



## International Workshop on Marine Energy Data Sharing Workshop Report

Wednesday, May 12, 2021

8:00 – 10:00 AM PDT (15:00 – 17:00 UTC)

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On behalf of Ocean Energy Systems (OES) and the US Department of Energy, the PRIMRE (Portal and Repository for Information on Marine Renewable Energy) team held an international workshop to explore the potential for sharing data on marine energy. The workshop was held online, hosted by the three US national laboratories that make up the PRIMRE team [Pacific Northwest National Laboratory (PNNL), National Renewable Energy Laboratory (NREL), and Sandia National Laboratories (SNL)]. The workshop participants were invited to attend based on their knowledge and experience with, or responsibilities for, marine energy databases and portals in their respective nations. The workshop agenda included presentations and discussions focused around the value of data sharing, the barriers to data sharing, and solutions to overcome those barriers (Appendix A). A total of 24 professionals participated in the workshop from 11 countries (Appendix B). Prior to the workshop, the participants were surveyed about the marine energy databases they manage, and the results were presented at the workshop (Appendix C). A recording of the workshop presentations can be found [here](#). The three individual breakout sessions were not recorded, but a record of the written (using Google JamBoards) and oral discussion was made to contribute to this report.

The objectives of the workshop were to:

- Examine existing means to share marine energy data;
- Explore whether international collaboration in this arena is feasible and useful; and
- Set up a means to pursue an international collaboration if it is warranted.

### Workshop Structure

The PRIMRE team reviewed the results of the international marine energy databases survey, and gave short presentations on the value of data sharing, and on the PRIMRE system. Three breakout rooms were used to bring together 7-8 participants per room with two PRIMRE staff acting as facilitators and notetakers. Each breakout room was asked to work through four JamBoards with the following questions/topics:

1. Introductions
2. What values are important to you in sharing marine energy data?
3. What barriers to data sharing exist in your organizations (technical, financial, organizational)?

#### 4. How can we overcome these barriers?

After the breakout sessions, the groups reported their major findings and a discussion was held around three areas that must be addressed to overcome barriers to sharing of marine energy data:

- Technological solutions
- Financial solutions
- Social/legal solutions

#### Key Workshop Outcomes

The results of three questions that were asked in the breakout groups are shared at a high level here. The full breakout groups' output can be found in Appendix D.

##### The value of sharing data and information

There was a strong consensus that there is value to sharing data and information on marine energy among nations. The workshop participants identified certain criteria that are important for implementing marine energy data sharing, as well as identifying the values that data sharing will provide.

Key drivers for marine energy data sharing are:

- Application of the FAIR principle (Findable, Accessible, Interoperable, and Reusable) to all data to be shared.
- Data must be traceable and transparent and have accompanying citations and attribution for the methods of data collection and provenance, as well as appropriate metadata.
- Sustainable infrastructure is needed to commit to sharing data.
- Should be accompanied by a license and/or permission statement for use of the data.

Specific values from the sharing of marine energy data identified included:

- Discoverability of datasets.
- Supporting the marine energy industry as it moves forward; especially useful for new entrants into the field.
- Can ensure that maximum value of data is derived, especially for publicly-funded data; can justify support.
- Avoids duplicating studies and modeling that has already been done.
- Smaller countries can benefit from work done in larger nations.
- Can act as a stamp of approval for data if standard process is in place.
- Makes provenance and quality of the data clear.
- Underlying support for journal articles, with data all discoverable in one place.
- Allows for access to data and also synthesized products, graphical representation, etc.
- Encourages collaboration.

##### Barriers to sharing data in organizations, countries

The major barriers identified included:

- Need for infrastructure and financial resources to maintain data sharing and databases, and for a new business model to support this.

- Data with intellectual property may not be shared; need for non-disclosure agreements and other legal requirements.
- Sense of ownership of data that may impede sharing.
- Need to provide long-term support and access to data.
- Not enough technical staff to support sharing, not enough time for current staff to manage.
- Closed mindset, including threats to agencies who perceive this as undermining responsibilities/authorities.
- Concerns under unknown costs, resources needed, impact on future reputation.
- Lack of training early careers for good data management.
- Difficult to store, maintain, and transfer large datasets.
- No clear location or methods for sharing.
- Restricted access or multiple layers to get to data.
- Governments tend to be slow to adopt new technologies.
- Data management and sharing tend to come at the end of projects, when funds are depleted.
- May be some hurdles of language and unit conversion.
- Perceptions that data is the property of the organization that collected it; some personal and professional reluctance to share.

#### Concepts for overcoming these barriers

- Use existing data standards where they exist for continuity, need clear data sharing rules.
- Governments need to recognize the long term value of supporting data management systems.
- Raise data products to the same level of respect as publications.
- Need a good overarching framework that defines data management in marine energy, with long term commitments to funding.
- We need more than metadata, including access to the data products themselves.
- Public-private partnerships and business models that help to provide some return for data generators could help with sustaining data sharing systems.
- Need incentives for researchers and others to share data and keep them updated.
- Need training for researchers, companies, and government to understand value of data sharing.
- Need to link in other types of relevant ocean data, not just marine energy community products.
- Will likely need legislation or regulation by governments to ensure sharing, tied to public funding especially.
- Build-in data management fee for marine energy applications so government can pay to support data management systems.
- We will need patience and persistence.
- Must adopt new technologies (cloud-based), and new ways of accessing data (application programming interfaces, web applications).
- Must focus on discoverability and accessibility of data to demonstrate value broadly.
- Funding of studies and other data collection efforts must be able to ask for dedicated data management funds.
- Hold workshops to demonstrate value of shared data to sponsors and data generators.
- Documentation on how to share data, book of rules.
- Engage with data scientists as professional members of marine energy teams.
- International sharing!

## Conclusions & Next Steps

After hearing the output from the three breakout groups, the workshop participants determined that there are a series of solutions needed to enable international data sharing of marine energy that fall into three categories: technological solutions, financial solutions, and social/legal solutions. The major solutions in each area are summarized here and the entire output is listed in Appendix E.

### Technological Solutions

There is a need for common metadata, as well as standardization and quality control of data that are to be shared, to ensure that users understand and can trust the data and information. Data systems all need to focus on easy access and discoverability.

### Financial Solutions

There needs to be some new and innovative solutions to ensuring financial support and sustainability of data systems to ensure that shared data are curated and maintained. This could take the form of new business models for providing a revenue stream to pay for maintenance of databases, public-private partnerships, or fees paid by developers as part of the application process to sustain data management systems.

### Social/Legal Solutions

There is a need for appropriate licensing agreements for data that are not restrictive, and publishing under open-source umbrellas such as Creative Commons. Governments need to find mechanisms to require data managements plan, implementation of those plans, and data sharing, as part of public funding. Processes for sharing among governments, institutions, and private companies are needed.

### Next Steps

The participants were in wholehearted agreement that they thought the workshop was valuable and would like to see a group come together periodically to update on progress in data sharing. They also strongly supported the proposition of implementing many of the suggestions put forward at the workshop, but had limited ideas how to carry this out.

## Appendix A – Agenda

Time	Item	Notes
08:00-08:15 AM PDT 15:00-15:15 UTC	Introductions/Purpose of Workshop	Presenter: Andrea Copping (PNNL)
08:15-08:25 AM PDT 15:15-15:25 UTC	Results of Databases Survey	Presenter: Andrea Copping (PNNL)
08:25-08:45 AM PDT 15:25-15:45 UTC	Presentations <ul style="list-style-type: none"> <li>• Value of Data Sharing</li> <li>• PRIMRE</li> </ul>	Presenter: Jon Weers (NREL) Presenter: Andrea Copping (PNNL)
08:45-09:15 AM PDT 15:45-16:15 UTC	Breakout Groups	Group #1: <ul style="list-style-type: none"> <li>• Facilitator: Andrea Copping (PNNL)</li> <li>• Notetaker: Lysel Garavelli (PNNL)</li> </ul> Group #2: <ul style="list-style-type: none"> <li>• Facilitator: Jon Weers (NREL)</li> <li>• Notetaker: Hayley Farr (PNNL)</li> </ul> Group #3: <ul style="list-style-type: none"> <li>• Facilitator: Kelley Ruehl (SNL)</li> <li>• Notetaker: Jonathan Whiting (PNNL)</li> </ul>
09:15-09:30 AM PDT 16:15-16:30 UTC	Report Out	
09:30-10:00 AM PDT 16:30-17:00 UTC	Discussion & Next Steps	

## Appendix B – Attendees

PRIMRE Team: Andrea Copping, Chitra Sivaraman, Hayley Farr, Jonathan Whiting, Lysel Garavelli (PNNL); Jon Weers (NREL); Kelley Ruehl (SNL)

<b>Country</b>	<b>Name</b>	<b>Organization</b>
Canada	Julien Cousineau	National Research Council Canada
Chile	Nathalie Almonacid	Marine Energy Research and Innovation Centre (MERIC)
China	Ji Wang	National Ocean Technology Center/IEA OES TCP
	Xiaoyong Wang	National Ocean Technology Center
	Yizhou Fang	National Ocean Technology Center
France	Kelly Cayocca	France Énergies Marines
Germany	Fabian Thalemann	Fraunhofer Institute
Mexico	Marisa Martinez	Instituto de Ecología (INECOL)
	Rodolfo Silva Casarin	Universidad Nacional Autónoma de México
Portugal	José Chambel Leitão	Hidromod
	Pedro Vinagre	WavEC
Spain	Pablo Ruiz-Minguela	Tecnia
Singapore	Jacqueline Sim	OceanPixel
	Michael Abundo	OceanPixel
United Kingdom	Danny Coles	University of Plymouth
	Philipp Thies	University of Exeter
United States	Justin Day	Pacific Northwest National Laboratory

## Appendix C – Survey Results

Country/Region	Database Name	Database URL	Data Use	Data Format
Canada	Marine Energy Resource Atlas Canada	via API (api.meracan.ca)	Resource Characterization	Numerical model data and geographic layers
Chile	EMMAP	<a href="http://www.emmap.cl/">http://www.emmap.cl/</a>	Resource and site characterization, territorial information	geodatabase format: mainly kmz and tiff, source links and documents
Chile	Explorador Marino	<a href="http://marino.minenergia.cl/explorador">http://marino.minenergia.cl/explorador</a>	Significant height and period of the waves along the coast of Chile and power.	png and tabular data with annual values for a singular point
China	China Marine Renewable Energy Management Service Platform	<a href="http://www.cmreac.com/">http://www.cmreac.com/</a>	Resource characterization, projects, and policy	geographic layers, and documents
European Union	European Biofouling Database	<a href="http://oceanic-project.eu/biofouling-database/">http://oceanic-project.eu/biofouling-database/</a>	Marine Communities characterization, numerical modelling	Excel file
European Union	MARENDATA	<a href="https://marendata.eu/">https://marendata.eu/</a>	Consenting and licensing processes	Several different formats

European Union	OpenAire - OPERA project	<a href="https://explore.openaire.eu/search/project?projectId=corda_h2020::401650656619c8970d7fa072ac7ec9fa">https://explore.openaire.eu/search/project?projectId=corda_h2020::401650656619c8970d7fa072ac7ec9fa</a>	13 open-access publications, 6 research data, 1 software	Explained in the metadata
France	RESCORE	No public URL at the moment	All subjects touching on MRE development.	Geographic layers, documents
France	SEXTANT	<a href="https://sextant.ifremer.fr/">https://sextant.ifremer.fr/</a>	All	Geographic layers
Ireland	INFOMAR	<a href="https://data-infomargis.opendata.arcgis.com/">https://data-infomargis.opendata.arcgis.com/</a>	Bathymetry and seabed characteristics	Tabular and graphical
Ireland	Marine Institute Data Catalogue	<a href="http://data.marine.ie/">http://data.marine.ie/</a>	Environmental, metocean	Tabular and maps
International	OES Web-GIS	<a href="https://www.ocean-energy-systems.org/ocean-energy/gis-map-tool/">https://www.ocean-energy-systems.org/ocean-energy/gis-map-tool/</a>	Deployments, test sites, resources, protected areas, political boundaries, ports, population, bathymetry	primary in an Oracle SQL database, finally in a postgres-postgis database
Philippines	Philippine Ocean RE Service Contract Areas	<a href="https://www.doe.gov.ph/renewable-energy/awardedocean?ckattempt=1">https://www.doe.gov.ph/renewable-energy/awardedocean?ckattempt=1</a>	Project service contract areas	Documents



Singapore	OceanPixel	<a href="http://www.oceanpixel.org/">http://www.oceanpixel.org/</a>	Market, Technology, Sites, Projects, Resource	Paid report products
Southeast Asia	SEACORE	<a href="https://blogs.ntu.edu.sg/seacore/">https://blogs.ntu.edu.sg/seacore/</a>	Initiatives / efforts in Southeast Asia	blog / documents
United Kingdom	IMARDIS	<a href="http://portal.imardis.org/">http://portal.imardis.org/</a>	Multi-purpose, site characterization, environmental effects, and others as further data ingested	Data - Tabular data (csv and database), geographic layers, documents, codes, images
United Kingdom - Wales	Lle Geo-Portal	<a href="http://lle.gov.wales/home">http://lle.gov.wales/home</a>	Not MRE specifically, general environmental data for Wales	Spatial data
United States	PRIMRE	<a href="https://www.primre.org">https://www.primre.org</a>	Resource characterization, projects, performance, environmental effects	Data, documents, codes, software, guidance

## Appendix D – Output from Breakout Groups

### What values are important to you in sharing marine energy data?

#### Breakout Group #1

- FAIR (Findable, Accessible, Interoperable, and Reusable) principles
- Yes, FAIR is key, as well as data exchanging standards that are respected and widely deployed.
- Discoverability; findability
- Referencing, appropriate data characterization
- Traceability and Transparency
- Easing the transition to MRE. Better access to data.
- Attribution (citation of sources, referencing)
- Data, methods, standards very useful for new entrants and countries coming into the sector
- With publicly funded data, ensuring maximum value derived
- Reproducibility
- Many smaller countries can rely on other larger countries' data collection efforts.
- Acceptance and "Stamp of Approval" (from Reputable community, organization/s, etc)
- Common Methods and Standards
- Sustainable infrastructure
- Do we need to define Marine Energy Data - some may be very specific other data maybe more broadly applicable, beyond marine energy interests
- Also important to consider results from models run by different countries/groups. Can we compare, can we integrate results in some useful manner.

#### Breakout Group #2

- Data Provenance - I want to know where my data came from.
- Lessons learned
- We can learn from experiences by other groups. This involves design efficiency, environmental impact, social perception.
- We can have a best picture with less effort. Other researchers can check the quality
- Acknowledgement of source and effort in collecting it
- Avoid duplication
- Public funding for the common good...
- We can collaborate with other groups
- More possibilities to justify financial supports given to us
- Communicated in a way that people outside the industry or new to the industry can understand to some extent
- Clear metadata
- License and permission to use
- Underlying support for journal articles

#### Breakout Group #3

- Discoverability
  - Open access, discoverability, data quality, continued access
  - Synthesized data, graphs, findings, etc

- Availability + Knowledge Transfer
  - In particular with marine energy, for creating awareness in public
  - Collaboration, not replicating efforts
  - Facilitates, accelerates with knowledge, the path to MRE project applications
- Access
  - Access to data where applicable easy to access, discoverability, standardized data so I can wrangle data easily, what other similar data is available, a place to access and run my code to process data - data analysis center where we can query standardized data.
  - Data access - open access (generally low res) vs. commercially sensitive data (generally more useful, but only accessed through NDA's)
- Data Quality
  - We need accuracy in data for implementing a MRE project, therefore the more the variables and accuracy the less the risk for investors
  - Data quality - resolution (spatial and temporal), duration and spatial coverage.
- MARENDATA: Vision: The renewable energy industry requires complex environmental information in order to overcome the challenges of harnessing energy from the marine environment. This will be delivered through an established open platform aggregating multiple sources of raw and secondary data to ensure access to meaningful information for the user. Mission: Establish an adequate IT platform that links with existing and new data repositories; Enable access to raw and secondary data; Disseminate data and knowledge previously reviewed by experts; Survive individual projects' financing constraints; Reach a significant audience in the industry.

What barriers to data sharing exist in your organization (e.g., technical, organizational, financial)?

#### Breakout Group #1

- Data maintenance requires infrastructure and financial resources...agree and a functional business model is key -too
- Data with high intellectual property value may not be shared.
- Commercial Sensitivity
- Ownership, funding
- Long term accessibility to data
- Lack of technical support (people)
- Closed Mindset
- Threatening the roles of some Agencies who may have that authority / mandate
- Financial cost to matching formats and sharing
- Time needed to preserve and manage data
- Fear of the Unknowns (Costs[upfront, ongoing, resourcing], Reputation, etc)
- Lack of training early on for good data management practices
- The EU funded EMODnet programme is a well-funded long term marine data management initiative underpinned by a business case for the value of data
- Lack of 'Bandwidth' towards Data Management (e.g., lack of: funding, capability, long-term commitment)
- Data decrease in value if not maintained.

## Breakout Group #2

- Dealing with large datasets - hard to store and share
- It is a challenge to have long validated series
- Transfer of large datasets
- Difficult to know where to share
- Restricted access / availability. Big data, log ins, globus, etc.
- Hard to adopt new technology in the government
- Difficult to adopt new technologies in the government
- Resource and staff time for data sharing at the end / post project
- More initial work to organize the information
- Heavy lift to share data, takes time and \$\$
- Personal and professional concerns about data sharing
- Confidentiality calluses / requirement of project partners
- More of the researchers are not confident to share the data without losing the right to write papers
- Organizational: who would be responsible for preserving data and sharing
- Cost of storing large datasets and who pays for it
- Long term maintenance
- Financial: staff to handle the dataset, and up-to date technology for storage
- Differences in international rules?
- Rules for data sharing and credits-need to be clear
- Sometimes the sponsor asks for special rights
- Language and unit conversion (translation)

## Breakout Group #3

- Technical
  - Domain specific data difficult to find
  - Technical: for maintaining the data sharing platform
  - Outreach of the data sharing platforms
- Organizational
  - Organization doesn't support sharing
  - Legal and non-disclosure agreements often needed, typically take time to get agreement
  - Large file sharing not facilitated by organization (University)
  - Not always available (confidential issues) to share raw data
  - A perception that data should live with whatever organization produced the data
- Financial
  - Continued Project Funding

## How can we overcome these barriers?

### Breakout Group #1

- We should follow existing standard where they exist and are fit
- Governments need to recognize the long term value of supporting data management systems
- Level the value of data with publications...achieve equitability
- Make outputs of data equally valuable as publications

- Ocean Data Interoperability Programme is one international approach that may be relevant (ODIP)
- Good Over-arching Frameworks towards Data Management (with long-term commitment - resourcing, etc)
- Data without a context (metadata) provides little value (even if you can find it)
- Collaborate (Public-Private Partnerships) towards building systems (technological, organizational) and sustainable value models (revenue, efficiency-related savings, etc)
- Need to find incentives to keeping data available.
- Finding hidden data
- Training: to researchers, to companies, to government
- Example of good practices might be with GOOS
- We ought to bring data from closely related data types (like ocean observation) into marine energy data
- Force: legislation, funder requirement, peer approval?
- Providing data infrastructures that can store data but also add value, for example through access advanced analytics
- Enable Data Ecosystems
- We suggested an obligation to all ocean energy projects receiving public funds to share comparable results (e.g., cost projections, performance metrics, ...)
- Build in data management fee for marine energy applications so government can pay to support data management systems.
- Perhaps a business model that rewards data growth/ contributions

#### Breakout Group #2

- Patience and persistence
- Adopting new technologies, (i.e., Cloud technologies)
- New ways of accessing the data (i.e., application programming interfaces, web application)
- Easy access to data
- Focused efforts on discoverability and accessibility
- Planning ahead to save money and time for data translation and dissemination is key.
- Adequate funding to have the technology and staff to store and share data
- Included allowance in funding request
- Clear data-sharing rules
- Through workshops showing the advantages to sponsors and information generators.
- International collaboration?!
- Agreements between institutions on how to share data
- Collaboration between different institutions, work groups
- A manual documenting established rules / guidelines / best practices / processes that anyone can refer to
- Highlight the long-term value of shared data to creator and user to get organizational support
- Engaged with data scientists to analyze available raw data
- Turing Institute: "Rent a Data Scientist" DS on loan to other programs for quick deployments.
- Data standardization
- Data standards that account for internationalization.

### Breakout Group #3

- Data management platform
- Domain specific platform
- Inter-connectivity with other databases
- Centralized platforms (to avoid project funding limitations)
- Outreach, to create awareness about the relevance of data sharing practices and hubs of information (e.g., workshops)

## Appendix E - Full Group Discussion of Possible Solutions

### Technological Solutions

- Search engine optimization for discoverability
- Common metadata...show the existence of data, wherever it exists. Who owns it and how can one access it?
- A need for data standards, QC methods, etc.
- Machine to machine communication
- Domain specific platform
- Blockchain?
- Standardized data format
- Centralized Database
- from data sets to data lakes to data oceans :)
- Improving discoverability and accessibility
- Ensuring data is 'analytics ready'

### Financial Solutions

- Data distribution fees can be programmed into specific project funding.
- Educating funding agencies about the need for continued maintenance and support
- Build-in Data / Data Mgt related support in fees (to certain agencies - in terms of permitting, licensing, etc.)
- Public investment (e.g., agencies build data mgt 'systems' into their budgets, 'common overhead cost')
- Private-Public Partnerships (e.g., private Sector to help in 'commercializing' some data and report products for the agencies)

### Social/Legal Solutions

- Non-restrictive data licensing agreement
- EULA (end user license agreement)
- Non-disclosure agreement or cooperative research and development agreement through funding agency
- Sharing with the public the most relevant data to get public support
- Governments to require data management plan and implementation
- Agreements between institutions for data sharing; clear sharing rules
- Obligatory data sharing given government funding (partially already applied)
- Ensure Good Common Frameworks for Data Management Practices
- Education on value data sharing and maintaining intellectual property/data right
- copyright for software, parallel for data rights?
- Creative Commons?
- Create agreements among governments or institutions to share data or at least metadata