POLICY BRIEF

Senate Energy and Natural Resources Committee Hearing on Offshore Energy Technologies

September 22, 2020
Official Testimony from Stuart Davies, CEO, ORPC, Inc.

Executive Summary

The marine hydrokinetic (MHK) energy industry, powered by river and tidal currents, is an essential element in the global energy transformation and has the ability to become the third component, along with wind and solar, of a 100 percent renewable energy future. Targeted government policies, including infrastructure investment and renewable energy loan programs, can help these technologies accelerate growth and create thousands of new manufacturing and marine industry jobs in the process. Given the river and tidal resources available in the U.S., the country should develop a network of smart microgrids that combine MHK as baseload power supply with wind, solar and battery storage to provide a fully renewable energy solution. This infrastructure would give local communities control over their power supply, increase the U.S. electricity grids reliability and security, and dramatically reduce greenhouse gas emissions helping the U.S. achieve its climate change goals. Regulatory policy will need to be adjusted to accelerate the installation of devices that are needed for renewable energy growth.

Introduction

Achieving a 100 percent clean energy economy and net-zero emissions, along with its attendant sustainable economic development through job creation, are important goals in currently proposed climate change plans. But to avoid the worst consequences of climate change, an aggressive renewable energy solution must be the path taken to reduce CO2 emissions. Solar and wind have made significant reductions in CO2 emissions over the past decade, but this provides an incomplete picture. The most transformative solution is smart microgrid technology that uses MHK energy from tides and rivers as a baseload resource with wind/solar/battery storage as a necessary complement. This is technically possible.

In recent years, historic transformative plans have been developed to address climate change and local air pollution. The Green New Deal, for example, is a 2019 congressional resolution that calls for a 10-year mobilization plan that would achieve 100 percent clean energy to supply all U.S. power. Other plans call for 100 percent clean energy economy and net-zero emissions no later than 2050. However aspirational these goals are, components of the plans are not consistent with what leading industry players indicate are possible and therefore will fall short of meeting targeted goals. At a recent renewable energy conference, the CEO's of the market leaders in wind, solar and hydropower shared their vision for 2030 and forecasted that renewable energy would meet 50 percent of the electricity demand despite a five-fold increase in energy storage. This forecast did not predict any shift in industrial or transportation emissions, which comprise 50 percent of U.S. energy needs (Figure 1).[1]

[1] https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

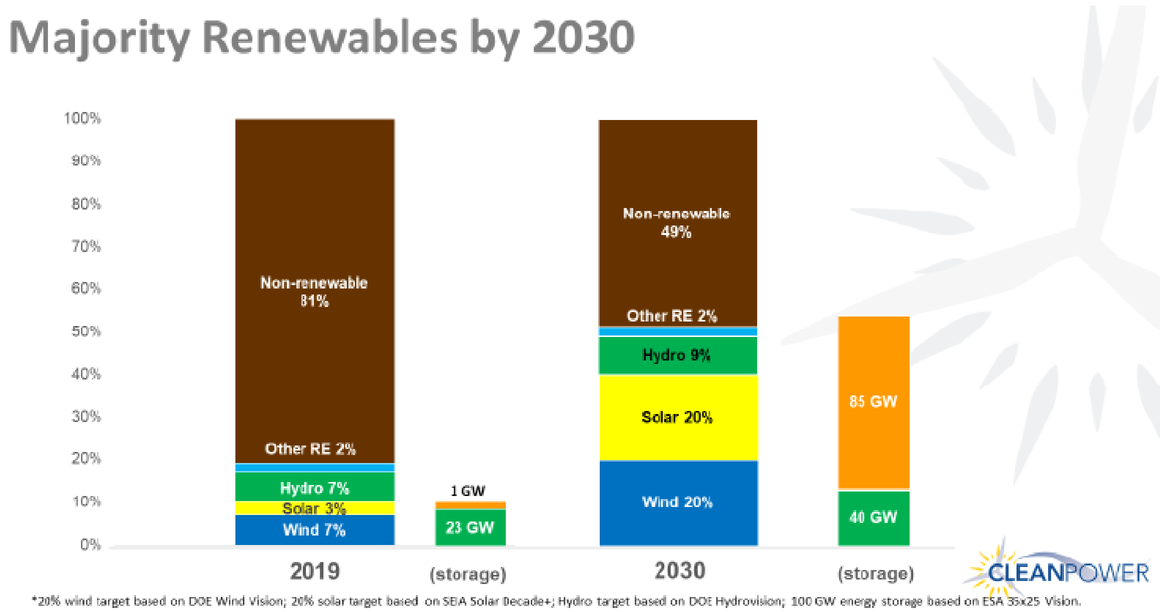


Figure 1. Forecast of majority renewables by 2030. Source: American Wind Energy Association, CLEANPOWER

As these technologies continue to mature, local communities will more and more be faced with land use and siting issues and be forced to make choices between arable land, housing stock, and renewable energy capacity. To truly unlock the potential growth and limit the land area required for wind and solar technology, the U.S. needs a baseload resource to pair with wind and solar that has no land use issues. New waterpower technologies (tidal and river) can provide that solution. With significant socio-economic benefits, favorable economic policies, scalable technology, and enabling regulatory policy, a transformative achievement can be made.

Background on the Marine Hydrokinetic Energy Industry

MHK energy is a promising yet underrepresented piece of the renewable energy sector, which offers high predictability and energy diversification. Roughly 40 percent of the world's population lives within 100 kilometers of the ocean,[2] and 6.5 percent of the world's population live in close proximity (median distance = 3 km) to a large river.[3] It is generally acknowledged that tidal current resources can be found in straits (e.g., Johnstone Strait, Canada; Pentland Firth, Scotland; Sound of Islay, Scotland; and Cook Strait, New Zealand), off of headlands (e.g., the Anglesey Skerries, Wales), in bays (e.g., Cook Inlet, Alaska; Western Passage, Maine; Minas Passage in the Bay of Fundy, Canada; and River Severn, UK), or between islands and landmasses (e.g., Rathlin Island, Ireland) where the coastal geometry helps to enhance the tidal currents.[4] River currents as a suitable resource are well-documented in the U.S.,[5] Canada,[6] and portions of South America.[7]

[2] https://www.un.org/sustainabledevelopment/wp-content/uploads/2017/05/Ocean-fact-sheet-package.pdf

[3] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3110782/#s3

[4] Borthwick, A, G.L, Marine Renewable Energy Seascape, 2016. Engineering 2 (2016) 69–78.

[5] Electric Power Research Institute, Assessment and Mapping of the Riverine Hydrokinetic Resource in the Continental United States, 2013

[6] Natural Resources Canada, Assessment of Canada's Hydrokinetic Power Potential, Phase 2 Report, 2011

[7] Inter-American Development Bank, Preliminary Analysis of Potential for River Hydrokinetic Energy Technologies in the Amazon Basin, 2015

Significant river and tidal capacity exist across North and South America, Europe, and East Asia-Pacific. In the U.S., riverine hydrokinetic technologies have the potential to provide a significant low-carbon energy supply contribution for many regions. A 2012 study suggests that theoretical recoverable energy potential is estimated to be 1,381 TWh per year.[8] For context, approximately 90,000 homes can be powered by 1 TWh of electricity generation each year.[9] Tidal energy resources in the U.S. are clustered in southern Alaska, sections of the northeastern coast, and in Washington. In 2018, the National Renewable Energy Laboratory published a study that put the U.S. tidal resource at 445 TWh per year, resulting in a total tidal and river resource potential to provide power to up to 150 million Americans.[10]

There are a number of companies that are active in the river and tidal hydrokinetics with MHK devices, many that are at or near commercialization. These companies have spent the past decade refining their technologies, and the industry has reached the milestone where it needs to deploy devices in the water. Once early solar and wind deployments demonstrated to the market their reliability and resiliency, utilities, homeowners, and businesses began installing these systems. More importantly, the financial markets gained confidence in the technology and increasingly cheap and abundant capital flowed into the sector driving the rapid adoption that we have experienced over the past 10 years. Policy initiatives that support MHK device deployment will unlock the potential for a similar cycle to repeat for tidal and river power.

ORPC, Inc., a Maine-based company, is included among this group and develops MHK power systems combined with smart microgrid technology to turn local river and tidal currents into a comprehensive baseload-renewable energy solution for both remote off-grid communities and urban communities. The RivGen® Power System has been operating for the past ten months in Igiugig, Alaska (Figure 2). It has proven it can survive harsh winter conditions in a remote community in Alaska, has received its scheduled summer maintenance, and is back on the bottom of the river providing power again to the community.

ORPC is using the same core technology in its TidGen®-80 device for tidal locations. ORPC is currently working on projects to deploy tidal devices in False Pass, Alaska, and Eastport, Maine. Both Igiugig and False Pass are representative of a number of remote communities that pay five to ten times as much for electricity as the average American, so developing projects like these not only adds renewable energy capacity, but it also provides the opportunity for economic growth through lower energy costs, as well as jobs.

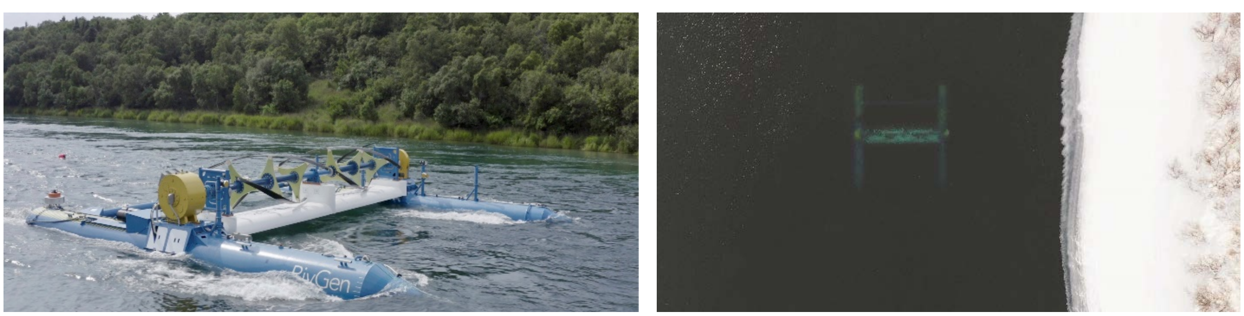


Figure 2. The ORPC RivGen Power System during and after installation at Igiugig, Alaska, 2019.

[8] Electric Power Research Institute: *Riverine Hydrokinetic Resource Assessment and Mapping*, 2012

[9] United States Department of Energy: *Quadrennial Technology Review*, 2015

[10] Marine Hydrokinetic Energy Site Identification and Ranking Methodology Pat II: Tidal Energy. NREL 2018.

ORPC's proposed project in Eastport, Maine, stands to serve as a model for a renewable energy future as it will combine tidal energy with solar, battery storage, and a smart microgrid to provide a 100 percent renewable energy solution for the community of Eastport.

Almost 700 million people globally use diesel generators for electricity, and there were about 789 million people in 2018 without access to electricity.[11] Many of these people live near ocean or river resources, so the solutions in Igiugig and Eastport could be a model around the world. This approach could develop into a major export for U.S. manufacturing over the next 20 years and create high-paying manufacturing jobs as the market grows.

In addition to remote communities, regions like Alaska are well positioned for utility-scale MHK to power regional grids and provide a renewable baseload power source for the future electrification of infrastructure. The Cook Inlet tidal energy resource has the potential to power 100 percent of the Alaskan economy (Figure 3). Industries looking for predictable baseload renewable resources to drive electrification include transportation, shipping, underwater data centers as well as defense and oil and gas facilities. These applications can be part of Alaska's economic opportunity as the gateway to the Northwest Passage. These are also applicable to other states with MHK resources, located on coasts (e.g., Alaska, Maine, and Washington) and inland (e.g., Idaho, Louisiana, Ohio, Missouri, Mississippi, Colorado, Tennessee, and West Virginia).

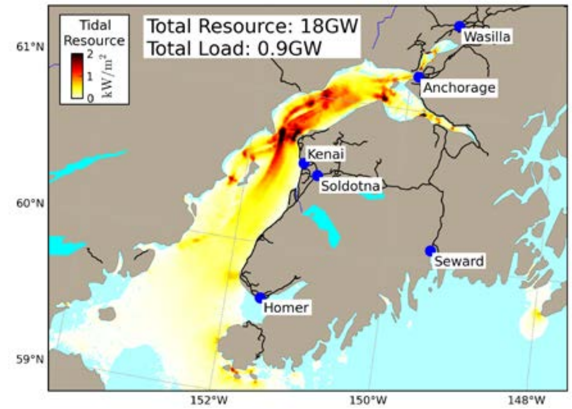


Figure 3. Tidal resource for Cook Inlet, Alaska. Source: National Renewable Energy Laboratory

Lowering LCOE: The Next Five Years

The MHK industry needs to get its levelized cost of energy (LCOE) down to truly drive wide adoption. Wind and solar are currently below $.10 but given that tidal and river energy can provide baseload power, if MHK can provide power in the $0.15-$0.20 range, it will be a viable source of electricity.

As a representative player and leader in the MHK market, ORPC's three-year plan to drive costs down to $0.20 per kWh includes product innovation, manufacturing volume discounts, and lowering installation costs through gaining experience deploying a number of devices. Like a newly launched jet engine or automobile, the only way to help MHK companies gain wide market acceptance is to have run-time on multiple devices in multiple operating environments. Having a small fleet of devices deployed in multiple conditions would enable ORPC to refine its technology and bring it to full commercialization, as well as achieve market adoption over the next 12 to 18 months. Other industry players face similar challenges and opportunities and so the background provided about ORPC's process applies to all MHK companies.

[11] World Bank Publications, 2020 Tracking Sustainable Development Goal 7: The Energy Progress

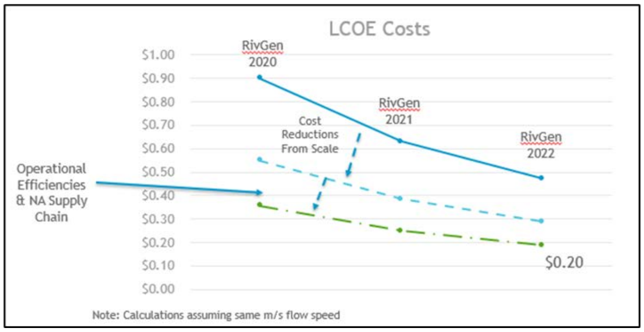


Figure 4. Estimated LCOE costs for the RivGen Power System

Product Innovation

The RivGen Power System in Igiugig, Alaska, has cycled over 7 million times over the past 10 months. This has provided ORPC's engineers with a wealth of information about individual component and overall device performance. This knowledge has been incorporated into system design, and ORPC estimates that the second unit scheduled for deployment in 2021 will see a 50 percent increase in power output. ORPC also has a series of product innovation tests over the next six months, which could contribute an additional 30-40 percent boost to output.

Volume Manufacturing

To lower LCOE, ORPC has had detailed conversations with a number of vendors about potentially managing ORPC's supply chain as it scales up. Several of these firms have refused to even quote given the small scale of our current order book. Each of the companies, however, has consistently indicated two things:

1. ORPC could reduce manufacturing costs of a device by 20-30 percent by ordering multiple units.
2. Minor adjustments to the design for manufacturing could achieve up to 50 percent cost savings between ordering a higher volume of components and minor tweaks to the device design.

ORPC asserts that if it had the ability to order ten devices, it could attract a number of U.S. vendors to bid on supplying components for its RivGen Power System. In addition, ORPC estimates that it could achieve an initial 20-30 percent cost savings from buying at volume as shown in Figure 4.

Installation Costs

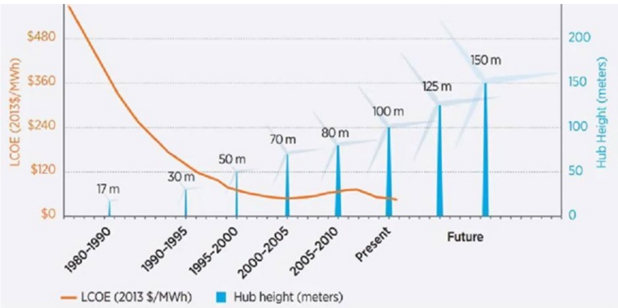
The other big component of LCOE is the installation cost of the device. ORPC calculates that it can achieve meaningful economies of scale by deploying multiple devices.

To prove the effectiveness of its technology and better understand installation and maintenance costs, it will be important to demonstrate operating performance in a variety of environments. Parameters for measurement and comparison include:

a. Single vs multiple device deployments
b. Severe winter conditions vs mild winter conditions
c. Distance to infrastructure
d. Efficiency and cost of local resources
e. Efficiency and cost of local and state permitting
f. Ease of working with regional utilities and overall receptivity

A federally-funded program that enabled MHK companies to each deploy 5-10 units would enable Congress, at a relatively low cost comparable to overall renewable energy spending programs, to finally answer questions that face the hydrokinetic industry while creating a framework for future deployments across the U.S. Predictably, the lower LCOE will parallel the decline in solar costs and the rise of annual installations (Figure 5).

Importantly, there are several communities where these policies could drive down overall electricity costs in the process. Many remote community markets in Alaska pay between $0.40 and $1.20 per kWh and so the right policies can help these communities serve as early adopter markets of this technology and help these communities achieve energy equality with their fellow Americans. In addition, many rural markets in the lower-48 also face high power costs and increasing levels of power outages due to the miles of transmission lines that need to be maintained. Helping these communities develop local microgrids will improve their energy reliability and lower overall system costs.



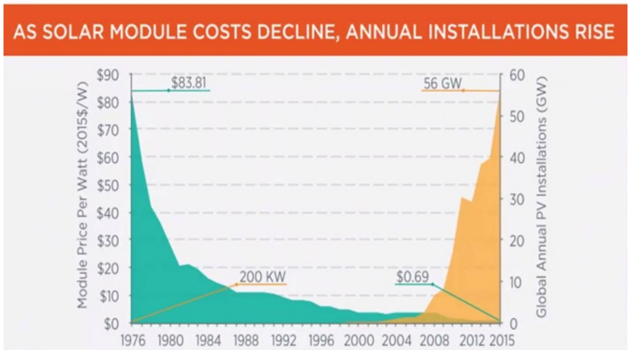


Figure 5. Solar module costs decline, annual installations rise. Source: U.S. Department of Energy

Economic Benefits

ORPC is well positioned to deploy its technology in multiple sites across the U.S. Building off the successful operation through the 2019-2020 winter in Alaska, we have identified near-term market opportunities based on our project development experience in site identification, permitting, and stakeholder engagement. These near-term opportunities are clustered around the Northeast and Alaska.

In addition, we are pursuing deployments in other regions of the U.S. including:

- Pacific Northwest
- Mississippi River
- Missouri River
- Ohio River

While this program would be an ambitious undertaking, ORPC has the internal resources and expertise coupled with an external partnership network to deliver on the necessary site assessments, permitting, and development of site-specific installation plans to accomplish this undertaking in a short period of time. Proving its capabilities to handle the rollout of a ten-unit deployment will give both foreign and domestic customers the confidence to purchase devices from OPRC. In addition, building up a track record of run-time and successful deployments will help ORPC attract additional debt and equity investors who will fund future commercial projects. This effort will move ORPC to a fully commercial business and propel MHK opportunities as conventional renewable energy solutions into the market.

Jobs

Given the significant economic impacts of the COVID-19 emergency, sustainable economic development is essential for economic recovery. Segments of the economy with projects ready to go ("shovel ready") should be prioritized for funding support. ORPC, with its technology readiness and proven approach to project development, has a portfolio of projects that meet this criterion.

ORPC will need to hire locally to successfully complete these installations. From boat captains and crew to on-site assembly and power facility operations personnel, ORPC would bring immediate employment opportunities to the communities selected. In addition, there would be on-going work opportunities for future deployment in these locations as well as annual maintenance work. Finally, there would be significant locally made purchases for supplies, goods, and services. ORPC site supervisors and senior personnel would travel to these locations and remain for several weeks, which means they would eat and lodge locally resulting in an additional boost to the local economies.

ORPC has numerous examples of this type of economic activity in Alaska and Maine, where in each state our footprint extends to dozens of partners, contractors, and services providers, and includes extensive collaboration with public universities.

Supply Chain

ORPC's plan is to activate a supply chain that utilizes a number of small businesses and potentially a large strategic vendor to manage ORPC's supply chain. By establishing this program in today's environment, ORPC estimates that it could lead to a higher percentage of its devices being sourced domestically. This is due to the fact that in the current environment, many small and mid-size businesses that make component parts now have the capacity to take on this work, hire back workers, and diversify their businesses.

Exports

Many remote communities that rely on diesel generators for electricity and heat are situated near rivers or oceans where there is sufficient resource to deploy ORPC's devices. ORPC has established partners and a pipeline of remote community projects in Canada and Chile that present a significant near-term export opportunity for ORPC. Market interest has also been received from Africa and southeast Asia. In addition, ORPC is receiving market pull from both Canada and Europe for utility-scale RivGen installations.

ORPC estimates that this initial market adoption alone represents a multi-billion-dollar market for its devices. Accelerating ORPC's speed to full commercialization and adding to its run-time track record will increase demand in the global market and give ORPC the ability to establish itself ahead of its growing list of European- and Chinese-based competitors.

Enabling Regulatory Policy

The permitting and licensing for MHK projects in state waters is a lengthy and costly process involving numerous consultations with stakeholders and the approval of local, state, and federal agencies.[12] The Federal Energy Regulatory Commission (FERC) has licensing jurisdiction over hydrokinetic projects in state waters.

The licensing process for commercial hydroelectric dams is well established and is used as a framework to authorize the testing and demonstration of MHK devices. FERC developed an innovative approach to licensing smaller-scale MHK devices and in 2008, and issued a whitepaper, *Licensing Hydroelectric Pilot License Projects*. This whitepaper established a pilot project licensing process, based on the integrated licensing process established for commercial hydroelectric development, that provides an opportunity for developers to prove emerging hydrokinetic technology devices, determine appropriate sites, and gather information on environmental and other effects of the devices.

The process for obtaining an MHK pilot license involves four main steps:

- Site assessment/informal consultation
- Preliminary permitting
- Pre-filing activity
- Post-filing Activity

For pilot projects, FERC's *Guidance for Pilot Project Licensing* indicates that a license decision may be reached within 6-12 months from the filing of a complete application. This 6-12-month timeframe does not include other required authorizations, so the overall time it takes to authorize an MHK pilot project exceeds 12 months—with initial industry estimates of 5 years when local, state, and federal permits are considered.

A review of MHK pilot projects in state waters licensed by FERC shows that the average time to obtain approval is 7.5 years. This time frame is prohibitive to scaling-up the commercialization of mature MHK devices in state waters.

ORPC recommends the following adjustments to provide a more efficient permitting pathway for a large-scale commercialized permitting pathway:

- FERC to revisit the 2008 *Licensing Hydroelectric Pilot License Projects* whitepaper and revise guidance to better reflect the realities scale and impact of MHK devices to the environment

[12] U.S. Department of Energy, Handbook of Marine Hydrokinetic Regulatory Processes, August 2020

- FERC to revise memorandums of understanding (MOUs) with state and federal agencies for more streamlined and timely coordination between agencies in the licensing process, like the one that the State of Maine and FERC executed
- Congress to provide an exemption for MHK projects similar to that provided for qualifying conduit hydropower facilities, creating an accelerated licensing framework with FERC

Call-to-Action

The Department of Energy Office of Energy Efficiency & Renewable Energy's Water Power Technologies Office (WPTO) provides tens of millions of dollars of funding annually on a competitive basis to industry, university research centers, and national laboratories supporting hydrokinetic technology development at various technology readiness levels. Between 2010 and 2020, budget levels rose from approximately $30 million to about $100 million annually.[13]

Related support is also provided from DOE's Office of Science Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs, the Advanced Research Projects Agency – Energy (ARPA-E), and the Office of Indian Energy Policy and Programs. The U.S. Department of Agriculture also supports remote community power system development.

ORPC has been awarded funding from programs offered by all of these federal offices. ORPC also provides its own funding resources to complement the public investments, and in fact the awarding of federal funds to our company has always spurred additional private equity investments in our company. We are grateful to DOE for their financial, program, and project management support of our efforts, and we support the American Energy Innovation Act developed by the Senate Committee on Energy and Natural Resources, which urges continuance and expansion of DOE's role our industry. Nonetheless, as the MHK industry advances to commercialization and provides necessary energy solutions to domestic markets, other public sector financial instruments will be required to help the industry fully mature. As a comparison, consider the extraordinary progress achieved by the wind and solar industries. In the past decade, these industries received about $75 billion in various levels of support to enable technology readiness, rapid cost reduction, and workforce talent development. This allowed the wind and solar industries to become mainstream market options in the U.S., but somehow the country lost the manufacturing advantage in these industries to Europe and China. A similar scenario may play out in the MHK sector.

The European Union recognizes this opportunity and are looking to spend roughly €670 million over the next 5 years alone in support of ocean energy. They expect the ocean energy industry to provide 10 percent of Europe's power needs by 2050 and create over 400,000 direct jobs in a global industry that they expect to reach €53 billion in annual revenues, which is about the size of the U.S. market for pickup trucks.[14]

As a first step, we propose an infrastructure funding program through DOE to support communities that want to install river and tidal power systems. Most early adopter communities have unsustainably high costs of power and do not have the economic resources to purchase systems. An infrastructure funding program will not only grow renewable energy but also improve economic opportunity for these communities through lower energy costs.

Second, DOE has a financial program that can assist with domestic MHK industry goal of increasing the number of devices in the water and by extension our country's interest in long-term job creation. The Title XVII Innovative Energy Loan Guarantee Program, a $25 billion investment tool, is a good example. MHK technologies are a perfect fit for the program's

[13] https://www.energy.gov/eere/water/water-power-technologies-office-budget

[14] https://www.oceanenergy-europe.eu/ocean-energy/

eligibility requirements—new technology, reduce greenhouse gases, located in U.S., etc. But the minimum requirement of $1 million upfront costs for due diligence is unreasonable as it effectively makes the program unavailable to projects below the $40 million to $50 million range. We propose that Congress simply carve out approximately 2 percent of the program to create a $500 million subset for smaller projects. This loan program can be a game changer by allowing MHK companies and their customers to structure loan, loan guarantee and leasing company structures that can advance the industry and help meet the nation's renewable energy, job creation, and energy security goals.

With the proposed funding programs and accelerated permitting assistance, the U.S. is poised to achieve a 100 percent clean energy economy and net-zero emissions, along with its attendant sustainable economic development through job creation.