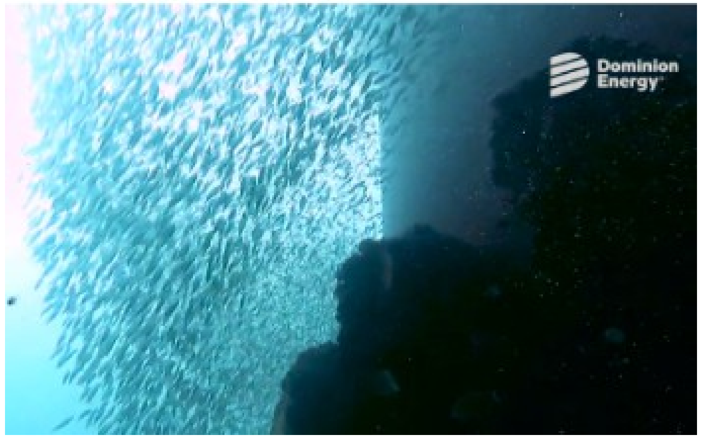
"MOCEAN: Accelerating A Just Energy Transition While Nurturing Healthy Oceans and New Blue Economies Through Innovative Nature-Inclusive Offshore Wind Farms"



Agenda

10:00 Welcome, Agenda, and Introduction to Regional Innovation Engines Program

10:10 a. Overview, Vision, and Rationale
- Q&A on Purpose of Engine

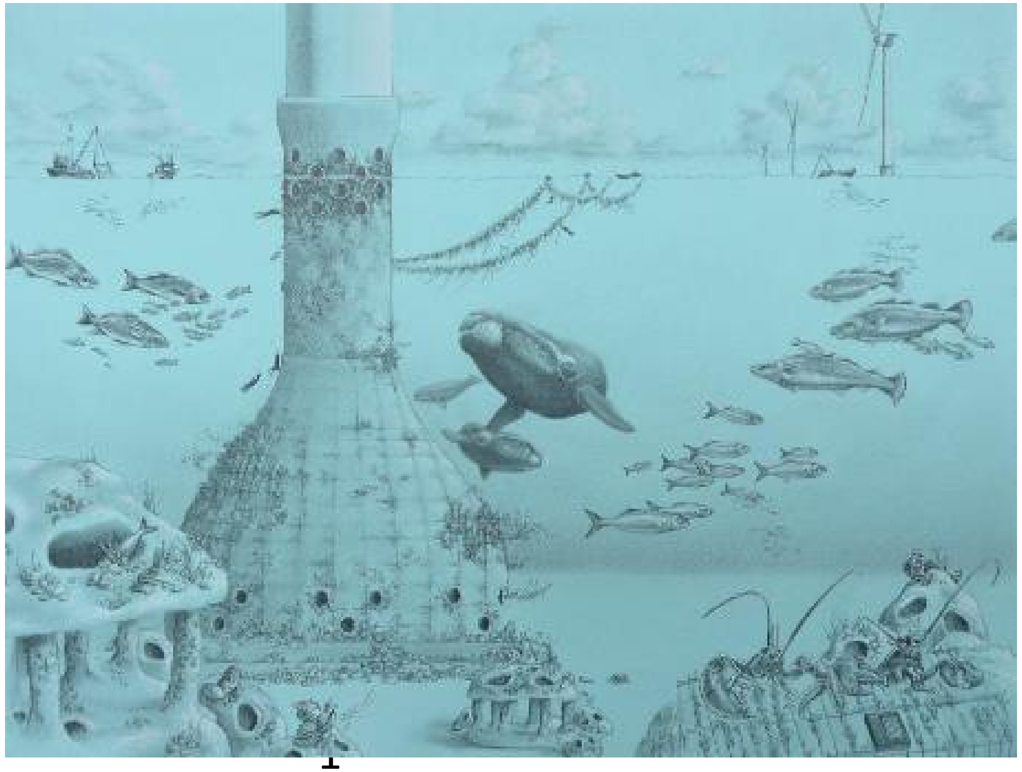
10:25 b. Proposing Team and Organizational Structure
- Communities Needed for Achieving Engine Objectives
- Introduction to Working Groups, Convergent Projects, and Engine Infrastructure
- Approach to Working Group Leadership and Collaboration - Examples
- MOCEAN Engine Infrastructure
- Q&A on All Part (b) Items & Jamboard

10:48 c. Strategic and Implementation Plans
- Use-inspired research and development
- Convergent Project-1: Impact of Materials & Geometry on Marine Ecosystems
- Convergent Project-2: Concrete Gravity Base Foundations
- Convergent Project-3: The New Blue Economy for Fisheries (NJ)
- Convergent Project-4: Monitoring Marine Life around Monopiles
- Convergent Project-5: Establishing Equitable Pathways to Opportunity
- Workforce development to grow and sustain regional innovation
- Culture of diversity, equity, inclusion, and accessibility
- Q&A on Convergent Projects

11:20 d. Management Plan - Long-term Sustainability Plan

11:23 e. Broader Impacts

11:26 Closure and Next Steps



Regional Innovation Engines

Facing global competition for talent and leadership in science, technology, engineering, and mathematics research and education[1], the U.S. must expand its innovation capacity by leveraging the resources, creativity, and ingenuity that exists across all geographic regions of the country.

Through a bold, new U.S. National Science Foundation initiative, the Regional Innovation Engines, or NSF Engines, program catalyzes and fosters innovation ecosystems across the U.S. to:

- Advance critical technologies
- Address national and societal challenges
- Foster partnerships across industry, academia, government, nonprofits, civil society, and communities of practice

- Type-1 Engines: Fund up to 50 $1M Projects in Development Phase
- **Type-2 Engines: Fund about Five $160M Engines over 10 years; Budget is $7.5M/year (yrs 1 & 2), $15M/year (yrs 3-5), and $20M/year (yrs 6-10).**
- Type-3&4 Engines: TBD – Higher TRL Levels

Characteristics of an NSF Engine

R&D innovation to achieve regional economic growth	Building an inclusive innovation ecosystem that will thrive for decades to come	Flexible Engine structure and activities with accountability to NSF
• Robust regional partnerships • Use-inspired R&D • Translating innovation to practice • Comprehensive workforce development	• Financial sustainability • Culture of innovation • Diversity, equity, Inclusion, and accessibility (DEIA) at all levels • Community wealth building	• Engine structure • Leadership • Accountability through evaluation

Definition of a region of service: U.S. geographical area, ranging from a single metropolitan area (including rural areas) to multiple adjacent states.

RIEs must be driven by partnerships, stakeholders, and end-users within the defined region of service and must be rooted in regional interests:

- Driven by applications important to the local regional economy
- Potential to grow regional talent and jobs

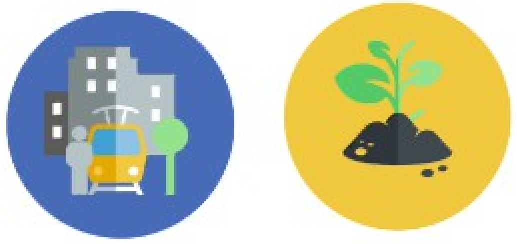
European Commission

Horizon 2020 is the financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness.

Horizon Program 2014-2027 (€175 Billion)

Five Missions Areas

Adaptation to climate change, including societal transformation | Cancer | Healthy oceans, seas, coastal & inland waters



Climate-neutral & smart cities | Soil health & food

Seen as a means to drive economic growth and create jobs, Horizon 2020 has the political backing of Europe's leaders and the Members of the European Parliament. They agreed that research is an investment in our future and so put it at the heart of the EU's blueprint for smart, sustainable and inclusive growth and jobs.

By coupling research and innovation, Horizon 2020 is helping to achieve this with its emphasis on excellent science, industrial leadership and tackling societal challenges. The goal is to ensure Europe produces world-class science, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering innovation.

Horizon 2020 is open to everyone, with a simple structure that reduces red tape and time so participants can focus on what is really important. This approach makes sure new projects get off the ground quickly – and achieve results faster.

The EU Framework Programme for Research and Innovation will be complemented by further measures to complete and further develop the European Research Area. These measures will aim at breaking down barriers to create a genuine single market for knowledge, research and innovation.

Well more than half of the funding goes to industry

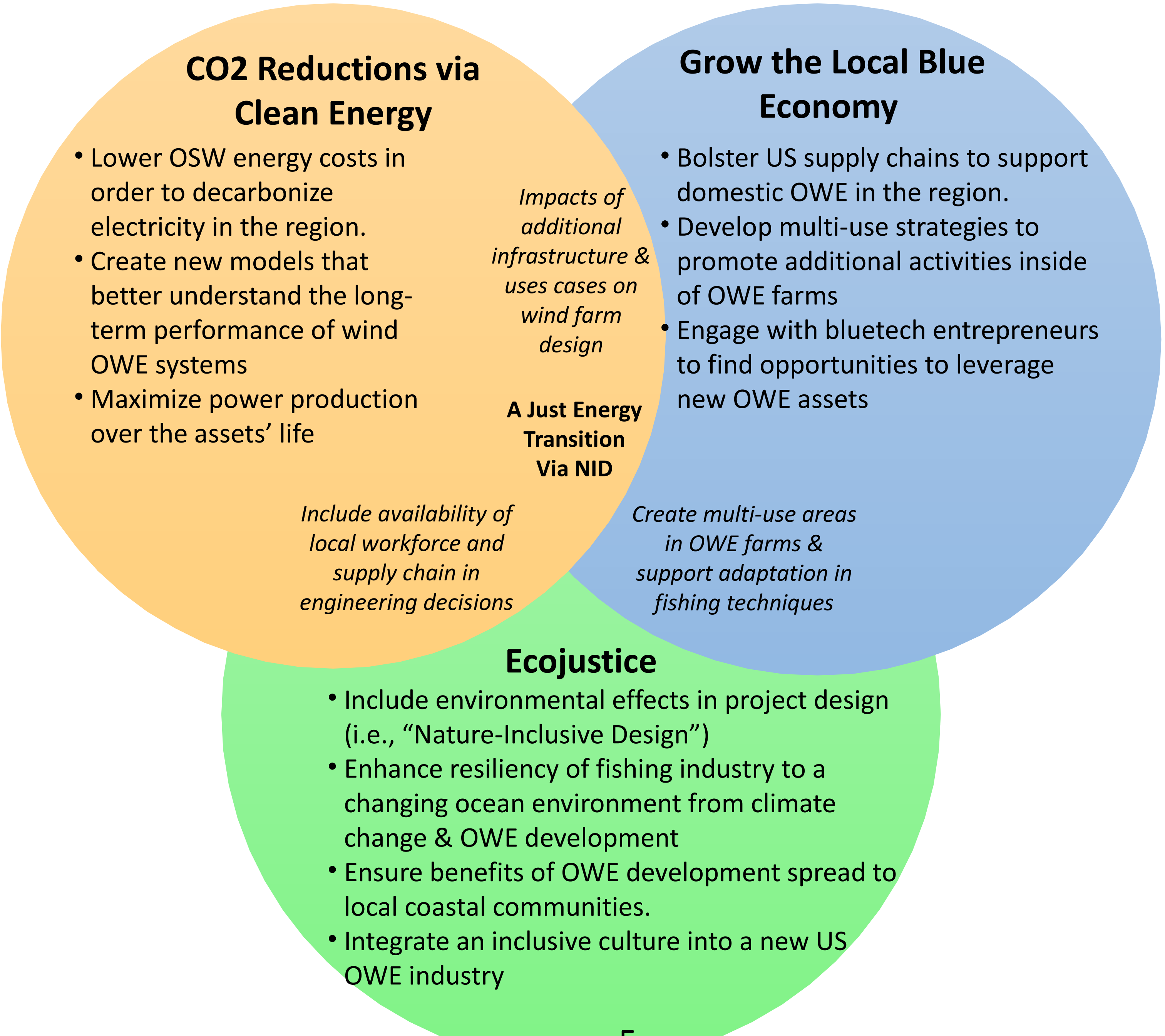
Horizon 2020 is the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract. It promises more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market.

MOCEAN: A Once In a Lifetime Opportunity

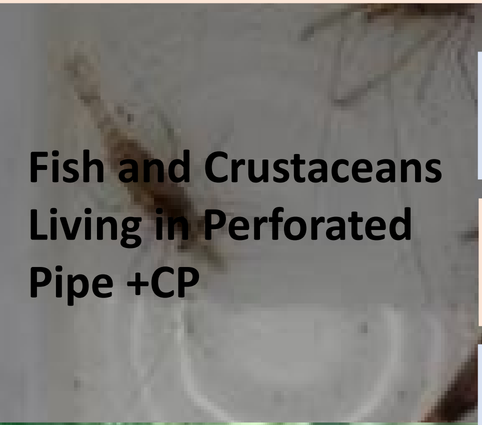
- ***Advance*** **clean energy**
- ***Enhance*** **marine ecologies and economies**
- ***Lift*** **underserved communities through equitable access to innovation**

NSF ENGINE Priorities

- ✓ Advance critical technologies
- ✓ Address national and societal challenges
- ✓ Foster partnerships across industry, academia, government, nonprofits, civil society, and communities of practice
- ✓ Promote and stimulate economic growth and job creation
- ✓ Spur regional innovation and talent



Nature-Inclusive Offshore Wind Farms Can Enhance Marine Ecologies and Economies



Fish and Crustaceans Living in Perforated Pipe +CP

- **Marine infrastructure** (e.g. foundations, cable lines, docks) create substrates that lead to the formation of marine ecosystems
- **Artificial Reef** community is advancing the science and practices for how to achieve predictably positive benefits
- Europe has made significant research investments to support projects on **multi-purpose structures** that support both wind turbines and aquaculture with very encouraging results
- **Offshore Wind Industry** has recognized they must include nature-inclusive design that provides net-positive benefits to the environment as well as fisheries and other communities
- Effective Nature-Inclusive Design can create a **win-win** for environmentalists, fisheries, industry, innovators, society, and the planet. However, **significant advancement** is needed in science, technologies, practices, policy, and community building to achieve reliable and effective nature-inclusive designs

Belgian offshore gravity-based wind turbine

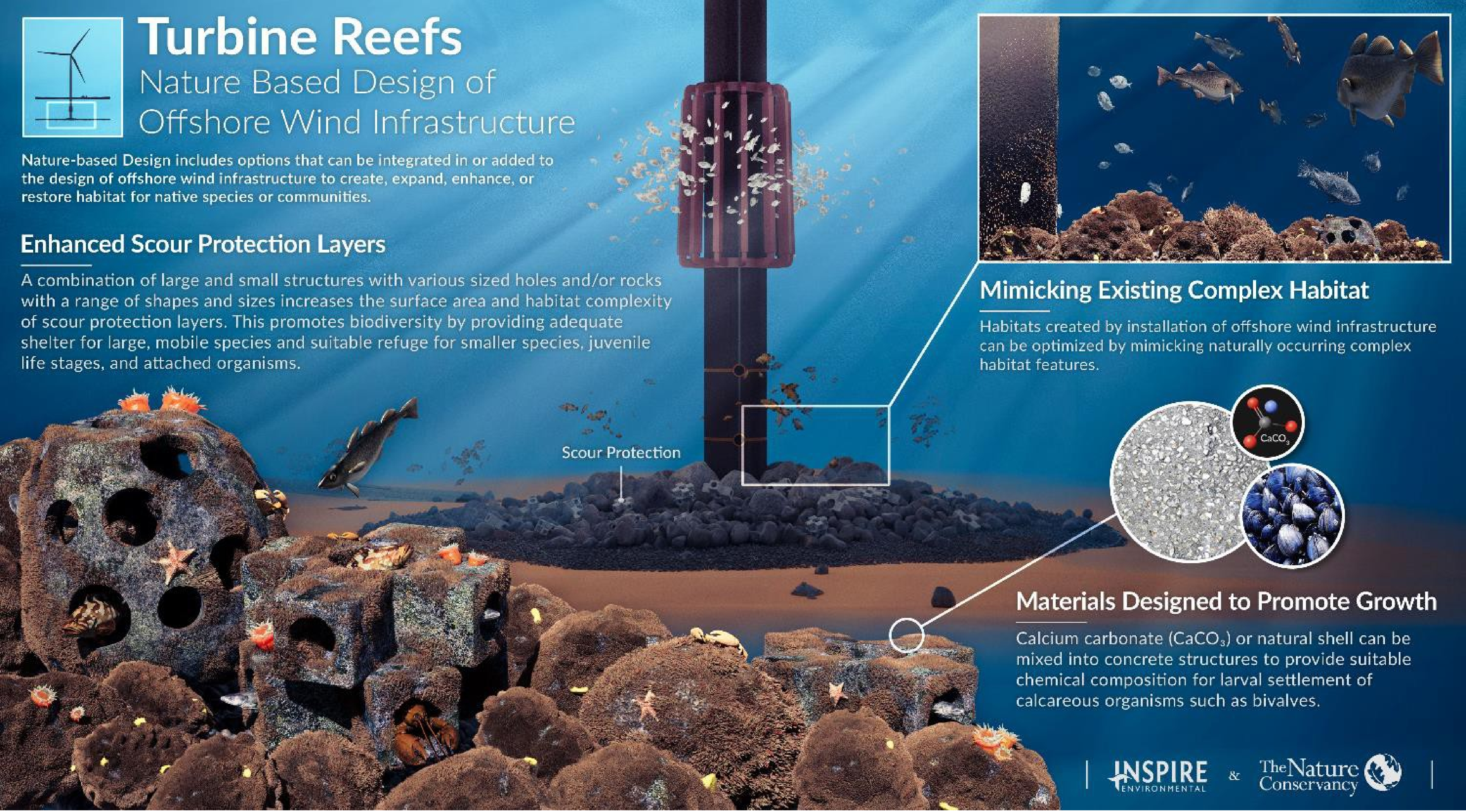
Block Island Wind Farm

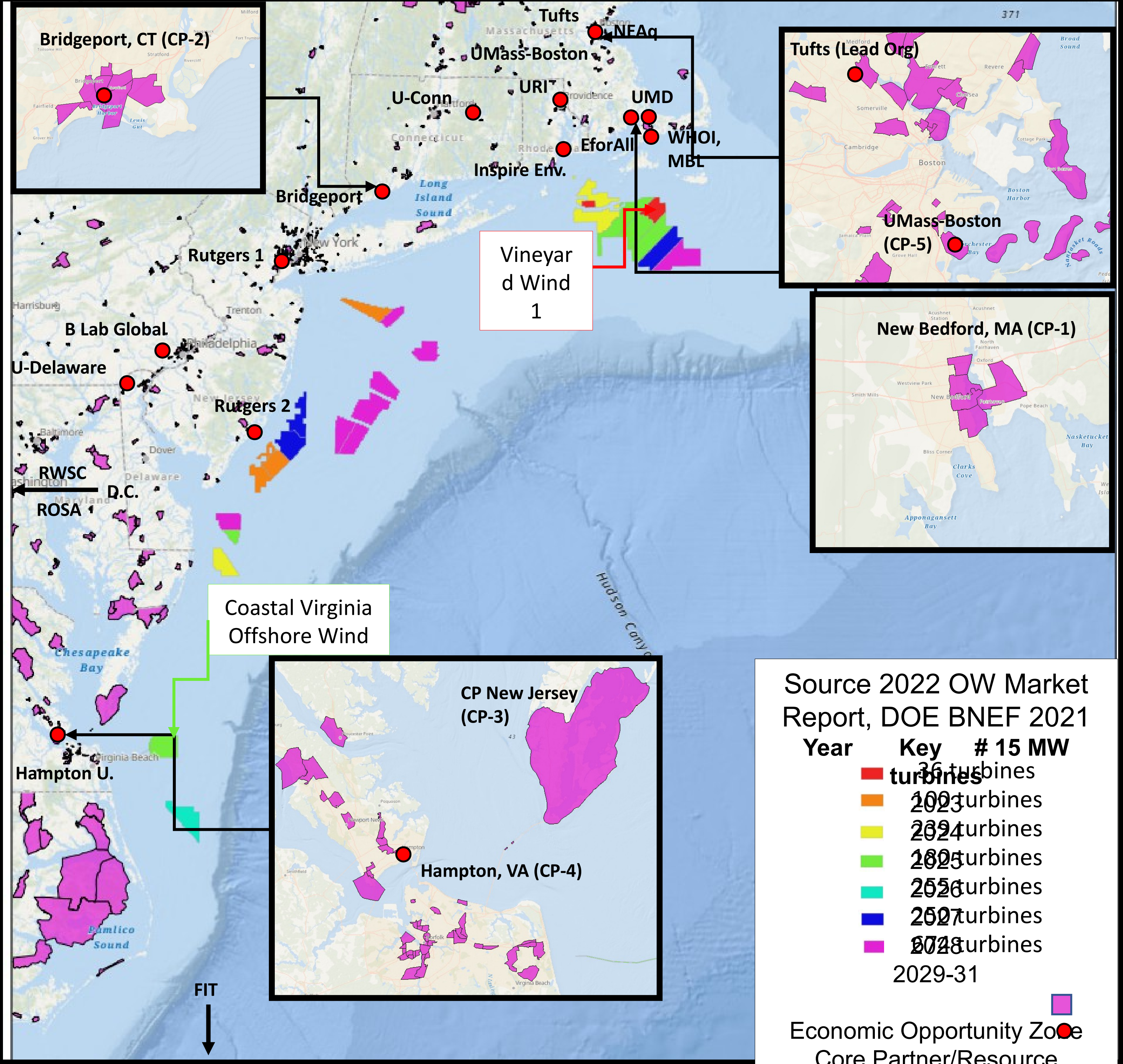
Virginia Wind Farm

Belgian-Dutch consortium “Wier & Wind” Seaweed Mariculture

Nature-Inclusive Offshore Wind Turbine Foundations and Scour Protection Can Restore & Enhance Ecosystems

11,700 sq. km of coral (14% of total) lost since 2009. One-third of the remaining coral reefs under threat to disappear over the next 30 years.

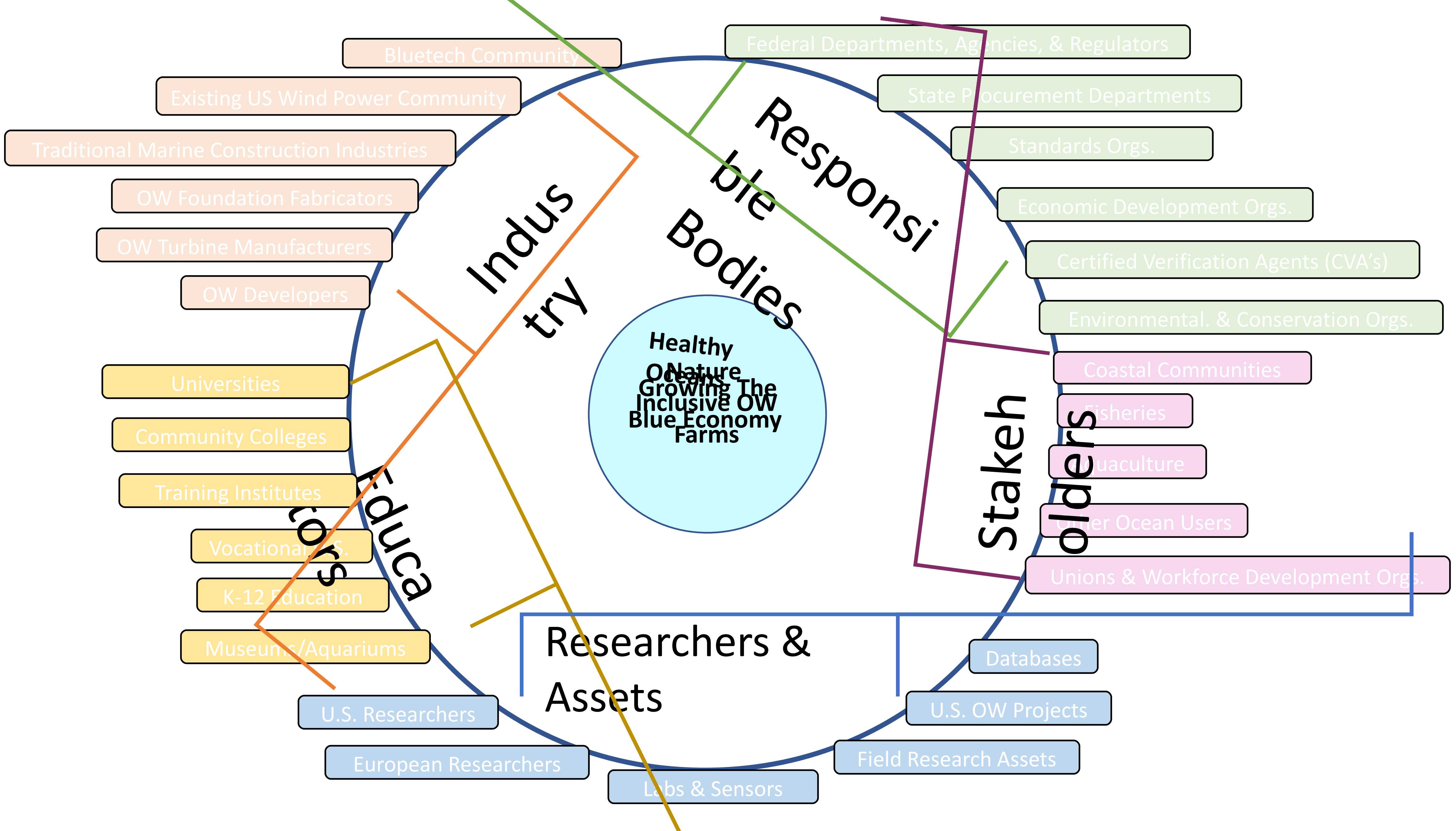

Turbine Reefs
Nature Based Design of Offshore Wind Infrastructure
Nature-based Design includes options that can be integrated in or added to the design of offshore wind infrastructure to create, expand, enhance, or restore habitat for native species or communities.
Enhanced Scour Protection Layers
A combination of large and small structures with various sized holes and/or rocks with a range of shapes and sizes increases the surface area and habitat complexity of scour protection layers. This promotes biodiversity by providing adequate shelter for large, mobile species and suitable refuge for smaller species, juvenile life stages, and attached organisms.
Scour Protection
Mimicking Existing Complex Habitat
Habitats created by installation of offshore wind infrastructure can be optimized by mimicking naturally occurring complex habitat features.
$CaCO_3$
Materials Designed to Promote Growth
Calcium carbonate ($CaCO_3$) or natural shell can be mixed into concrete structures to provide suitable chemical composition for larval settlement of calcareous organisms such as bivalves.
INSPIRE ENVIRONMENTAL
&
The Nature Conservancy



Core Partners

- Bristol Community College – Workforce
- EforAll – Entraprenureship for all (DEIA focus)
- Inspire Environmental – Habitat Monitoring for OW
- Florida Institute of Technology – Foundation Lifespans
- Hampton University - Marine Habitats
- Marine Biological Laboratory – Artificial Reefs
- New England Aquarium
- Regional Wildlife Science Collaborative (RWSC/CSSF)
- Responsible Offshore Science Alliance (ROSA)
- Rutgers – New Blue Economy incl. Fisheries
- SeaAhead – Bluetech Innovation
- Tufts University – Foundations
- University of Connecticut – New Blue Economy
- University of Delaware – New Blue Economy
- University of Massachusetts-Boston – Workforce
- University of Massachusetts-Dartmouth – Fisheries
- University of Rhode Island – Foundations
- Woods Hole Oceanographic Inst.– Ocean Science

Communities that Needs to Come Together to Achieve the Engine Objectives



Working Group (WG) Focus Areas

WG-1 Nature Inclusive Offshore Wind Farms
- WG-1.1 Foundations
- WG-1.2 Scour Protection & Ecosystem Enhancement
- WG-1.3 Asset Management including Ecocosts

WG-2 Ocean Science
- WG-2.1 Baseline & Longitudinal Data
- WG-2.2 Marine Growths & Habitats
- WG-2.3 Climate Effects
- WG-2.4 Environmental Conservation

WG-3 New Blue Economy
- WG-3.1 Bluetech
- WG-3.2 Shared Use of Oceans & Coasts
- WG-3.3 Future Fisheries
- WG-3.4 Future Aquaculture

WG-4 Education, Outreach, & Training
- WG-4.1 Community Engagement
- WG-4.2 Workforce Training
- WG-4.3 College Curriculum & Prof. Development
- WG-4.4 Pathways to Transformative Opportunities

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Engine Infrastructure (EI)
Crosscutting Elements

- **EI-1 Diversity, Equity, Inclusion, & Accessibility (DEIA)**
- **EI-2 Data, Models, & Tools**
- **EI-3 Societal Cost of Energy (SCoE)**
- **EI-4 Policies & Decision-Making Frameworks**
- **EI-5 Lead Organization Management & Business Functions**

Convergent Projects (CP) for Innovation, Evaluation, Economic Development, & Equity

- **CP-1 Impact of Infrastructure Materials & Geometry on Marine Ecosystems (MA)**
- **CP-2 Concrete Gravity Base Foundations (CT)**
- **CP-3 The New Blue Fisheries Economy (NJ)**
- **CP-4 Monitoring Marine Life around Monopiles (VA)**
- **CP-5 Establishing Equitable Pathways to Opportunity**
- **CP-6.# TBD** (*After Year 2*)

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Strategic Collaborations to Lead Working Group Activities

ROSA
Responsible Offshore Science Alliance

Leading Regional Offshore Wind and Fisheries Research

The Responsible Offshore Science Alliance (ROSA) is a nonprofit organization leading a collaborative effort to advance research and monitoring on the potential effects of offshore wind on fisheries.

At the heart of ROSA's work is a community–of fishermen, offshore wind developers, academics, government representatives, and others–united behind a common goal: objective, collaborative science. Together, we aim to generate scientific data to support effective decision-making and policy.

- Setting research priorities
- Enabling collaboration among scientists
- Reducing redundancy
- Providing scientific leadership
- Administering research (forthcoming)

Offshore Wind Project Monitoring Framework and Guidelines
March 2021

Regional Framework Database

Report and Recommendations on Fisheries Resource Data Production, Storage, and Accessibility

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RWSC Regional Wildlife Science Collaborative for Offshore Wind

MISSION: To collaboratively and effectively conduct and coordinate relevant, credible, and efficient regional monitoring and research of wildlife and marine ecosystems that supports the advancement of environmentally responsible and cost-efficient offshore wind power development activities in U.S. Atlantic waters.

eNGO Sector

Mass Audubon
Mystic Aquarium
National Audubon Society
National Wildlife Federation
Natural Resources Defense Council
New England Aquarium
New Jersey Audubon
Ocean Conservancy
Ocean Conservation Research
The Nature Conservancy
Wildlife Conservation Society

Offshore Wind Industry Sector

American Clean Power
Atlantic Shores Offshore Wind
Attentive Energy LLC
Avangrid Renewables
Copenhagen Infrastructure Partners/Copenhagen Offshore Partners
Dominion Energy
EDF-Renewables
Equinor
Mayflower Wind
Ocean Winds
Ørsted North America
RWE
Shell
US Wind

SUBCOMMITTEES

SEA TURTLES
HABITAT & ECOSYSTEM
MARINE MAMMALS
BIRDS & BATS
PROTECTED FISH SPECIES
CROSS-TAXA

SECTOR CAUCUSES

FEDERAL CAUCUS
STATE CAUCUS
OFFSHORE WIND INDUSTRY CAUCUS
eNGO CAUCUS

NORTHEAST OCEAN DATA
Maps and Data for Ocean Planning in the Northeastern United States

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SeaAhead

2022 IMPACT REPORT

Bringing the climate battle out to sea

People, planet, profits. Win, win, win.

The ocean's future is what we make it. And together we're making it better by supporting bluetech ventures that focus on human, environmental, and business success.

WHY WE STARTED

One planet, one ocean, endless possibility.

In 2018, we realized that early-stage startups in the blue economy were missing two important drivers for success: support infrastructure and access to funding. We formed SeaAhead to bring together entrepreneurs, investors, industry leaders, and stakeholders. In just a few years, we've grown into an open-innovation ecosystem that produces scalable commercial solutions to modern-day challenges.

100+
Bluetech startups supported to date

$18M+
Raised by BlueSwell Alumni

35+
Corporate partners, global affiliates, and brands

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Examples of Questions to be Explored, Discussed, & Debated

- What should be the operational design life of foundations?
- What public data is most needed on Engineering properties of the seabed?
- What monitoring strategies are needed to evaluate remaining design life?
- How well do understand the health of marine ecosystems?
- Is maximizing or retailing/re-establishing bio-diversity a better strategy, and what factors should be considered to determine this?
- What can we learn from previous offshore wind and O&G platforms?
- What are the largest uncertainties and their significance?
- What type of work is needed to reduce uncertainties?
- What are the barriers to fully-probabilistic design, and which of these can and should be addressed by the Engine?
- What data would be most beneficial for advancing the state-of-the-art?
- Who can and should set data collection and sharing requirements?
- What future projects and participants are needed to address the priorities established above?
- What should be the lease length of wind farms?
- How can reliability be assessed?
- Where would public/private partnerships be most helpful?
- What are the areas that U.S. industry can compete in near, mid, and long-term, and what is needed to support this?
- What factors are appropriate to consider when measuring the value of offshore wind energy farms?

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Engine Infrastructure (EI)
Crosscutting Elements

EI-1 Diversity, Equity, Inclusion, & Accessibility (DEIA)

EI-2 Data, Models, & Tools

EI-3 Societal Cost of Energy (SCoE)

EI-4 Policies & Decision-Making Frameworks

EI-5.5 Lead Organization Management & Business Functions

Working Groups

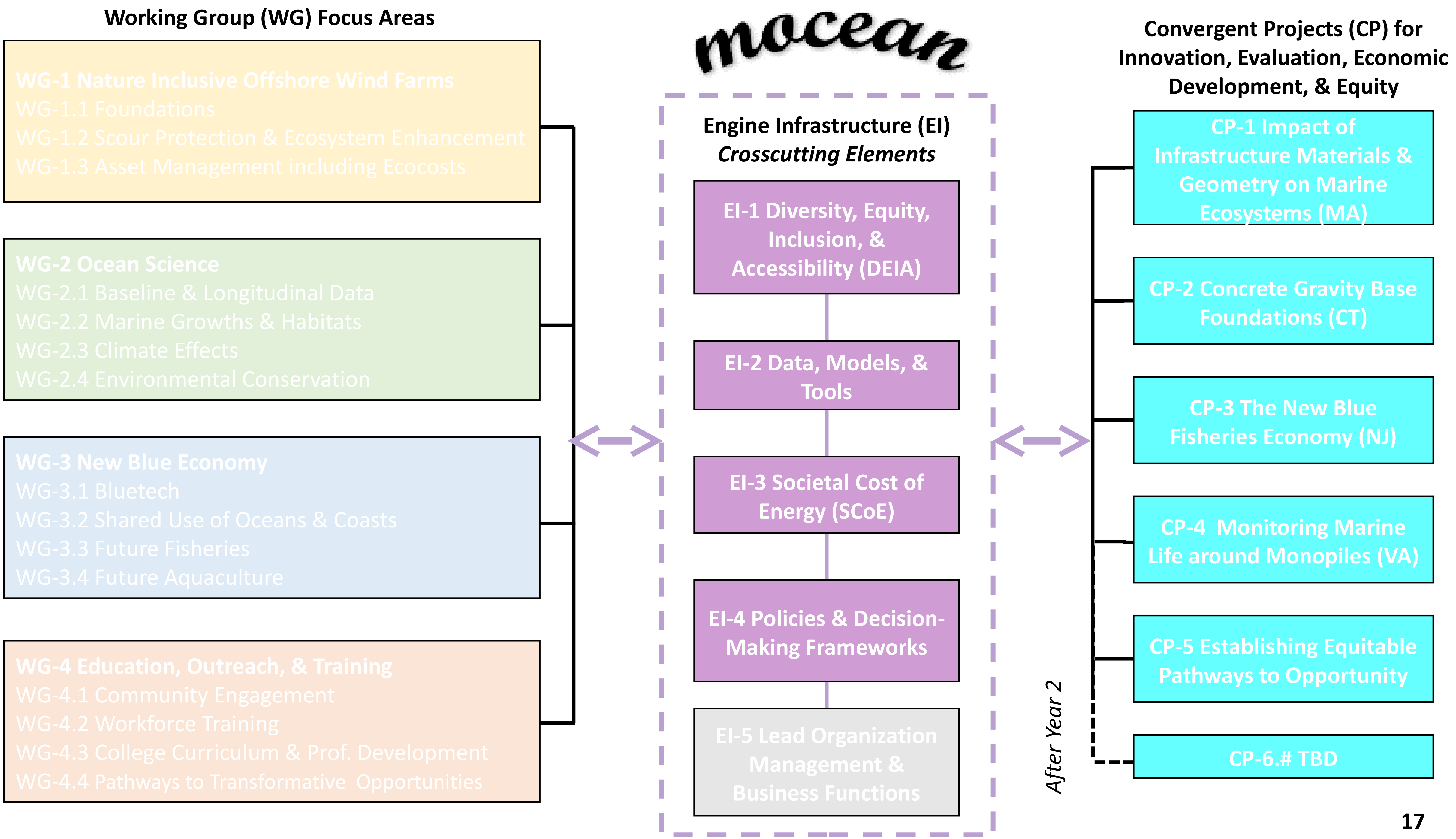
Name of Entity that Leads the Engine is **MOCEAN** (our **M**ission is the **OCEAN**) Pronounced the same as "motion", which is indicative of the elements of nature-inclusive offshore wind farms that are in significant motion (wind, blades, waves, fish, mammals, boats, workers, etc.) and the conditions that change over time due to offshore wind and the effects of climate change (benthic conditions, reefs, water chemistries, stratification, yearly current patterns, etc.). The Engine puts physical, human, and financial resources in motion, and the fuel for this Engine include investments from NSF, other governmental sources, industry, and other communities. The largest source of fuel is that from industry which will invest between $150B - $1T dollars in the Engine's region by 2050..

Convergent Projects

SCOE: Society's costs of electricity [EUR/MWh]
Projection for Germany in 2025 - custom Scenario

	Nuclear	Coal	Gas	Photovoltaics	Wind On	Wind Off
LCOE w/o CO2	79,2	80,3	67,3	100,2	55,4	95,0
- thereof CO2	0,0	23,4	10,4	0,0	0,0	0,0
Cost subsidies	47,4	0,0	0,4	0,0	0,0	0,0
Transmission	0,0	0,0	0,0	10,8	3,2	2,8
Variability	1,0	0,5	0,0	15,4	14,5	13,6
LCOE + system costs	**127,6**	**80,8**	**67,8**	**126,4**	**73,1**	**111,4**
Social impact	0,1	0,1	0,1	0,0	4,0	0,0
Employment effects	-34,1	-6,2	0,0	-49,3	-19,4	-49,0
Geopolitical impact	0,3	2,5	5,9	0,0	0,0	0,0
SCOE	**93,8**	**77,2**	**73,8**	**77,1**	**57,8**	**62,3**

E W ST SCC / CWN / 2014-08-26 / Projection for Germany in 2025 - custom Scenario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CP-5 Establishing Equitable Pathways to Opportunity
After Year 2
CP-6.# TBD

Convergent Project 1 (CP-1): Impact of Infrastructure Materials and Geometry on Marine Ecosystems and Design Life

Two-year Objectives/Tasks:

Objective 1: *Identify optimal materials, corrosion control, geometric modifications, and deployment approaches for small scale testing of offshore wind nature inclusive design*

Objective 2: *Construct and deploy materials increasing in complexity that will lead to enhanced recruitment and biodiversity of OSW structures*

- Test an array of chemical compositions of and surface modifications to steel and concrete materials.
- Couple chemical and physical modifications using small prototype concrete structures cast in nature-inspired geometric designs.

Objective 3: *Quantify the impact of nature-inclusive design modifications on biodiversity, ecosystem structure and function, environmental parameters, structural integrity and design life*

- Continuous monitoring of benthic communities, ecosystem function, and organismal health using deployable biogeochemical sensors and cameras.
- Discrete sampling to further characterize ecosystem biogeochemistry and identify future sensing needs for monitoring and models.
- Monitor structures for corrosion and biodeterioration

Should Monopiles be Open to the Ocean?

Engineering ✓
Marine Ecosystem ✗

Engineering ?
Marine Ecosystem ✓

Eco-friendly design of scour protection: potential enhancement of ecological functioning in offshore wind farms

Towards an implementation guide and experimental set-up

Convergent Project 2 (CP-2): Nature Inclusive Concrete Gravity Base Foundations (GBFs) for Offshore Wind Turbines

Why Concrete: Durability, Local Jobs, Future Proofing, More Versatile for Nature Inclusive Design

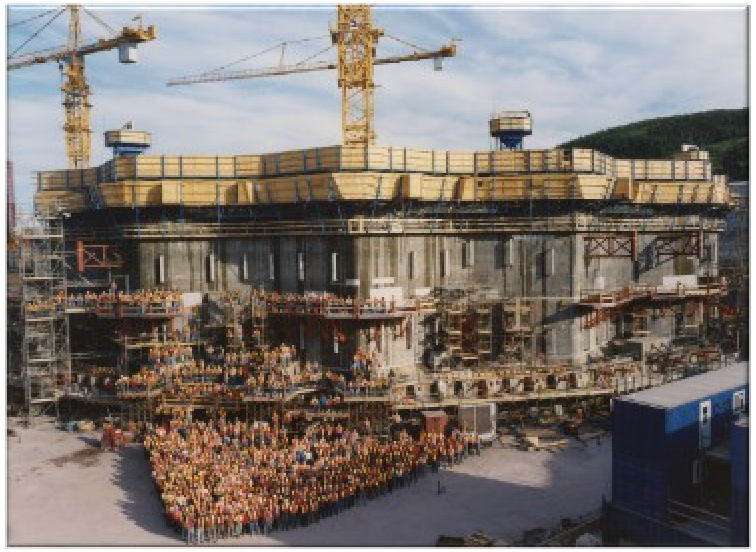
Two-Year Objectives/Tasks:

Objective 1: *Compare Designs for Concrete and Steel Structures for different Conditions*

- *Task 1*: Development of Geotechnical and Geophysical Profiles for Selected Seabeds
- Task 2: Assessment of Bearing and Lateral Load Capacity of the Seabed
- *Task 3:* Create Wind and Wave Time Series, and Roses
- *Task 4:* Optimize the Shape of the concrete GBF for 15 MW Turbine in 40 meters of water
- *Task 5:* Repeat Task 4 for 15, 20, and 25 MW turbines
- *Task 6:* Repeat Task 5 for a Monopile Foundation

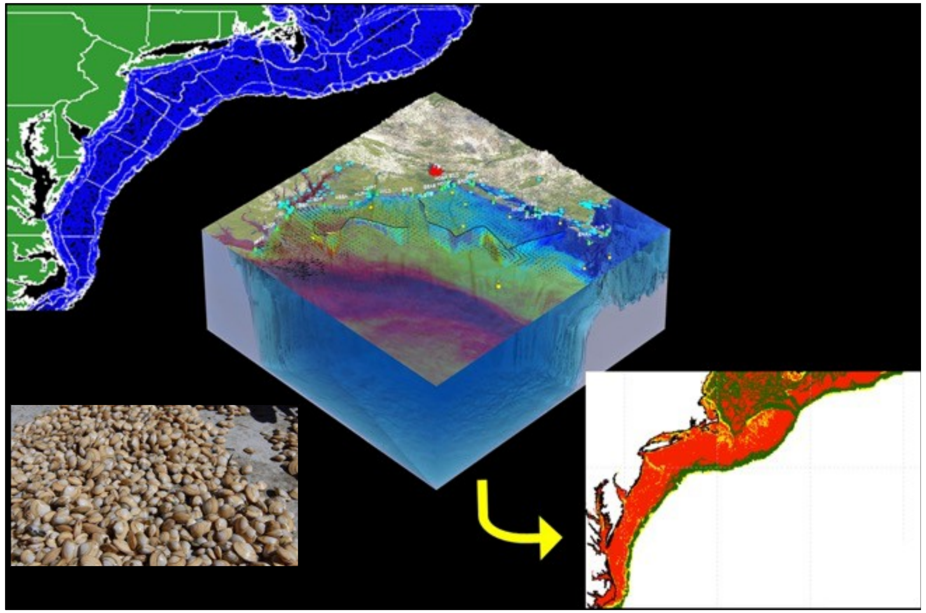
Objective 2: *Compare the Costs and Benefits of concrete GBFs verses Steel Monopiles*

- *Task 6:* Evaluate the Cost Differential for Different Design Lives, and Turbine Sizes
- *Task 7:* Conduct Life-Cycle Eco-Cost Comparison of Steel versus Concrete Foundations
- *Task 8:* Compare Value of Designing a concrete GBF versus steel Monopile for aTurbine Class as Opposed to a specific OEM Turbine
- *Task 9:* Compare Effective Lifespans of concrete GBFs versus steel Monopiles



***Objective 3*:** Identify policies, incentives, and investments need for the selection and use of concrete GBFs;

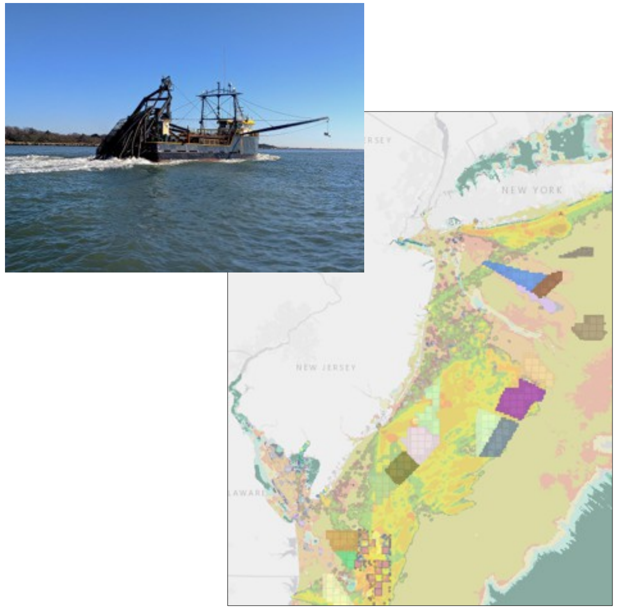
Convergent Project 3 (CP-3): The New Blue Fisheries Economy

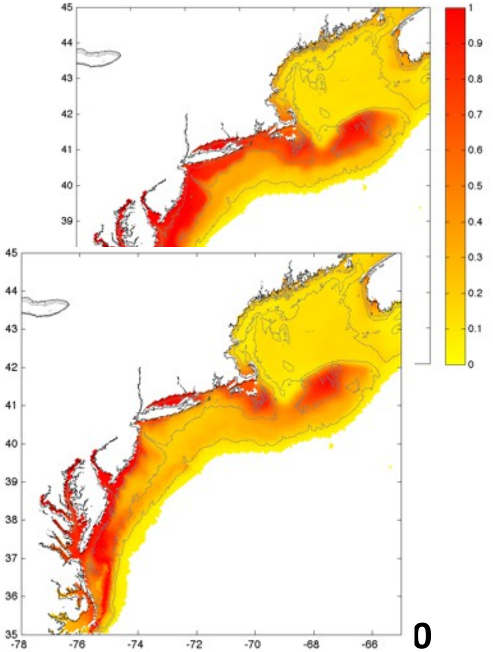


Two-Year Objectives/Tasks

Objective 1: Identify spatial patterns of ocean characteristics, species abundance, individual size frequency, biomass, and growth.

Objective 2: Artificial Intelligence/ Machine Learning (AI/ML) Framework:





Objective 3: Initial Product Development (Years 1 and 2):

- Develop a shellfish habitat assessment tool.
- Initial development of a thermal finfish habitat mapping tool.

Convergent Project 4 (CP-4): Monitoring of Marine Life around Monopiles

Two-Year Objectives/ Tasks:

Objective 1: *To determine abiotic (prevailing currents, water depth) and biotic factors (species interactions) that influence benthic community structure and function on the monopile foundations and surrounding seafloor.*

Objective 2: *To explore emerging technologies to effectively and efficiently monitor shifts in benthic community structure and function associated with the monopile foundations to inform guidance on monitoring requirements.*

- eDNA sampling and analyses,
- ultra-high resolution stereo imagery to construct photogrammetric models,
- emerging in-situ sensors

Objective 3: *To develop opportunities for undergraduate marine science students and training workshops for host organizations.*

- Internship programs to provide undergraduates insight into various scientific career paths
- Training workshops for companies and organizations to foster effective mentorship and a welcoming environment to optimize professional development opportunities

Convergent Project 5 (CP-5) : Establishing Equitable Pathways to Opportunity


Two-Year Objectives/ Tasks:

Objective 1: Develop effective public engagement tools, activities, and programs in future offshore wind ports: New Bedford and Salem, MA as pilot coastal communities.

> ***Task 1:*** Use ***outreach strategies*** including exhibits, interactive websites, and social media to expose people to the benefits and opportunities in nature-inclusive offshore wind.
>
> ***Task 2:*** Co-develop three effective, ***hands-on educational activities*** that can be used in a variety of educational settings. Examples include 1) designing ocean bottom structures that support increased biodiversity, 2) measuring the energy produced by a scaled model of an offshore wind turbine, and 3) mapping a diverse coastal community that can support and benefit from offshore wind.
>
> ***Task 3:*** Engage two future offshore wind port communities: New Bedford, MA and Salem, MA, to ***conduct youth-led needs assessment***, project job growth, and map educational and training programs and share the results with community and government leaders.
>
> ***Task 4:*** Form a ***Community Advisory Council*** to the New England Aquarium with representatives from New Bedford and Salem including the above engaged youth, teachers, and informal educators, and community organizations so that we can listen carefully to community needs as we develop NIOSW marketing and educational materials.

Workforce development to grow and sustain regional innovation

If Nature-Inclusive Design can be done reliably and provide net positive benefits for the marine ecosystems and the fisheries and aquaculture communities, then very large-scale development of the U.S. offshore wind resources could be developed.

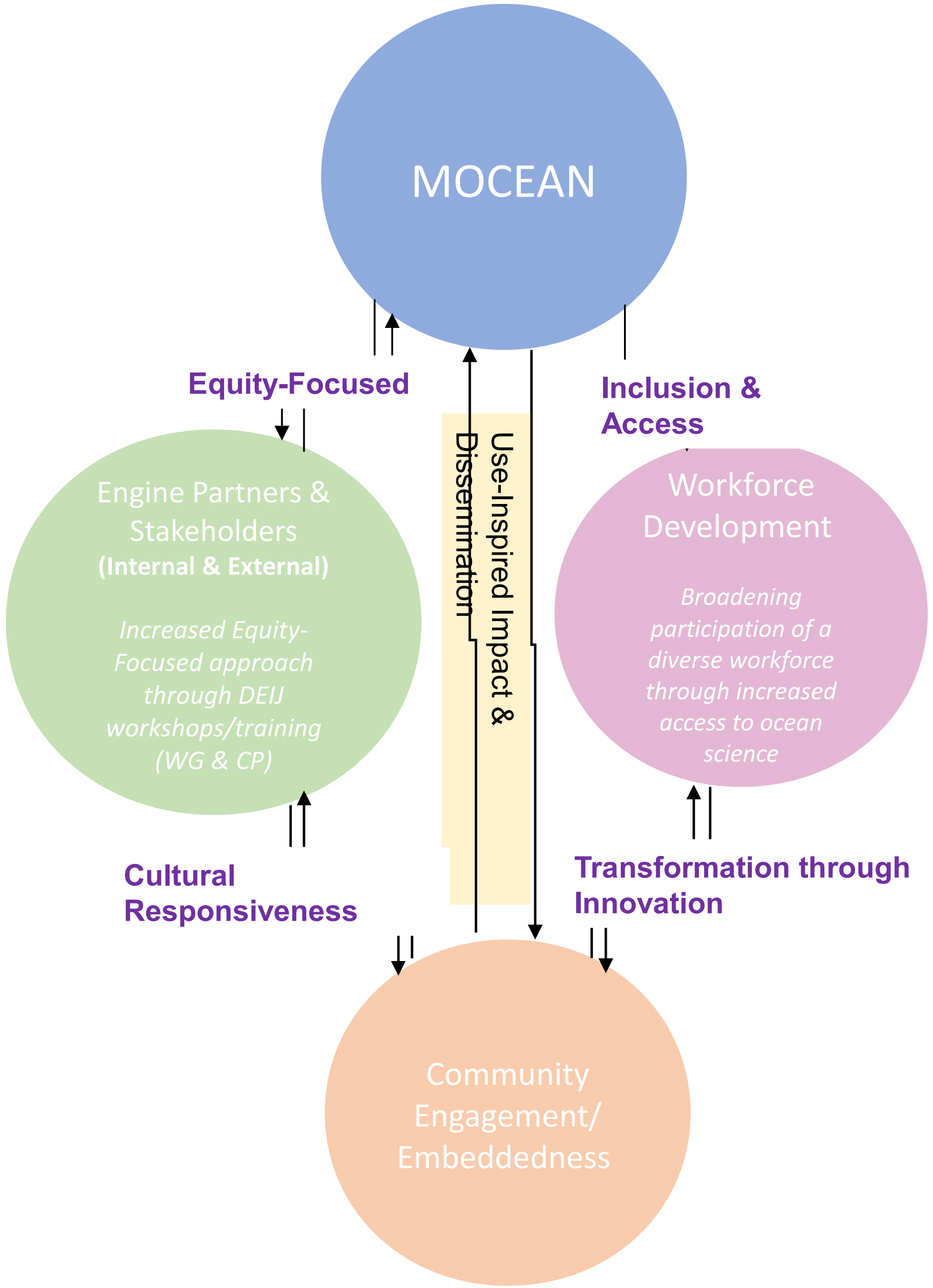
Workforce development challenges and opportunities include:

- new educational programs in vocational high schools, community colleges, and universities for technical trades, ocean scientists, material scientists, engineers, data managers, policy makers, economists, and many others (K-grey);
- creating system-level thinkers and approaches that can account for the complexity and uncertainty associated with ocean management and energy systems;
- development of new fishing and aquaculture practices and educational programs for co-location with offshore wind farms;

	Ratios	Engine	2050		
	Per GW	10-years	Netherlands	Biden	15% Demand
Amount of Installed Capacity (GW)	**1**	**30**	**70**	**110**	**300**
# of 15 MW Turbines	**67**	**2000**	**4667**	**7333**	**20000**
Total Development Cost ($B)	4	120	280	440	1200
Electricity Production per Year (GWh)	4906	147168	343392	539616	1471680
Generation Cost of Electricity ($/kWh)	0.08	0.08	0.08	0.08	0.08
Total Annual Revenue ($B)	0.39	11.77	27.47	43.17	117.73
Salary with Benefits ($/year)	150000	150000	150000	150000	150000
Number of Annual Jobs	**2,616**	**78,490**	**183,142**	**287,795**	**784,896**

Culture of diversity, equity, inclusion, access, and justice

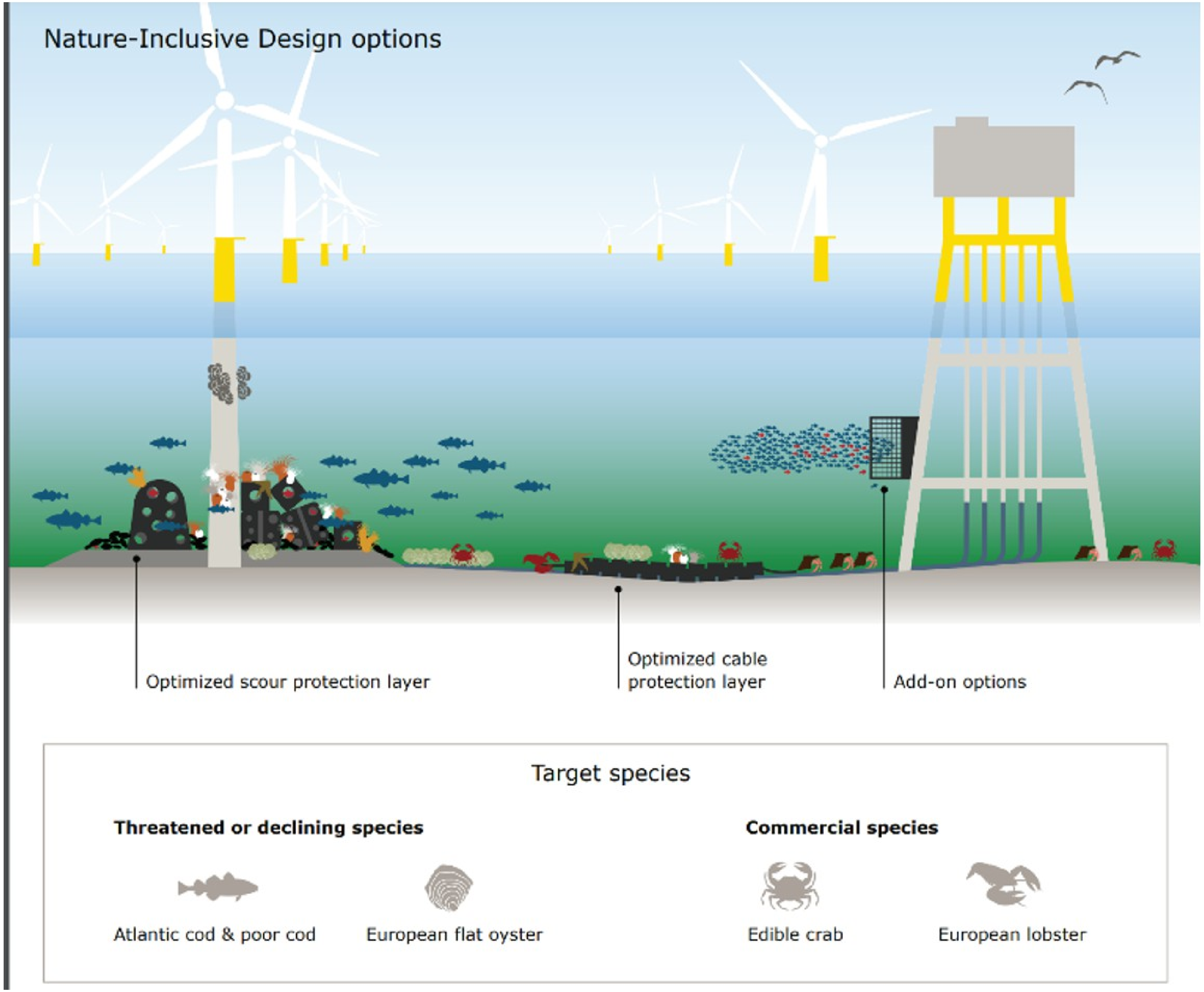
- **Distributed model –**
  - DEIAJ objectives integrated across the Engine at all levels, including leadership and in decision-making processes
    - NSF: Engine needs to prioritizes economic development and addressing issues of justice through use-inspired research, innovation, and investments
  - DIEAJ team comprised of multiple partners across the Engine
    - Leverage existing personnel across the organizations committed to achieving these objectives
    - Meet regularly to develop strategies that drive WG activities and CPs
  - Embody a culture of DEIAJ throughout the Engine
- Adopt and advance promising practices and support and expand existing programs
- DEIAJ objectives and approach are SMART (Strategic, Measurable, Achievable, Realistic, and Time-Bound)



Convergent Projects (CP) for Innovation, Evaluation, Economic Development, & Equity

- CP-1 Impact of Infrastructure Materials & Geometry on Marine Ecosystems (MA)
- CP-2 Concrete Gravity Base Foundations (CT)
- CP-3 The New Blue Fisheries Economy (NJ)
- CP-4 Monitoring Marine Life around Monopiles (VA)
- CP-5 Establishing Equitable Pathways to Opportunity
- CP-6.# TBD

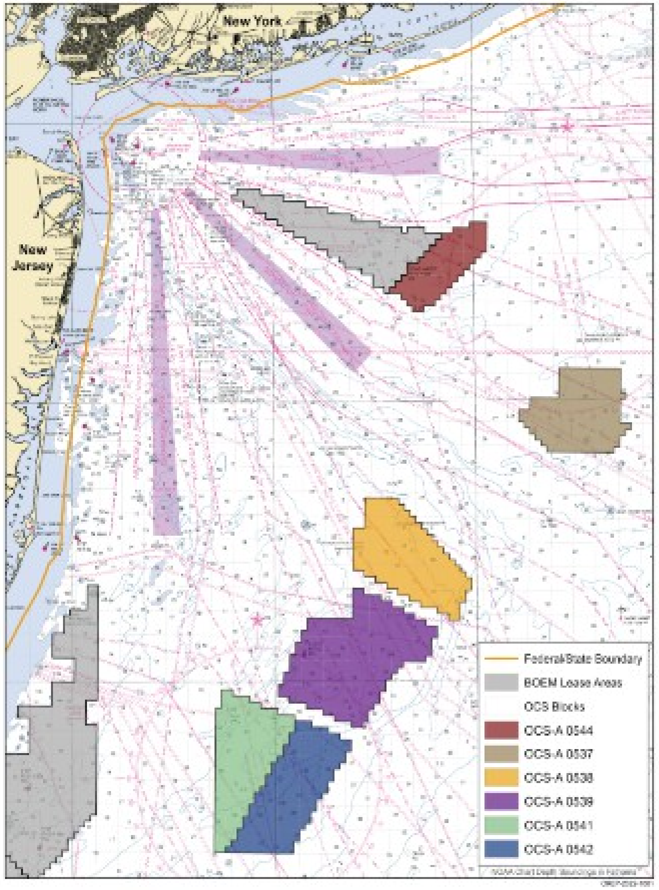
After Year 2



Long-term Sustainability Plan

Evidence of Monies for Jointly-Funded Projects and Sustainability of Engine

- Hundreds of billions is be spent to develop and operate U.S. offshore wind farms by 2050
- Billions of dollars in lease sales alone
- Mechanisms to require developer support of initiatives
- State and community economic development in advancing Climate Tech. – (e.g. recent announcement by Governor Elect Maura Healey)
- Interest by Venture Funds to advanced innovation given scale of opportunity
- Climate-related research is attractive



Provisional Winners of the New York Bight Lease Areas, $4.37 Billion in High Bids

OCS-A 0544	Mid-Atlantic Offshore Wind LLC, $285,000,000
OCS-A 0537	OW Ocean Winds East, LLC, $765,000,000
OCS-A 0538	Attentive Energy LLC, $795,000,000
OCS-A 0539	Bight Wind Holdings, LLC, $1,100,000,000
OCS-A 0541	Atlantic Shores Offshore Wind Bight, LLC, $780,000,000
OCS-A 0542	Invenergy Wind Offshore LLC, $645,000,000

BOEM Bureau of Ocean Energy Management

Need for an NSF Engine

- Interests of society are different and longer-term than the interests of industry alone
- Industry not generating or sharing the data needed to advance the state-of-the-art and the state-of-the-practice
- Need to change value proposition from Levelized Cost of Energy (LCoE) to Societal Cost of Energy (SCoE)
- Need to advance and support innovation in U.S. industry for it to catch up to European industry
- Need to complete globally in R&D; EU has and is investing Billions in the topic areas of the proposal work through the European Horizons and other programs; the EU has not invested in a large project with this holistic focus – an opportunity for U.S. leadership
- NSF's approach is different and complementary to investments by other national and state funding organizations

Part (e). Broader Impacts

- Advancing methods that enable the Nature-Inclusive Design of offshore wind farms will greatly increase thee acceptance of these farms, and thereby their contribution to fighting climate change; in the limit, offshore wind could provide close to 100% of the needed electricity in coastal regions
- Create new types of significant employment opportunities in fishing and aquaculture
- By revitalizing coastal communities in areas of greatest need, it will shift the flow of people to these regions as opposed to away from these regions to higher-population centers
- Drive further innovation in Bluetech technologies
- Create the need for new educational programs, majors, training, and retraining activities
- Attract young people motivated to address climate and societal challengers to study in fields of science and engineering who otherwise may not have considered studying science and engineering because a less obvious contribution to the environment and society
- Enable a deeper study of the ocean environment that would have otherwise been possible, and this will lead to new discoveries with unforeseeable benefits
- By understanding how to design offshore wind infrastructure to be more durable and nature-inclusive, this will also then lead to improvement in the design and performance of other marine infrastructure such as ports, piers, breakwalls, buildings, and highways