U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

2019 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
WATER POWER TECHNOLOGIES OFFICE

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LETTER FROM THE DIRECTOR

Dear Colleague:

On behalf of the U.S. Department of Energy's Water Power Technologies Office (WPTO), I am happy to release the 2019 WPTO Peer Review report. This report is the product of a comprehensive review of the Marine and Hydrokinetics (MHK) and Hydropower Programs, including evaluations of both programs' strategies, as well as individual projects and new initiatives. The review covered 77 individual projects funded by the office, including 41 projects funded by the MHK Program and 36 by the Hydropower Program. These projects represent the majority of WPTO's active portfolio between fiscal years (FY) 2017 and 2018, though some projects were funded and initiated as early as FY 2014, before WPTO was an independent office. The projects reviewed represent about $230 million in executed funding, which includes funds appropriated in prior fiscal years and non-federal cost share.

WPTO is required to conduct an office-wide review every two years in accordance with departmental guidance; we in WPTO consider this an important responsibility and opportunity, as it is the most comprehensive mechanism that we have for gathering feedback on our programs and projects. We could not do our jobs without the help and input of our stakeholders, which is why the objectives in our office's Outreach and Engagement Strategy are embedded in everything we do, including how we planned and executed this review. We were deliberate in planning this review to achieve the key goals outlined in the strategy: (1) demonstrate transparency, (2) elicit feedback, (3) disseminate results and tools developed through R&D, and (4) provide objective and accurate information to the public. We also sought to provide all attendees—not only the reviewers—a variety of opportunities to provide feedback and engage WPTO staff, whether comment boxes to anonymously submit feedback or a "Town Hall" with WPTO staff at the end of the review to provide an opportunity for open-ended feedback and discussion. The engagement opportunities and input provided through this type of comprehensive review is invaluable to our programs.

This year's review was particularly important to WPTO for a few reasons. Primarily, this was the first Peer Review of WPTO's portfolio as an independent office, separate from the Wind Energy Technologies Office. It also reflected the new programmatic structure and strategies put in place since 2017, including some expansion to new areas where hydropower and MHK technologies can have a significant impact, such as leveraging hydropower's full range of grid benefits (HydroWIRES Initiative / Grid Reliability, Resilience, and Storage) and marine energy applications in the Blue Economy (Powering the Blue Economy). In addition, during the period under review, WPTO leveraged new funding and partnership mechanisms—some of which were novel for DOE at large. These funding mechanisms are helping WPTO attract a diverse set of innovators to support our mission of reducing costs and improving the reliability of water power technologies. Lastly, significant budget increases over the last few years made 2019 an even more critical time to independently review our work and discuss how to most effectively use public funds to drive the greatest R&D impacts.

Only a few months after the review, I can already say the feedback we received is proving useful. At an office-level, we received encouraging feedback on our strategies, including both the R&D activities we fund and the mechanisms by which we fund them. One trend we noticed is the average scores for both the MHK and Hydropower Program strategies were higher than the average weighted scores of all projects reviewed under the respective programs. This indicates that our current program objectives—which have been updated since some of the reviewed projects were initiated—are well aligned with industry needs, even if these strategic objectives may not have always been executed perfectly in individual projects. The reviewers

were particularly supportive of the new HydroWIRES and Powering the Blue Economy initiatives. We also received overwhelming support from both reviewers and general attendees for WPTO's efforts in leveraging a variety of funding mechanisms, beyond traditional lab contracts and cooperative agreements. We will continue to think critically about diverse R&D challenges and the appropriate funding structure to address each one, whether that means a funding opportunity announcement, a prize competition, a notice of technical assistance, or some other mechanism we have not yet created.

While WPTO appreciates the positive feedback, we are also very grateful for the constructive suggestions, particularly related to our stakeholder engagement, use of performance metrics, and our approach to the collection, management, and dissemination of data. With respect to stakeholder engagement, we heard that some areas of our programs are doing this well, while others need improvement. For example, we learned earlier and more frequent industry engagement could have benefitted several projects, in particular our new small hydropower projects. We also received specific feedback on organizations we should collaborate with more closely on shared marine energy research interests, such as the Bureau of Ocean Energy Management. We cannot overstate how important meaningful stakeholder engagement and impactful dissemination is to our mission. We plan to work more closely with our colleagues and project teams to ensure their plans for stakeholder engagement are appropriate throughout the entire project cycle, and that they have an impactful strategy to disseminate results, tools, and lessons learned. Second, we heard that both the MHK and Hydropower Programs have more work to do in the area of performance metrics, both at a project level (i.e., how do we define success) and at a program level (specifically in quantifying WPTO's impact, return on investment, and commercialization successes). The office has been working hard over the past year to define performance metrics for marine energy devices as part of our new Testing Expertise and Access for Marine Energy Research (TEAMER) program, and we plan to pilot new program-wide impact assessment in FY 2020. Third, we learned we need to strengthen our data efforts. We recognize that we are collecting large amounts of valuable data, but our current structures for accessing these data don't adequately ensure quality and ease of use. Finally, we received useful feedback on the structure of the review. Most notably, we heard time and time again that reviewers would have benefitted from having more information on WPTO's go/no-go decisions and how funded projects move forward. We will incorporate this feedback into our planning for the next Peer Review.

To all who contributed to our office's 2019 Peer Review, thank you. To all the attendees, thank you for taking an interest in our programs and offering your feedback. To the project teams and principal investigators that presented, thank you for the time you have invested in this review, as well as in the important work you do every day. To our invited speakers, thank you for offering your perspectives and challenging our community to think differently about our approaches to innovation and the impact of our work. And last but most certainly not least, thank you to our reviewers. On behalf of WPTO, I am deeply grateful for the significant time and energy you put into this review. The team was honored by your willingness to share your expertise with us and dive deeply into our portfolio. We know the marine energy and hydropower communities will benefit for years to come thanks to your strategic advice on the direction of our R&D programs.

Sincerely,

Alejandro Moreno
Director, Water Power Technologies Office
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

EXECUTIVE SUMMARY

Introduction

The U.S. Department of Energy's (DOE's) Office of Energy Efficiency and Renewable Energy's (EERE's) Water Power Technologies Office (WPTO, or "the office") 2019 Peer Review was held on October 8–10, 2019, in Alexandria, Virginia. The purpose of the peer review was to evaluate DOE-funded projects for their contribution to the mission and goals of the office, to assess progress made against stated objectives, and to assess the office's overall management and performance. All programs within EERE are required to undertake rigorous, objective peer reviews covering their key projects, as well as 80%–90% of their funded active project portfolio every two years.

Review Process

Most projects in WPTO's fiscal year (FY) 2017–2018 research and development (R&D) portfolio were presented to the public and systematically reviewed by 24 external subject-matter experts from industry, academia, and federal agencies. During the event, principal investigators (PIs) presented on 77 projects in WPTO's R&D portfolio, and WPTO staff presented on each program's strategy and high-priority initiatives. See Table 1 for a list of the programs, the activity areas, and the number of projects in each.

Table 1. WPTO's Peer Reviewed Projects and Strategic Initiatives.

Program	Activity Area	Number of Projects
Hydropower	Technology R&D for Low-Impact Hydropower Growth	8
	Grid Reliability, Resilience, and Storage	9
	Modernization, Upgrades, and Security	2
	Environmental R&D and Hydrologic System Science	10
	Big-Data Access and Management	7
	*HydroWIRES Initiative**	
Marine and Hydrokinetics	Foundational and Crosscutting R&D	12
	Technology-Specific Design and Validation	8
	Reducing Barriers to Testing	15
	Data Sharing and Analysis	6
	*Powering the Blue Economy**	
	Total Number of Projects	**77**

*Strategic initiatives

These projects and program strategies were organized into four groups, referred to as "tracks" for the peer review. There were two tracks for the Hydropower Program and two tracks for the Marine and Hydrokinetics (MHK) Program. Each track included one or more activity areas. See the agenda in Appendix A for a list of tracks and associated activity areas. Two review chairpersons were selected to oversee the peer review tracks

and review process: Greg Lewis, formerly of Duke Energy, presided over the Hydropower tracks and Elaine Buck, of the European Marine Energy Centre, presided over the MHK tracks.

Evaluation Criteria

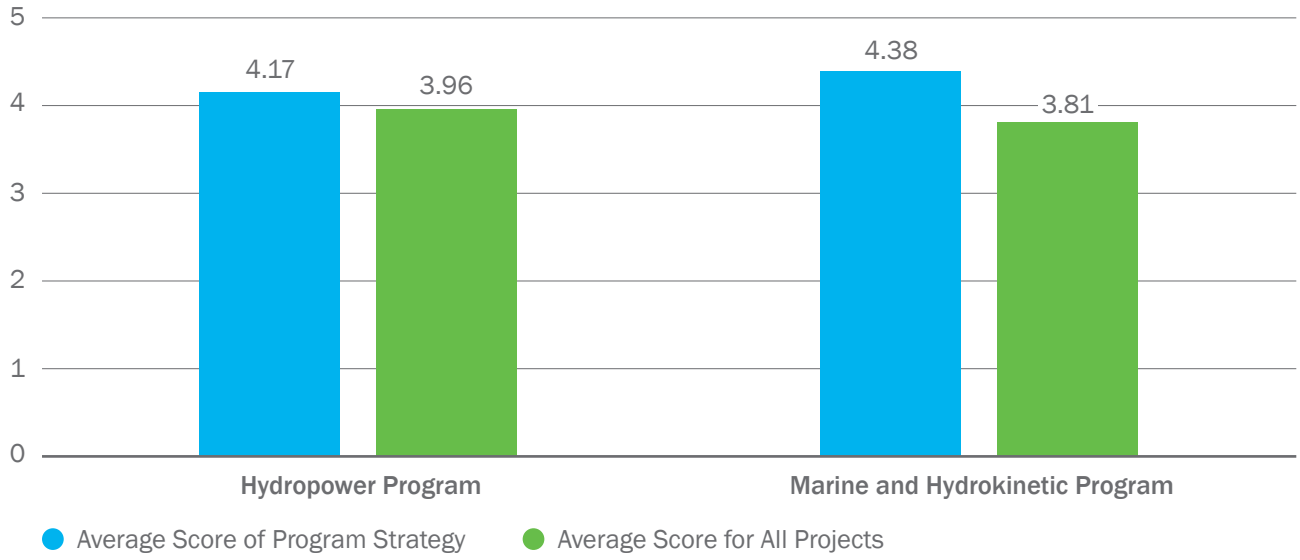
Reviewers were asked to evaluate WPTO's major R&D programs and significant initiatives (i.e., Powering the Blue Economy and HydroWIRES [Water Hydropower and Water Innovation for a Resilient Electricity System]) at a strategic level, both numerically and with specific, concise comments to support each evaluation. Reviewers evaluated each program or strategic initiative on the following equally weighted criteria: (1) program strategy and objectives; (2) program portfolio; (3) program management approach; and (4) stakeholder engagement, outreach, and dissemination. Reviewers provided scores on a scale of 1 ("unsatisfactory") to 5 ("superior") for each criterion and were also asked to answer unscored, supplemental questions for each program or strategic initiative, which are outlined in Appendix A.

In addition, reviewers were asked to evaluate a set of WPTO's projects, both numerically and with specific, concise comments to support each evaluation. Reviewers evaluated each project on the following specific criteria: (1) project objectives, impacts, and alignment with the program strategy; (2) end user engagement and dissemination strategy; (3) management and technical approach; (4) technical accomplishments and progress; and (5) future work. Project scoring involved weighting the evaluation criteria based on each project's category—sunsetting/completed, ongoing, or new—which was based on the project's start and/or end date. Reviewers were asked to comment on the strengths and weaknesses behind their scoring and to provide recommendations that they felt that the office should consider.

Scoring Overview

Figure 1 summarizes reviewers' quantitative assessments of how WPTO's programs are performing overall, including the average score of each program's strategy and the average score of all projects reviewed per program.

Figure 1. Average score per program



Overall, the average scores in Figure 1 indicate that reviewers rated each program's strategy higher than the average score for all individual projects. This shows that our current program objectives—which were updated after some of the earliest projects were initiated—align well with evolving industry needs. Reviewers agreed that the strategies are sound, and they were particularly supportive of the new HydroWIRES and Powering the Blue Economy initiatives.

WPTO's Key Objectives for the 2019 Peer Review

WPTO staff and management considered the 2019 Peer Review a significant milestone and opportunity for the portfolio given this was the first comprehensive evaluation of WPTO as a standalone office. WPTO established key objectives that guided how the review process was planned and executed before, during, and after the event. With the overarching goal that all participants should leave feeling like their time was well spent, our additional objectives included the following:

- Give reviewers a transparent and comprehensive view of the portfolio and WPTO's vision for marine energy and hydropower R&D.
- Gather valuable feedback on funded R&D, technical accomplishments, and management approach, and leverage this feedback to inform future decision making.
- Enable all participants (not just reviewers) to provide feedback on the future of WPTO and the programs' strategic directions.
- Complement the review sessions with presentations from inspiring and insightful thought leaders offering outside perspectives to stimulate thoughtful discussion.
- Provide opportunities for networking, so all attendees can leverage and learn from the expertise of others.

The objectives above were set to ensure the peer review aligned with WPTO's Outreach and Engagement Strategy, which includes four key goals:

1. **Transparency**: Demonstrate good stewardship of taxpayer funds by persistently and transparently communicating how WPTO funds are utilized and evaluate project impacts.
2. **Feedback**: Gather feedback from stakeholders to inform and improve WPTO projects and strategy.
3. **Dissemination**: Maximize the impact of WPTO-supported research by effectively disseminating results of projects and tracking usage of various products.
4. **Objective and accurate information**: Provide access to accurate and objective information and data that can help to accelerate industry development and inform decision makers.

While WPTO has identified opportunities for improvement, the office concluded the experience was highly successful in meeting the stated key objectives for the 2019 Peer Review. For the overarching goal of ensuring participants' time was well spent, the results from a post-event survey suggest that the office was largely successful on this metric, and 84% of post-event survey respondents said that they would consider attending a future WPTO peer review, even if their participation was not requested (i.e., not serving as a reviewer or presenting as a PI).

A summary of WPTO's lessons learned, recommendations for other peer reviews, as well as the feedback collected from all non-reviewers can be found in General Feedback and Lessons Learned.

LIST OF ACRONYMS

AEP	Annual Electricity Production
BOEM	Bureau of Ocean Energy Management
CEATI	Centre for Energy Advancement through Technological Innovation
CFD	computational fluid dynamics
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
EERE	Office of Energy Efficiency and Renewable Energy
EMEC	European Marine Energy Centre
EPAct	Energy Policy Act of 2005
EPRI	Electric Power Research Institute
FERC	Federal Energy Regulatory Commission
FMEA	failure modes and effects analysis
FOA	funding opportunity announcement
FY	fiscal year
GLIDES	Ground-Level Integrated Diverse Energy Storage
HFI	Hydropower Fleet Intelligence
IEA	International Energy Agency
IEA-OES	International Energy Agency Ocean Energy Systems
IEC	International Electrotechnical Commission
IECRE	IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications
IFRMER	French Research Institute for Exploitation of the Sea
IO&M	installation, operations, and maintenance
IP	intellectual property
ISO	independent system operator
LCOE	levelized cost of energy
MHK	marine and hydrokinetic
MHKDR	Marine and Hydrokinetic Data Repository
MPC	model predictive control
MRE	marine renewable energy
NGOs	non-governmental organizations
NHA	National Hydropower Association
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
NWEI	Northwest Energy Innovations
O&M	operations and maintenance
OE	Ocean Energy
OES	Ocean Energy Systems

OPI	Oscilla Power Inc.
ORNL	Oak Ridge National Laboratory
ORPC	Ocean Renewable Power Company, Inc
OSU	Oregon State University
PBE	Powering the Blue Economy
PI	principal investigator
PNNL	Pacific Northwest National Laboratory
PRIMRE	Portal and Repository for Information on Marine Renewable Energy
PSH	pumped-storage hydropower
PTO	Power Take off
Q&A	question and answer
QA	quality assurance
QC	quality control
R&D	research and development
RAPID	Regulatory and Permitting Information Desktop
RMA	reliability maintainability and availability
ROI	return on investment
RTO	regional transmission organization
SAM	System Advisor Model
SBIR	Small Business Innovation Research
SBV	Small Business Vouchers
SMH	standard modular hydropower
SNL	Sandia National Laboratories
STTR	Small Business Technology Transfer
SWA	Secure Water Act
TC	Technical Committee
TCF	Technology Commercialization Fund
TEAMER	Testing Expertise and Access for Marine Energy Research
TPL	technology performance level
TRC	Technical Review Committee
TRL	technology readiness level
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WBS	work breakdown structure
WEC	wave energy converter
WEC-SIM	Wave Energy Converter SIMulator
WES	Wave Energy Scotland
WETS	Wave Energy Test Site
WPTO	Water Power Technologies Office

CONTENTS

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