OCEAN RENEWABLE ENERGY INNOVATION CENTER: A PROSPECTUS

March 2024

The Massachusetts Clean Energy Center (MassCEC) has committed resources to initiate the development of an Ocean Renewable Energy (ORE) Innovation Center in the area of New Bedford, Massachusetts. The objectives of the Innovation Center will be to provide facilities and services that:

- Advance the efforts of the Commonwealth's entrepreneurs, small businesses, and academic and research institutions to address the key technical and organizational challenges to rapid deployment of ocean renewable energy technologies; and
- Strengthen the competitive position of the Commonwealth's businesses, institutions, government bodies, and communities to grow an ocean renewable energy[1] industry cluster[2] and capture the economic benefits of accelerated technology development, including increased business activity, employment, and environmental quality.

The Innovation Center will complement other initiatives at MassCEC, as well as the efforts of other government agencies, academic research institutions, and private sector businesses to advance offshore wind and other ocean renewable energy research and innovation in the Commonwealth.

MassCEC commissioned DNV, an international technology consultancy with deep experience in the offshore energy sector to conduct a study to characterize the need for an ORE Innovation Center and related initiatives, develop a high-level program plan, and assess the prospects for sustainable operations. This Prospectus summarizes the results of that study, lays out next steps in the development of the Center, and identifies opportunities for stakeholder input and involvement in that process.

[1] Ocean Renewable Energy refers to a set of electricity generation technologies that currently includes fixed-bottom offshore wind, floating offshore wind, tidal, and wave energy. Of these, only fixed-bottom wind has achieved commercial scale and viability. Floating wind is currently in the demonstration stage with several small installations in operation worldwide. Tidal and wave technologies are in earlier phases of development.

[2] An industry cluster is a group of firms and stakeholders that gain productive advantages from operating in close proximity -- such as deep labor pools, access to customers and suppliers, knowledge spillovers, other economies of scale.

The business case for an ORE Innovation Center and related programs

The business case for Massachusetts state government investment can be summarized as follows.

- **Development of offshore wind energy resources in the Commonwealth and nearby states served by Massachusetts companies and institutions provides a rare opportunity to generate substantial regional economic and environmental benefits through focused public/private initiatives.** Building out the current offshore wind pipeline for Southern New England, New York, and Northern New Jersey (24 GW[3]) will generate an estimated $41.5 billion in revenues to regional businesses for development, manufacturing, and construction, plus $1.3 billion per year for operations and maintenance. A 2023 study of workforce requirements for this development estimated net job creation in the Commonwealth of 2,000 FTEs by 2030 and 9,300 FTEs by 2050 for the "Business-as-Usual Case, which assumes that 3.2 GW of OSW capacity will be installed through 2030.[4] Extending those results, completion of projects with established site control in the regional pipeline could generate as many as 23,000 jobs in the region in 2035. Finally, the clean electricity produced by the offshore wind facilities will contribute to a 61% reduction of the Commonwealth's current greenhouse gas (GHG) emissions for the electricity sector by 2050 and 12% of total economy-wide emissions. The Commonwealth's most recent net zero energy roadmaps call for installation of more than 23 GW of ORE capacity in the Massachusetts wind area alone by 2050.
- **Technology innovation and deployment has been and will continue to be the key driver in ORE growth.** The capacity of offshore wind farms in operation globally has increased from less than 3 GW in 2010 to 56 GW in 2022. This growth has been enabled by advances in composite manufacturing, blade design, materials engineering, foundation design, and turbine controls, among other technologies, which in turn have enabled manufacturers to build progressively larger turbines. Those advances support the use of fewer turbines to produce targeted levels of output. The associated reductions in capital and operating costs led to a 50% reduction in the Levelized Cost of Energy (LCOE) between 2014 and 2021. Continuing these trends for offshore wind, and the commercialization of other ocean energy technologies, will require rapid progress in on technical solutions to reduce costs and risks and to increase the range of benefits ORE can produce. These include production of green fuels and grid stabilization through co-located energy storage.
- **Much of the technology innovation and demonstration that fueled the early development of offshore wind resulted from collaboration among key stakeholders, with the support of government investments and programs.** Development and testing of solutions to the novel challenges of ORE deployment requires coupling basic and applied science research capabilities typically found in universities to the manufacturing, construction, logistical, project financing, and business management capabilities of large corporations. Moreover, the pace of ORE development often requires the nimbleness and acceptance of risk most often associated with entrepreneurial companies and start-ups. In Europe, national and regional governments, along with the European Union, have taken the lead in facilitating such collaborations. They have also undertaken targeted investment in testing centers and other critical facilities which no single

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[3] US DOE Office of Energy Efficiency & Renewable Energy, *Offshore Wind Market Report 2023.* This area includes the Massachusetts, Rhode Island, and New York Bight Wind Energy Areas. The pipeline figure of 24 GW includes only projects for which developers have attained site control or progressed to a further stage of development.

[4] BW Research Partnership. 2023. *Powering the Future: A Massachusetts Clean Energy Workforce Assessment.* Massachusetts Clean Energy Center. July, 2023. See Appendix B of the full report for further details on business spending, employment, and emissions impact estimates..

company has sufficient resources or incentives to undertake on its own. These European organizations are now leading offshore wind development worldwide. The experience of these initiatives provides guidance for shaping efforts to achieve similar objectives in the Commonwealth.

- **The elements of a high-functioning ORE innovation ecosystem are well-established in Massachusetts, especially for the offshore wind segment.** These include:
  - Port infrastructure improvements in New Bedford, Somerset, and Salem to enable manufacturing, construction, and operations of offshore wind facilities and other ORE technologies in the southern New England wind energy areas;
  - Graduate-level academic and research programs in wind energy at six major universities and academic research institutions, most with extensive ties to renewable energy industries;
  - Major facilities or offices for many of the leading developers, manufacturers, construction, and engineering companies in the offshore wind industry;
  - Home location of roughly 100 small marine science and technology companies, many of which provide products and services for the offshore renewable energy sector, as well as roughly 200 companies in more conventional marine services such as shipbuilding and marine electronics which could participate in the ORE supply chains;
  - Entrepreneurial support organizations including Greentown Labs, SeaAhead, The Engine and many others that provide business advice, networking to customers and investors, and shared facilities to early-stage companies in ORE and related fields; and
  - Proactive state government agencies, such as MassCEC, the Department of Energy Resources, and the Office of Coastal Zone Management that have developed and deployed programs and built critical infrastructure needed to accelerate ORE development over the past decade.
- **Higher levels of coordination among organizations in the Commonwealth's ORE innovation infrastructure are needed to meet the industry's short- and medium-term technology requirements and to secure benefits for the Commonwealth.** All representatives of the key stakeholder groups interviewed for this project report that the pace of innovation and adoption of innovative practices by local businesses and institutions must accelerate dramatically if deployment goals are to be met and related economic benefits achieved. They also agreed that the best general approach to this challenge is to leverage existing industrial and academic capabilities and assets through highly targeted public-sector investments in programs and facilities. This view is consistent with over two decades of ORE industry development experience in Europe.

High-level program recommendations and supporting research

DNV was asked to identify practical program approaches and potential facility and other investments to accelerate the development of the Massachusetts ORE innovation infrastructure, amplify its benefits, and leverage the strengths and assets of the SouthCoast[5] region, an area that has lagged behind the rest of the state in employment, income, and other measures of economic well-being. DNV developed recommended programs based on the following research activities.

- **Market Assessment.** The success of any program or investment depends on its fit with key elements of its operating environment, including:
  - The interests, capabilities, and assets of key stakeholders;
  - Government policies shaping electricity markets, environmental protection, taxes, emissions reduction, education and workforce development, transportation, and a wide range of other areas that affect ORE; and
  - Regional economic characteristics such as access to offshore energy resources, ports, population of business establishments, academic institutions, financial and professional support businesses.

DNV interviewed representatives of over 30 stakeholder organizations from the following groups: developers, manufacturers and large suppliers, small businesses in the region, academic and research institutions, and government agencies. Through these interviews we gathered information on the following:

- Current involvement in the regional ORE market;
- Identification of key business opportunities and challenges in that market;
- Current innovation activities and partnerships;
- Views on the strengths and gaps in the Commonwealth's innovation ecosystem; and
- Interests in participation in and use of potential program offerings and public assets.

DNV supplemented these interviews with extensive literature review and online research on the subject companies and the industries they represent. The project team synthesized this information into an assessment of the value that potential program approaches offer to each key stakeholder group.

Figure ES-1 summarizes our findings on each group's assessment of the value to them and other organizations in their sector of the four major kinds of innovation support programs. The color of each cell in the figure represents the level of value the members of the stakeholder group in the column ascribe to the program type in the row. The cells also contain the most important values the various stakeholder groups identified for program type, with the value mentioned most frequently underlined in **bold**.

The key conclusions from this analysis are as follows:

[5] The region of southeastern Massachusetts consisting of the southern Bristol and Plymouth counties, bordering Buzzards Bay which includes the cities of Fall River, New Bedford, the southeastern tip of East Taunton and nearby towns

- Small businesses active in ORE and related industries reported that they would find high value in all four of the recommended program types.
- All stakeholders identified high value in creating a pre-permitted ocean testing platform to support early-stage technology validation and performance testing.
- All business stakeholders reported high potential value in enhanced supply chain networking services to link local suppliers and larger businesses.
- Generally, universities did not identify an urgent need for closer coordination with their peers. However, representatives of several universities mentioned that increased coordination among the universities in the state and even the region would be worthwhile to mount effective applications for large federal grant opportunities and to increase utilization of expensive specialized facilities and test equipment.

Figure ES-1. Stakeholders' reported value of potential programs

Key: **High Reported Value;** **Some Reported Value;** **Low Reported Value**
Most frequently mentioned values in bold

Program Type	Stakeholder Group: Developers	OEMs/ Large Suppliers	Universities & Research Inst.	Startups & Small Businesses
Entrepreneur Support	**Advantage for lease & PPA bids** Line-of-sight to IP	Generally working with large firms, testing centers, universities for external innovation	Already offering some of these services, do not see need for more	**Networking to customers, investors** BD advice Shared facilities
Supply Chain & Resource Networking	**Advantage for lease & PPA bids** Reduce time & risk of finding suppliers	**Reduce time & risk of finding suppliers** **Advantage for team in lease & PPA bids**	No reported problems in finding partners & vendors for research needs	**Increase efficiency in finding sales leads & investors** Reduce time & risk in finding partners
Joint Industry/ University Programs	Generally satisfied with current bilateral and multi-party arrangements	Generally satisfied with current bilateral and multi-party arrangements	Increase chance of winning large grants Increase use of specialized faciliites	**Report needing greater access to university technical resources**
Product Validation & Testing	**Pre-permitted ocean testing platform for a wide range of technologies**	**Pre-permitted ocean testing platform for a wide range of technologies**	**Pre-permitted ocean testing platform for a wide range of technologies**	**Pre-permitted ocean testing platform for a wide range of technologies**

- **Assessment of Peer Program Experience.** DNV gathered information from organizations in Europe and the United States that support offshore wind technology innovation, testing, and deployment. The project team interviewed representatives of nine such organizations and supplemented the interviews with extensive online research. The European cohort featured primarily well-established organizations developed and funded largely through national government efforts to leverage existing industrial and academic capabilities and assets through investments in programs and testing facilities. Many of these initiatives resulted in the development of program and testing facilities located near offshore wind deployment ports to take advantage of "cluster effects" and generate benefits to economically disadvantaged communities. No such organizations have been developed in the United States to date. The project team focused its research in this country on programs that aim to coordinate and enhance the scope of academic research and align it with industry needs. We also assessed a number of entrepreneur support

programs that provide business guidance, networking to potential customers, investors, and partners, and access to shared facilities to early-stage companies in ORE and related industries.

- **Validation of high-level program design.** Based on the research described above, MassCEC has developed a high-level proposed program design comprising the three components described below. DNV created a four-page brochure that summarized the program and distributed it to stakeholders for review. The project team conducted a second round of interviews with 14 stakeholders to gather their assessment of the value of the programs to their organizations and the likelihood that they would participate in/support the programs. The program description below reflects this revised version.

  1. **Ocean Renewable Energy Innovation Center (Center).** This component will consist of a 15,000 – 25,000 square foot facility in the port of New Bedford. Placing the Center in New Bedford will take advantage of recent investments and initiatives by key stakeholders to build facilities and programs that can expand upon an ORE industry cluster. Initiatives in and around New Bedford harbor include:

     – Ramp-up of OSW deployment activities at the New Bedford Marine Commerce Terminal;
     – The opening of the National Offshore Wind Institute workforce training facility, operated by Bristol County Community College;
     – Continued operation and program expansion of the UMASS Dartmouth School of Marine Science and Technology;
     – Redevelopment of the former Eversource facilities into the New Bedford Foss Marine Terminal and other significant port infrastructure improvements;
     – The maturation and progress of the New Bedford Ocean Cluster expanding its role as convener, connector, and partner for the maritime business community; and
     – Major university research programs and over one hundred private companies active in ORE and related industries located within a 50-mile radius of New Bedford harbor.

     The facility will house the following program activities:

     1. Start-up support programs. These will include periodic technology challenges and accelerator cohorts, networking and information events on the ORE industry, liaison to potential customers, investors, and partners, liaison to professional legal and other professional service providers, liaison to academic researchers and institutions, mentoring from experienced entrepreneurs and industry professionals.
     2. Supply chain and resource networking. For companies with existing products and services program offerings will include networking support to develop customer, investor, and partner relationships, including events, directories, and individualized networking support. This function will also be supported by provision of temporary office space to developers and large suppliers entering the Massachusetts market.
     3. Onsite and Networked Resources. Providing direct access to shared and subsidized resources to reduce overhead expenses, expedite business and product development, and achieve more efficient utilization of specialized resources. Onsite resources will include shared office, co-working, and convening space, workshop and prototyping space, and direct deep-water berth at the Center. The Center will facilitate access to nearshore and offshore ocean test sites (see Track 3) as well as networked assets in universities and other institutions, including specialized wet and dry labs, test tanks, and other resources to support the development and testing of ocean technologies.

2. **ORE Research Programs.** These programs will continue and expand MassCEC's current efforts in supporting and coordinating the work of universities and academic research institutions in supporting the advancement of ORE technologies and businesses. Activities under this component will include:

    1. Facilitation for the development of Joint Industry Projects through NOWRDC, WindSTAR, and other special cases, as well as funding support for the projects;
    2. Facilitation of planning and priority setting for academic and industry organizations involved in joint research efforts;
    3. Provision of cost share support for major federal and industry-based funding opportunities;
    4. Provision of competitive research funding grants to institutions and individual faculty; and
    5. Provision of stipends to PhD and post-doctoral students in basic sciences and engineering related to offshore renewable energy technologies.

    These program activities will not be headquartered at the ORE Innovation Center but may be coordinated with the Center and use the Center's facilities for events, seminars, and water access as appropriate.

3. **ORE Testing and Validation Network.** This component will expand and support access to testing and product validation facilities related to ORE industries. The activities under this component will be:

    1. Offshore testing facility needs assessment. Representatives of all stakeholder groups identified the need for and value of a pre-permitted ocean test platform. Given the high cost of permitting, designing, and building such a facility, it will be necessary to develop a more detailed specification of the functions it will serve and the platform's physical requirements before proceeding to permitting, funding, and construction activities. MassCEC has issued a Request for Information (RFI) to relevant stakeholder organizations seeking input on the priority of functions to be served, location, design, and equipment.

    2. Develop an ocean test sites network. MassCEC is partnering with the Woods Hole Oceanographic Institution and the New Bedford Ocean Cluster on a proposed ocean testbeds program that fill gaps in the existing market both in terms of site specifics and geography of test location.
        - Development of a dockside test facility at the ORE Innovation Center in New Bedford, with coordinated monitoring and measurement capabilities onsite for localized equipment testing.
        - Development of a nearshore testing site, easily accessible with smaller vessels with benchmark data collection via buoy-based sensors.
        - Development of a multi-technology offshore open-ocean test site at the WHOI's existing offshore Air-Sea Interaction Tower (ASIT):
            - Establish an open-ocean test site for buoy and anchor testing, with pre-permitted mooring locations, met-ocean reference buoys, and benchmark data collection.
            - Enhance the existing ASIT facility to support a wider, larger range of platform, vehicle, and sensor development activities including the testing and calibration for underwater systems and bottom, ocean, atmospheric sensors and technologies.

    3. Develop a database and marketing process for existing testing and product validation facilities in Massachusetts. This activity aims to increase the utilization and financial value of existing testing facilities located in universities, academic institutions, non-profit organizations, and businesses. Database and referral services will be available to businesses and academic researchers searching for testing facilities with specific types of equipment, capabilities, and accreditation.

Financial feasibility assessment of the ORE Innovation Center

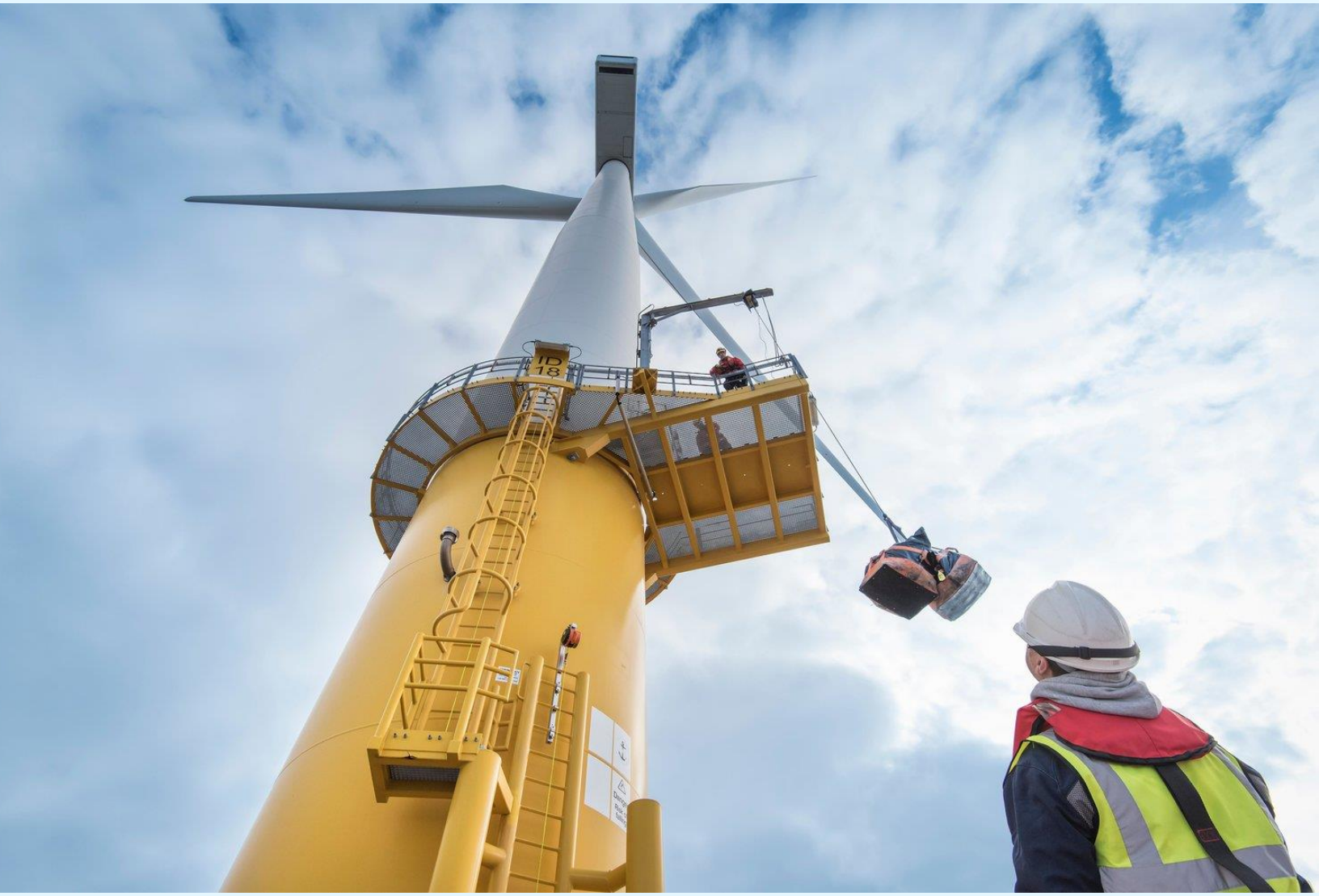
To assess the financial feasibility of the ORE Innovation Center as described above, DNV developed forecasts of program costs and revenues, estimated the gap to be filled by public and private sector funding sources, and assessed the likelihood of filling those gaps given information on amounts available from each likely funding source, its eligible uses, and award criteria for relevant funding sources.

Approach. The steps in the financial feasibility assessment were as follows.

1. **Develop start-up and operating period scenarios**. DNV used information from peer organizations to build detailed scenarios for a start-up phase spanning Q4 2023 to the end of 2026. Each scenario details organizational, program and facility development activities, early program delivery activities, MassCEC staffing, and high-level scopes for program delivery contractors. The project team developed similar scenarios for each year of the operating period spanning calendar years 2027 through 2033. In addition to the elements discussed above, the operating period scenarios included more detailed assumptions on program participation, revenues, and outcomes.
2. **Develop estimates of program cost and program revenue, and funding gaps**. DNV developed estimates for each cost element called out in the scenarios using a variety of references. These included reports of similar programs, internal MassCEC records, public sources on real estate and construction costs, and consultation with experts on various aspects of the proposed program. From these sources, the project team developed a standard pro-forma template to estimate annual and cumulative external funding requirements.
3. **Compile information on relevant funding sources.** DNV researched funding sources that could be applied to the various program and capital elements of the ORE Innovation Center. Key sources included Federal agency funding opportunities, economic development commitments from offshore wind developers, and MassCEC internal resources. In the Commonwealth's 2022 Climate Bill, MassCEC received a one-time allocation of $50 million in Federal American Rescue Plan Act ("ARPA") funding, which was directed into the Clean Energy Investment Fund. In May 2023, MassCEC's Board of Directors authorized the use of the ARPA funds for a portfolio of priority initiatives that included the ORE Innovation Center. These funds must be committed to specific uses and contracts by the end of 2024 and fully expended by the end of 2026. The proposed start-up scenario accounts for these conditions on the use of the ARPA funds.
4. **Assess the feasibility of securing additional funding**. DNV assessed the feasibility of securing the required level of external funding by assessing the likelihood of raising funds from the sources mentioned above based on historic experience in Massachusetts and other states.

Financial analysis and future funding needs. The key findings from the analysis are as follows.

- **The ARPA allocation should cover the full costs of facility development, program development, and launch during the Start-up Phase.** The costs of program launch and facility development during the Start-up Phase ending December 2026 are estimated to be approximately $7.0 million. The approved $10 million investment of ARPA funds to this project will support the Start-up Phase and will allow for the advancement of offshore testing and validation facilities, which was identified as having high value by all stakeholder groups.
- **The average annual external funding needs for the Operating Period is estimated at roughly $1.5 to 2 million.** DNV estimated the average annual difference over the Operating Period between program revenues and total costs at $1.5 to 2 million. DNV used this amount as the annual target in assessing the likelihood of meeting the program's external funding needs. The project team reviewed total funding amounts allocated, eligible uses, current activities, and criteria for award or release of the three funding sources identified above. Based on this review, we concluded that it will be feasible to meet funding requirements from those three sources given a focused and consistent effort by MassCEC with support from partners and stakeholders.



NEXT STEPS AND OPPORTUNITIES FOR STAKEHOLDERS

In Q4 2023, MassCEC launched the following activities to advance the development of the Center and related initiatives. Throughout the start-up phase, MassCEC will be in contact through both informal channels and structured processes with stakeholders, potential partners, participants, and interested program providers to ensure that the initiatives will address their needs and provide value to citizens of the Commonwealth.

ORE Innovation Center

- Hire Senior Program Manager to advance development of the Center.
- Conduct informal discussions with stakeholders, potential program operators, and program to further detail their interests and expectations.
- Conduct outreach to potential program funders to assess interests and develop value propositions.
- Recruit Advisory Board.
- Conduct facility site selection through a two-phase solicitation process first seeking expressions of interest from lessors and landowners and then subsequent proposals and bids, and finally negotiating and securing a preferred location.
- Develop facility design plans and work with lessor and contractors on facility build-out.
- Advance program plans, solicit expressions of interest and then proposals from potential program contractors, prospective tenants, and other partners and collaborators.

ORE Research Support

- Identify funding sources to amplify and leverage MassCEC investments.
- Consult with university/research institution representatives to gather ideas on how best to structure the various research support initiatives, including governance and coordination among participating institutions.
- Development and issuance of a new MassCEC Offshore Wind Science and Research Solicitation offering competitive funding for projects, partnerships, and initiatives.

ORE Testing Facilities

- Conduct a Request for Information process to assess stakeholder interests in a pre-permitted offshore testing platform, including specification of the functions it will serve, the platform's physical requirements, the frequency of use, and willingness to pay. MassCEC will share selected results of the study with stakeholders and potential users.
- Seek funding for ocean testing platforms. MassCEC is partnering with the Woods Hole Oceanographic Institution and the New Bedford Ocean Cluster to secure funding and other support for a proposed ocean testbeds program that fill gaps in the existing market both in terms of site specifics and geography of test location. The partners recently submitted a component project application to U.S. Economic Development Administration as part of the federally-designated Ocean Tech Hub.
    - Development of a dockside test facility at the ORE Innovation Center in New Bedford, with coordinated monitoring and measurement capabilities onsite for localized equipment testing.
    - Development of a nearshore testing site, easily accessible with smaller vessels with benchmark data collection via buoy-based sensors
    - Development of a multi-technology offshore open-ocean test site at the WHOI's existing offshore Air-Sea Interaction Tower to support a range of platform, vehicle, and sensor development activities as well as buoy and anchor testing, with pre-permitted mooring locations, met-ocean reference buoys, and benchmark data collection.