. Particularly where operations are in more high energy environments and cost incentives to share infrastructure.
	Oil and Gas (incl. submarine pipelines and other infrastructure)	**Likely** – Wave energy resources coincide with well and petroleum licensing blocks off Pembrokeshire, located in the Outer Bristol Channel.	**Unlikely** – For safety and operational reasons, wave devices usually spatially from oil and gas structures atop the sea. Proximity agreements/crossing agreements utilised by the operators where the device cables intersect pipelines
	Miscellaneous (incl. overhead power lines, power station, substations)	**Possible** – Wave energy resources and deployment of wave energy devices at sea, whereas miscellaneous infrastructure predominantly at or on the shore.	**Likely** – Maritime occurrence of wave devices, whereas miscellaneous structures present at the coast or in the case of substations (e.g. for operational renewable developments), tend not to be sited directly in footprint of the wave devices or associated cabling.
Aquaculture	Bottom culture - shellfish	**Possible** – Wave energy resources overlap with resources for seabed aquaculture (shellfish bottom cultivation). This is mainly off the coast of Pembrokeshire, located in the Outer Bristol Channel.	**Unlikely** – For safety and operational reasons, licensed wave devices (especially seabed anchored) are likely to be separate spatially from shellfish cultivated on the seabed.
	Cage culture - finfish	**Possible** – Wave energy resources overlap with resources for cage-based finfish cultivation. This is mainly off the coast of Pembrokeshire, located in the Outer Bristol Channel.	**Possible** - At present the wave regime required for wave devices is not consider suitable for fish farm sites, and there may be limited financial incentives for co-location. But in the future, there is potential for overlap, should finfish aquaculture (notably

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
			on-growing aspects of production) and wave devices move offshore into more extreme, high energy conditions[28].
	Rope culture - shellfish	**Possible** – Wave energy resources overlap with resources for rope culture of shellfish, mainly off the coast of Pembrokeshire (located in the Outer Bristol Channel).	**Possible** – Wave regime required for wave devices may not be suitable for shellfish rope cultivation, and there may be limited financial incentives for co-location. But in the future, there is potential for overlap should the rope cultivation and wave devices move offshore into more extreme, high energy conditions[9]. Notably, potential for combining wave energy and seaweed aquaculture. Recognised by partnership of Wave Dragon, Seaweed Energy Solutions (SES) and BELLONA Foundation, which is seeking to progress combined project to commercialisation[29] (also see Dalton et al., 2019).
	Rope culture - seaweed	**Possible** – Wave energy resources overlap with resources for rope culture of seaweed, mainly off the coast of Pembrokeshire (located in the Outer Bristol Channel).	
	Trestle culture - shellfish	**Unlikely** –Presence of trestle cultivation internally compared with wave energy resources in coastal and offshore waters.	**Possible** – Spatial separation from wave devices at sea and intertidal nature of trestle cultivation.
Fisheries	Mobile mid-water gear	**Likely** - Where wave energy resources coincide with locations where mobile gears are fished.	**Unlikely** – Safety and operational reasons, wave devices (notably seabed mounted) and associated anchors/lines, are likely to be kept spatially separate from grounds fished by mobile fishing gears.
	Mobile bottom gear		
	Static gear (pots, lines, nets etc)	**Likely** - Where suitable wave resources at surface coincide with locations targeted by fishers with static types of gears.	**Unlikely** – Safety and operational reasons, wave devices (notably seabed mounted) and associated anchors/lines, likely to be kept spatially separate from grounds fished by static gear fishing gears.
	Hydraulic dredging	**Likely** – Where suitable wave resources coincide with locations for hydraulic dredging (mainly for bivalves).	**Unlikely** – Safety and operational reasons, wave devices (notably seabed mounted) and associated anchors/lines, likely to be kept spatially separate from hydraulic dredging operations.

[28] Source: Aquatera (2014).

[29] Source: Wave Energy & Offshore Aquaculture in Wales, UK (http://maribe.eu/wave-aquaculture) [Last access: 06/04/2020].

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
	Rod and lining	**Likely** – Where suitable wave resources coincide with locations for rod and lining.	**Unlikely** – Safety and operational reasons, wave devices (notably seabed mounted) and associated anchors/lines, likely to be kept spatially separate from rod and lining.
	Hand gathering	**Unlikely** – Where hand gathering is primarily intertidal compared with wave energy resources at sea.	**Unlikely** – Spatial separation from wave devices at sea and intertidal nature of hand gathering
Ports and Shipping	Shipping - navigation routes **Refer to Figure 4.16 for the indicative sector interaction map.**	**Likely** – Wave energy resources coincide with vessel traffic routes including to/from Pembroke/Milford Haven, Pembrokeshire.	**Likely** – Safety zone and navigational measures in place immediately around devices to minimise risks for shipping traffic. Vessels used during operation and maintenance activities for the wave devices may utilise existing navigational routes and statutory navigational measures.
	Anchorage areas	**Likely** – Wave energy resources and partial overlap with coastal anchorage sites off the Pembrokeshire coast, located in the Outer Bristol Channel.	**Unlikely** – Where anchorage areas are already present before wave device deployment and, the potential for co-location on operational and safety grounds is limited.
Subsea cables	Cables and telecommunications **Refer to Figure 4.15 for the indicative sector interaction map.**	**Likely** – Wave energy resources off Pembrokeshire coincide with several subsea cable routes landing into south wales and areas of south-west England.	**Likely –** A separation of approximately 1 nm is considered good practice between offshore renewable installations and subsea cable infrastructure. However, if the distance is <1 nm then proximity agreements/crossing agreements, utilised by the operators[8].
Surface water and wastewater treatment and disposal	Intakes and outfalls, including licensed discharges	**Unlikely** – On the basis of intakes/outfalls at the coastline or nearshore, being distant from the wave energy resources.	**Likely** – Though most infrastructure inshore at present hence minimal spatial interaction. But if surface water and wastewater treatment and disposal developments were to coincide with wave energy resources, there is scope for the two to co-exist.
Dredging and Disposal	Designated disposal sites (Active)	**Likely** – Wave energy resources offshore of Pembrokeshire, in the Outer Bristol Channel, coincides with designed disposal sites.	**Unlikely** – Safety and operational reasons, wave devices (notably seabed mounted) and associated anchors/lines, likely to be kept spatially separate from designated disposal sites.
Defences	Military exercise areas/ammunition disposal sites	**Likely** – Wave energy resources off Pembrokeshire, in the Outer Bristol Channel, coincide with parts of existing Military Practise Areas.	**Unlikely** – Safety and operational reasons, defence areas usually kept separate from wave devices. . Future development for wave energy areas would need to be in dialogue with the MoD.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
	Refer to Figure 4.18 for the indicative sector interaction map.		
Tourism and Recreation	Recreational Sea Angling (RSA) **Refer to Figure 4.17 for the indicative sector interaction map.**	**Possible** – Wave energy resources likely to coincide with RSA undertaken from chartered vessels around seabed features/wrecks, and islands e.g. Skomer.	**Possible –** Boat-based RSA considered possible around devices, subject to accessibility and safety. Also, possibility of wave energy devices in the areas of suitable resource, could act as fish aggregating devices which may draw RSA to fish in the area.
	RYA marinas and sailing routes **Refer to Figure 4.17 for the indicative sector interaction map.**	**Possible** – Sailing routes overlap with wave energy resources at sea. Unlikely overlap with coastal based marinas.	**Possible** - Devices and recreational sailing routes could co-exist, subject to safety measures e.g. device lighting and marking, safe clearance above devices for recreational craft.
	Water sports (e.g. surfing, kite surfing, diving, rafting)	**Possible** – Possible use of the sea surface or water column for water sports, in proximity to wave energy resources.	**Possible –** For safety and operational reasons, water sports are not likely to occur in the footprint of the devices but may occur around the device.
	Shore based activity (e.g. coasteering, hiking, dog walking, kites)	**Unlikely** – Shore-based activities compared with wave energy resources occurring out at sea.	**Possible** – Activities on/by the shore would not directly in the footprint of the devices. Also, energy cables from the devices to shore would be buried and only affect shore activities and access, should they need to be accessed for repairs/maintenance.
	Wildlife watching - shore based		
	Wildlife watching - boat based	**Possible** – Wave energy resources and boat-based tourism could overlap. Potential for boat-based tourism in proximity to the devices, due to the device being of interest, attracting wildlife or through proximity to islands that are wildlife hotspots.	**Possible** – Devices could co-exist with boat-based wildlife tourism. Though this is likely to be subject to safety measures e.g. device lighting and marking, safe clearance above devices for vessels. Boat-based tourism may also be flexible in locations and visited areas to accommodate wave devices.

4.4 Aquaculture resources

4.4.1 Seabed resource for shellfish aquaculture

A summary of interaction appraisal for seabed resource and shellfish aquaculture (bottom cultivation) and other sectors is shown in Table 4.4.

As mentioned in section 3.1.2 and 3.1.3, there is unlikely to be spatial co-existence between seabed aquaculture resources and marine aggregate, tidal stream and wave energy resources. Although as already discussed, the timing/sequencing of the sectors could influence these interactions and potential constraints imposed for other sectors.

For seabed cultivation, there is unlikely to be a spatial co-existence with other sectors that could disturb seabed within the harvesting area; for instance fishing with mobile and static gear, or dredging and disposal (Figure 4.21). There is also unlikely to be a spatial co-existence where there is also a risk of contamination, such as sewage outfalls (wastewater infrastructure) or smothering or contamination from dredging and disposal of marine sediment.

It is recognised existing production (mainly of shellfish) occurs chiefly in areas designated through a Several Order where fishing rights are exclusive to the area, or through a Regulating Order. As such, were the aquaculture sector for seabed cultivation to expand in the future, a smaller area of the indicated resource area could likely be utilised, thereby potentially minimising spatial conflict potential with other sectors.

Spatial and temporal management could be applied to sequence the activities of each sector. Such future planning would benefit from dialogue between the respective sectors and their associated regulators. Having these resource overlaps mapped (e.g. Figure 4.21) and considering the interactions (Table 4.4) will help to target this dialogue on forward-looking, proactive and spatial planning.

With regards to the spatial overlap between focal sectors, the aquaculture seabed resources covers an area of ca. 4,209 km^2, of which ca. 31.6% (ca. 1,330 km^2) overlaps with marine aggregate resources, ca. 0.65% (ca. 27 km^2) with tidal stream energy resources, 0.74% (ca. 31 km^2) with wave energy resources and ca. 83.4% (ca. 3,512 km^2) with water column aquaculture resources.

As mentioned in section 3.2.12 and in Table 4.2, there is potential for co-location of seabed cultivation of bivalves and offshore wind energy. Likewise, a co-existence potential of seabed cultivation with rope-based aquaculture. There is also potential co-existence with several other sectors including fisheries (Figure 4.19 and Figure 4.20), shipping (Figure 4.21), tourism and recreation (Figure 4.23) as well as tidal range energy (Figure 4.24). Overall, this could mean an opportunity for maximising spatial co-existence between these sectors and future planning would benefit from dialogue between the respective sectors and their associated regulators.

Depending on the characteristics of potential new shellfish sites, development with fixed structures would need the permission of the Ministry of Defence when considered to be located in Cardigan Bay, around the Pembrokeshire coast, off Tenby and in Carmarthen Bay (Figure

4.25) due to creating potential navigational hazard for military practice. Mussel relaying practice can, however, continue to co-exist with the defence sector.

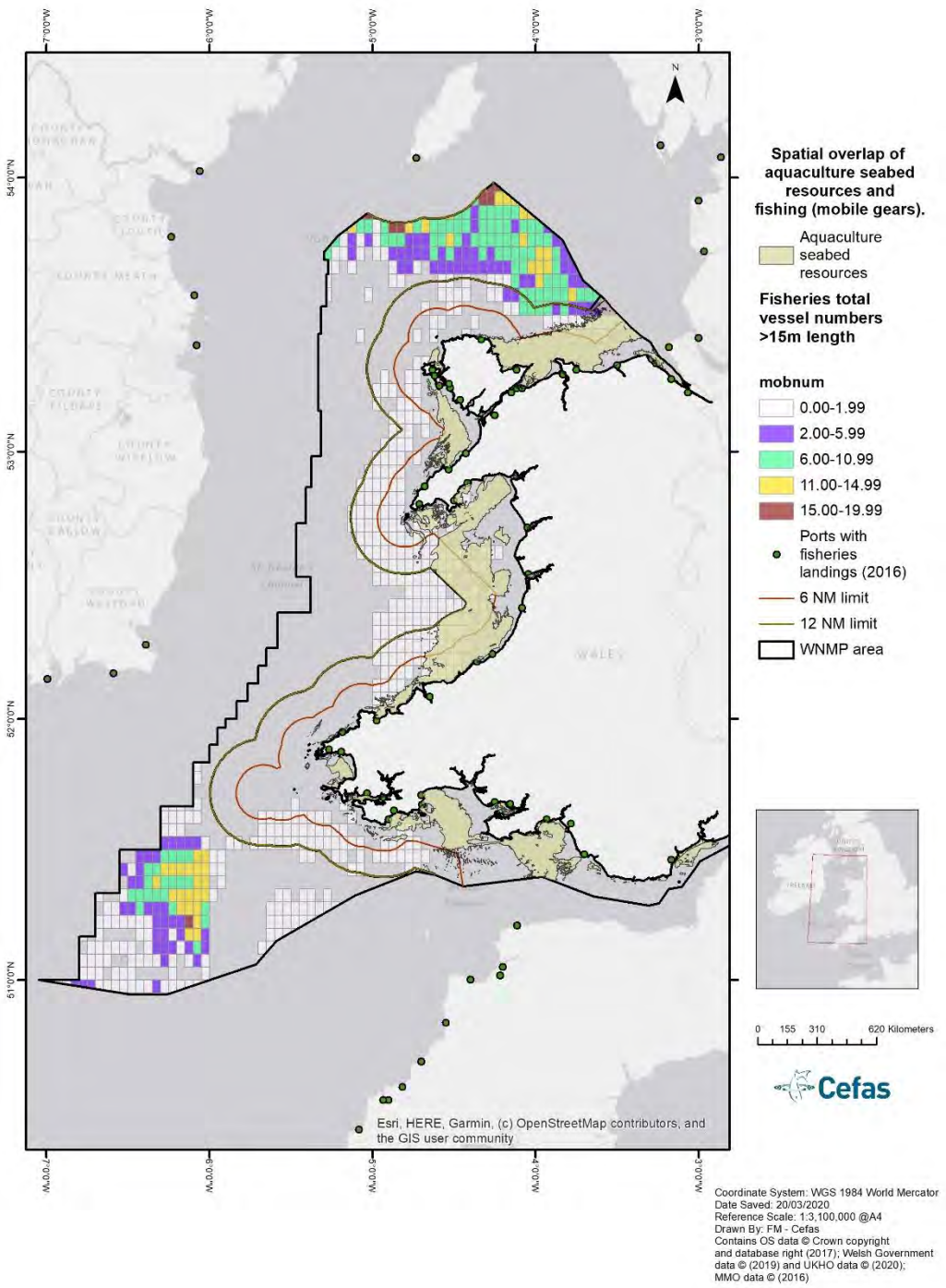

Figure 4.19: Spatial overlap of aquaculture seabed resources and fisheries (mobile gears e.g. trawls)[20].

The map is indicative and is based on fisheries activity from 2016 data and depicts ports with recorded landings (in 2016) and total vessel numbers (≥15m vessel length) recorded per ICES sub-rectangle[21].

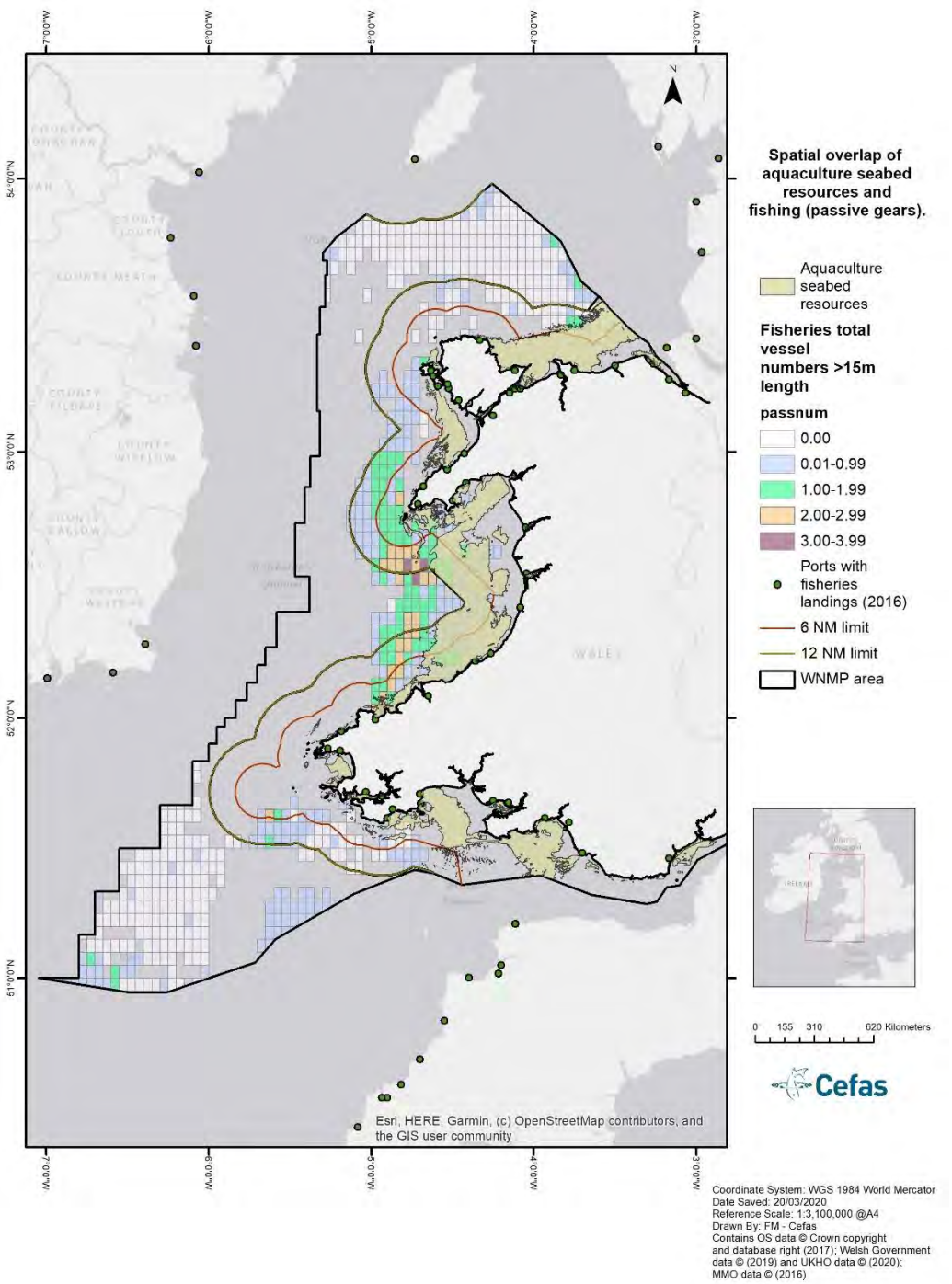

Figure 4.20: Spatial overlap of aquaculture seabed resources and fisheries (passive gears e.g. pots/lines)[20].

The map is indicative and is based on fisheries activity from 2016 data and depicts ports with recorded landings (in 2016) and total vessel numbers (≥15m vessel length) recorded per ICES sub-rectangle[21].

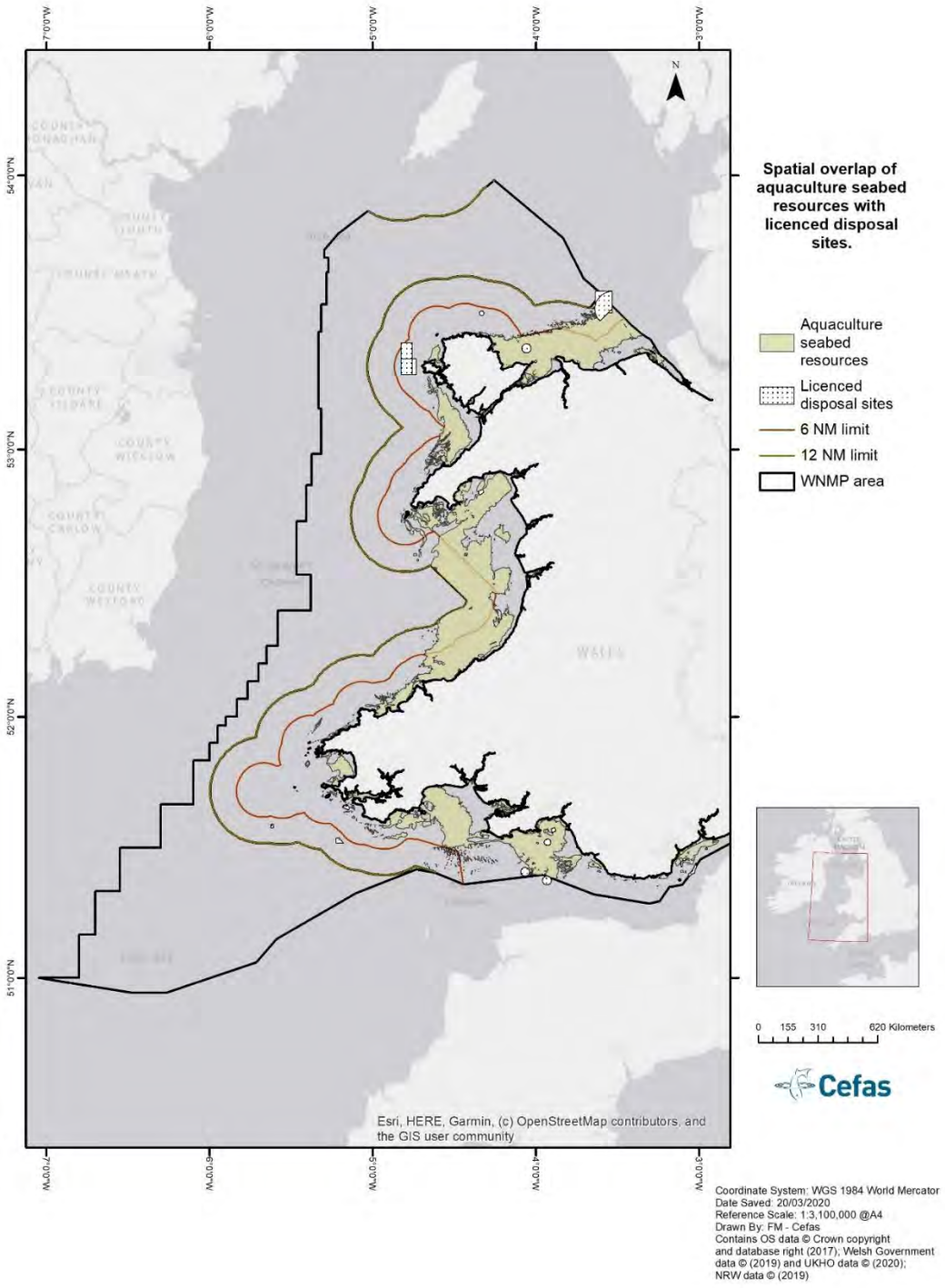

Figure 4.21: Spatial overlap of aquaculture seabed resources and licenced disposal sites.

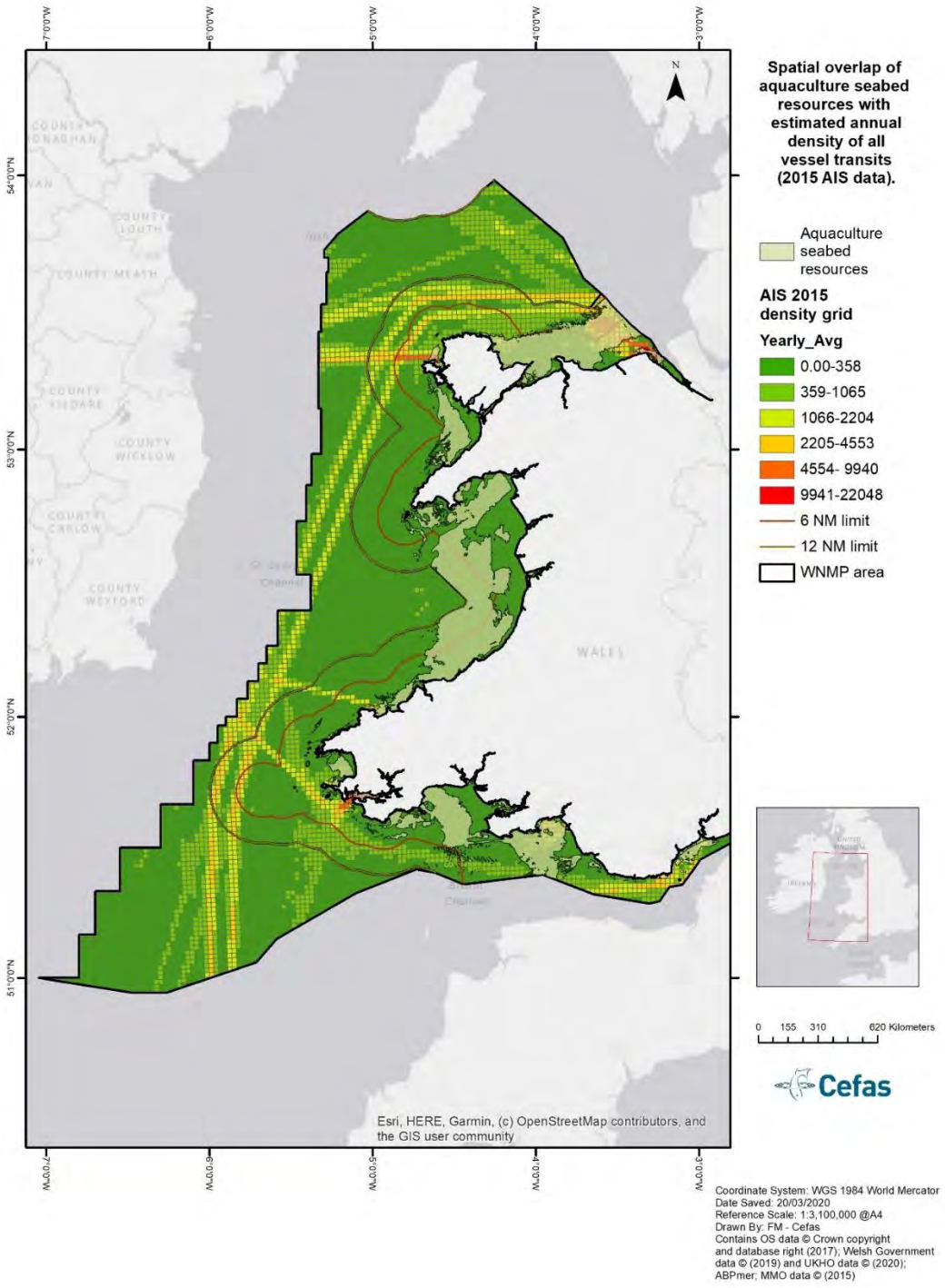

Figure 4.22: Spatial overlap of aquaculture seabed resources and shipping.
Shipping activity represented by estimated annual density of all vessel transits from Automatic Identification Systems data (2015).

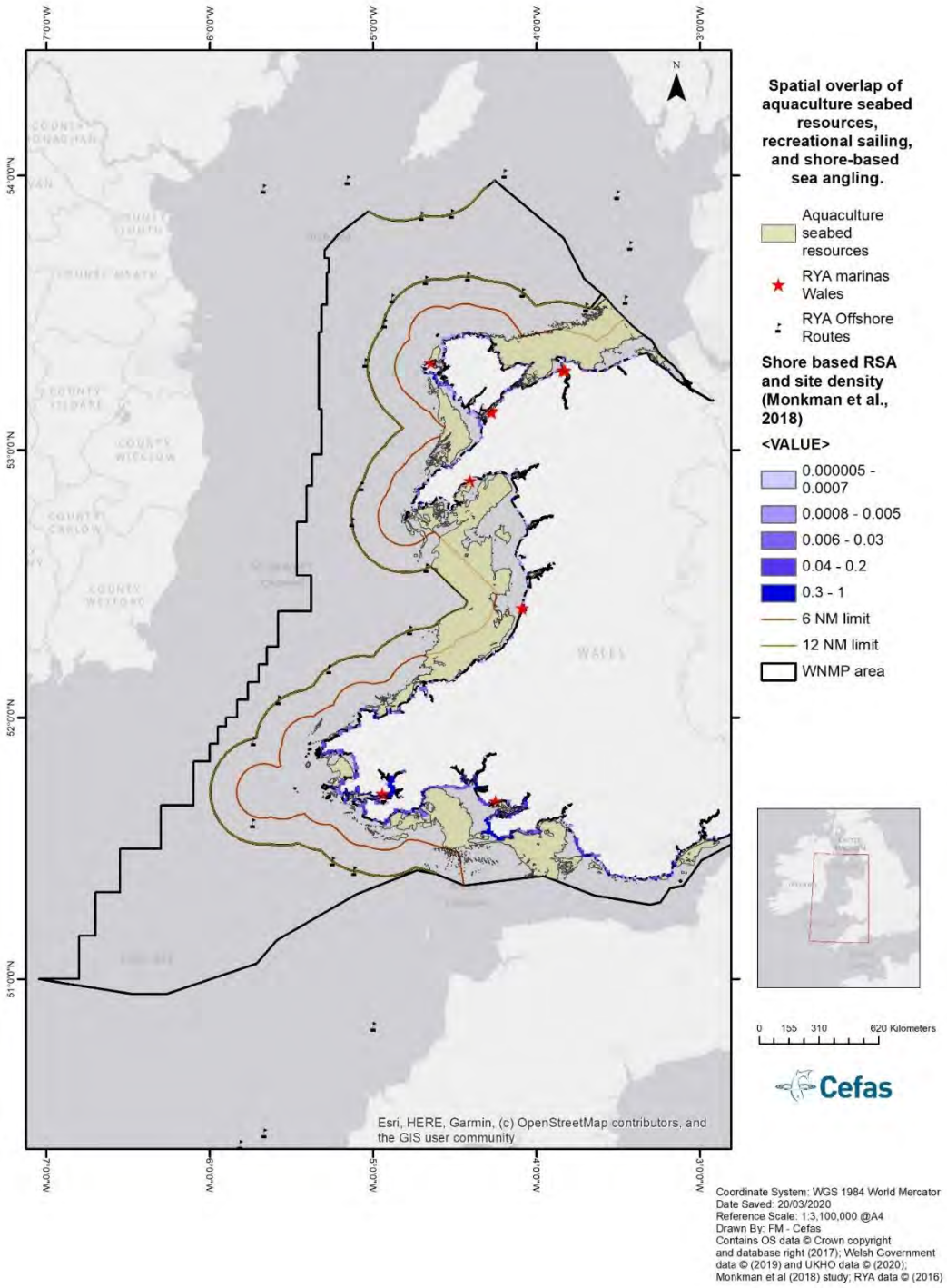

Figure 4.23: Spatial overlap of aquaculture seabed resources and recreational activities. Examples of sailing and shore locations for sea angling (source: Monkman et al., 2018).

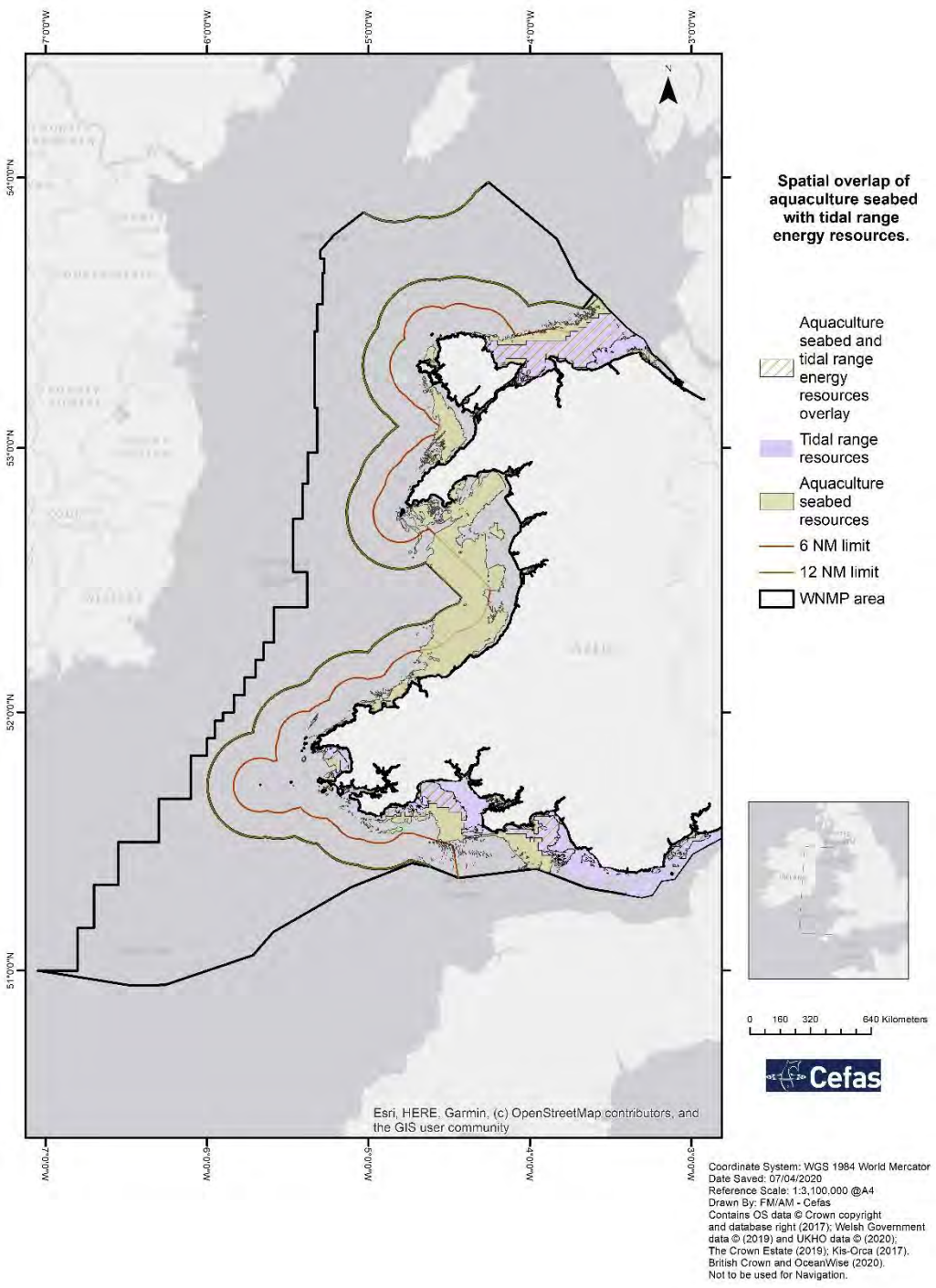

Figure 4.24: Spatial overlap of aquaculture seabed and tidal range energy resources.

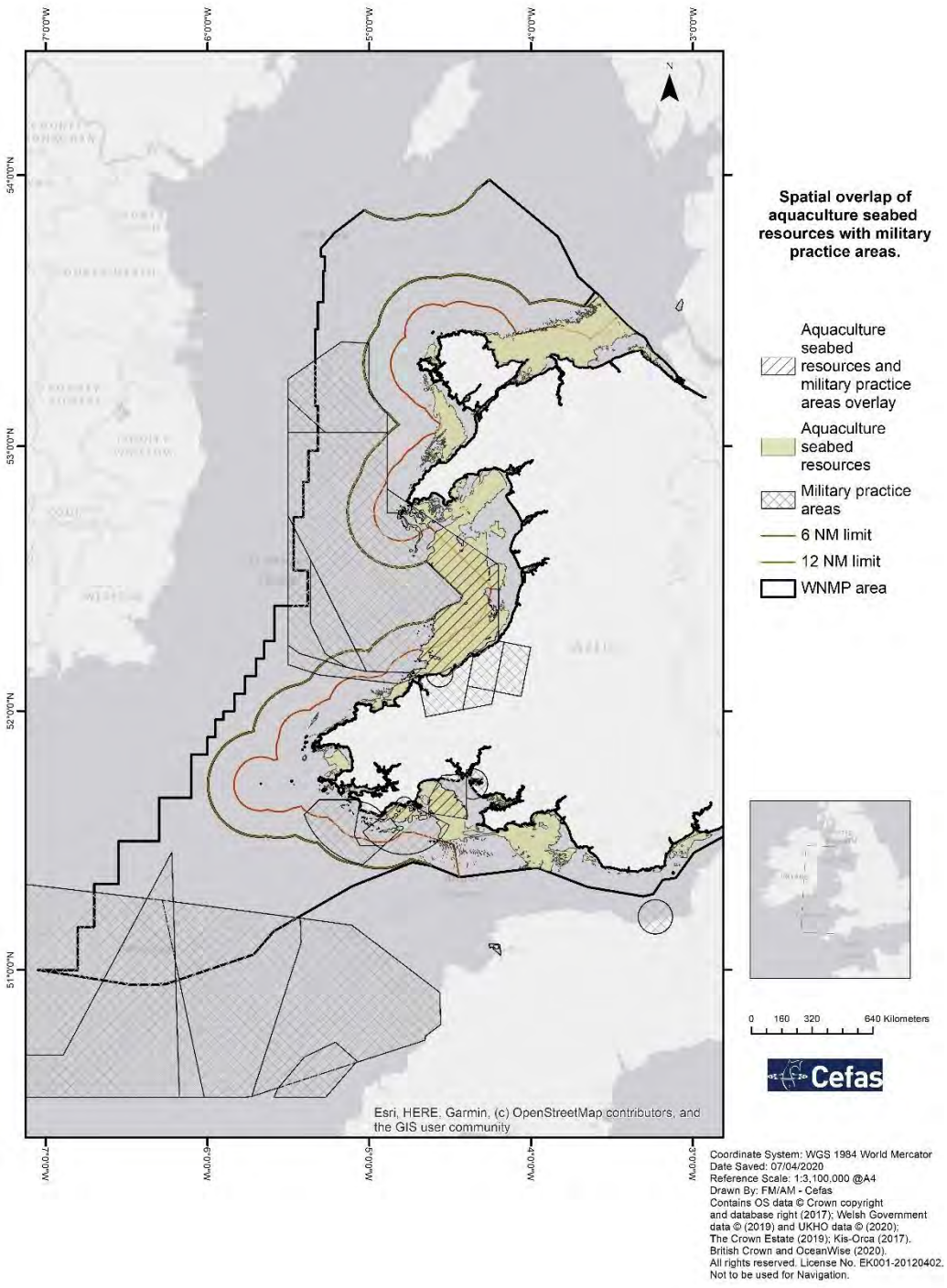

Figure 4.25: Spatial overlap of aquaculture seabed resources and military practice areas.

Table 4.4: Summary of seabed resource for shellfish aquaculture (bottom cultivation) and interaction with focal and other sectors.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
Marine minerals	Marine aggregates	**Possible** – Seabed aquaculture resources coincide with aggregate resources in several locations: north-east Anglesey, off North Wales, south Pembrokeshire, and Carmarthen and Swansea Bay.	**Unlikely** – Safety and operational reasons, areas of seabed cultivation spatially separate from aggregate extraction.
Energy	Wave energy	**Possible –** Seabed aquaculture resources and wave resources overlap off Pembrokeshire, and coastal sites in South Wales.	**Unlikely** – Safety and operational reasons, wave devices on the sea surface/water column spatially separate from seabed cultivation.
	Tidal stream (fixed and floating)	**Possible** – Seabed aquaculture resources and tidal stream resources overlap off the Llŷn Peninsula, Pembrokeshire, and coastal sites in South Wales.	**Unlikely** – Safety and operational reasons, tidal stream devices on the sea surface/water column or on the seabed, spatially separate from seabed cultivation.
	Tidal range **Refer to Figure 4.24 for the indicative sector interaction map.**	**Possible** – Seabed aquaculture resources and tidal range resources overlap off Anglesey and coastal sites in South Wales.	**Unlikely** – Safety and operational reasons, tidal range devices on the sea surface/water column or on the seabed, spatially separate from seabed cultivation.
	Wind turbines (fixed and floating)	**Possible** – Seabed aquaculture resources and wind energy resource overlap off North Wales, to the north-west of Anglesey, around the Llŷn Peninsula, within Cardigan Bay, off Pembrokeshire, as well as coastal sites in South Wales.	**Possible** – Currently only one example in Wales of co-location, involving a trial of mussel cultivation within North Hoyle OWF (Wales) in 2010. Future opportunity to potentially scale up shellfish cultivation within OWFs, particularly where operations are in more high energy environments and cost incentives to share infrastructure.
	Offshore wind farms (fixed and floating)		
	Oil and Gas (incl. submarine pipelines and other infrastructure)	**Possible** – Seabed aquaculture resources coincide with oil and gas infrastructure and petroleum licensing blocks in off North Wales, in Liverpool Bay.	**Unlikely** – Safety and operational reasons, seabed cultivation is likely to be spatially separate from oil and gas structures atop the sea surface and pipelines/well heads etc on/along the seabed.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
	Miscellaneous (incl. overhead power lines, power station, substations)	**Unlikely** - Seabed cultivation of shellfish at sea and hence separate from coastal structures.	**Likely** – Maritime occurrence of shellfish aquaculture, whereas miscellaneous structures present at the coast or in the case of substations (e.g. for operational renewable developments), tend not to be sited directly in the middle of the shellfish bed/resource.
Aquaculture	Rope culture - shellfish	**Likely** – Seabed aquaculture resources and water column resources, suitable for rope-culture of bivalves, overlap in several locations. This includes off North Wales, north-west Anglesey, north coast the Llŷn Peninsula, and off Pembrokeshire.	**Possible** – Wave regime required for wave devices may not be suitable for shellfish rope cultivation, and there may be limited financial incentives for co-location. But in the future, there is potential for overlap should the rope cultivation and wave devices move offshore into more extreme, high energy conditions. Notably, potential for combining wave energy and seaweed aquaculture. Recognised by partnership of Wave Dragon, Seaweed Energy Solutions (SES) and BELLONA Foundation, which is seeking to progress combined project to commercialisation (also see Dalton et al., 2019).
	Rope culture - seaweed	**Likely** – Seabed aquaculture resources and water column resources, suitable for rope-culture of seaweed, overlap in several locations. This includes off south coast of the Llŷn Peninsula, within Carmarthen and Swansea Bay.	
	Trestle culture - shellfish	**Unlikely** – Where trestle cultivation is intertidal compared with subtidal cultivation of shellfish.	
Fisheries	Mobile mid-water gear **Refer to Figure 4.19 for the indicative sector interaction map.**	**Likely** – Fishing is a mobile activity and hence could overlap with seabed aquaculture resources and water column resources suitable for rope-culture of bivalves.	**Unlikely** – Safety and operational reasons, seabed aquaculture resources are likely to be kept spatially separate from grounds fished by mobile fishing gears
	Mobile bottom gear **Refer to Figure 4.19 for the indicative sector interaction map.**		
	Static gear (pots, lines, nets etc) **Refer to Figure 4.20 for the indicative sector interaction map.**	**Likely** – Fishing is a mobile activity and hence could overlap with seabed aquaculture resources and water column resources suitable for rope-culture of bivalves.	**Unlikely** – Safety and operational reasons, seabed aquaculture resources are likely to be kept spatially separate from grounds fished by static gear types. But potential for flexibility in the locations of gear deployment

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
			to accommodate areas of bottom cultivation with future development.
	Hydraulic dredging	**Likely** – Fishing is a mobile activity and hence could overlap with seabed aquaculture resources and water column resources suitable for rope-culture of bivalves.	**Unlikely** – Safety and operational reasons, seabed aquaculture resources are likely to be kept spatially separate from hydraulic dredging areas.
	Rod and lining	**Likely** – Fishing is a mobile activity and hence could overlap with seabed aquaculture resources and water column resources suitable for rope-culture of bivalves.	**Unlikely** – Safety and operational reasons, rod and lining is unlikely to occur in locations of seabed aquaculture resources.
	Hand gathering	**Unlikely** – Where hand gathering is primarily intertidal compared with subtidal seabed cultivation of shellfish.	**Likely** – Spatial separation from subtidal shellfish cultivation at sea, and intertidal nature of hand gathering.
Ports and Shipping	Shipping - navigation routes **Refer to Figure 4.22 for the indicative sector interaction map.**	**Possible** – Seabed aquaculture resources coincide with vessel traffic routes including to/from Pembroke/Milford Haven, Pembrokeshire and Holyhead, Anglesey.	**Likely** – Seabed presence of shellfish and passage of vessels above or in nearby area, subject to harvesting vessels being able to access the cultivated area.
	Anchorage areas	**Possible** – Seabed aquaculture resources overlap with coastal anchorage sites off north-east Anglesey, south Pembrokeshire and Swansea Bay.	**Unlikely** – Designated shellfish beds unlikely to want damage or risk of damage from anchors, hence co-existence is considered unlikely.
Subsea cables	Cables and telecommunications	**Possible** – Seabed aquaculture resources coincide with submarine cabling into north/north-west Anglesey and into/from the Swansea coastline.	**Unlikely** – Safety and operational reasons, subtidal shellfish cultivation likely to be kept spatially separate from subsea cables. This would ensure accessibility to the infrastructure during operational and maintenance works.
Surface water and wastewater treatment and disposal	Intakes and outfalls, including licensed discharges	**Possible** – Seabed aquaculture resources coincide with coastal outfall pipes including from the coasts of Cardiff, Swansea, Pembrokeshire and North Wales.	**Unlikely** – Preference is to locate shellfish bottom cultivation away from sources of potential contamination, such as sewage outfalls.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
Dredging and Disposal	Designated disposal sites (Active) **Refer to Figure 4.21 for the indicative sector interaction map.**	**Possible** – Seabed aquaculture resources coincide to the north/north-west of Anglesey, Liverpool Bay and Swansea Bay, coincide with licensed disposal sites.	**Unlikely** – Preference is to locate shellfish bottom cultivation away from dredging and disposal sites, due to the potential for smothering and contamination.
Defences	Military exercise areas/ammunition disposal sites **Refer to Figure 4.25 for the indicative sector interaction map.**	**Possible** – Seabed aquaculture resources overlap with existing Military Practise Areas encompassing Cardigan Bay, around the Pembrokeshire coast, off Tenby and in Carmarthen Bay.	**Possible** – Potential for harvesting of bottom cultivated bivalves to occur within military practise areas unless they are subject to temporal restrictions during operational test and military training periods.
Tourism and Recreation	Recreational Sea Angling (RSA) **Refer to Figure 4.23 for the indicative sector interaction map.**	**Possible** – RSA undertaken from chartered vessels around seabed features/wrecks, and islands e.g. Skomer, likely to overlap seabed aquaculture resources.	**Likely -** RSA notably from boats or from shore, could occur near to subtidal shellfish beds.
	RYA marinas and sailing routes **Refer to Figure 4.23 for the indicative sector interaction map.**	**Possible** – Possible that sailing routes pass by or through areas of seabed aquaculture resources.	**Likely** - Supporting vessels for shellfish harvesting may utilise existing navigational routes.
	Water sports (e.g. surfing, kite surfing, diving, rafting)	**Possible** – Possible use of the sea surface or water column for water sports, in proximity to potential aquaculture (bottom culture) resource. Notably, diving sites around Grassholm and Skokholm islands.	**Likely** – Water sports could occur in waters around and above subtidal shellfish beds, subject to access for harvesting vessels and placement of markers.
	Shore based activity (e.g. coasteering, hiking, dog walking, kites)	**Unlikely** – Shore-based activities not likely to occur within subtidal seabed areas of seabed aquaculture resources.	**Likely** – Spatial separation from subtidal shellfish cultivation at sea and activities on/by the shore. Harvesting vessel and marker buoys possibly visible from shore if operations are inshore.
	Wildlife watching - shore based		**Likely** – Spatial separation from finfish aquaculture at sea and activities on/by the shore.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
	Wildlife watching - boat based	**Possible** – Seabed aquaculture resources and potential for overlap with boat-based tourism. Such as in proximity to islands that are wildlife hotspots e.g. Grassholm and Skokholm.	**Likely** – Wildlife tourism could occur in waters around and above subtidal shellfish beds, subject to access for harvesting vessels and placement of markers.

4.4.2 Water column resource

In general, the aquaculture water column resources covers an area of ca. 7,545 km^2, of which ca. 37.4% (ca. 2,824 km^2) overlaps with marine aggregate resources 6.2% (ca. 466 km^2) with tidal stream energy resources, ca. 7.3% (ca. 552 km^2) with wave energy resources and 46.5% (ca. 3,512 km^2) with seabed column aquaculture resources.

4.4.2.1 Water column resource: rope-based aquaculture

A summary of interaction appraisal for water column resources (rope-based aquaculture) and other sectors is shown in Table 4.5.

As mentioned in section 3.1.1 and section 3.1.2, there is unlikely to be spatial co-existence between rope-based aquaculture and marine aggregates and tidal stream. Although the timing/sequencing of the sectors could influence the interaction. There is also unlikely to be a spatial co-existence with other sectors, including surface water and wastewater treatment and disposal, dredging and disposal as well as military defence.

However, spatial and temporal management could be applied to sequence the activities of each sector. Such future planning would benefit from dialogue between the respective sectors and their associated regulators. Having these resource overlaps mapped and considering the interactions (Table 4.5.) will help to target this dialogue on forward-looking, proactive and spatial planning.

As referenced in section 3.2.12 and in Table 4.2, there is potential for spatial co-existence of rope-based aquaculture and offshore wind energy and wave energy (Figure 4.26) as well as tidal range energy (Figure 4.27). Likewise, there is the potential for co-existence between seabed cultivation and rope-based aquaculture.

Potential co-existence exits for several, other sectors including fisheries, shipping (Figure 4.28), subsea cables (Figure 4.29), and tourism and recreation (Figure 4.30), in locations around the Wales marine plan area. Overall, this could mean an opportunity for maximising spatial co-existence between these sectors and future planning would benefit from dialogue between the respective sectors and their associated regulators.

New development of aquaculture in Cardigan Bay, around the Pembrokeshire coast, off Tenby and in Carmarthen Bay (Figure 4.31) would need the permission of the Ministry of Defence due to potentially creating navigational hazards for military practices.

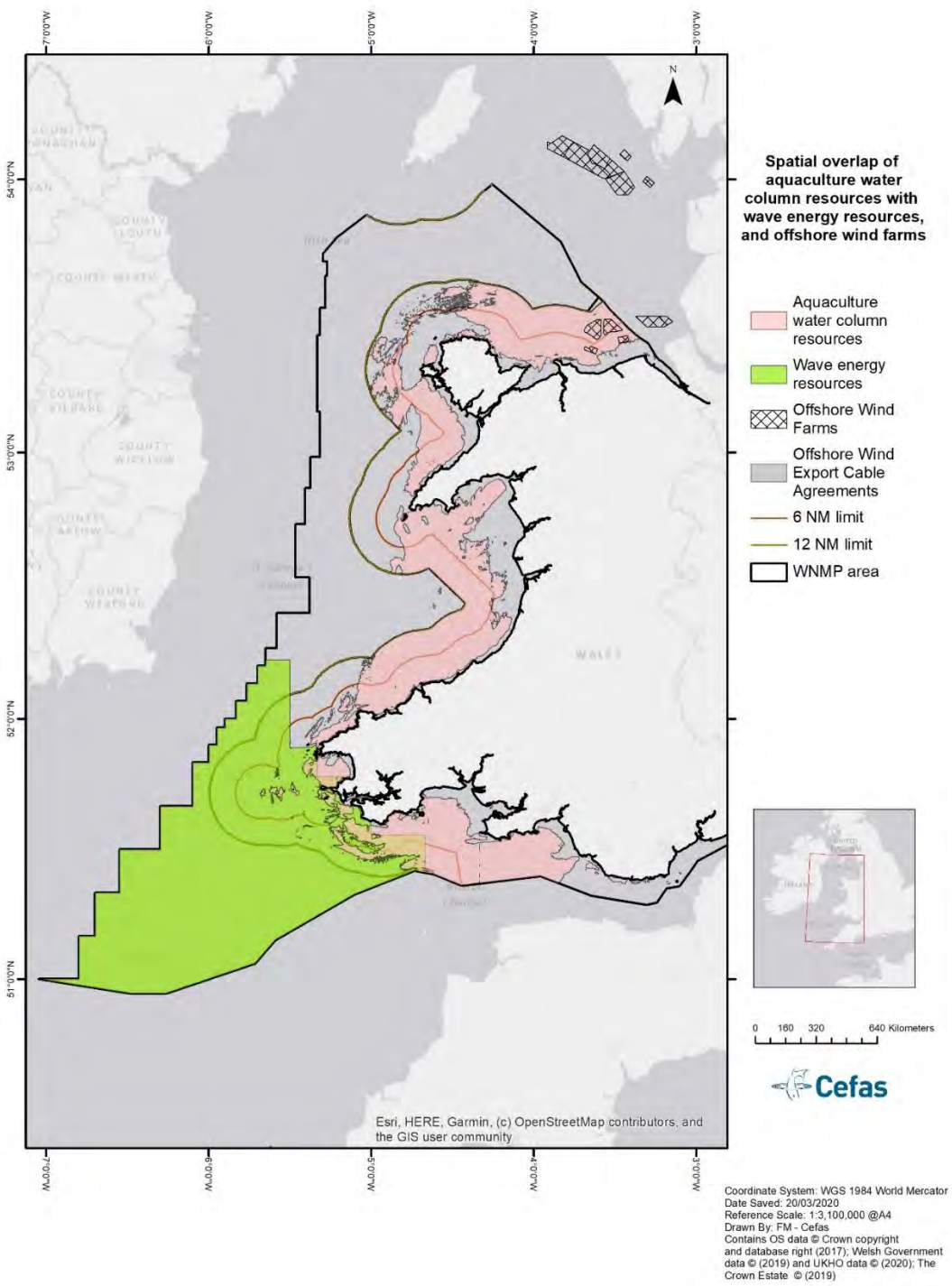

Figure 4.26: Spatial overlap of aquaculture water column resources, wave energy resources and offshore wind farms (as of 2017).

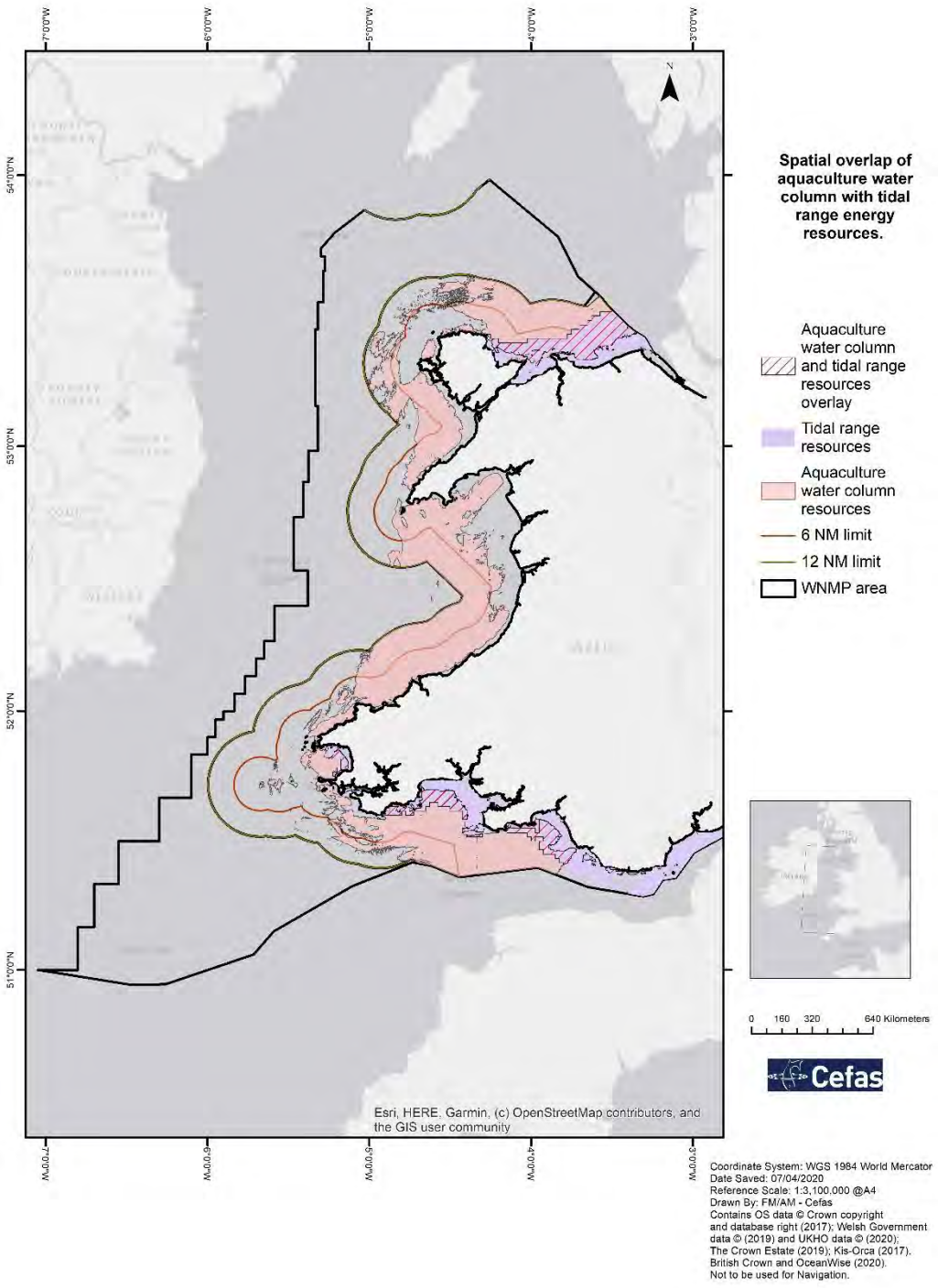

Figure 4.27: Spatial overlap of aquaculture water column with tidal range energy resources.

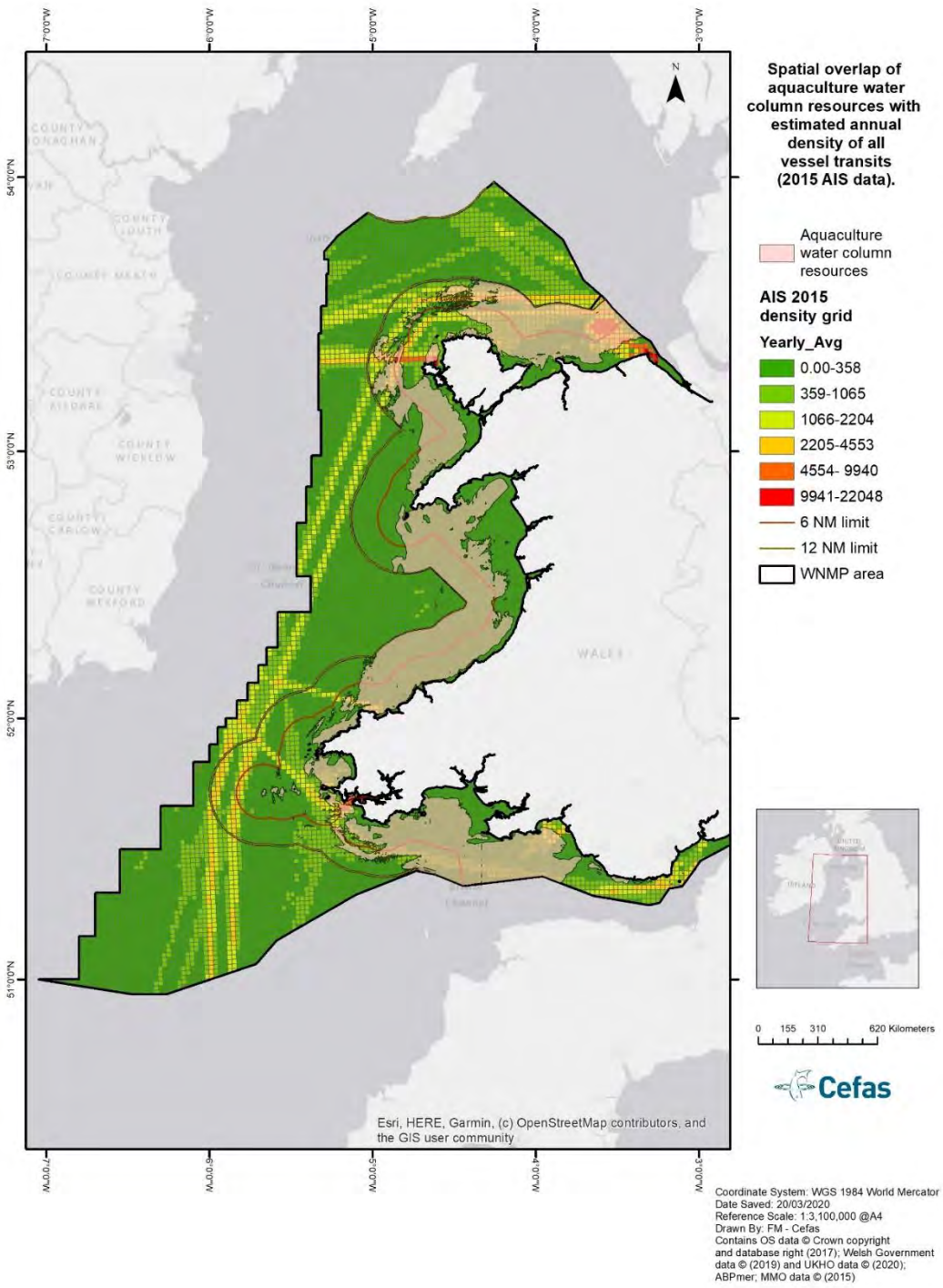

Figure 4.28: Spatial overlap of aquaculture water column resources and shipping.
Shipping activity represented by estimated annual density of all vessel transits from Automatic Identification Systems data (2015).

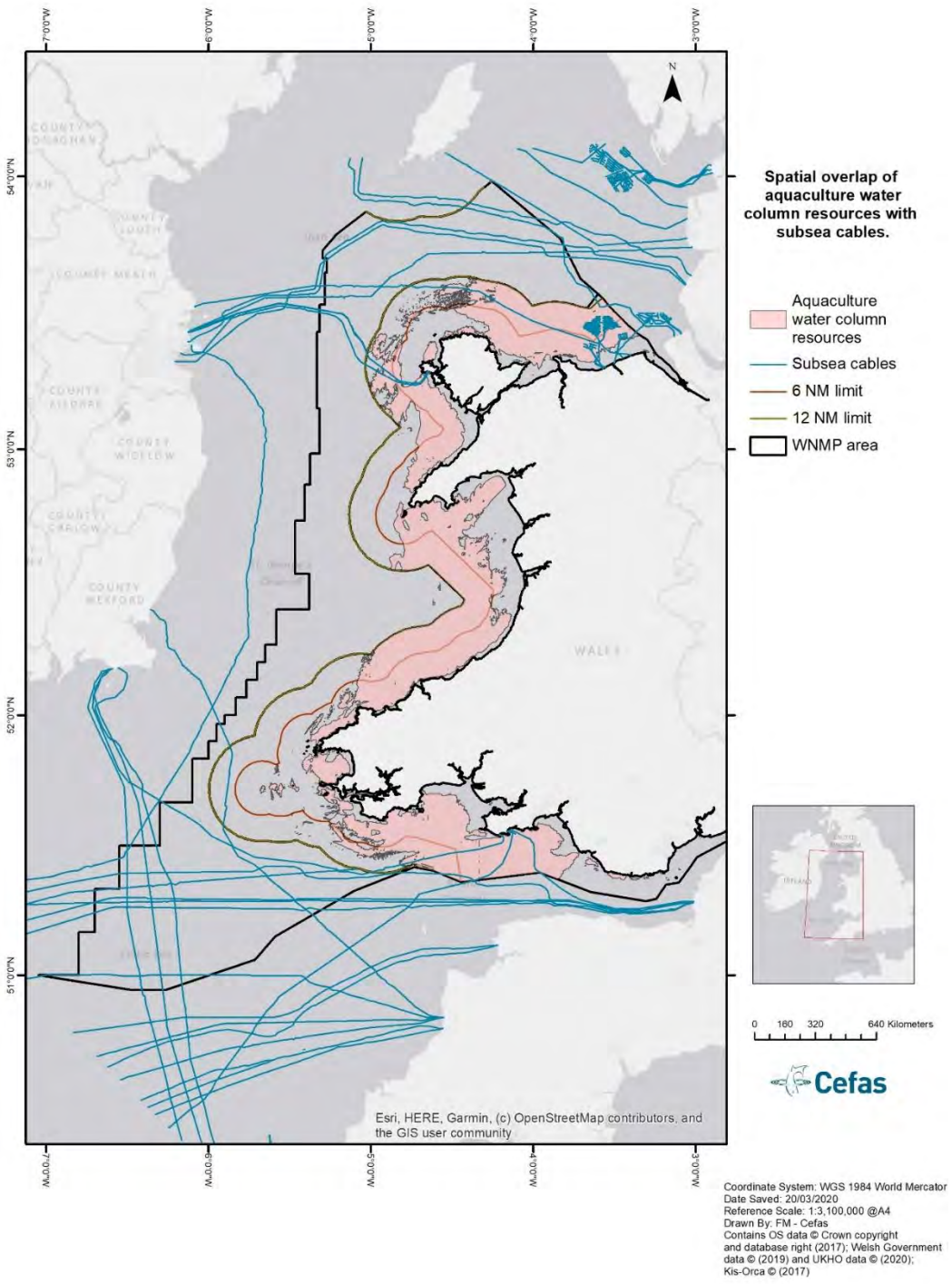

Figure 4.29: Spatial overlap of aquaculture water column resources and subsea cabling.

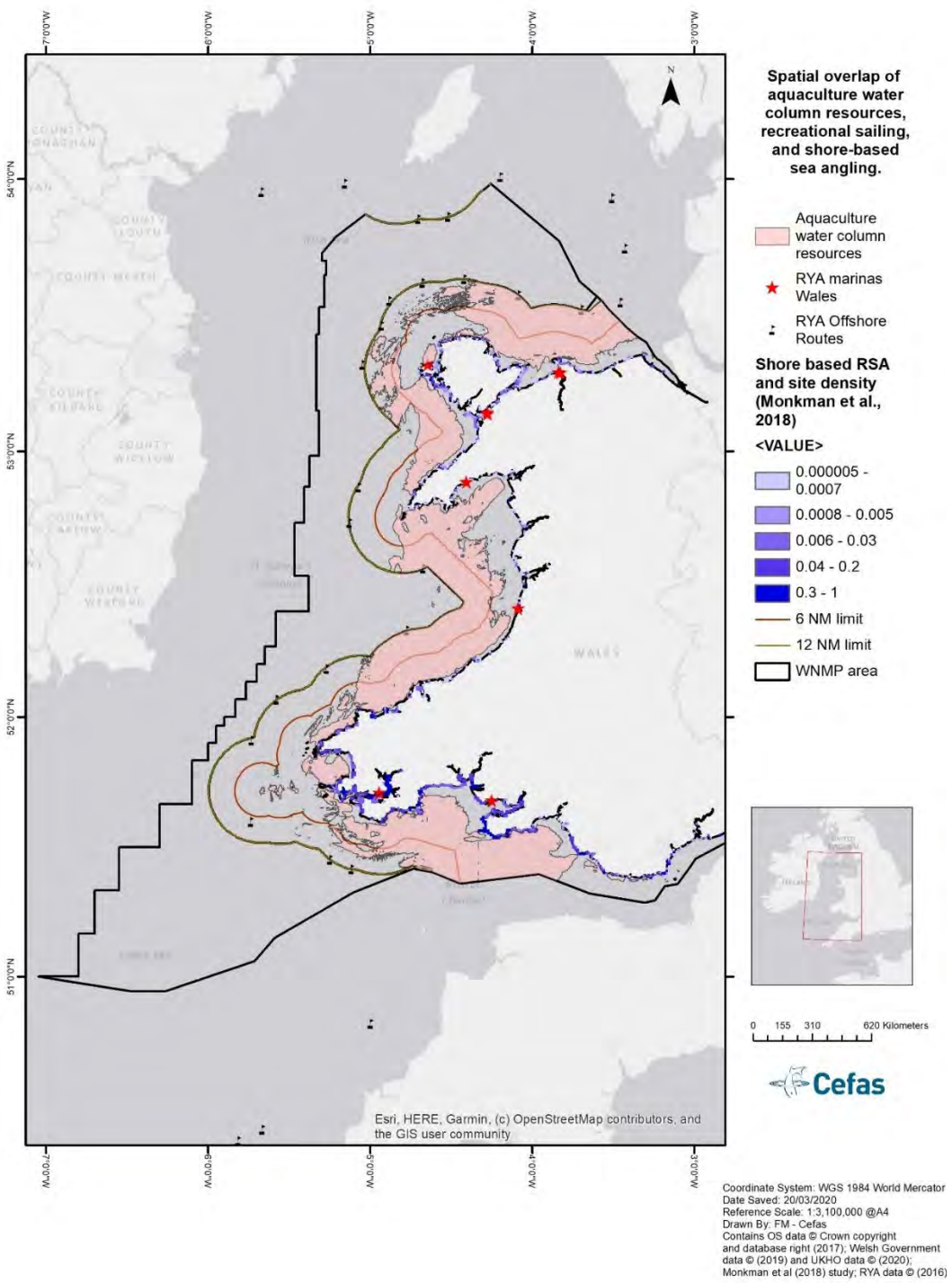

Figure 4.30: Spatial overlap of aquaculture water column resources and recreational activities. Examples of sailing and shore locations for recreational sea angling (source: Monkman et al., 2018).

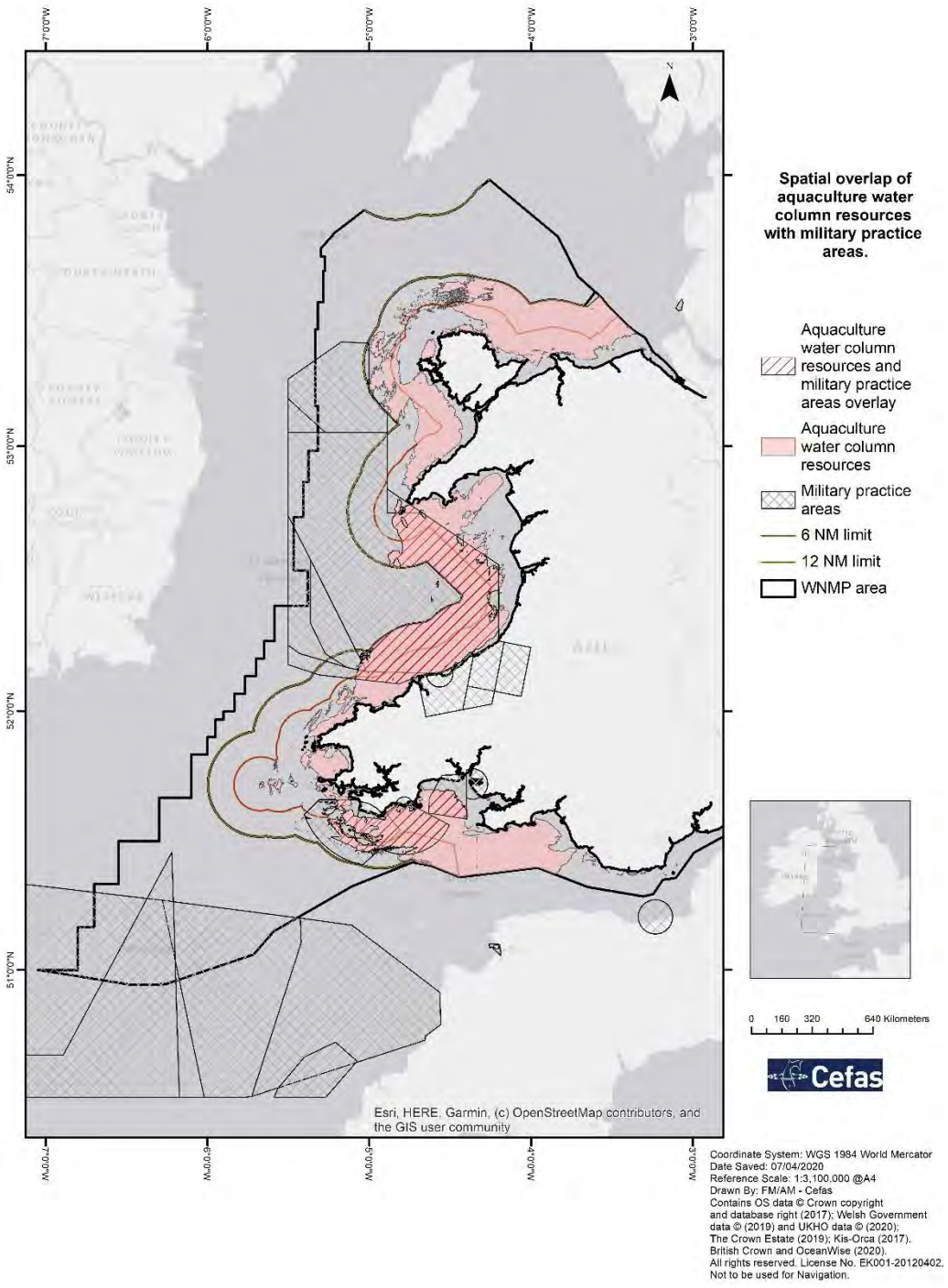

Figure 4.31: Spatial overlap of aquaculture water column resources and military practice areas.

Table 4.5: Summary of water column resource and rope-based aquaculture (shellfish and seaweed) and interaction with focal and other sectors.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
Marine minerals	Marine aggregates	**Possible** – Water column aquaculture resources (rope-based aquaculture), coincide with aggregate resources in several locations: north-east Anglesey, off North Wales, south Pembrokeshire, and Carmarthen and Swansea Bay.	**Unlikely** – Safety and operational reasons, aggregate extraction spatially separate from rope cultivation in the water column.
Energy	Wave energy **Refer to Figure 4.26 for the indicative sector interaction map.**	**Possible** – Water column aquaculture resources (rope-based aquaculture), coincide with wave energy resources off Pembrokeshire.	**Possible** – No known examples in Wales at present, of integrated aquaculture (finfish and shellfish/macroalgae). However, a potential co-location opportunity for the future.
	Tidal stream (fixed and floating)	**Possible** – Water column aquaculture resources (rope-based aquaculture), coincide with tidal stream resources off the Llŷn Peninsula, Pembrokeshire, and coastal sites in South Wales.	**Possible** – No known examples in Wales at present, of integrated aquaculture (finfish and shellfish/macroalgae) and tidal stream. However, a potential co-location opportunity for the future.
	Tidal range **Refer to Figure 4.27 for the indicative sector interaction map.**	**Possible** – Water column aquaculture resources (rope-based aquaculture), coincide with tidal stream resources off Anglesey and coastal sites in South Wales.	**Possible** – No known examples in Wales at present, of integrated aquaculture (finfish and shellfish/macroalgae) and tidal range. However, a potential co-location opportunity for the future.
	Wind turbines (fixed and floating)	**Possible** – Water column aquaculture resources (rope-based aquaculture), coincide with wind energy resource off North Wales, to the north-west of Anglesey, around the Llŷn Peninsula, within Cardigan Bay, off Pembrokeshire, as well as coastal sites in South Wales.	**Possible** – No known examples in Wales at present, of integrated aquaculture (finfish and shellfish/macroalgae). However, a potential co-location opportunity for the future.
	Offshore wind farms (fixed and floating) **Refer to Figure 4.26 for the indicative sector interaction map.**		
	Oil and Gas (incl. submarine pipelines and other infrastructure)	**Likely** – Water column aquaculture resources (rope-based aquaculture), coincide with oil and gas infrastructure and petroleum licensing blocks in off North Wales, in Liverpool Bay.	**Unlikely** – Safety and operational reasons, rope-based cultivation is likely to be spatially separate from oil and gas structures atop the sea surface and pipelines/well heads etc on/along the seabed.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
	Miscellaneous (incl. overhead power lines, power station, substations)	**Unlikely** – Water column aquaculture resources (rope-based aquaculture), in coastal waters or further offshore and hence separate from coastal structures.	**Likely** – Maritime occurrence of shellfish aquaculture, whereas miscellaneous structures present at the coast or in the case of substations (e.g. for operational renewable developments), tend not to be sited directly in the middle of the shellfish bed/resource.
Aquaculture	Cage culture – finfish	**Possible** – Water column aquaculture resources (rope-based aquaculture) and for caged finfish aquaculture, likely to insert in locations, including off North Wales, north-west Anglesey, north coast the Llŷn Peninsula, and off Pembrokeshire.	**Possible** – No known examples in Wales at present, of integrated aquaculture (finfish and shellfish/macroalgae). However, a potential co-location opportunity for the future.
	Bottom culture – shellfish	**Possible** – Water column aquaculture resources (rope-based aquaculture) and seabed aquaculture resources overlap in several locations. This includes off south coast of the Llŷn Peninsula, within Carmarthen and Swansea Bay.	
	Trestle culture - shellfish	**Unlikely** – Where trestle cultivation is intertidal compared with subtidal rope cultivation of shellfish and algae.	
Fisheries	Mobile mid-water gear	**Likely** – Fishing is a mobile activity and hence could overlap with water column aquaculture resources (rope-based aquaculture) and for caged finfish aquaculture.	**Possible** – Safety and operational reasons, water column aquaculture resources (rope-based aquaculture) likely to be spatially separate from grounds fished by mobile fishing gears. Likely that there could be flexibility in the activity location to meet requirements of mobile gear deployment and fished areas.
	Mobile bottom gear		
	Static gear (pots, lines, nets etc)	**Likely** – Fishing is a mobile activity and hence could overlap with water column aquaculture resources (rope-based aquaculture) and for caged finfish aquaculture.	**Possible** –Safety and operational reasons, water column aquaculture resources (rope-based aquaculture) likely to be spatially separate from grounds fished by static gear types. It is likely, however, that there could be flexibility in the activity location to meet requirements of static gear deployment and fished areas.
	Hydraulic dredging	**Likely** – Fishing is a mobile activity and hence could overlap with water column aquaculture	**Possible** – Safety and operational reasons, water column aquaculture resources (rope-based aquaculture) likely to be

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
		resources (rope-based aquaculture) and for caged finfish aquaculture.	spatially separate from hydraulic dredging areas. It is likely, however, that there could be flexibility in the activity location relative to dredging locations.
	Rod and lining	**Likely** – Fishing is a mobile activity and hence could overlap with water column aquaculture resources (rope-based aquaculture) and for caged finfish aquaculture.	**Possible** – Safety and operational reasons, rod and lining is unlikely to overlap with water column aquaculture resources (rope-based aquaculture). It is likely, however, that there could be flexibility in the activity location relative to lining locations.
	Hand gathering	**Unlikely** – Where hand gathering is primarily intertidal compared with subtidal rope-cultivation of seaweed and bivalves.	**Likely** – Spatial separation from typically subtidal cultivation at sea, and intertidal nature of hand gathering.
Ports and Shipping	Shipping - navigation routes **Refer to Figure 4.28 for the indicative sector interaction map.**	**Likely** – Water column aquaculture resources (rope-based aquaculture) overlap with vessel traffic routes including to/from Pembroke/Milford Haven, Pembrokeshire and Holyhead, Anglesey.	**Likely** – Rope cultivation with surface markers and associated infrastructure, would be present in the water column and near the sea surface. This is likely to preclude vessels directly passing through the licenced cultivation area, although access around the harvested area could remain accessible. Likely that there could be flexibility in the activity location to meet requirements of navigational routes and port activity.
	Anchorage areas	**Likely** – Water column aquaculture resources (rope-based aquaculture) overlap with coastal anchorage sites off north-east Anglesey, south Pembrokeshire and Swansea Bay.	**Unlikely** – Avoidance of anchoring among rope cultivation and infrastructure, and potential negative impacts.
Subsea cables	Cables and telecommunications **Refer to Figure 4.29 for the indicative sector interaction map.**	**Likely** – Water column aquaculture resources (rope-based aquaculture) overlap with submarine cabling into north/north-west Anglesey and into/from the Swansea coastline.	**Likely** – Safety and operational reasons, rope-based cultivation could occur in water column above cables, though agreements needed between operators for accessibility to the infrastructure during operational and maintenance works.
Surface water and wastewater treatment and disposal	Intakes and outfalls, including licensed discharges	**Likely** – Water column aquaculture resources (rope-based aquaculture) overlap with coastal outfall pipes including from the coasts of Cardiff, Swansea, Pembrokeshire and North Wales.	**Unlikely** – Preference is to locate rope-based cultivation of shellfish and macroalgae away from sources of potential contamination, such as sewage outfalls.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
Dredging and Disposal	Designated disposal sites (Active)	**Likely** - Water column aquaculture resources (rope-based aquaculture) overlap with licenced disposal sites. Including to the north/north-west of Anglesey, Liverpool Bay and Swansea Bay.	**Unlikely** – Preference is to locate rope-based cultivation of shellfish and macroalgae away from dredging and disposal sites, due to the potential for smothering and contamination.
Defences	Military exercise areas/ammunition disposal sites **Refer to Figure 4.31 for the indicative sector interaction map.**	**Likely** – Water column aquaculture resources (rope-based aquaculture) overlap with Military Practise Areas encompassing Cardigan Bay, around the Pembrokeshire coast, off Tenby and in Carmarthen Bay.	**Possible** – Potential for rope-based aquaculture to occur within military practise areas unless they are subject to temporal restrictions during operational test and military training periods. Future development for rope-based aquaculture where fixed infrastructure to be used, would need to be in dialogue with the MoD.
Tourism and Recreation	Recreational Sea Angling (RSA) **Refer to Figure 4.30 for the indicative sector interaction map.**	**Possible** –RSA undertaken from chartered vessels around seabed features/wrecks, and islands e.g. Skomer. Potential to overlap with water column aquaculture resources (rope-based aquaculture).	**Possible** – RSA from boats could occur in waters around the cultivation area, subject to access for harvesting vessels and placement of markers.
	RYA marinas and sailing routes **Refer to Figure 4.30 for the indicative sector interaction map.**	**Possible** – Water column aquaculture resources (rope-based aquaculture) overlap with sailing routes.	**Possible** – Sailing could occur in waters around the cultivation area, subject to access for harvesting vessels and placement of markers.
	Water sports (e.g. surfing, kite surfing, diving, rafting)	**Possible** – Water column aquaculture resources (rope-based aquaculture) and potential to overlap with water sports atop the sea or through the water column e.g. recreational scuba diving. Notably, diving sites around Grassholm and Skokholm islands.	**Possible** – Water sports could occur in waters around and above subtidal shellfish beds, subject to access for harvesting vessels and placement of markers.
	Shore based activity (e.g. coasteering, hiking, dog walking, kites)	**Unlikely** – Water column aquaculture resources (rope-based aquaculture) at sea compared with shore/coastal location of activities.	**Possible** – Spatial separation from subtidal cultivation at sea and activities on/by the shore. Harvesting vessel and marker buoys possibly visible from shore if operations are inshore.
	Wildlife watching - shore based		**Possible** – Spatial separation of water column aquaculture resource (rope-based aquaculture) at sea and activities on/by the shore.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
	Wildlife watching - boat based	**Possible** – Water column aquaculture resources (rope-based aquaculture) and potential for overlap with boat-based tourism. Such as in proximity to islands that are wildlife hotspots e.g. Grassholm and Skokholm.	**Possible** – Wildlife tourism could occur in waters around the cultivation area, subject to access for harvesting vessels and placement of markers.

4.4.2.2 *Water column resource: finfish aquaculture*

A summary of interaction appraisal for water column resources (finfish aquaculture) and other sectors is shown in Table 4.6.

Water column aquaculture (finfish) is unlikely to spatially co-exist with marine aggregate resources, tidal stream resources, and seabed and water column aquaculture resources. This is considering safety and operational restrictions and consenting basis, applicable to combining the activities in space. There is also unlikely to be a spatial co-existence with other sectors, including surface water and wastewater treatment and disposal, dredging and disposal, tidal range energy as well as defence.

Spatial and temporal management could be applied to sequence the activities of each of the sectors. Such future planning would benefit from dialogue between the respective sectors and their associated regulators. Having these resource overlaps mapped and considering the interactions (Table 4.6) will help to target this dialogue on forward-looking, proactive and spatial planning.

Table 4.6: Summary of water column resources and finfish aquaculture interaction with focal and other sectors.

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
Marine minerals	Marine aggregates	**Possible** – Water column aquaculture resources (finfish cultivation), overlaps with aggregate resources in several areas: north coast and south-west of Anglesey, south Pembrokeshire, and Carmarthen and Swansea Bay.	**Unlikely** – Safety and operational reasons, aggregate extraction spatially separated from finfish cages in the water column.
Energy	Wave energy	**Possible** – Water column aquaculture resources (finfish cultivation) and overlap with wave energy resources off Pembrokeshire.	**Unlikely** – Safety and operational reasons, wave devices on the sea surface/water column and finfish cages in the water column are likely to be spatially separate.
	Tidal stream (fixed and floating)	**Possible** – Water column aquaculture resources (finfish cultivation) and overlap with tidal stream resources off Anglesey, the Llŷn Peninsula, Pembrokeshire, and coastal sites in South Wales.	**Unlikely** – Safety and operational reasons, tidal stream devices on the sea surface/water column or on the seabed, and finfish cages in the water column, are likely to be spatially separate.
	Tidal range	**Possible** – Water column aquaculture resources (finfish cultivation) and overlap with tidal range resources off Anglesey.	**Unlikely** – Safety and operational reasons, tidal range devices on the sea surface/water column or on the seabed, and finfish cages in the water column, are likely to be spatially separate.
	Wind turbines (fixed and floating)	**Possible** – Water column aquaculture resources (finfish cultivation) and overlap with wind energy resource off North Wales, to the west of Anglesey, around the Llŷn Peninsula, within Cardigan Bay, off Pembrokeshire, and coastal sites in South Wales.	**Possible** –Currently for safety and operational reasons, finfish cages in the water column, kept spatially separate from fixed/floating turbines (and turbines together in a wind farm) and wind farms. But in the future, it could be conceivable to co-locate wave devices and wind farms, particularly where operations are in more high energy environments and cost incentives to share infrastructure[9].
	Offshore wind farms (fixed and floating)		
	Oil and Gas (incl. submarine pipelines and other infrastructure)	**Likely** – Water column aquaculture resources (finfish cultivation), coincide with oil and gas infrastructure and petroleum licensing blocks in Liverpool Bay, off the west coast of Anglesey, and off Pembrokeshire, located in the Outer Bristol Channel.	**Unlikely** - Safety and operational reasons, finfish cages in the water column are likely to be spatially separate from oil and gas structures atop the sea surface and pipelines/well heads etc on/along the seabed.
	Miscellaneous (incl. overhead power lines, power station, substations)	**Unlikely** – Water column aquaculture resources (finfish cultivation) separate from coastal-based infrastructure like power stations.	**Likely** – Maritime occurrence of shellfish aquaculture, whereas miscellaneous structures present at the coast or in the case of substations (e.g. for operational renewable

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
			developments), tend not to be sited directly in the middle of the shellfish bed/resource.
Aquaculture	Bottom culture - shellfish	**Possible** – Water column aquaculture resources (finfish cultivation) and seabed aquaculture overlap off North Wales, north-west Anglesey, north coast of the coast of Llŷn Peninsula, as well as Carmarthen and Swansea Bays.	**Possible** – No known examples in Wales at present, of integrated aquaculture (finfish and shellfish/macroalgae). However, a potential co-location opportunity for the future.
	Rope culture - shellfish	**Possible** – Water column aquaculture resources for finfish cultivation and for rope cultivation intersect off North Wales, north-west Anglesey, north coast the Llŷn Peninsula, and off Pembrokeshire.	
	Rope culture - seaweed	**Possible** – Water column aquaculture resources for finfish cultivation and for rope cultivation, intersect off the south coast of the Llŷn Peninsula, within Carmarthen and Swansea Bay.	
	Trestle culture - shellfish	**Unlikely** – Where trestle cultivation is intertidal compared with subtidal resources for finfish cultivation.	
Fisheries	Mobile mid-water gear	**Likely** – Fishing is a mobile activity and hence could overlap with water column aquaculture resources (finfish cultivation).	**Possible** – Safety and operational reasons, water column aquaculture resources (finfish cultivation) likely to be spatially separate from grounds fished by mobile fishing gears. Likely that there could be flexibility in the activity location to meet requirements of mobile gear deployment and fished areas.
	Mobile bottom gear		
	Static gear (pots, lines, nets etc)	**Likely** – Fishing is a mobile activity and hence could overlap with water column aquaculture resources (finfish cultivation).	**Possible** –Safety and operational reasons, water column aquaculture resources (finfish cultivation) likely to be spatially separate from grounds fished by static gear types. It is likely, however, that there could be flexibility in the activity location to meet requirements of static gear deployment and fished areas.
	Hydraulic dredging	**Likely** – Fishing is a mobile activity and hence could overlap with water column aquaculture resources (finfish cultivation).	**Possible** – Safety and operational reasons, water column aquaculture resources (finfish cultivation) likely to be spatially separate from hydraulic dredging areas. It is likely,

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
			however, that there could be flexibility in the activity location relative to dredging locations.
	Rod and lining	**Likely** – Fishing is a mobile activity and hence could overlap with water column aquaculture resources (finfish cultivation).	**Possible** – Safety and operational reasons, water column aquaculture resources (finfish cultivation) likely to be spatially separate from rod and lining areas. But likely that there could be flexibility in the activity location relative to lining.
	Hand gathering	**Unlikely** – Where hand gathering is conducted in the intertidal zone compared with subtidal resources for finfish cultivation.	**Unlikely** – Spatial separation from finfish aquaculture e.g. pens and associated anchors/lines at sea, and intertidal nature of hand gathering.
Ports and Shipping	Shipping - navigation routes	**Likely** – Water column aquaculture resources (finfish cultivation) overlap with several vessel traffic routes, including to/from Pembroke/Milford Haven, Pembrokeshire and Holyhead, Anglesey.	**Likely** - Finfish aquaculture e.g. pens and associated anchors/lines at sea, usually spatially separate from shipping traffic and designated anchorages.
	Anchorage areas	**Likely** – Water column aquaculture resources (finfish cultivation) overlap with coastal anchorage sites off north-east Anglesey and Swansea Bay.	**Unlikely** – Where anchorage areas are already present before finfish pens, the potential for co-location on operational and safety grounds is limited.
Subsea cables	Cables and telecommunications	**Likely** – Water column aquaculture resources (finfish cultivation) overlap with submarine cables into north/north-west Anglesey, Swansea coast as well as routes into the Inner Bristol Channel.	**Likely** – Pens for fish in the water column could co-occur over seabed with buried subsea cables.
Surface water and wastewater treatment and disposal	Intakes and outfalls, including licensed discharges	**Possible** – Water column aquaculture resources (finfish cultivation) coincide with coastal outfall pipes including from the coasts of Swansea, Pembrokeshire and North Wales.	**Unlikely** – Finfish aquaculture e.g. pens and associated anchors/lines usually locations away sources of potential contamination, such as outfalls.
Dredging and Disposal	Designated disposal sites (Active)	**Likely** – Water column aquaculture resources (finfish cultivation) overlap with licensed disposal sites to the north/north-west of Anglesey, Liverpool Bay and Swansea Bay.	**Unlikely** – Safety and operational reasons, finfish aquaculture e.g. pens and associated anchors/lines, likely to be kept spatially separate from designated disposal sites.
Defences	Military exercise areas/ammunition disposal sites	**Likely** – Water column aquaculture resources (finfish cultivation) coincide with Military Practise Areas encompassing Cardigan Bay, around the	**Unlikely** – Safety and operational reasons, finfish aquaculture e.g. pens and associated anchors/lines, likely to be kept spatially separate from military defence areas. Future development for finfish aquaculture where fixed

Marine Plan Sector	Activity/Sector	Are the two activities likely to interact (possible, likely or unlikely)? If so, how interact?	Can the structures/activities physically co exist in space, recognising activities could occur in the same space yet at different times (possible, likely or unlikely)?
		Pembrokeshire coast, off Tenby and in Carmarthen Bay.	infrastructure to be used, would need to be in dialogue with the MoD.
Tourism and Recreation	Recreational Sea Angling (RSA)	**Possible** –RSA undertaken from chartered vessels around seabed features/wrecks, and islands e.g. Skomer. Potential to overlap with water column aquaculture resources (finfish cultivation).	**Possible** – Boat-based RSA in proximity to the cages, though not directly in the cage 'footprint'.
	RYA marinas and sailing routes	**Possible** – Water column aquaculture resources (finfish cultivation) likely to overlap with sailing routes.	**Possible**- Supporting vessels for tidal stream operations, may utilise existing navigational routes to access devices. However, navigational measures and best practise measures would limit close spatial co-existence, mainly on safety grounds.
	Water sports (e.g. surfing, kite surfing, diving, rafting)	**Possible** – Water column aquaculture resources (finfish cultivation) and potential to overlap with water sports atop the sea or through the water column e.g. recreational scuba diving. Notably, diving sites around Grassholm and Skokholm islands.	**Unlikely** – Safety and operational reasons, finfish aquaculture sites separate spatially from water sports.
	Shore based activity (e.g. coasteering, hiking, dog walking, kites)	**Unlikely** – Shore-based activities compared with subtidal nature of water column aquaculture resources (finfish cultivation).	**Unlikely** – Spatial separation from finfish aquaculture at sea and activities on/by the shore.
	Wildlife watching - shore based		**Unlikely** – Spatial separation from finfish aquaculture at sea and activities on/by the shore. Vessels and surface buoys may be visible if cages inshore.
	Wildlife watching - boat based	**Possible** – Water column aquaculture resources (finfish cultivation) and potential for overlap with boat-based tourism. Such as in proximity to islands that are wildlife hotspots e.g. Grassholm and Skokholm.	**Possible** – Wildlife tourism could occur in waters around the cultivation area, subject to access for harvesting vessels and placement of markers.

5 Plan, policy and legislative considerations

5.1 Additional UK Plan and policy considerations

Considerations include policies in existing Marine Plans like the Integrated Marine Plan for Ireland and marine policies/objectives set by the Isle of Man Government. There are also future Marine Plans for areas bordering the WNMP where cross-boundary considerations may apply, for instance, the south-west and north-west England Marine Plans and The Republic of Ireland Marine Planning Framework.

Policy considerations include the Marine Policy Statement, and sector specific National Policy Statements.

5.2 National Development Framework and Regional and Local Plans

Relevant terrestrial plans/frameworks at a national, regional and local level have been identified, in view of potential links and relevance to the focal sectors e.g. jobs that could exist on land because of the focal activity.

5.2.1 National Development Framework 2020-2040[30]

The draft National Development Framework (NDF)[28] applies to all of Wales and the Strategic and Local Development Plans must support the implementation of the NDF. The draft NDF contains several objectives of relevance to the focal sectors including climate change, decarbonisation and energy, natural resources, economic prosperity and regeneration. Potential NDF policies with relevance to the focal sectors have been identified and summarised in Table 5.1.

Table 5.1: National Development Framework policies and descriptions with potential relevance to focal sectors, under the WNMP[28].

Policy	Description from NDF 2020 2040
Policy 8 – Strategic framework for biodiversity enhancement and ecosystem resilience	*"opportunities where strategic green infrastructure could be maximised as part of development proposals, requiring the use of nature based solutions as a key mechanism for securing sustainable growth, ecological connectivity, social equality and public well-being."*
Policy 13 – Other Renewable Energy Developments	Reference to Policy 11 for Wind and Solar Energy Outside of Priority Areas *"Outside of the Priority Areas for Solar and Wind, planning applications for large scale wind and solar development must demonstrate the proposal is acceptable, in accordance with the criteria below.*

[30] Source: https://gov.wales/sites/default/files/consultations/2019-08/Draft%20National%20Development%20Framework.pdf [Last access 06/04/2020]. This version is still in draft / consultation form and is the most up-to-date consultation draft of the NDF. It is, however, liable to change as the final version has not yet been adopted.

Policy	Description from NDF 2020 2040
	Planning applications must demonstrate how local social, economic and environmental benefits have been maximised and that there are no unacceptable adverse *effects on, or due to, the following:* *• landscape and visual impacts;* *• cumulative impacts;* *• the setting of National Parks and Areas of Outstanding Natural Beauty;* *• visual dominance, shadow flicker, reflected light or noise impacts;* *• electromagnetic disturbance to existing communications systems; and* *• the following identified protected assets:* *- archaeological, architectural or historic assets;* *- nature conservation sites and species;* *- natural resources or reserves.*"
Policy 17 – Wrexham and Deeside **(linkage to North Wales Strategic Development Plan)**	"*The Welsh Government supports Wrexham and Deeside as the primary focus for regional growth and investment. Wrexham and Deeside's role within the North region and the wider cross-border areas of Cheshire West and Chester and Liverpool City Region should be maintained and enhanced.*"
Policy 18 – North Wales Coastal Settlements	"*The Welsh Government supports the built up coastal arc from Caernarfon to Deeside as the focus for managed growth, reflecting this area's important sub-regional role supporting the primary growth area of Wrexham and Deeside.* *Strategic and Local Development Plans across the region should recognise the role of this corridor as a focus for housing, employment and key services.*"
Policy 20 – Port of Holyhead	"*The Welsh Government will work with port operators, local authorities and investors to support the development of the port and facilitate new investment in order to ensure that its strategic gateway role is maintained and enhanced. Investment to improve the port's capacity to accommodate cruise ships is supported…*"
Policy 23 – Swansea Bay and Llanelli	"*Swansea Bay and Llanelli will be the main focus for regional scale growth and investment.* *Regional and local development plans should recognise Swansea Bay and Llanelli as the focus for strategic growth; essential services and facilities;*

Policy	Description from NDF 2020 2040
	transport and digital infrastructure; and consider how they can support and benefit from their strategic regional role."
Policy 24 – Regional Centres **(linkage to Mid and West Wales Strategic Development Plan)**	"*…Carmarthen, Llandrindod Wells, Newtown, Aberystwyth and the four Haven Towns will be the focus for managed growth, reflecting their important sub-regional functions.* *Regional and local development plans should recognise the roles of these settlements as being a focus for housing, employment and key services within their wider areas and consider how they continue as a focal point for sub-regional growth.*"
Policy 28 – Newport **(linkage to South East Wales Strategic Development Plan)**	"*The Welsh Government supports Newport as the focus for regional growth and investment…the strategic emphasis should be focussed on achieving growth in the city.* *Strategic and Local Development Plans across the region should recognise Newport as a focus for strategic housing and economic growth; essential services and facilities; transport and digital infrastructure; and consider how they can support and benefit from Newport's increased strategic regional role. Development in the wider region should be carefully managed to support Newport's growth and to provide a focus for regional planning.*"

5.2.2 Wales Strategic Development Plans

Strategic Development Plans (SDPs) are applicable at regionals/sub-regional level and existing SDPs are for the following regions in Wales:

- South East Wales (Local Authority Areas of Cardiff, Newport, Monmouthshire, Bridgend, Vale of Glamorgan, RCT, Merthyr Tydfil, Torfaen, Blaenau Gwent and Caerphilly).
- South West and Mid Wales (LA areas of Powys, Carmarthenshire, Ceredigion, Pembrokeshire, Swansea, Neath Port Talbot).
- North Wales (LA areas of Gwynedd, Anglesey, Conwy, Flintshire, Wrexham and Denbighshire).

5.2.3 Wales Local Development Plans

Local Development Plans (LDPs) are prepared by each Local Authorities. Where LDP are available online, these have been reviewed and LDP policies with relevance to the (maritime) focal sectors, subsequently identified (Table 5.2). The LDP with a link to the WNMP focal sectors appears to be for counties situated on the coast and those with a link to maritime sectors/activities e.g. Swansea and aggregate wharves.

The types of relevant policies identified from the LDP are those for renewable energy and low carbon energy, where in the marine environment these are Energy – Low Carbon: Wave energy.

Tidal stream (fixed and floating) and Offshore Wind Energy (Table 5.2). There are LDP policies about safeguarding (terrestrial) aggregate resources and sustainable mineral resources e.g. Cardiff Council LDP (Table 5.2). These are considered to be relevant where marine minerals supplement terrestrial sources, such as for the construction industry.

There are relevant LDP policies about shipping freight, (associated with shipping activity), harbours/ports and associated access channels e.g. Cardiff LDP (Table 5.2). These have been identified given the socio-economic importance of shipping and coastal infrastructure e.g. ports which support and enable operations (marine and ashore) associated with the focal sector and non-focal sectors/activities.

Policies about managing water quality such discharges from land to coastal waters (e.g. Swansea Council LDP, Table 5.2), are considered relevant. This is given the importance of water quality for sectors like fisheries, aquaculture and recreational activities.

Table 5.2: Examples of Local Development Plan policies with potential relevance to focal sectors, under the Welsh National Marine Plan

Local Authority	Local Development Plan and relevant policies
Cardiff Council	Local Development Plan 2006-2026[31] Policies of relevance: EN12: Renewable energy and low carbon technologies M6: Sand wharf protection areas M7: Safeguarding of sand and gravel resources
Ceredigion County Council	Local Development Plan 2007-2022[32] Policies of relevance: Policy LU25: Renewable Energy Generation Policy LU27: Sustainable Supply of Mineral Resources
Gwynedd Council	Anglesey and Gwynedd Joint Local Development Plan 2011 – 2026[33] Policies of relevance: Strategic policy PS 7: renewable energy technology, with reference to marine energy sources including wind and tidal stream energy.
Isle of Anglesey County Council	

[31] Source: https://www.cardiff.gov.uk/ENG/resident/Planning/Local-Development-Plan/Documents/Final%20Adopted%20Local%20Development%20Plan%20English.pdf [Last access: 06/04/2020].

[32] Source: https://www.ceredigion.gov.uk/media/6223/ceredigion-local-development-plan-ldp-volume-1-strategy-and-policies-english.pdf [Last access: 06/04/2020].

[33] Source: https://www.gwynedd.llyw.cymru/en/Council/Documents---Council/Strategies-and-policies/Environment-and-planning/Planning-policy/Anglesey-and-Gwynedd-Joint-Local-Development-Plan-Written-Statement.pdf [Last access: 06/04/2020].

Local Authority	Local Development Plan and relevant policies
	STRATEGIC POLICY PS 22: Minerals and reference to "*Protect maritime wharf and railhead facilities as a means of encouraging sustainable transport of aggregates*."
Neath Port Talbot County Borough Council	Local Development Plan 2011-2026[34] <u>Policies of relevance:</u> Policy EN 1: The Undeveloped Coast and reference to "*The management and/or maintenance of shipping channels/port access and other associated infrastructure*." SP18: Renewable & Low Carbon Energy Policy TR 4: Safeguarding Freight Facilities Including: *TR4/1 Port Talbot Tidal Harbour* *TR4/2 Port Talbot Docks* *TR4/3 Existing & Potential Wharves* *TR4/4 Existing Rail Connections & Sidings*
Pembrokeshire County Council	Local Development Plan 2013-2021[35] <u>Policies of relevance:</u> GN.4 Resource Efficiency and Renewable and Low-carbon Energy Proposals SP 6 Minerals and referencing "*Safeguarding the landfall locations for marine dredged sand and gravel*."
Swansea Council	Local Development Plan 2010-2025[36] <u>Policies of relevance:</u> EU 1: Renewable and low carbon energy developments ER 1: Climate Change and reference to "*Promoting energy and resource efficiency and increasing the supply of renewable and low carbon energy.*" RP 11: Sustainable development of mineral resources and reference to "*Wharves in Swansea Docks used for the unloading of marine dredged sand and gravel will be safeguarded*." RP 3: Water pollution and the protection of water resources, and reference to "*Development proposals that would have a significant adverse impact on biodiversity, fisheries, public access or water related recreation use of water resources, will not be permitted*."

[34] Source: https://www.npt.gov.uk/media/7321/ldp_written_statement_jan16.pdf [Last access: 06/04/2020].
[35] Source: https://www.pembrokeshire.gov.uk/adopted-local-development-plan [Last access: 06/04/2020].
[36] Source: https://www.swansea.gov.uk/article/30232/Core-documents---Submitted-LDP-Docs-LDP [Last access: 06/04/2020].

6 Summary and Recommendations

The increasing demand and competition for marine space requires a sound approach for the optimal management of the marine and coastal environment. The approach needs to address the multiple, cumulative and potentially conflicting uses of the sea whilst promoting the effective protection of natural resources (OECD, 2016).

It is suggested that, although there are challenges to understand and develop the marine spatial planning process, co-existence and co-location are choices which deserve greater consideration from Welsh marine planners and stakeholders, whose goal is to minimise conflicts and maximise benefits between different sea users (Kyvelou and Ierapetritis, 2019).

The Welsh National Marine Plan (WNMP) defines the long-term vision for the sustainable development of the Welsh seas, which underpin the well-being of coastal regions and the wider Welsh population. The WMNP vision will be achieved "*through an integrated, evidenced and plan-led approach that respects established uses and interests whilst securing benefits from new opportunities, recognising the importance of our heritage, ecosystem resilience, the value of biodiversity and imperative to tackle climate change*" (Welsh Government, 2019, p. 1).

The WNMP is anchored into the Well-being of Future Generations (Wales) Act (WFGA) 2015 and Environmental (Wales) Act 2016. These legislative measures stress the sustainable current and future use of the marine resources as well as the consideration of co-existence of maritime activity, when and where feasible. However, the sustainability appraisal of the WNMP found several negative impacts regarding the promotion of the sectors: marine aggregates, energy - oil and gas, and energy – low carbon. Co-existence may offset the footprint of these sector and, therefore, enables early measure to counterbalance any potential negative environmental or social, culture impacts of developing these sectors. The sustainability appraisal recommends careful appraisal of the blue growth goal to achieve well-being goals. This report contributes to this appraisal and seeks to give more information, from a socio-economic perspective, on potential co-existence but also spatial and temporal conflicts between sectors.

To this end, the objectives of this report was to compile and synthesise evidence regarding sector-sector interactions - focal marine sectors and other marine activities – drawing on evidence from the Welsh marine area or from UK and international examples where Welsh specific data were lacking. This is to promote a better and clearer understanding of interaction opportunities and constraints within the SRA. We focused on the socio-cultural and economic factors impacting interaction between activities/uses of the marine space. The report is complemented by an overview of plans and polices at national, regional and local scales in Wales and elsewhere in the UK.

Primary evidence on sector-sector interactions are limited and dominated by consideration of **co-location** of **aquaculture** and **offshore renewables** (mostly offshore wind farms) in the UK and other Northern European countries, such as Germany, from both the industrial and academic perspective. This is demonstrated by more socio-economic available evidence of the impact of co-locating these two sectors presented in this report. On one hand, this is likely due to the expansion of the renewable energy sector. But on the other hand, it may be due to the potential for increasing seafood production to reduce pressure on the fish stocks.

Similarly, co-existence between the **marine aggregate** sector and other important activities for coastal communities (e.g. fisheries and tourism) has received more attention. This is partially a result of research targeting the marine aggregate industry, which has been subsidised between 2002 and 2011 through the Marine Aggregate Levy Sustainability Fund (MALSF). The outputs of the research undertaken over this decade have provided valuable inputs to the wider marine science, that underpins the planning and management of multiple activities taking place in the marine environment round the UK.

As a result of the evidence review the following recommendations are made. These have been divided in general recommendations and sector-sector interaction specific ones.

General recommendations include:

- More evidence targeting specifically the socio-cultural impacts of co-existence and co-location of marine activities is required. An interdisciplinary, bottom-up approach should be adopted. As such, stakeholder representatives from the private sector representing various Welsh marine industries and marine groups, public authorities and researchers should be involved at the early stages of the marine/coastal development proposal and throughout the spatial planning process.

- We suggest the adoption of the definition of Social Impact Assessment (SIA) provided by (Vanclay, 2003, p. 5) which states that SIA *"includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions"*. The social assessment plays an important role in understanding the interdependence between the marine environment and coastal communities and how the impacts distribute differently amongst different groups in society. It is also a tool to collect information about relevant social factors which will complement the environmental and social domains in order to inform planning and management decisions (Voyer et al., 2012).

- Good governance is indispensable in complex decision-making when assessing development options for marine sectors. It is also a key factor to enable adequate management of social, economic and ecological systems which incorporate human well-being. Planning should happen through a collaborative process where all relevant stakeholders with competing or common interests, are engaged. This is to identify strategic options, assess opportunities and risks and thus improving the design and administration of plans (Blau and Green, 2015; Partidario and Gomes, 2013). Moreover, a collaborative approach is likely to result in higher levels of compliance and wider social cohesion (Blau and Green, 2015).

- Equally, methods for evaluating the economic benefits and trade-offs of multiple seas uses should be defined. There is complexity associated with valuing ecosystem goods and benefits, and there are uncertainties with the lack of market prices for certain goods and benefits provided by nature. The economic appraisal was determined as best oriented towards economic efficiency and the management of sustainable economic growth, stemming from the combination and integration of activities developing or

occurring in a specific area (Eggenberger and Partidário, 2000). Economic valuation is a crucial mechanism to unveil the total economic value of final goods and benefits (also called "ecosystem services") supplied by the marine and coastal environments, and inform policy choices and business decisions (Bateman et al., 2014; Turner et al., 2014). There are already methods available to quantify the value of ecosystem goods and services (e.g. water quality, healthy climate) (Partidario and Gomes, 2013; Turner et al., 2014).

- Ultimately, a flexible framework should be adopted for the integrated evaluation of environmental, social and economic impacts of sector-sector interactions. This could assist Welsh policy makers in planning for the use and management of coastal and marine resources to reflect the local context and needs.

Sector-sector interaction specific recommendations include:

- Much of the work undertaken to investigate opportunities for co-existence or co-location of offshore infrastructures (aquaculture farms and low carbon energy arrays), seems to prioritise technological and environmental factors and issues. Whereas research should be developed further to address social acceptance and spatial distribution of the users of the coastal areas where the infrastructures are planned to be located, together with associated potential impacts as well as economic viability of multiple uses of the same marine space.

- It would be useful to develop a context-specific framework, to provide guidance about the licensing process and safety regulations. This could also delineate minimum technical requirements and financial pathways (e.g. incentives, insurance coverage) for the co-location of aquaculture and low carbon energy installations. This type of framework should adopt a consultative process with representatives from the private sector (marine industries and groups) as well as public authorities and researchers. Engaging stakeholders is essential from the early stages of the planning process to develop a new project, a new strategy or action plan. Hence, an interdisciplinary bottom-up approach should be adopted.

- Displacement of activities (e.g. fisheries, recreational activities) resulting from interacting sectors can be a concern. This issue could be addressed through innovative, cooperative and coordinated ways between the parties involved, facilitated by strong stakeholder engagement. An example of cooperation between the fishing industry and the marine aggregate sector is provided in section 3.2.4.

- Building on existing examples of positive interaction between aquaculture and tourism in southern European countries (section 3.2.15), in depth research is needed to investigate how aquaculture and tourism can positively interact. For instance, interaction that promotes education and/or recreational activities, and associated societal and economic benefits.

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Appendix 1: Marine Plan Activity/Sectors

Marine Plan Sector	Activity/Sector category
Marine aggregates	Aggregate extraction
Energy	Wave
	Tidal stream (fixed and floating)
	Tidal range energy (tidal lagoons)
	Wind turbines (fixed and floating)
	Offshore wind Farms (fixed and floating)
	Oil and Gas (incl. submarine pipelines and other infrastructure)
	Miscellaneous (incl. overhead power lines, power station, substations)
Aquaculture **Resources in the mapping (Section 4) distinguish seabed resources, bottom cultivation of shellfish, and water column resources e.g. rope cultivation of shellfish.**	Bottom culture - shellfish
	Cage culture - finfish
	Rope culture - shellfish
	Rope culture - seaweed
	Trestle culture - shellfish
Fisheries	Mobile mid-water gear
	Mobile bottom gear
	Static gear (pots, lines, nets etc)
	Hydraulic dredging
	Rod and lining and hand gathering
Ports and Shipping	Shipping - navigation routes
	Anchorage areas
Cables and telecommunications	Subsea cables
Surface water and wastewater treatment and disposal	Intakes and outfalls, including licensed discharges
Dredging and Disposal	Designated disposal sites, and licensed maintenance/capital dredging
Defence	Military practise/operation areas; areas of intense aerial activity
Tourism and Recreation	Recreational Sea Angling
	Royal Yachting Association marinas and sailing routes
	Water sports (e.g. surfing, kite surfing, diving, rafting)
	Shore based activity (e.g. coasteering, hiking, dog walking, kites)
	Wildlife watching - shore based
	Wildlife watching - boat based

Appendix 2: Mapping data layers summary

Data layer	Data type (Points, Polygon, Polyline, Gridded)	Data source
Marine aggregate resources	Polygons	Key Resource Areas (KRA) identified by The Crown Estate (2014), cited in Welsh Government (2019).
Tidal stream resources	Polygons	Key Resource Areas (KRA) identified by The Crown Estate (2014), cited in Welsh Government (2019).
Tidal range resources	Polygons	Key Resource Areas (KRA) identified by The Crown Estate (2014). Includes data from ABPmer (2008), cited in Welsh Government (2019).
Wave energy resources	Polygons	Key Resource Areas (KRA) identified by The Crown Estate (2014). Includes data from ABPmer (2008), cited in Welsh Government (2019).
Seabed aquaculture resources	Polygons	Welsh Government (2015a).
Water column aquaculture resources	Polygons	
Offshore wind farms (Leasing rounds 1, 2 and 3 plus round 1 and 2 extensions **available for 2017**)	Polygons	The Crown Estate (2019).
Offshore wind export cable agreements	Polyline	The Crown Estate (2017).
Subsea cabling	Polyline	KIS-ORCA (2017).
Fishing activity data - Fishing activity for UK vessels 15m and over in 2016	Polygon & points	MMO (2016).
Vessel transits – Automatic Identification System (AIS) data	Density layer based on points	ABPmer and MMO (2015).
Licensed disposal sites	Polygons	Natural Resources Wales (2019)
Sea angling locations	Points and polygons	Monkman et al. (2018).
RYA marinas	Points	RYA (2016).
RYA offshore sailing routes	Points	RYA (2016).
Defence – Military Practise Areas	Polygons	British Crown and OceanWise (2020) License No. EK001-20120402.

Centre for Environment Fisheries & Aquaculture Science

Cefas

About us

We are the Government's marine and freshwater science experts. We help keep our seas, oceans and rivers healthy and productive and our seafood safe and sustainable by providing data and advice to the UK Government and our overseas partners.

We are passionate about what we do because our work helps tackle the serious global problems of climate change, marine litter, over-fishing and pollution in support of the UK's commitments to a better future (for example the UN Sustainable Development Goals and Defra's 25 year Environment Plan).

We work in partnership with our colleagues in Defra and across UK government, and with international governments, business, maritime and fishing industry, non-governmental organisations, research institutes, universities, civil society and schools to collate and share knowledge.

Together we can understand and value our seas to secure a sustainable blue future for us all and help create a greater place for living.

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Innovative, world-class science is central to our mission. Our scientists use a breadth of surveying, mapping and sampling technologies to collect and analyse data that are reliable and valuable. We use our state-of-the-art Research Vessel Cefas Endeavour, autonomous marine vehicles, remotely piloted aircraft and utilise satellites to monitor and assess the health of our waters.

In our laboratories in Lowestoft and Weymouth we:
- safeguard human and animal health
- enable food security
- support marine economies.

This is supported by monitoring risks and disease in water and seafood; using our data in advanced computer models to advise on how best to manage fish stocks and seafood farming; to reduce the environmental impact of man-made developments; and to respond to serious emergencies such as fish disease outbreaks, and to respond to oil or chemical spills, and radioactivity leaks.

Overseas, our scientists currently work in Commonwealth countries, United Kingdom Overseas Territories, South East Asia and the Middle East.

Our customer base and partnerships are broad, spanning Government, public and private sectors, academia, non-governmental organisations (NGOs), at home and internationally.

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