Pacific Northwest
NATIONAL LABORATORY

PNNL-32960

Use of Tethys Engineering by the Marine Energy Community

User Review Report

June 2022

Hayley Farr
Jonathan Whiting
Andrea Copping

U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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1.0 Introduction

In partial fulfillment of the Annual (SMART) Milestone for Q3 of FY22, this report details the results of the user review process carried out on the use and function of *Tethys Engineering*. The pertinent part of the Milestone is:

> User review of *PRIMRE* and two knowledge hubs' content and functionality (*MHKDR* and *Tethys Engineering*), including quantitative and qualitative metrics for use, data uploads, data accessibility, and other useful measures.

2.0 Methods

During Q3 of FY22, Pacific Northwest National Laboratory (PNNL) solicited broad feedback from a self-selected subset of the marine energy community on the use and effectiveness of key pages on *Tethys Engineering*, and the site as a whole. Respondents were solicited using an online Survey Monkey survey between May 2 and June 9, 2022, via emails to all 2,367 *Tethys Engineering* email subscribers on May 2 and May 16, 2022, and via the *Tethys Engineering* Blast on May 6, May 20, and June 3, 2022.

The survey included 8 questions (Table 1), some of which were quantitative while others allowed for open-ended answers. The answers for all multiple-choice questions were collated and analyzed to determine the use of *Tethys Engineering*. For questions that allowed for open-ended feedback, the responses were collated and analyzed to determine respondents' favorite features and what can be improved or expanded upon.

Table 1. Questions included in the 2022 *Tethys Engineering* User Review survey.

Question No.	Question	Choices
1	Which marine energy technology are you most interested in?	– Current Energy (e.g., Tidal, Ocean Current, Riverine) – Wave Energy – Ocean Thermal Energy Conversion – Salinity Gradient Energy
2	What is your role?	– Device Developer – Project Developer – Researcher – Regulator – Student – Interested Public – Consultant – Non-Profit – Other (please specify)
3	How have you used *Tethys Engineering*? Please check all that apply.	– To find literature in the Knowledge Base and/or Map Viewer – To receive the *Tethys Engineering* Blast via email – To search the Photo Library for photos – Other (please specify)
4	How effective do you find the following pages?	Rate effectiveness of: – Knowledge Base – Map Viewer – Photo Library – Organizations – Databases – Glossary
5	What do you like best about *Tethys Engineering*?	Open-ended response.

6	In your opinion, how can *Tethys Engineering* be expanded or improved upon?	Open-ended response.
7	How comprehensive do you find the literature on marine renewable energy on *Tethys Engineering*?	Slider from 1 to 10.
8	Do you know of any relevant literature (e.g., peer-reviewed journal articles, reports, theses) that are not currently on *Tethys Engineering*? Please list them.	Open-ended response.

3.0 Results and Discussion

A total of 39 responses were collected from the greater marine energy community. The number of responses for each individual question varies due to respondents' ability to skip questions. The results of each question are summarized, and pertinent material analyzed, below. A condensed list of action items is provided in section 4.0.

Question 1: Which marine renewable energy technology are you most interested in?

Of the 39 total respondents to Question 1, 23 (58.97%) respondents selected current energy (e.g., tidal, ocean current, riverine) and 16 (41.03%) respondents selected wave energy (Figure 1). Zero respondents selected either ocean thermal energy conversion or salinity gradient energy. These results align with the results from the 2020 Peer Review Report, highlighting that *Tethys Engineering's* audience is primarily interested in current and wave energy technologies.

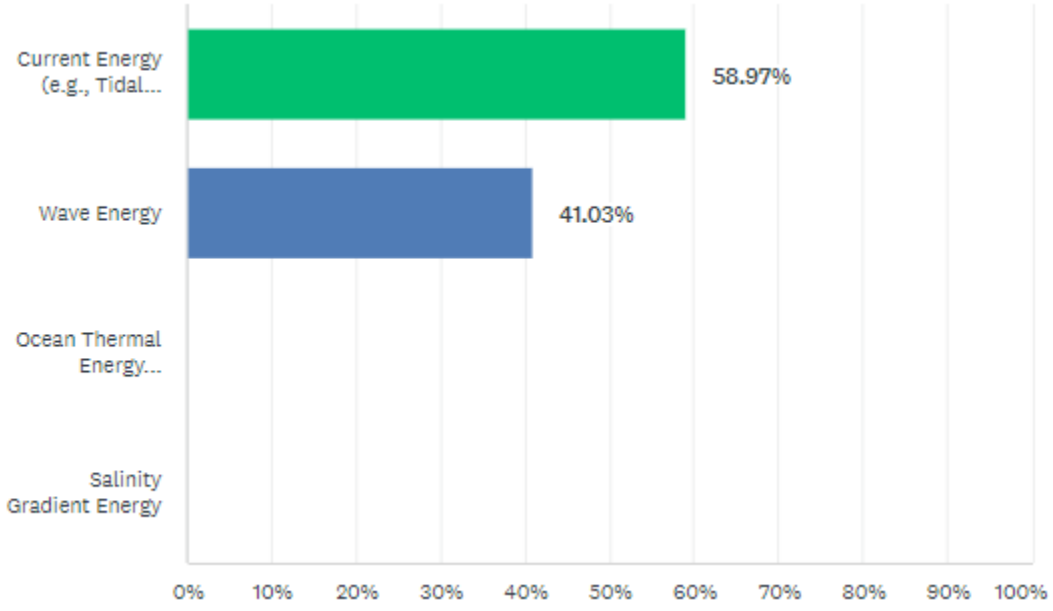

Figure 1. Respondents' marine energy technology interests.

Question 2: What is your role?

Of the 39 total respondents to Question 2, 14 (35.90%) identified as a researcher, 6 (15.38%) identified as a device developer, 5 (12.82%) identified as a regulator, 5 (12.82%) identified as a consultant, 4 (10.26%) identified as 'other', 2 (5.13%) identified as a student, 1 (2.56%) identified as a project developer, 1 (2.56%) identified as a non-profit employee, and 1 (2.56%) identified as a member of the interested public (Figure 2). Those that identified as 'other' specified their roles as an academic, an electric utility provider, and an employee of a Marine Extension program.

This distribution indicates that *Tethys Engineering* is reaching its intended audience of researchers, device developers, regulators, and consultants, engaged in the marine energy field. Notably, the number of regulators who participated in the survey increased from 1 in 2020 to 5 in 2022. Additional outreach and engagement directed towards students, project developers, non-profits, and the interested public may ensure that these groups are aware of and using *Tethys Engineering* as well.

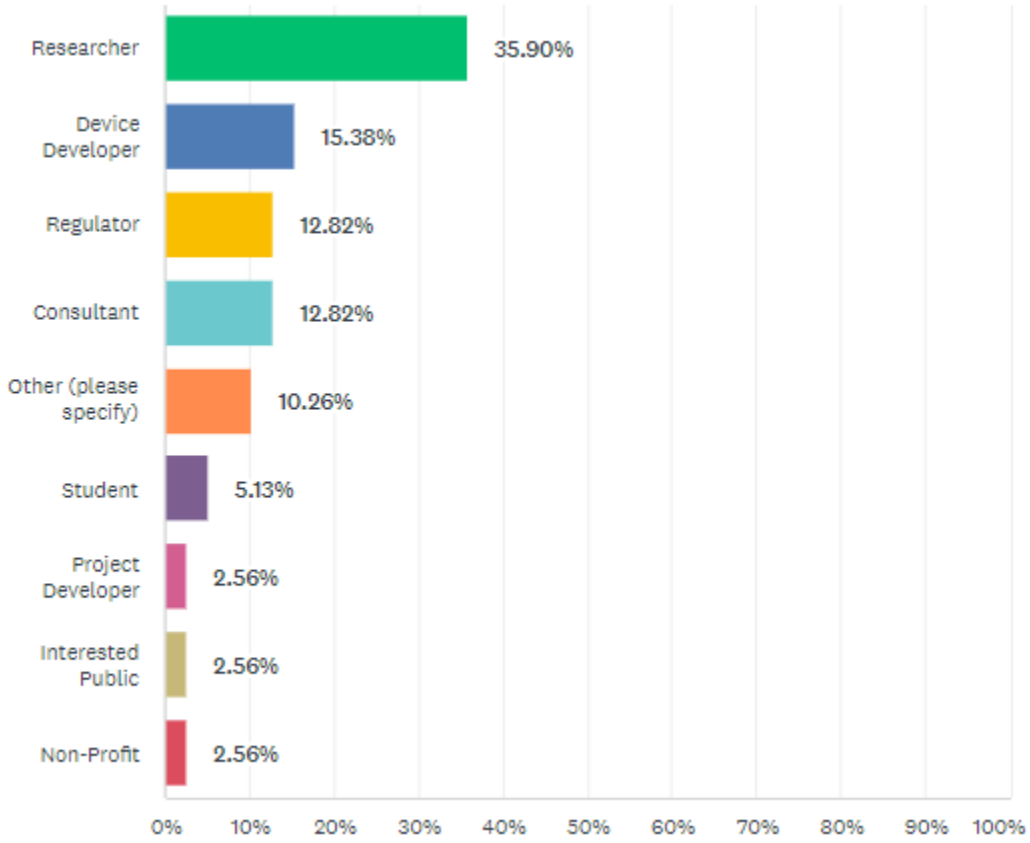

Figure 2. Respondents' roles in the marine energy community.

Question 3: How have you used *Tethys Engineering*? Please check all that apply.

Out of the 37 total respondents to Question 3, 35 (94.59%) use *Tethys Engineering* to receive the *Tethys Engineering* Blast via email, 23 (62.16%) use *Tethys Engineering* to find literature in the Knowledge Base and/or Map Viewer, 10 (27.03%) use *Tethys Engineering* to search the Photo Library for photos, and 4 (10.81%) selected 'other' (Figure 3). Those that selected 'other' specified that they use *Tethys Engineering* to contribute literature and keep track of internship and fellowship opportunities for students.

The significant number of people who receive the Tethys Engineering Blast is likely influenced by a selection bias where survey responses were primarily gathered with announcements to the Tethys Engineering Blast list. However, it is likely still representative that the most used features of *Tethys Engineering* are the *Tethys Engineering* Blast and the Knowledge Base and/or Map Viewer, indicating good alignment with the mission of *Tethys Engineering*. Outreach, engagement, and content curation consume the greatest amount of PNNL staff time, so these features' usage rates are also in line with the level of effort required to maintain them. The Photo Library likely receives less usage because device photos may not be needed as frequently, though the usage still substantial and highlights the value of the resource.

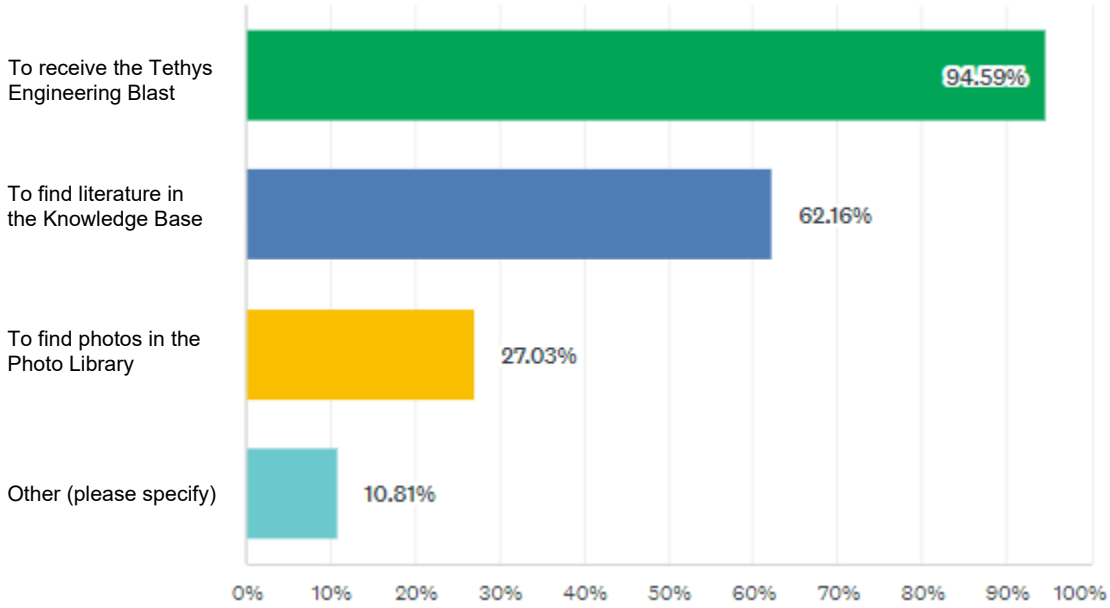

Figure 3. Various ways respondents have used *Tethys Engineering*.

Question 4: How effective do you find the following pages?

Respondents were asked to rate specific pages on *Tethys Engineering* as **not effective** (-2), **somewhat effective** (-1), **moderately effective** (0), **very effective** (+1), or **extremely effective** (+2). The weighted average effectiveness of pages was rated from -2 to +2 as: +1.25 for the Databases page, +1.13 for the Knowledge Base, +0.90 for the Photo Library, +0.87 for the Organizations page, +0.82 for the Glossary, and +0.80 for the Map Viewer (Figure 4).

All pages were viewed positively by respondents. Respondents viewed the Databases and Knowledge Base pages as the most effective, and the Map Viewer as the least effective. However, it is important to note that these numbers reflect perceived effectiveness of the page, which could be interpreted as either ease of functionality or usefulness of the information, or most likely a combination of the two. For example, the Map Viewer likely ranks low because of its slow loading speed, which the *Tethys Engineering* team is working to improve.

Not reflected in these statistics are the numbers of respondents who indicated that they do not use certain pages. Out of the 37 total respondents, 21 (58.33%) don't use the Organizations page, 20 (55.56%) don't use the Databases page, 18 (51.43%) don't use the Glossary, 16 (44.44%) don't use the Map Viewer, 15 (41.67%) don't use the Photo Library, and 7 (18.92%) don't use the Knowledge Base (Figure 4). These results may be similarly influenced by a selection bias since survey responses were primarily gathered with announcements via the *Tethys Engineering* Blast, so many respondents may only be familiar with the Blast. Additional outreach and engagement emphasizing the availability of some of the site's other features through the Blast may improve use and awareness. The User Review survey itself also serves as an excellent opportunity to make users aware of *Tethys Engineering's* various features.

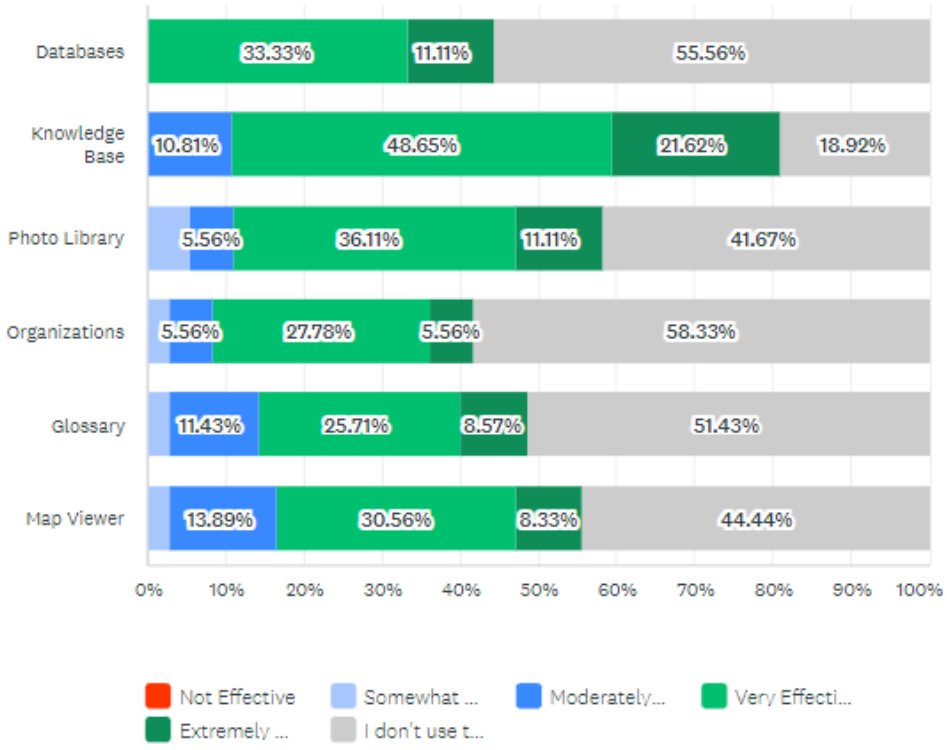

Figure 4. Effectiveness of various pages on *Tethys Engineering*.

Question 5: What do you like best about *Tethys Engineering*?

Out of 39 total respondents, 26 responded to Question 5. The open-ended responses have been combined or merged where there was considerable commonality (Table 2).

In alignment with the 2020 survey results, respondents noted the *Tethys Engineering* Blast as their most liked feature; however, responses were primarily gathered with announcements to the *Tethys Engineering* Blast list, so these results may be influenced by selection bias. Overall, responses indicate that *Tethys Engineering* provides several valuable resources and serves as a central location to easily find new literature, events, news, and other information.

Table 2. Respondents' open-ended responses on what they like best about *Tethys Engineering*.

Response	No. of Responses
Tethys Engineering Blasts	8
Central location to find and share information	4
Wide breadth of information	3
Tethys Engineering Photo Library	2
Information and news	2
Knowledge Base	1
Database	1
It exists and is of use	1
Timely and well-organized	1
Easy to search for new literature	1
The level of engagement that *Tethys* has with its audience	1
General overview of companies, projects, conferences, and other news	1
It is an effective way to keep up with the latest publications and with industry news releases in all of the technical areas	1

Question 6: In your opinion, how can *Tethys Engineering* be expanded or improved upon?

Out of 39 total respondents, 16 responded to Question 5. The open-ended responses have been combined or merged where there was considerable commonality (Table 3).

Table 3. Respondents' open-ended responses on how *Tethys Engineering* can be improved.

No. of Comments	Comment	Response*
6	"You're doing a very good job already", "For me, it is perfect as it is", etc.	Thanks!
1	"Continuation of what you are already doing and increase the repository of data, photos etc."	Thanks! Will do!
1	"It takes a little time for map viewer to be presented."	We are aware that the page takes a while to load and are working on improvements.
1	"More info on fundamental research in universities"	The PRIMRE team is actively coordinating with UMERC, and will look into additional ways to highlight these projects further.
1	"Collect proceedings from main event (ICOE, EWTEC, AWTEC, PAMEC, etc.)"	We will continue to collect proceedings from all major marine energy events and share that content when copyright allows.
1	"A detail explanation how I can use *Tethys Engineering*"	We will develop a Tips for *Tethys Engineering* page that will highlight the resources available on the site. We will also explore developing a short video that highlights key features.
1	"Expand the photo library to more developers and more photos for those already listed"	We will continue to contact developers for additional photos for the Photo Library.
1	"Creating training frameworks for various groups or sectors that help in a better knowledge and for decision-making in these issues of marine energies and related aspects"	We will explore various use cases and work with UMERC to assist in increasing training opportunities.
1	"Floating wind technologies face very similar challenges as MRE. I would be very interested if this source of energy would be included, or at least partially, in aspects which are common to MRE technologies."	Floating offshore wind technologies are not currently within *Tethys Engineering's* scope.
1	"There are some duplicate articles. I think that if these were removed, then the site would be better."	We will review *Tethys Engineering's* existing content and remove any duplicate articles that were mistakenly added.

*These responses are not shared with the respondents who made the initial comments. Rather, these responses are generated to systematically review comments and document potential action items.

Question 7: How comprehensive do you find the literature on marine renewable energy on *Tethys Engineering*?

Out of the 39 total respondents, 32 responded to Question 7. Respondents were asked to pick a number between 1 (not comprehensive) and 10 (extremely comprehensive). On average, respondents rated *Tethys Engineering's* comprehensiveness at 8.0, with individual ratings ranging from 2 to 10 and a median of 8.

At a high level, this shows that most respondents find the literature on *Tethys Engineering* very comprehensive.

Question 8: Do you know of any relevant literature (e.g., journal articles, technical reports, conference papers, theses) that are not on *Tethys Engineering*? Please list them.

Out of the 39 total respondents, 8 responded to Question 8. Most wrote some variation of "none" or pointed to resources where additional literature can be found (e.g., EWTEC, EWEC, https://meric.cl/repositorio/, https://www.homepages.ed.ac.uk/shs/).

The *Tethys Engineering* team will review and add additional literature from the sources identified by survey respondents. One respondent commented that "literature from Canada and the Bay of Fundy is often underrepresented in comparison to U.S. and/or U.K.", so the *Tethys Engineering* team will also work to identify and add more content for this region.

4.0 Action Items

Based on the results of the user review process, we have identified the following action items as potential opportunities to enhance the use and function of *Tethys Engineering*:

- Regularly highlight key *Tethys Engineering* features and content in the *Tethys Engineering* Blast.
- Target additional outreach and engagement towards audiences interested in ocean thermal energy conversion and salinity gradient energy.
- Engage with UMERC to integrate and highlight fundamental research from universities.
- Develop a Tips for *Tethys Engineering* page, potentially with an interactive interface and use cases for different user groups, and a short overview video that highlight key features and content available on the site.
- Improve page loading speed for *Tethys Engineering* Map Viewer.
- Review *Tethys Engineering* to identify and remove any potential duplicate publications.
- Conduct a focused literature search for proceedings from major past conferences.
- Conduct a focused literature search for relevant work in Canada and the Bay of Fundy.

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