2.4.2.405 – Water Power STEM Workforce Development (Marine Energy)

THIS PEER REVIEW PRESENTATION WILL FOCUS ON MARINE ENERGY ASPECTS OF THIS PROJECT AND COMPLEMENTS HYDROPOWER PRESENTATION PRESENTED DURING THE HYDROPOWER PEER REVIEW

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Project Overview

Project Summary

- As interest in renewable energy grows, marine energy (ME) technologies will continue to play a growing role in reaching our nation's clean energy objectives. As it is still a nascent industry, developing a ME workforce will require a wide range of expertise and tight competition with other energy sectors. The industry needs to attract and train talent to help develop the workforce pipeline.
- WPTO efforts to address these needs include more programs, improved program accessibility, and an increased awareness of ME as a renewable energy career (secondary school, vocational and apprenticeship programs, and undergraduate curricula). There is much more work to be done.

Intended Outcomes

- A growing water power workforce that is competitive in the global marketplace and that incorporates multiple disciplines into strong diverse teams.
- Although not expected immediately, an increased number of new students pursuing marine energy coursework and new hires (including people moving from other sectors) employed in the marine energy industry.
- This project covers the breadth of the water power educational infrastructure, including hands-on activities, competitions, curricula development, engagement of industry and academia, networking, matchmaking and more.

Project Information

Principal Investigator(s)

- Elise DeGeorge (hydropower focus) and Arielle Cardinal (marine energy focus)

Project Partners/Subs

- See Next Slide

Project Status

- Ongoing

Project Duration

- October 2018
- Project End Date tbd

Total Costed (FY19–FY21)

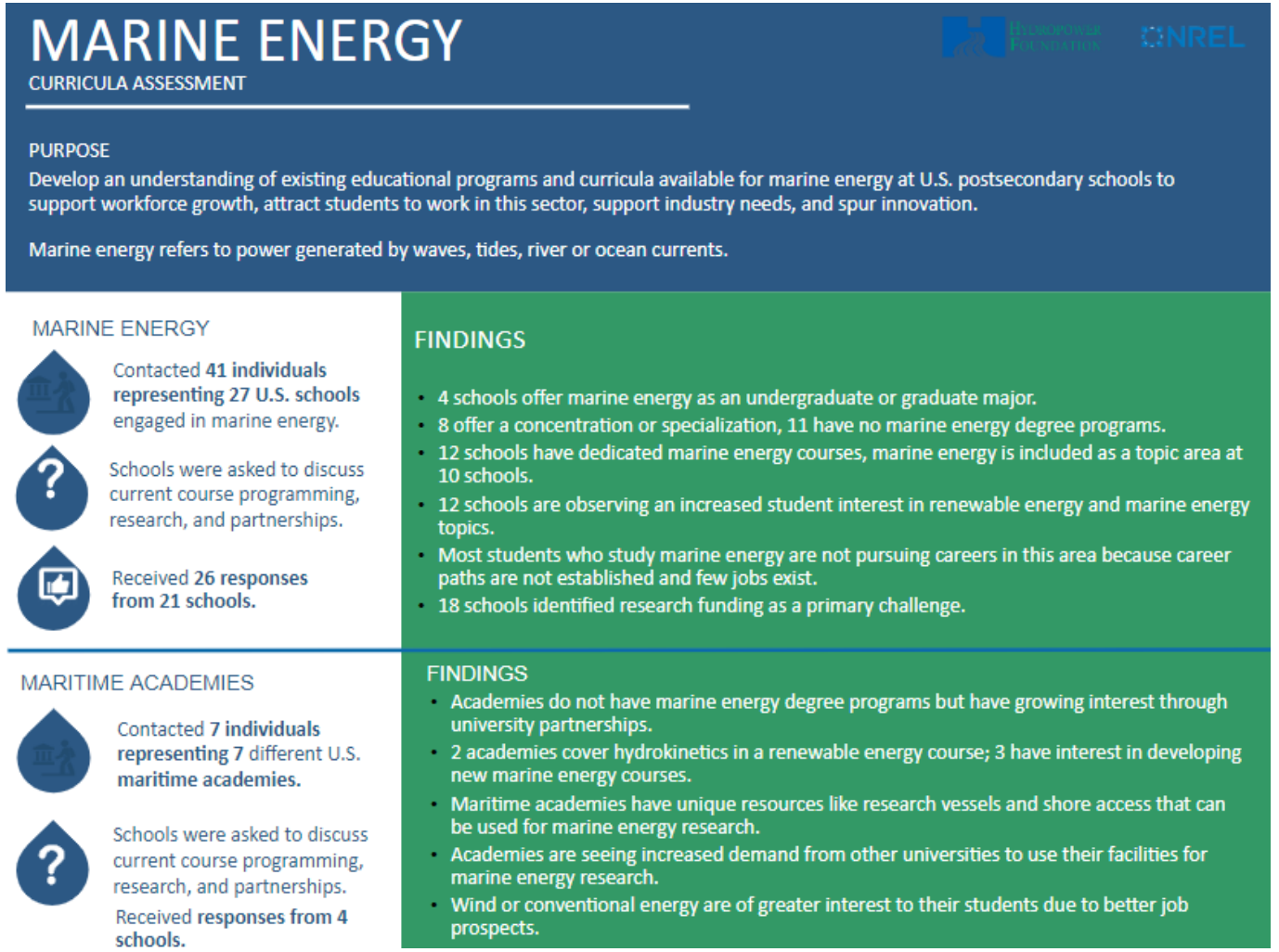
$2.8M (both marine energy and hydropower)
$2.1M ME

Water Power STEM Team

Name	Organization	Expertise
Technical Staff	NREL	A team of technical staff supports Water STEM by providing hydropower and marine energy specialized expertise where needed for content development and review and project management support.
Bree Mendlin/Linda Ciocci	Hydropower Foundation	Supports assessment of available content and information needs, helps facilitate Dialogue Series, and supports development of materials and/or curricula.
Rebecca Lamb/Mary Spruil	The NEED Project	National Energy Education Development (NEED) helps with curriculum development focused on secondary students and the general public and bringing the materials to classrooms.
Mike Arquin	KidWind	KidWind supports material dissemination, activity development, and teach the teacher efforts.
Jules Smoke and Team	IKM Testing	IKM develops interactive digital content including the Renewable Energy Discovery Island (REDi Island).
Katie Cubina and Laura Batt	Mystic Aquarium	Mystic Aquarium creates museum displays and conducts community immersion activities through its Energy Engineers Program.
Parker Mullins, Chaun McQueen	Bonneville Environmental Foundation	Bonneville Environmental Foundation augments STEM content dissemination and localizes messaging in both directions as the program's first Clean Energy Talent Hub.

Project Objectives: Relevance

- To meet the workforce development challenge identified in WPTO's MYPP Activity 5 – Data Access, Analytics and Workforce Development and the subsequent action to "**support development of new educational resources where gaps currently exist, including curricula and training, to support an evolving ME workforce and increase awareness of ME opportunities,**" this project uses a multifaceted approach to knowledge transfer to address challenges described here and on the following page.

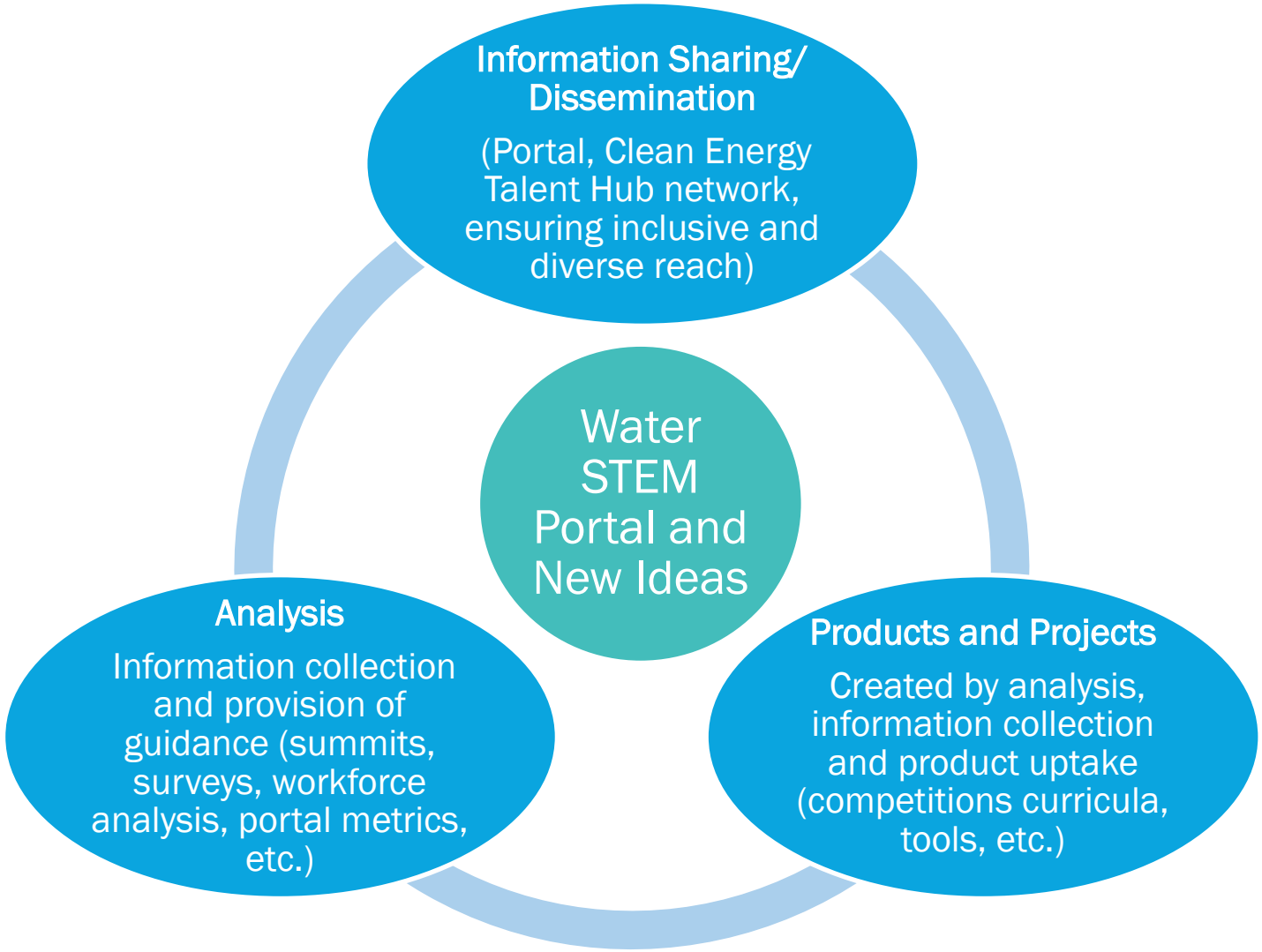


Project Objectives: Relevance

- The ME industry requires more research, development, and demonstration of technologies. This creates a need for a workforce that mixes strong ocean construction, nautical design, and ocean science with understanding of advanced materials, innovative power system development, and control theory. Additionally, the industry needs social scientists to perform economic evaluations of the technology and influence policy to reduce deployment barriers. The nascent stage of this industry means that there is not yet a steady flow of research funding or jobs in this sector.
- There are not currently many marine energy-focused degree programs or training programs.
- There's a great opportunity to attract new talent, and diverse talent—and help ensure the marine energy industry looks more like America as a whole.

- 4 of 21 schools responding to the ME energy curricula survey offer ME degree programs.
- Schools reported increased interest in renewable energy careers, but claim career paths are not clear for ME.
- A 2020 student survey showed that students lack a basic understanding of ME.
- A 2021 industry survey showed many recent student hires have limited to no understanding of ME.

Project Objectives: Three-Pronged Approach



Fundamentally, NREL's water power team uses the power of leveraging across multiple organizations (NEED curricula, KidWind, Energy Engineers, BEF, etc.) and other funded initiatives (e.g., PRIMRE*) to ensure the broadest impact possible within the available WPTO budget.

*PRIMRE = Portal and Repository for Information on Marine Renewable Energy

Project Objectives: Expected Outputs and Intended Outcomes

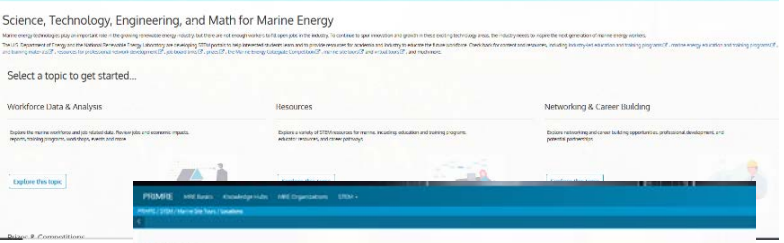
Outputs:

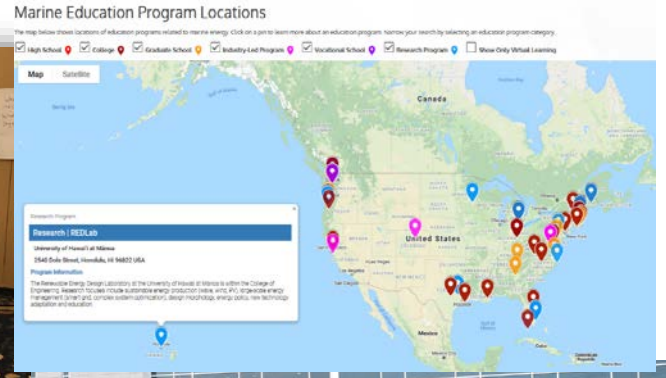
- Workforce analysis reports and dissemination of information collection mechanisms.
- Development, updates, and dissemination of STEM materials on the STEM for Marine Energy portal.
- Development of initial career competency maps.
- Development of materials that provide expanded details on ME workforce opportunities.
- Development of Marine Energy Collegiate Competition (MECC) in partnership with industry and academia.
- Continuation of dialogue "events" to occur quarterly either in person at industry conferences or virtual.
- Development of a Clean Energy Technology hub-and-spoke concept.
- Incorporation of water power education in after-school programs in disadvantaged communities across the nation through Energy Engineers.
- Development of animations, interactive 3D application, exhibits, Day-in-the-Life videos, curricula, teach-the-teacher programs and more sharing information and workforce opportunities.

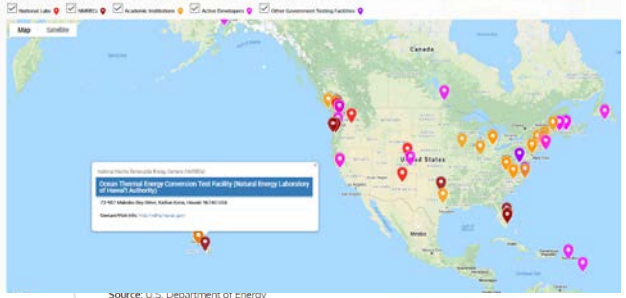
Outcomes:

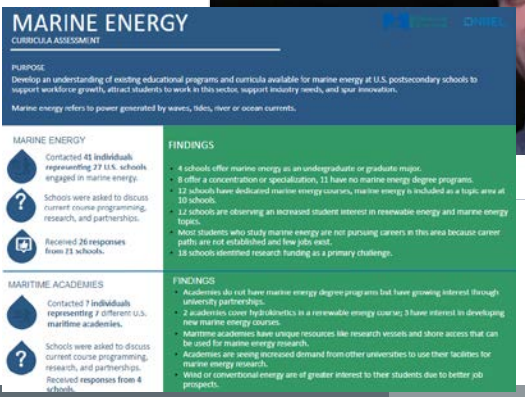
- A growing water power workforce that is competitive in the global marketplace and that incorporates multiple disciplines and has a diverse makeup.
- Increased number of new ME students and new hires employed in the ME industry.
- Utilization of hands-on activities, curricula, industry and academia engagement in STEM activities, and inclusion of ME in other renewable energy STEM activities that do not currently represent ME.
- ME perceived as necessary in getting the nation to 100% clean energy.

Sampling of Products and Reach









Marine Energy STEM/Workforce Timeline

FY 2019

- Received initial project funding and began scoping with WPTO
- Launched water power workforce assessment, in partnership with the Hydropower Foundation, through research, interviews and surveys
- Completed initial assessment of curricula and provided recommendations to HQ
- Confirmed plan for Marine Energy Collegiate Competition (MECC) and began the process of drafting Rules and Regulations
- Held stakeholder workforce/STEM information gathering workshop at Water Power Week
- Established formal partnership with Mystic Aquarium to support Ocean Energy Exhibit.

FY 2020

- Received approval on 5-year roadmap and formalized partnerships with NOSB, KidWind, Oceans First Institute, and NEED to achieve project goals
- Completed 3 Day-in-the-Life Videos featured at Mystic Aquarium and on the STEM portals
- Held inaugural MECC pitches and award ceremony
- Finalized IKM device animation to be featured on portals and Mystic Aquarium
- Launched the OpenEI STEM portals
- Shared student survey results with DOE and stakeholders.

FY 2021

- Launched bimonthly Hydropower and Marine Energy Dialogue Series with 30 attendees on average
- Launched JEDI and workforce reports pages on the STEM portal, populated maps w/ additional resources
- Announced teams selected for MECC 2021
- Launched Mystic Aquarium exhibit
- Finalized storyboard with IKM on island animation
- Disseminated findings from industry survey analysis
- Finalized MOU with BEF to serve as the first Clean Energy Talent Development Hub
- Held the 2021 MECC and awards ceremony
- Presented poster at ICOE: “Building a Strong Workforce Pipeline to Support a Powerful Blue Economy”
- Hired an intern to focus on expanding DEIB into the water STEM project
- Published NHA Powerhouse article to NHA: Expanding the Hydropower Workforce One Click at a Time (published on Nov. 1, 2021)

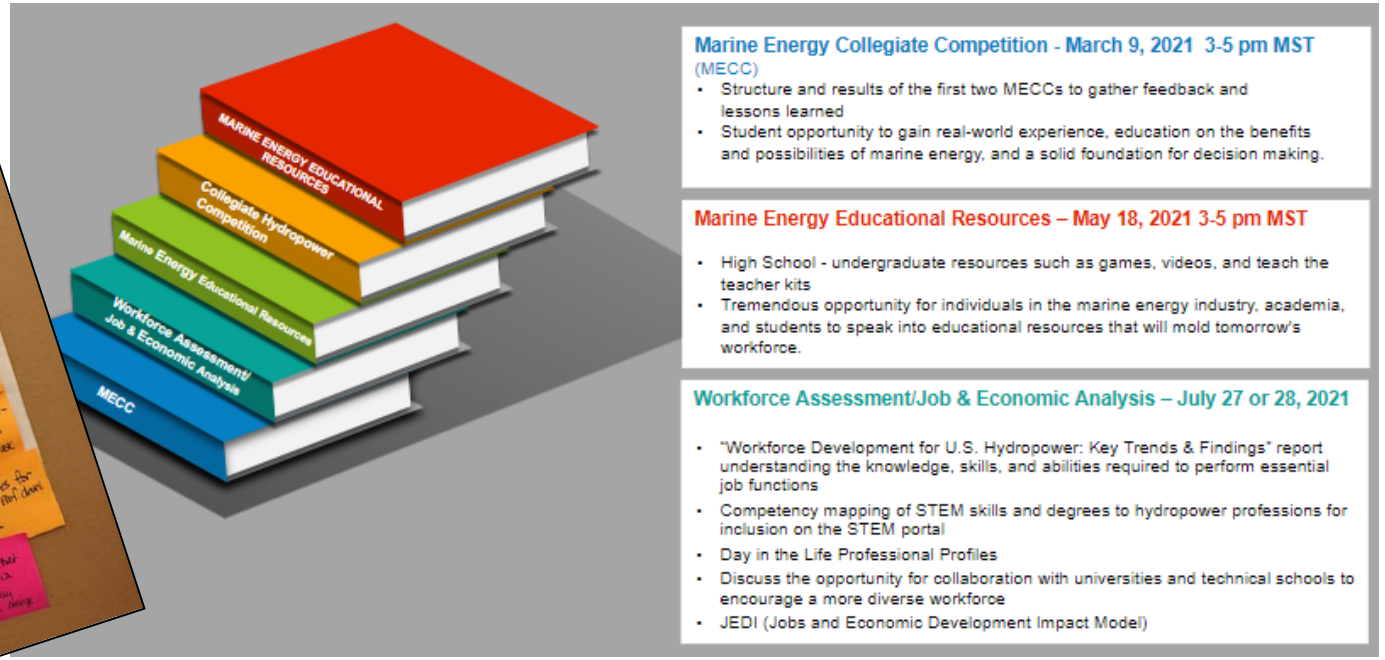
Project Budget

FY19	FY204	FY21	Total Actual Costs FY19–FY21
Costed	**Costed**	**Costed**	**Total Costed**
$574K	$953K	$1,266K	$2,793K
ME only: $430k	ME only: $715k	ME only: $950k	ME only: $2,094k

- There have been no variances against planned budget.
- Important to note that this budget covers both marine energy and hydropower activities – this presentation only covers marine energy activities.

End-User Engagement and Dissemination

- Engagement began with advisory committees and morphed into regular dialogues toggling between marine energy and hydropower.
- Products and approaches, such as REDi Island and MECC are continually grounded in dialogues such as these, survey results, and portal activity.



Marine Energy Collegiate Competition - March 9, 2021 3-5 pm MST
(MECC)

- Structure and results of the first two MECCs to gather feedback and lessons learned
- Student opportunity to gain real-world experience, education on the benefits and possibilities of marine energy, and a solid foundation for decision making.

Marine Energy Educational Resources – May 18, 2021 3-5 pm MST

- High School - undergraduate resources such as games, videos, and teach the teacher kits
- Tremendous opportunity for individuals in the marine energy industry, academia, and students to speak into educational resources that will mold tomorrow's workforce.

Workforce Assessment/Job & Economic Analysis – July 27 or 28, 2021

- "Workforce Development for U.S. Hydropower: Key Trends & Findings" report understanding the knowledge, skills, and abilities required to perform essential job functions
- Competency mapping of STEM skills and degrees to hydropower professions for inclusion on the STEM portal
- Day in the Life Professional Profiles
- Discuss the opportunity for collaboration with universities and technical schools to encourage a more diverse workforce
- JEDI (Jobs and Economic Development Impact Model)

Sampling of Water STEM Products Tailored to Different Audiences

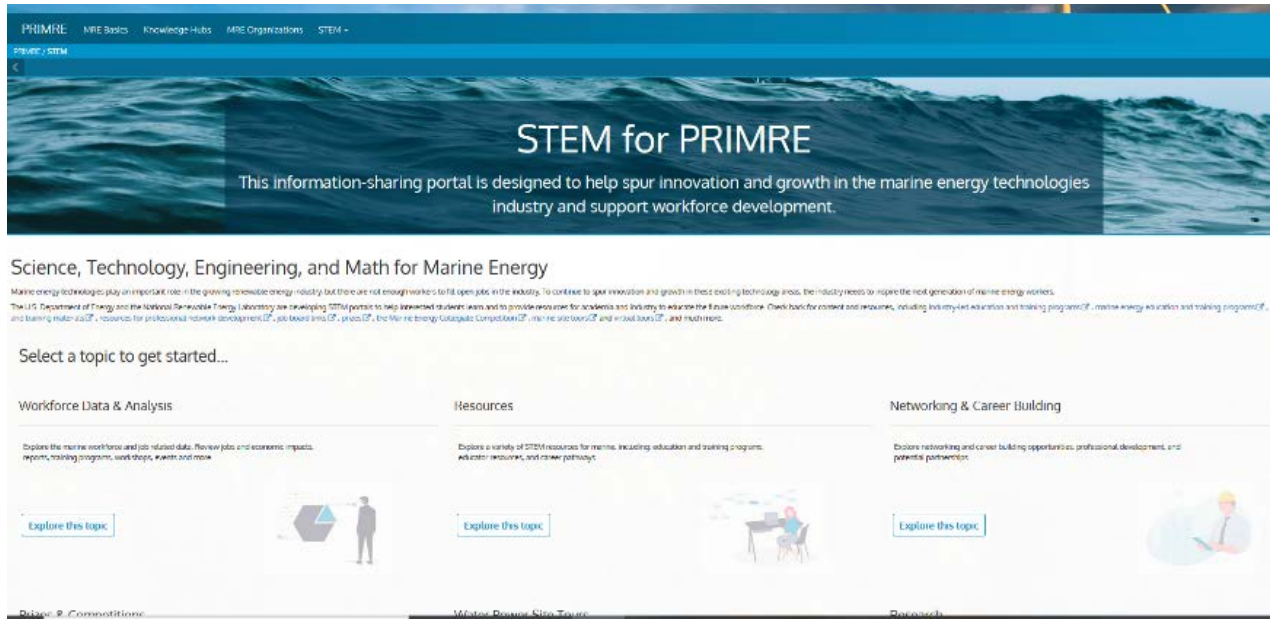
Mechanism	Target Audiences	Partners	Reach/ Impact
Online STEM Portals for Hydropower and Marine Energy	• K-12 students and educators • Post-secondary students/educators	• All Water STEM project partners, primarily Hydro Foundation, and interviewees for Day-in-the-Life videos	Many
REDi Island – a 3D Interactive Application	• All ages – Middle/High School, College, Trades, General Public, more	• IKM and national laboratory subject matter experts	Will be broad and deep
Clean Energy Talent Hub (CETH) Model including the Clean Energy Fellows Program	• Recent graduates (Bachelor's, Master's, and Doctoral graduates) • Early-career energy professionals • Tribal members	• Bonneville Environmental Foundation	Broad and deep regionalized focus
Curricula, Teach-the-Teacher Training and Student Competitions	• Middle school/high school students • Student families • Industry judges and volunteers	• NEED • KidWind • Hydro Foundation	Very broad and deep
Hydropower and Marine Energy Collegiate Competitions	• Undergrad and graduate students • Community college/trade school students • Professors and faculty • Industry employers and supporters	• Hydro Foundation • NHA • Industry	Hundreds of students/professors across many disciplines/employers
Energy Engineers After-School Program	• Middle school/high school students in disadvantaged communities	• Mystic Aquarium	Thousands of disadvantaged students/families

FY22 Events to Support End-User Engagement and Dissemination

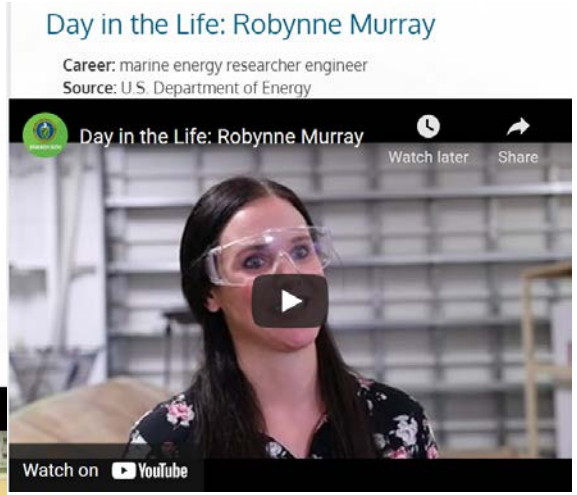
Dialogue Workshop Session	FY funded	Date	Venue	Location	Description/Objective
Think Tank and associated workshop	FY22	Oct. 20, 2021	Clean Currents	Atlanta, GA	Hosted workshop alongside the Hydro Foundation's Think Tank Competition
Teach-the-teacher training	FY22	Oct. 20, 2021	Clean Currents	Atlanta, GA	NEED held teacher workshop and tour
Clean Energy Education & Workforce Alliance Workshop	FY22	Feb. 10, 2022	CEEWA	Virtual	Increase visibility and inclusion of water power in the renewable energy STEM and Career Technical Education (CTE) national network and discussions among partners nationwide
No workshop - see notes	FY22	Feb. 23–25, 2022	Northwest Hydroelectric Association (NWHA) Annual Meeting	Portland, OR	Amplified activities at a BEF-hosted booth
No workshop - see notes	FY22	April 5–7, 2022	Water Power Week	Washington DC	Sharing Water STEM collateral and promoting HCC and MECC
HCC Informational Webinar	FY22	April 13, 2022	Virtual	Virtual	Promote HCC and provide application and competition information to prospective teams

Performance: Accomplishments and Progress

- One of the most important technical accomplishments achieved over the life of the project has been the portal. This is the main repository of the DOE WPTO investment in ME and STEM.



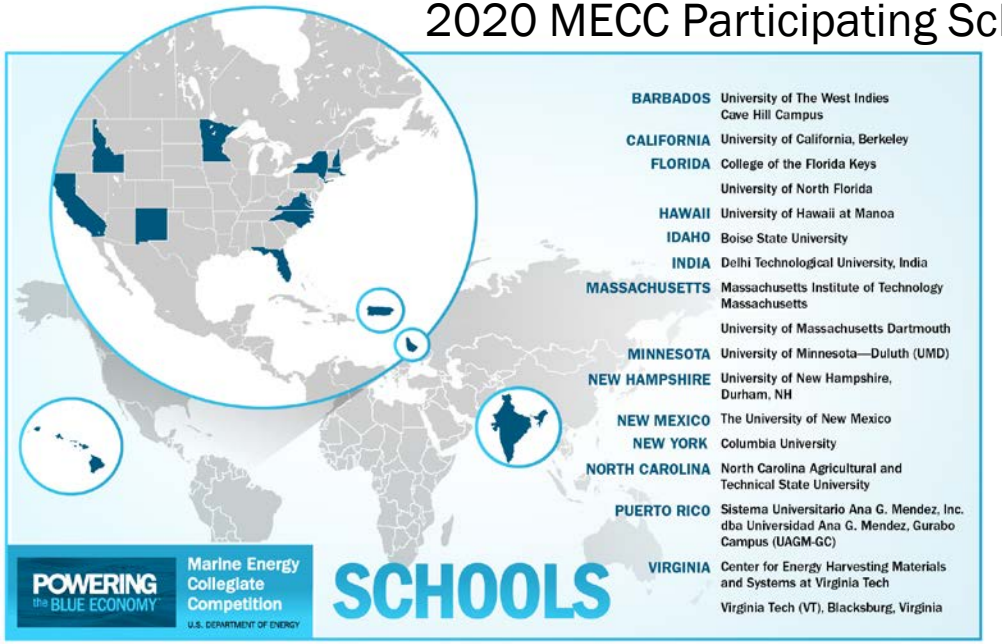
- This information-sharing portal is designed to help spur innovation and growth in the ME technologies industry and support workforce development.



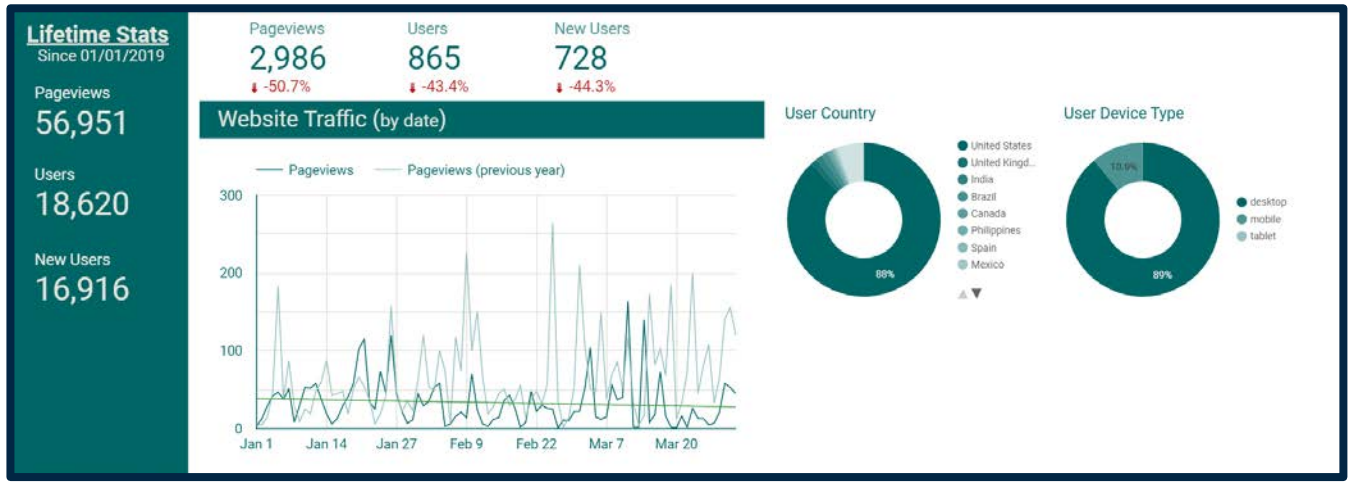
Performance: Accomplishments and Progress - Marine Energy Collegiate Competition

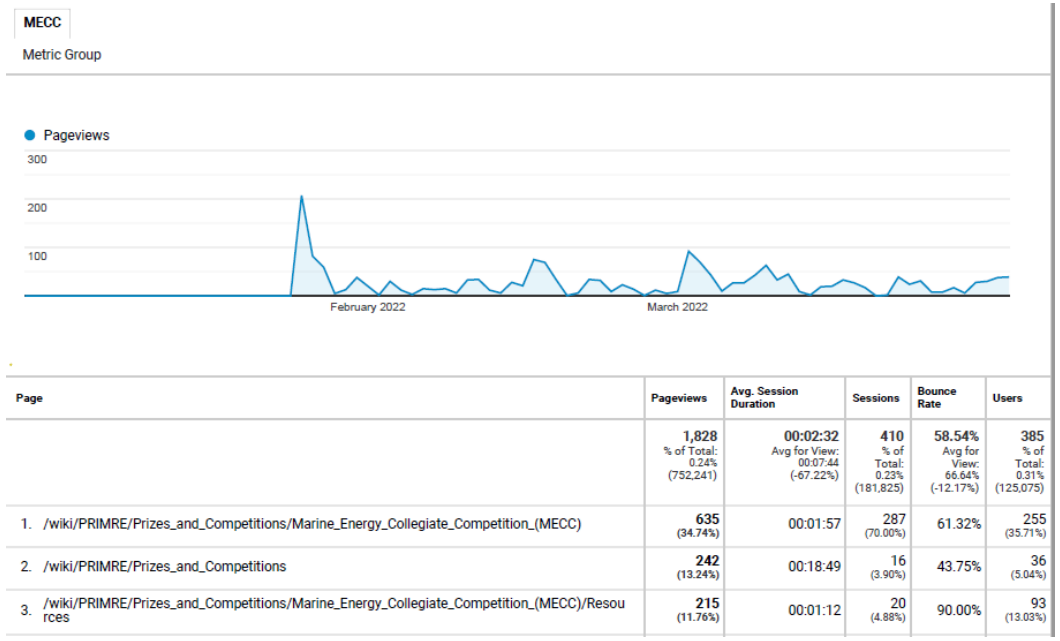
- In first 3 years of MECC:
  - 47 total institutions
  - 14 Minority Serving Institutions (represents 30% of all participating institutions)
  - 1 Community College
  - 10 international institutions
  - Roughly 480 students and 47 faculty advisors engaged
  - Without formally tracking (due to government restrictions), know of 6 students now working in the Marine Energy industry.
  - 15 applications received in first year compared to 21 in 2022 (40% increase)

2020 MECC Participating Schools



Portal Metrics to be Included in Broader Project Metrics





Page	Pageviews	Avg. Session Duration	Sessions	Bounce Rate	Users
	1,828 % of Total: 0.24% (752,241)	00:02:32 Avg for View: 00:07:44 (-67.22%)	410 % of Total: 0.23% (181,825)	58.54% Avg for View: 66.64% (-12.17%)	385 % of Total: 0.31% (125,075)
1. /wiki/PRIMRE/Prizes_and_Competitions/Marine_Energy_Collegiate_Competition_(MECC)	635 (34.74%)	00:01:57	287 (70.00%)	61.32%	255 (35.71%)
2. /wiki/PRIMRE/Prizes_and_Competitions	242 (13.24%)	00:18:49	16 (3.90%)	43.75%	36 (5.04%)
3. /wiki/PRIMRE/Prizes_and_Competitions/Marine_Energy_Collegiate_Competition_(MECC)/Resources	215 (11.76%)	00:01:12	20 (4.88%)	90.00%	93 (13.03%)

- OpenEI metrics for portal use being tracked.
- MECC metrics just beginning! New end of year survey allows for metrics tracking.
- Launching partnership with BW Research to support overarching project impact metric collection in FY22

[bw] RESEARCH PARTNERSHIP

Future Work

- Complete career maps for both hydropower and marine energy including craft and trades.
- Continue the quarterly stakeholder engagements.
- **Continual focus on the portal as the core of the water power STEM program and update regularly.**
- Enhance engagement with underrepresented communities (including rural communities, minorities, and veterans) and others who may not traditionally see or be aware of water power as a viable career opportunity. This could be through expansion of CETH and/or development/expansion of marine energy certification program or similar.
- Complete a proposed plan for the continuance of Water Power STEM activities for FY24 through FY26 including assessment of certification program and growth of the CETH network.
- Continue hosting Marine Energy Collegiate Competition and collecting feedback annually to inform future competitions.
- Release beta version of REDi Island educational app for testing incorporating NEED curricula and gaming aspects.
- Formalize metrics tracking program in FY22 with BW Research and align with metrics tracking from project partners.
- Expand upon DEI efforts with the help of summer internships.

Planned Continual Engagement with Industry

Session	FY funded	Date	Venue	Location	Description/Objective
Workforce Analysis and Career Mapping Workshop	FY22	July 12, 2022	Hydrovision International, Denver July	Denver, CO	2-1/2 hour workshop to coincide with Hydrovision which starts on July 11 to share and vet Workforce Analysis and career map outcomes. Purpose: Aligning Workforce and STEM programs to address gaps and meet workforce needs.
Teacher-Student Training for Careers in STEM	FY22	July 12, 2022	Hydrovision International, Denver July	Denver, CO	
NWHA Annual Meeting	FY22	9/13-14	NWHA Fall Regional Meeting	Tacoma, WA	BEF's CE program partnering with NWHA for their Hydropower Ambassadors program (TBD but will likely to provide workshop and/or networking session, exhibit), promote CETH and water power fellows/partnerships
Ocean Renewable Energy Conference	FY22	9/14-15	OREC	Portland, OR	BEF CE program to participate, engagement TBD but likely a booth and perhaps some networking opportunities, promote CETH and water power fellows partnerships
Multi-lab Coordination/Collaboration Workshop (with possible CETH deep dive to follow)	FY21 - using old University Coordination project funds that now sit under STEM	Sept xx, 2022 (OREC 9/14-15; NWHA 9/13-14)	OREC, / NWHA Fall Regional Meeting week	Washington/Oregon	Multi-lab collaboration meeting to ensure DOE WPTO's investments in Workforce/STEM are collaborative across labs being funded in this area and non-duplicative and appropriately leveraged
HydroU Information Gathering	FY21	September 20, 2021	NAWEA	Delaware	Session being planned by Tom Acker on WindU - would be great informaiton gathering and venue for sharing prospective HydroU concept
Mystic Aquarium Exhibit PR Event	FY22 but held in FY23	October 14, 2022	Mystic Aquarium	Mystic, CT	Mystic is hosting the National Ocean Film Festival and have also entered the animation stories we crated into the festival. Idea is to finally have an event to promote the exhibit, marine energy, NREL And DOE
Hydropower Certification Workshop	FY22 but held in FY23	October 18-20, 2022	Clean Currents	Sacramento, CA	HydroUniversity: Need and Advantage: to discern the benefit and need of having a hydropower accreditation program aligning multiple universities similar to WindU under the direction of Tom Acker
STEM Play Zone	FY23	October 18-20, 2022	Clean Currents	Sacramento, CA	Submitted abstract for a demo station
No workshop - see notes	FY23	October 2022	ICOE	San Sebastian, Spain	Abstract submitted to get international dialogue on Water STEM work
Inaugural HCC and MECC	FY23	May 8-10, 2023	Water Power Week	Washington DC	Possible location for inaugural HCC and MECC
CETH Discussion and Expansion Approach Workshop (and see note)	FY23	May 22-24, 2023	ACP CLEANPOWER	New Orleans, LA	Clean Energy Talent Hub expansion discussion, building out hub/spoke model and alignment with DOE Workforce Tiger Team efforts
No workshop - see notes	FY23	7/11-13/2023	Hydrovision International	Charlotte, NC	TBD