Ocean Energy

working to accelerate offshore consenting

ORJIP Ocean Energy

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Sharing Environmental Monitoring Data

October 2020

Report to: The Crown Estate, Crown Estate Scotland, Marine Scotland, Welsh Government, Scottish Natural Heritage and Natural Resources Wales

Issued by EMEC, Aquatera Ltd and MarineSpace Ltd

aquatera environmental services and products

MarineSpace Making Sense of the Marine Environment™

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Issue record

Version	Date	Details
V1.0	20 July 2020	Draft issued to Steering Group for consultation
V2.0	09 October 2020	Final version

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1 INTRODUCTION

The European Marine Energy Centre (EMEC) is a Steering Group member and jointly supports the secretariat function of the Offshore Renewables Joint Industry Programme for Ocean Energy (ORJIP OE). ORJIP OE is a UK-wide collaborative programme formed to ensure that environmental research conducted by the ocean energy sector will ultimately reduce the consenting risks associated with developing wave, tidal stream and tidal range projects.

As part of EMEC's role in the joint secretariat, Aquatera Limited has contracted EMEC to provide a short summary of the opportunities, issues and challenges associated with sharing environmental monitoring data. EMEC has based this report on the practical experience it has gained since the centre's sites were established in 2003.

The report has been prepared to provide an industry perspective on the topic and compliments the ORJIP OE Wave and Tidal Critical Evidence Needs report (2020). The topics considered within the report include:

- The key barriers to sharing environmental monitoring data and identifying the challenges that are required to be overcome.
- The issues associated with the drivers for academic research versus developer-led monitoring work, including an overview of how monitoring is typically funded and eventually carried out.
- A good practice example of sharing and disseminating environmental monitoring data.
- Opportunities and solutions for overcoming the key barriers identified.

2 KEY BARRIERS AND CHALLENGES TO SHARING ENVIRONMENTAL MONITORING DATA

The key barriers identified to sharing environmental monitoring data are:

- data collection costs;
- confidentiality and issues associated within intellectual property rights (IPR) (such as operational information);
- data formatting and inclusion of appropriate metadata for the purposes of sharing with third parties;
- data storage and dissemination platforms;
- resourcing data analysis and;
- risk of releasing environmental monitoring data that has not been thoroughly analysed by project or technology developer due to lack of internal resources.

2.1 COSTS

Gaining a greater understanding of the potential environmental impacts associated with deploying and operating wave and tidal energy devices can be a difficult exercise involving expensive sensors/instruments and collection methodologies. The costs associated with undertaking such monitoring programmes can impinge on the willingness of developers (or those conducting the monitoring) to share the results, particularly if the campaign has been privately funded (either wholly or partially). To date, the majority of successful monitoring campaigns have been either wholly or partly publicly funded and, therefore, it is typical for the dissemination of environmental monitoring data/results to be within the terms of the funding agreement. Unfortunately, often the terms relating to data dissemination are loosely defined within the funding agreement resulting in the data published being of little value for future research/analysis. Significant engagement with funders is required to ensure that terms are better designed and applied to ensure maximum value for future research/analysis. Significant engagement is also needed with those who do no release data that has been wholly/partially paid for using public funds.

2.2 CONFIDENTIALITY AND IPR

Depending on the funding mechanism for environmental monitoring campaigns, several issues associated with confidentiality may hamper a developer's willingness to disseminate the findings from the monitoring campaign. Firstly, if a developer has invested in conducting a monitoring campaign in order to gain an insight into the potential environmental impact of their technology for the purpose of supporting its future development potential, then there may be an advantage over competitor technologies in not divulging the results of the monitoring campaign. Holding information regarding a technology's specific impact on the environment may also support not only future consent applications for the site being monitored but also future development sites and therefore, the willingness to disseminate information may be driven by the investors in a technology. Examples from the offshore wind industry, e.g. performance data, can be used to demonstrate the possibilities of anonymising data and therefore, within sector competition should not be an issue. This is a perception held by some parties that is hindering progress, whereas the wider perception of the sector is that information which may show the limited or negligible effects of environmental impacts would benefit both the developer and the sector as a whole.

If the monitoring being conducted is to comply with a consent condition, it may be necessary for the developer to disseminate the findings to the regulator and statutory stakeholders. Developers are often obliging when fulfilling their consent conditions. However, in certain jurisdictions, e.g. UK, the collection of monitoring campaign data by the regulator is often not a priority, most likely due to resource constraints. When environmental monitoring data are collected and made available to the public, this may not always be promulgated in an effective manner. In Scotland, while the regulator, Marine Scotland, has taken to publishing monitoring programmes and reports on the Marine Scotland Information portal,

the publication of new information on the portal is not advertised. This significantly limits the audience for new reports and often places the onus on the developer to promote the availability and discoverability of their findings/results. It should be noted, the publication of monitoring programmes and reports by the regulator is not conducted across the board or in all UK jurisdictions and therefore a change in practices may allow for greater dissemination. However, programmes such as ORJIP Ocean Energy and OES Environmental (through Tethys) support the dissemination of these data and information.

A common misconception about one driver of the issues surrounding confidentiality is that of competition between industry rivals; it is often perceived that there is a level of competition between technology and project developers, creating a potential incentive to withhold data which might be of value to a competitor. Although this may have been the case 10 years ago, due to the lack of funding available to the ocean energy sector at present, there are increasing instances of technology and project developers joining forces to overcome key barriers to the sector. There are multiple examples in recent years where developers have sought funding through collaborative projects in order to surmount the joint challenges faced by the industry, such as uncertainty associated with environmental impact. As the industry continues to face restricted funding and a lack of viable revenue support, the collaborative approaches adopted across the sector are expected to continue. If and when such restrictions on funding and commercial viability are eased, then the relationships and alliances developed at this formative stage are likely to continue as each technology developer finds a niche within the market available. Key to the collaborative effort is identifying areas where sharing or combining environmental monitoring data will add value or achieve outcomes that would be difficult to achieve solely, particularly relating to areas where further evidence base is required.

In addition to the confidentiality issues which may be experienced by technology and project developers, researchers from academic institutions who may undertake the monitoring on behalf of the developer, or through a funded project, often intend to disseminate their research findings through academic peer-reviewed journals. The timeframes for publishing such papers are often quite long, potentially over a year from completion of the monitoring campaign, which means that there may be a time lag between data being collected and the results becoming publicly available. Researchers typically restrict the availability of their findings pending publication of the journal paper and may wish to embargo data for a period following its collection to allow the completion of their planned analyses and manuscript preparation. Similarly to the difficulty experienced in identifying published programmes and reports, often academic papers and journals are not widely publicised outside the academic community which restricts developer and stakeholder awareness of current research and knowledge.

2.3 DATA FORMATTING AND METADATA

An agreement may be put in place between regulators (or project funders) and developers on where and how to disseminate collected environmental monitoring data. However, there are often significant other details regarding data formatting, vocabularies used and metadata that underpin the usefulness of the data but are often overlooked. Unfortunately, data dissemination is often an afterthought and those wishing to conduct analysis of the raw data struggle to get hold of this information and may have to contact those directly involved in the data collection.

In addition to this, it can be quite difficult to differentiate raw data from processed data products where a level of IP has been invested in the quality and control process. Users of the data may believe that they would like access to the raw data but, when this is further defined, it is common for the user to actually want processed or summarised data. Often the request for the data products can be slightly different each time, resulting in user-specific products being required on each occasion. Furthermore, certain data products may require datasets to be processed to a particular generic format to ensure maximum reuse of the data in future. In general, an improvement in defining data requests and what the information requirement is would support the efficient production of useful data products.

When collecting certain monitoring data, it is also essential that contextual data can be linked and made available with the raw data. Without the contextual data, some raw data can be meaningless which means that having a mechanism for linking or connecting data streams is very important but can be problematic to implement. As an example, having access to the raw drifting acoustic data is useless without the simultaneous GPS track to determine the location of the data logger relative to the 'impact'.

It should be noted the inclusion of metadata is essential as metadata are not static but often reflect changes in monitoring and analytical technology and global standards.

It is worth noting that, when raw data are disseminated, they are often not accompanied by the appropriate calibration data/values. Although those conducting environmental monitoring generally carry out the required equipment calibration or methodology calibration, data acquired during these exercises may not always accompany the raw data that are made available. There is also the possibility that the calibration exercise itself could utilise IP developed by those collecting the data and there may, therefore, be issues with making the calibration data available.

2.4 DATA STORAGE AND DISSEMINATION PLATFORMS

Multiple efforts have been made to encourage developers, research institutes and academia to make their environmental monitoring data available on platforms often created specifically for the sector or specific regions. Unfortunately, multiple platforms have been created with little integration between them and no resources are available for their continued maintenance beyond the lifetime of a project. In addition, once the user has identified the platform containing the data of interest, many of the platforms are quite difficult to navigate and are not user-friendly, resulting in prolonged issues with accessing the required data. Furthermore, it is quite common for the platforms not to hold the data directly but to link to where the data can be found or simply provide contact information for requesting the data, which can become quickly out of date.

The data collected during monitoring campaigns can be extensive, with datasets requiring large data storage capacities. Such capacities can be expensive, and it can be difficult to find suitable measures for securing appropriate redundancy/back-up options. Once data are uploaded to dissemination platforms, an appropriate schedule for uploading further data needs to be agreed if the monitoring campaign is continuous. This can be complex and needs to be communicated clearly to the user to ensure they are aware of the lag in data upload.

It should be noted that utilising publicly available data storage and dissemination tools may be more important for certain types of datasets. It is likely to be more appropriate for behavioural type data to not be held on a platform as it may be more complex with less standardised data collection methods and instead there would be an agreed process for making the data available for third-party analysis. The findings from the third-party analysis could then be made available to wider stakeholders.

2.5 RESOURCING DATA ANALYSIS

A further challenge that the sector is facing is the lack of adequate resources and capacity to conduct the appropriate analysis. Where environmental monitoring data collection can occur, there are often scenarios where there is not sufficient resources or an oversight during the monitoring programme design to allow for appropriately robust statistical analysis of the data to occur following the data collection phase.

3 ACADEMIC RESEARCH VERSUS DEVELOPER-LED MONITORING

The timeframe within which the sector is seeking answers or solutions to gain a greater understanding of the environmental impacts associated with ocean energy does not align well with the timescales associated with robust research conducted by academia. To date, there has been differentiating aims between the monitoring being completed by technology developers/project developers and the fundamental research for the sector being conducted by academic institutions. Technology and project developers often conduct surveys and monitoring for consenting purposes which typically results in data rich but information poor (DRIP) data. To date, this has typically been sufficient to meet the needs of the developers in terms of either achieving consent or complying with their consent conditions. Conversely, research conducted by academia is driven by clearly defined, often novel, research questions; arguably all monitoring should be driven by such clear research questions in order to determine the objective and best methodology for the campaign, but this has not always been the case. However, those research questions may not always be the priority questions for the purposes of de-risking the consenting process and so it is vital that these are developed in collaboration with industry. A key step in research question-led monitoring is to establish the quantity and quality of data required in order to effectively answer the pre-defined research questions, and thereby define the duration of the monitoring period required. Without clearly defined research questions, monitoring programmes are conducted with the sole aim of complying with regulatory requirements. These programmes have the potential to collect large volumes of expensive data which cannot actually be used to provide genuine advancement of our understanding of the environmental impacts of marine renewable energy development or even useful in information site-specific assessments.

In addition, particularly in relation to interactions between wildlife and technologies, which by their nature are rare events, data often appear underpowered, though in reality the results may provide an accurate indication of low risk. Due to underpowered nature of the data, it is very difficult to provide statistically robust results from the monitoring data collected.

Furthermore, due to the inherent difficulties of monitoring in high energy environments, typically the monitoring campaigns developed are complex, with advanced sensors/instruments which are often unproven in the environments in which they are being used. This has resulted in monitoring campaigns completed by academia to date being limited with respect to the results obtained for the industry but useful in terms of lessons learnt and experience gained.

This difficulty of monitoring high-energy environments has necessitated the designing of innovative monitoring campaigns, including the development and refinement of hardware, deployment methodologies, and data processing and analysis software. This marries well with the need for academic research to include a 'novelty' factor. Conversely, developers are most likely to prefer to use simple instruments/sensors with a proven track record of providing good results and reduced likelihood of failure. To date, bespoke monitoring approaches have been developed which often make it difficult to compare like-for-like between different projects therefore, any opportunities to standardise monitoring approaches would be useful.

However, the most likely reason for a disconnect between developer-led monitoring campaigns and academic research is the differing objectives of each campaign. Understandably, developer-led monitoring campaigns are often focussed on reducing the costs associated with developing the site, to comply with regulatory requirements and justify employing adaptive management techniques, in turn improving investor confidence; this can be achieved by reducing the uncertainty and risks associated with consenting. On the other hand, the key objective of academic research is generally to learn or understand more regarding the environment without the same degree of focus on technological development. A number of projects have been funded to support the sector's efforts in collecting environmental monitoring data; however, typically, the data collection phase is funded well whereas the analysis of the data is either under-funded or not funded at all. Additionally, there is often little or no funding remaining for dissemination or outreach in relation to

the data collected. This has resulted in a number of projects producing data but with limited findings to contribute to the sector's progress. It is important to strike a balance between data collection and the data processing and analysis stage from both a resourcing perspective and in terms of project management.

When monitoring campaigns have been funded to date, there is an expectation on the project partners to produce deliverables to report the project's progress and findings. However, the deliverables/reports funded are not of the standard or comparable in content to those manuscripts/papers developed for publication. This in turn can result in a lack of confidence from regulators to accept findings as part of the established evidence base. The production of publication-quality manuscripts will take significantly longer due to the time required to research the topic and the inclusion of potentially more complex statistical analysis as well as the lengthy timescale associated with submission, review and publication. The timescales associated with academic publications do not align with the time available to developers for producing and reporting on projects; not only is a project's timeframe unlikely to accommodate the timescales associated with publishing in academic journals, but this also tends not to be a priority for project funders in any case. In addition, often academic research is conducted as part of a postgraduate qualification, with PhDs the primary method, working over 2 - 4 year timescales; unfortunately this can lead to a mismatch with developer requirements for conducting the data collection and reporting results. Strategic initiatives such as ORJIP OE and OES Environmental have a role in bridging this gap through collation of information (The Forward Look[1], State of the Science Report[2]) and dissemination of information.

Another difference to data requirements between academia and the developers arises in terms of long-term environmental monitoring. Academic institutions, typically governmental research agencies, are interested in long-term changes to assess or account for natural variability. However, developers and their investors would have difficulty in committing to funding such studies until a commercial development is given approval with a guarantee of income from power delivery.

[1] http://www.orjip.org.uk/sites/default/files/ORJIP%20Ocean%20Energy%20Forward%20Look%203%20FINAL.pdf

[2] https://tethys.pnnl.gov/publications/state-of-the-science-2020

4 GOOD PRACTICE EXAMPLE

Through the European Maritime and Fisheries Fund (EMFF) co-funded Strategic Environmental Assessment of Wave energy technologies (SEA Wave)[3] and Wave Energy in Southern Europe (WESE) projects[4], Hidromod has developed the MARENDATA platform[5] which hosts the data produced by both projects as well as integrating data produced in the previously completed SOWFIA project[6]. The MARENDATA platform has been designed to allow the future integration of data available from the marine renewable sector (including wave, tidal and offshore wind) and allow the instantaneous formatting of data to allow a basic level of interrogation and reporting for both a technical and non-technical audience. The platform has been designed to allow data to be searchable by project, location and time, and data can be viewed using one or multiple environmental parameters.

The platform has been developed with data collection, structuring and use of metadata at the forefront. The metadata have been structured to comply with Directive 2007/2/EC (INSPIRE) and European Commission Regulation No. 1205/2008 and meets the ICES Working Group on Data and Information Management guidelines.

Crucially, the data held on MARENDATA are discoverable through existing data platforms which are widely used across Europe including EMODNet[7], SeaDataNet[8] and Copernicus Marine Services[9]. Importantly, the funding required for the ongoing maintenance of the MARENDATA platform, beyond the EMFF funding, is already being sought to ensure sustainability going forward.

[3] http://www.emec.org.uk/projects/ocean-energy-projects/environmental-monitoring/sea-wave-strategic-environmental-assessment-of-wave-energy-technologies/

[4] http://wese-project.eu/

[5] https://marendata.eu

[6] https://ec.europa.eu/energy/intelligent/projects/en/projects/sowfia

[7] https://emodnet.eu/en

[8] https://www.seadatanet.org/

[9] https://marine.copernicus.eu/

5 OPPORTUNITIES FOR OVERCOMING BARRIERS

Following the identification of the challenges and issues faced by the sector in undertaking environmental monitoring and disseminating the findings/results, a number of opportunities have been identified for overcoming these perceived barriers.

5.1 FUNDING TERMS

A clear method for ensuring that environmental monitoring data and results are disseminated appropriately is by designing and implementing robust contract terms associated with funding for monitoring and research. In order for this to work effectively, it may be necessary to educate project funders on good data management practices to ensure that project contracts/grant agreements are worded such as to ensure project partners comply with such practices. Recipients need to ensure that they fully understand terms and conditions and should facilitate wider, strategic value wherever possible.

National Environmental Research Council (NERC)-funded research typically requires data to be shared through national data centres and, therefore, NERC includes data-sharing expenses in the funding. This approach is also typically adopted by the US Department of Energy. A similar approach should be adopted for renewable research projects.

5.2 GUIDANCE OR SUPPORT FROM DATA CENTRES/PORTALS

There is role for national data centres (e.g. British Oceanographic Data Centre) or international data-sharing portals (such as SeaDataNet or EMODNet) to disseminate good practices in terms of storing and structuring data and including appropriate metadata. The expectation on a developer to have sufficient resources and in-house skills to develop an appropriate data management plan does not align with the current developmental stage of the sector. If guidance and templates were available, this would support developers in adopting good practice.

5.3 RAW DATA VERSUS ANALYSIS

Where there is believed to be a competitive advantage in not providing access to monitoring data, whether from an academic research institute or technology or project developer perspective, there exists an opportunity for disseminating the raw data publicly but holding the analysed data confidentially. This may provide the confidence that the researcher or developer requires in terms of preventing competitors from directly benefitting from their monitoring campaign but ensure that the raw data are freely available for others to use as they see fit. This approach would mean that the IPR stay with those analysing the data (and where the real value of the data can be gained) but offers others the opportunity to undertake their own analysis. However, the issues that may arise in adopting this approach are that others may be able to publicise their findings ahead of the lead researcher, or data may be incorrectly interpreted, suiting opposing aims, resulting in misleading results being publicised. However, finding a method of anonymising analysed data is likely to be the ideal scenario from both a researcher and developer perspective.

There may be an opportunity, in devising future monitoring and analysis campaigns, for the data collection phase to be led by the developer and the analysis to be led by academic institutions or other research organisations. However, this would require extensive collaboration between partners at the early stages of developing the campaign in order to ensure that the research questions answer the developer's requirements and the campaign is designed and executed in such a way that makes it possible to answer those agreed research questions. There may be further opportunities to develop an approach where the evidence on a particular issue gradually builds through combined analysis whilst maintaining the underlying IPR and data ownership of the individual contributors. These kinds of opportunities can be facilitated by strategic programmes such as ORJIP OE and OES Environmental.

A greater number of collaborations between developers and academic research institutions/research organisations would support integrating monitoring research campaigns; however, project funding is often only available to certain organisation types and is rarely relevant to both SMEs and research institutes.

5.4 INCLUSION OF PUBLICATION TIMEFRAMES

As discussed previously, projects often cannot accommodate the publication of journal manuscripts/papers due to the timeframes and/or resources available, and this not being a priority for the project funder. The explicit inclusion of a requirement for appropriate publications within project calls would lead to the inclusion of such publications in dissemination and communication objectives for projects. This could include primary literature or inclusion in strategic publications such as the OES Environmental State of the Science Report. This would require a change to project timeframes or set-up to ensure that the publications produced are high-quality and not just a tick-box exercise.

5.5 REGULATORY COMPLIANCE

At present, developers are encouraged to report monitoring findings as part of the consent conditions. In marine licences, the typical wording relating to the monitoring reports produced following completion of monitoring programmes is as follows:

"The Licensee must submit written reports of such monitoring surveys to the Licensing Authority at timescales to be determined by the Licensing Authority. Subject to any legal restrictions regarding the treatment of the information, the results are to be made publicly available by the Licensing Authority, or by such other party appointed at their discretion."

This is open to interpretation in terms of the content of the reports and therefore does not encourage the developer to collect environmental monitoring data in a sufficiently robust manner which would support a rigorous reporting mechanism. There is limited detail provided regarding what level of data would be made publicly available which simply encourages developers to restrict what is made available to the regulator.

It is, therefore, important that monitoring reporting requirements are agreed between the licensee and regulator at the start of a project in order to encourage a suitable monitoring campaign and associated reporting mechanism. It would be important when developing such an approach that the objectives of the monitoring activity are clearly defined. This type of condition or agreement would support a transparent reporting and data dissemination strategy and allow the regulator to actively support the analysis of data. In establishing such an approach it would be important to develop guidance for regulators and industry to follow to ensure that, although the reporting requirements would be project-specific, there was standardisation across how they are identified, developed and adopted.

5.6 ROLE OF TEST SITES

Test sites have been established to support developers in proving their technology and ultimately reaching commercial viability. As part of this process, developers accessing test sites are encouraged to complete environmental monitoring of their technology in order to support future consenting applications, as well as to contribute towards industry understanding. Test sites around the world have a critical strategic role in advancing and promoting the knowledge base that has been developed at these sites. As part of the agreement for the use of test site facilities, an agreement could be reached between the test site and developer regarding the provision of facilities for disseminating environmental monitoring data on behalf of the developer.

This is similar to a condition that is placed on lease holders by The Crown Estate. The Crown Estate has the ability to request data collected within the boundaries of leased sites and holds onto these data for a period of five years. After five years, it is determined that the data have limited or no commercial value and, therefore, can be made publicly available through appropriate databases, typically operated by the Crown Estate.

6 CONCLUSION

The key barriers and challenges facing the ocean energy sector in sharing environmental monitoring data have been identified and can be summarised as follows:

- Environmental monitoring programmes are costly to perform and often the financial burden partially or wholly resides with the developer. As the developer is investing in the programme there is little incentive to publicise the results for the entire sector's benefit. Ensuring programmes which are partly publicly funded include well defined terms to support dissemination of data and/or findings will be crucial going forward.
- There are several reasons why confidentiality and IPR may affect the level of data sharing that is undertaken, this may vary from maintaining competitive advantage (both from technology/site developer and academic perspectives) to the embargoing of results to allow for publication through appropriate mechanisms. However, there is a clear opportunity to look to other industries and to understand how this has been managed through anonymisation techniques.
- The formatting and appropriate use of metadata is often overlooked when disseminating data. To avoid this oversight in the future it will be key to educate the sector and ensure there is sufficient resources/guidance to support the sector in adopting best practice.
- Storing and disseminating data well can be resource intensive and require several layers of built-in redundancy. To date, there have been numerous data sharing platforms set up which are often project-specific, sector-specific or even regional specific with little to no integration between them. It is crucial that if such platforms are to be used they are interconnected with widely recognised and managed data sharing platforms such as EMODNet.
- To date, many monitoring programmes have allowed significant levels of surveying and data collection to be conducted however this has not been supported by adequate funding for the necessary data analysis. This will require a step-change approach from funders in order to ensure future monitoring campaigns are funded adequately to support the analysis but also require those designing monitoring programmes to give greater weighting for this crucial phase within the campaign.

The role each of the identified barriers play is likely to be project-specific and will typically be dictated by the type or combination of funding supporting the monitoring programme.

There are two different approaches that can be taken to conducting surveying and monitoring of a site, but the approach taken must be informed by what level of understanding is to be achieved through the process. The approach taken to date often reflects the type of organisation leading the work, e.g. academia/research organisation versus developer.

However, ultimately, it is crucial that there is a feedback loop between the monitoring conducted and the research requirement. In certain incidences, it may be more appropriate to conduct an ongoing programme of generic site characterisation surveying which can inform multiple data products ('collect once, use many times') whereas in other cases where there is a specific research question, it may be more appropriate to apply a targeted monitoring campaign. A number of opportunities have been identified to support further sharing of environmental monitoring data across the sector. Some of these may be able to be achieved through minor changes in the method in which funding support is administered to regulators taking a more active role in the reporting of monitoring campaigns and supporting robust analysis. Fortunately, networks and groups such as ORJIP OE have been set up to support the ongoing improvement in practices adopted by the sector and therefore the production of guidance and the overall standardisation of approaches can be supported through the ORJIP OE network.

In the short term, the sharing of site characterisation survey data may be easier to achieve, but there is often a commercial value associated with data for site development purposes. Sometimes it may be easier to propose or develop

regional monitoring prior to individual sites being allocated or leased by the regulator or seabed rights authority. Research question led monitoring has the potential to offer a solution or greater understanding to help reduce the existing consenting uncertainties and risks for the ocean energy sector. Therefore, the sharing of the outputs of question-led research should be the priority for the sector at this stage.

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