CLEAN CURRENTS 2021

Where Waterpower Moves Forward | Powered by NHA

Building the U.S. Marine Energy Roadmap Strategy Summit

October 19th 2021

Agenda: Building the U.S. Marine Energy Roadmap Strategy Summit

1:00 – 1:15 p.m.	**Welcome,** *Paul Gay, co-chair, NHA Marine Energy Council*
1:15 – 2:15 p.m.	**Understanding Where the Sector Is Now**
	Partner Presentations by:
	DOE Multi-Year Marine Energy Program Plan - *Hoyt Battey, Market Acceleration and Deployment Program Manager, Wind and Water Power Technologies Office*
	Marine Energy Resource Assessment - *Levi Kilcher, Researcher IV-Mechanical Engineering, NREL*
	Reducing Environmental Risk - *Andrea Copping, Senior Researcher, PNNL*
	How to get on par with offshore wind - *Mike Lawson, Researcher V-Mechanical Engineering, NREL / Bob Thresher, Emeritus Researcher, NREL*
2:15 – 2:30 pm	***Break***
2:30 -2:45 pm	**Review of Commercialization Strategy for Marine Energy and Its Major Takeaways**
2:45 – 3:15 pm	**Breakout 1: PATHWAY TO WHERE?**
3:15 – 3:45 pm	***Discussion***
3:45 – 4:00 pm	**Review Industry Priorities Work Product**
4:00 -4:30 pm	**Breakout 2: HOW DO WE GET THERE?**
4:30 – 4:50 pm	***Discussion***
4:50 – 5:00 pm	**Adjourn**

WPTO Multi-Year Program Plan Update (now Strategic Plan)

U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY
WATER POWER TECHNOLOGIES OFFICE

WPTO Strategic Plan and Multi-Year Program Plan

Timeline:

- Began development in 2015/2016!
- Posted several Requests for Information (RFIs), received lots of good feedback.
- Development largely paused from 2017-2020.
- Began work again towards end of the Trump Administration.
- Energy Act of 2020 (Title 3, Subtitle A, Sec. 3001), now requires DOE to deliver a WPTO Strategic Plan by December 2021.
- Plan is to release the Plan as “Draft Final”, and host listening/feedback sessions.

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ENERGY EFFICIENCY & RENEWABLE ENERGY

WATER POWER TECHNOLOGIES OFFICE

Multi-Year Program Plan

August 2020

WPTO Strategic Plan & MYPP

1. **EXECUTIVE SUMMARY** (11 pages): Highlights major areas of benefit from Water Power R&D, and high-level overview of Programs, Activity Areas, and Goals

2. **WATER POWER TECHNOLOGIES OFFICE OVERVIEW** (7 pages): Congressional Authorization; Mission, Values, and Structure; Budget; Funding Mechanisms; Assessing Performance and Evaluating Success;

3. **HYDROPOWER AND MARINE ENERGY PROGRAM OVERVIEWS** (17 pages): Challenges and Approaches; Program Goals and Objectives; Program Logic Model;

4. **MYPP TECHNICAL ADDENDUMS** (108 pages): Activity and Sub-Activity Area Details, Performance Goals, Follow-on Objectives; Strategic Partnerships and Crosscutting Activities


U.S. DEPARTMENT OF ENERGY
Office of ENERGY EFFICIENCY & RENEWABLE ENERGY
WATER POWER TECHNOLOGIES OFFICE
Multi-Year Program Plan
August 2020

New Upfront Framing on the Value of Marine Energy

1. **There are near-term opportunities in high-energy-cost remote and distributed communities**
   - Focusing on community-centric needs in the iterative technology development and demonstration cycle is increasingly important.
2. **There is also significant deployment potential out to 2050 <u>and beyond</u>**
   - Even technologies that do not have huge commercial potential on the scale of other renewables in the next one to two decades can still play impactful roles in the longer-term. Models show that to meet long-term 2050 goals, deployment of renewables will need to continue accelerating past 2040, beyond already very large deployment levels prior.
   - Potential for tens of GW of deployment along densely populated coasts, and marine energy technologies utilize different materials, manufacturing and supply chains than other renewables.
   - Marine energy resources are also highly predictable, and in many places their potential generation profiles are complementary to other renewables.
   - U.S. energy needs will continue to grow after 2050, and many more renewables will still likely need to be deployed throughout the second half of the century.
   - Even if U.S. decarbonization goals are achieved on-time, other parts of the world may still have much more to do, and marine renewables may be the best options in many places.

New Upfront Framing on the Value of Marine Energy (continued)

3. **In addition to long-term energy goals, marine energy technology development also directly supports and engages Blue Economy priorities that will be important for the nation.**
   - Building sustainable aquaculture systems and dramatically expanding data collection from our oceans
   - Options for marine-powered renewable fuels production, potential pathways for decarbonization the maritime transportation sector
   - Supporting new science around utilization the oceans as environmentally appropriate sinks for carbon
   - Options for coastal desalination will also become increasingly important given climate pressures
4. **Investments in STEM and foundational research capacity at universities and other research organizations can support broader innovations and growth across important Blue Economy sectors and lay the groundwork for a robust set of future marine energy-focused U.S. industries.**

Mission and Activity Areas

MARINE ENERGY PROGRAM MISSION

Conduct transformative early-stage research that advances the development of reliable, cost-competitive marine energy technologies and reduces barriers to technology deployment.

FOUNDATIONAL R&D	TECHNOLOGY-SPECIFIC SYSTEM DESIGN AND VALIDATION	REDUCING BARRIERS TO TESTING
Drive early-stage R&D on components, controls, manufacturing, and materials; develop and validate numerical modeling tools; improve resource assessments and characterizations; develop quantitative metrics to evaluate devices' potential.	Validate performance and reliability of marine energy systems through prototype testing, including in-water testing, for grid-scale, power at sea, and resilient coastal community markets.	Enable access to open-water, grid-connected, and non-grid connected testing facilities; support environmental monitoring technologies, tools, and data collection to understand potential environmental risks and reduce costs.

DATA ACCESS, ANALYTICS, AND WORKFORCE DEVELOPMENT
Improve access to and use of data, tools, and science, technology, engineering, and (STEM) resources to increase awareness of marine energy technology advances and lessons learned; reduce cost, time, and uncertainty for marine energy permitting; and develop a skilled marine energy workforce.

Goals and Objectives

- **FY22–25 Research Priorities:**
  - Highlights main efforts the program intends to support within a sub-activity to achieve shorter-term performance goals and follow-on objectives. A flow diagram will illustrate the timing and sequencing of major areas of work.

- **Shorter-Term Performance Goals (2022-2025):**
  - Highlights certain significant outputs or products within each of the 4 Activity areas that are expected within the next five years
  - Key results and performance goals are critical to achieving the program's 2026-2030 objectives
  - Not intended to be comprehensive and may not include every output produced within the timeframe.

- **Follow-on Objectives (2025-2030):**
  - Short-term outcomes that the program aims to achieve by 2030, resulting from the successful completion of the 2022-2025 Key Results and Performance Goals
  - Follow-on objectives logically lead to longer-term outcomes and ultimate impacts defined in the program's logic model

Thanks!

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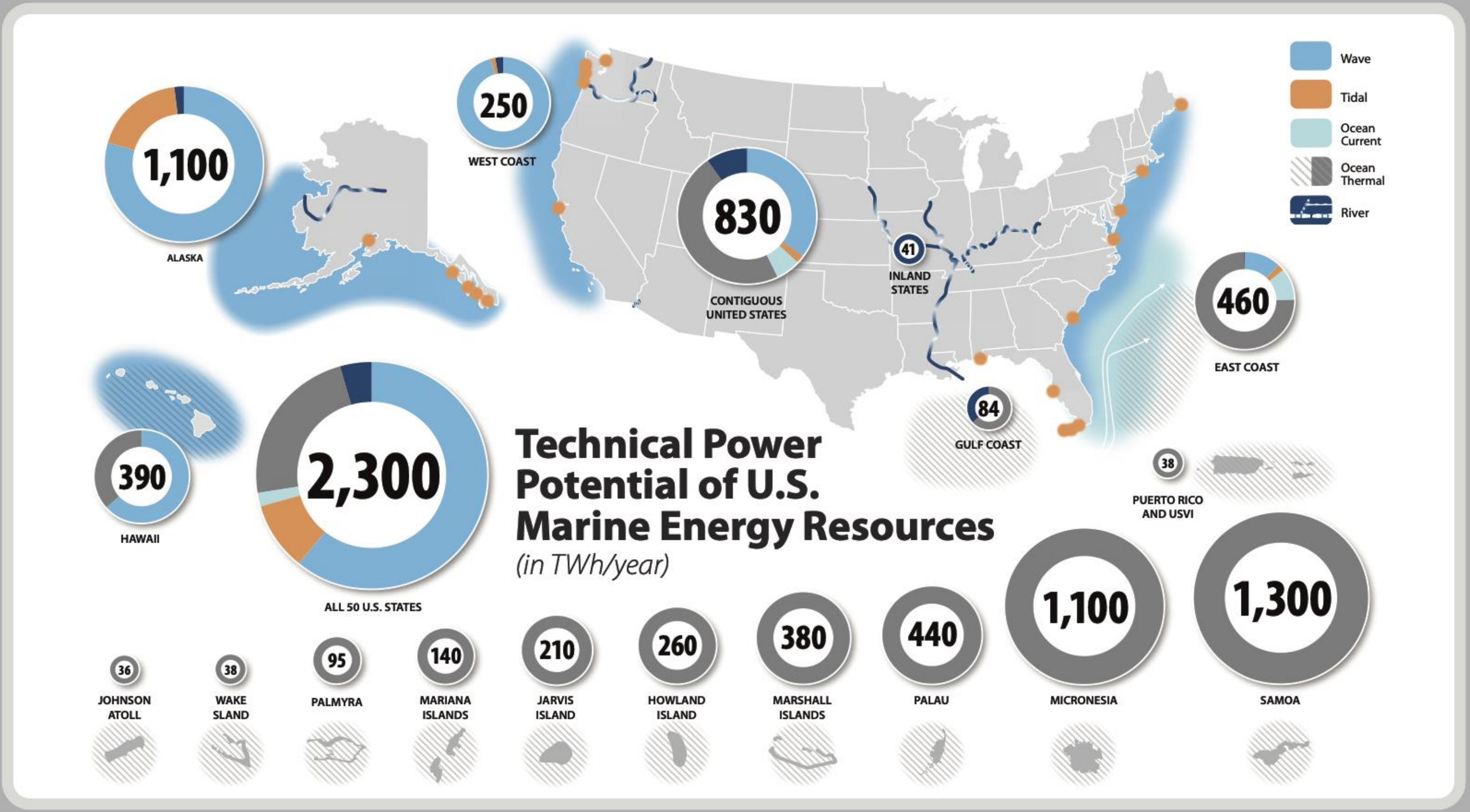
WATER POWER TECHNOLOGIES OFFICE

NREL
Transforming ENERGY

The U.S Marine Energy Resource

Levi Kilcher
Clean Currents — October 19, 2021



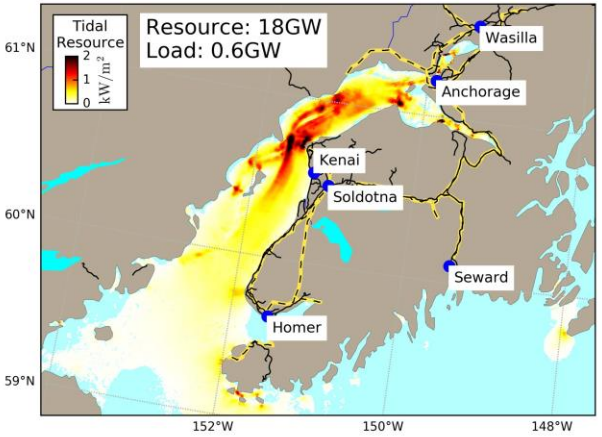
Technical Power Potential of U.S. Marine Energy Resources

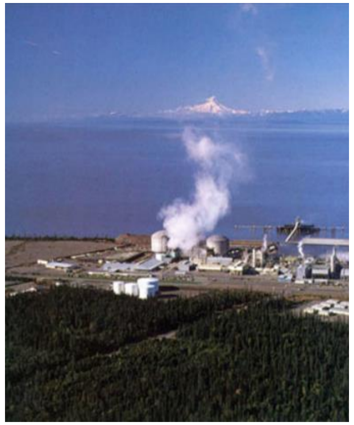
(in TWh/year)

Kilcher, Fogarty, Lawson. 2021. *Marine Energy in the United States: An Overview of Opportunities*. NREL/TP-5700/78773.

Current energy R&D priority: Cook Inlet & Florida Current pilot projects to demonstrate commercial viability

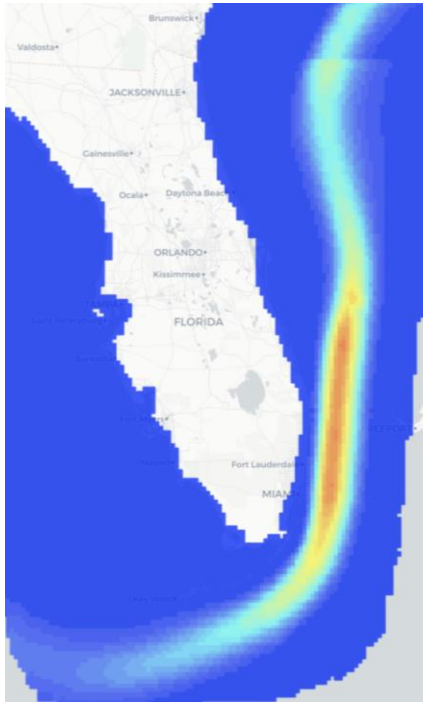
Cook Inlet





- Multi-GW tidal resource (35% of national total)
- Adjacent to transmission to 70% of AK population
- NREL-led resource measurements this summer!
- Space for large pilot area to test multiple technologies
- Near-term e-fuel production by providing power to existing infrastructure

Florida Current



- ~20 GW of resource (200 TW-h/year)
- Ocean current turbines can produce baseload power → 2-4x capacity factor of other renewables
- Technologies developed for Florida current could be exported and deployed globally
- Challenge - Located 12-20 miles offshore in 250-450 meters of water

Starts with 10MW+ pilot project now!

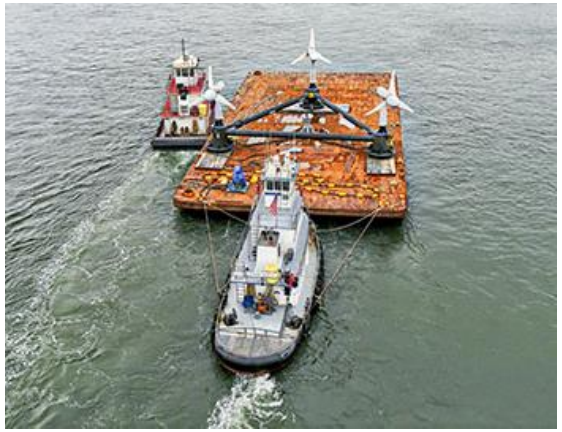
Marine Energy Standards — IEC TC114

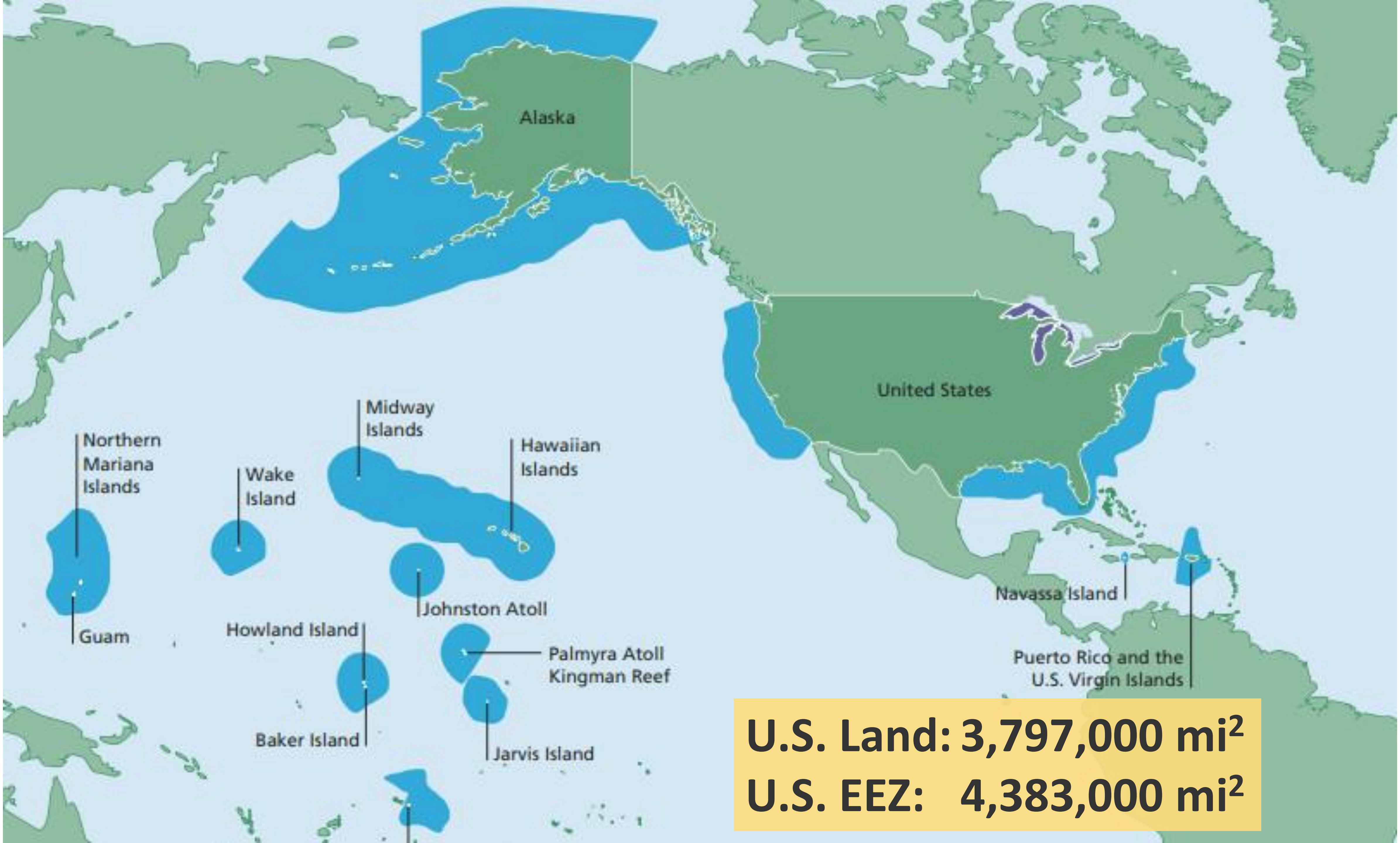
Wave, **Tidal**, **River**, **OTEC**

- Terminology
- Design Requirements
- Loads Measurement
- Technology Qualification
- Moorings
- Power Quality
- Acoustic Characterization
- Power Performance
- Resource Assessment

Resource Assessment & Site Characterization

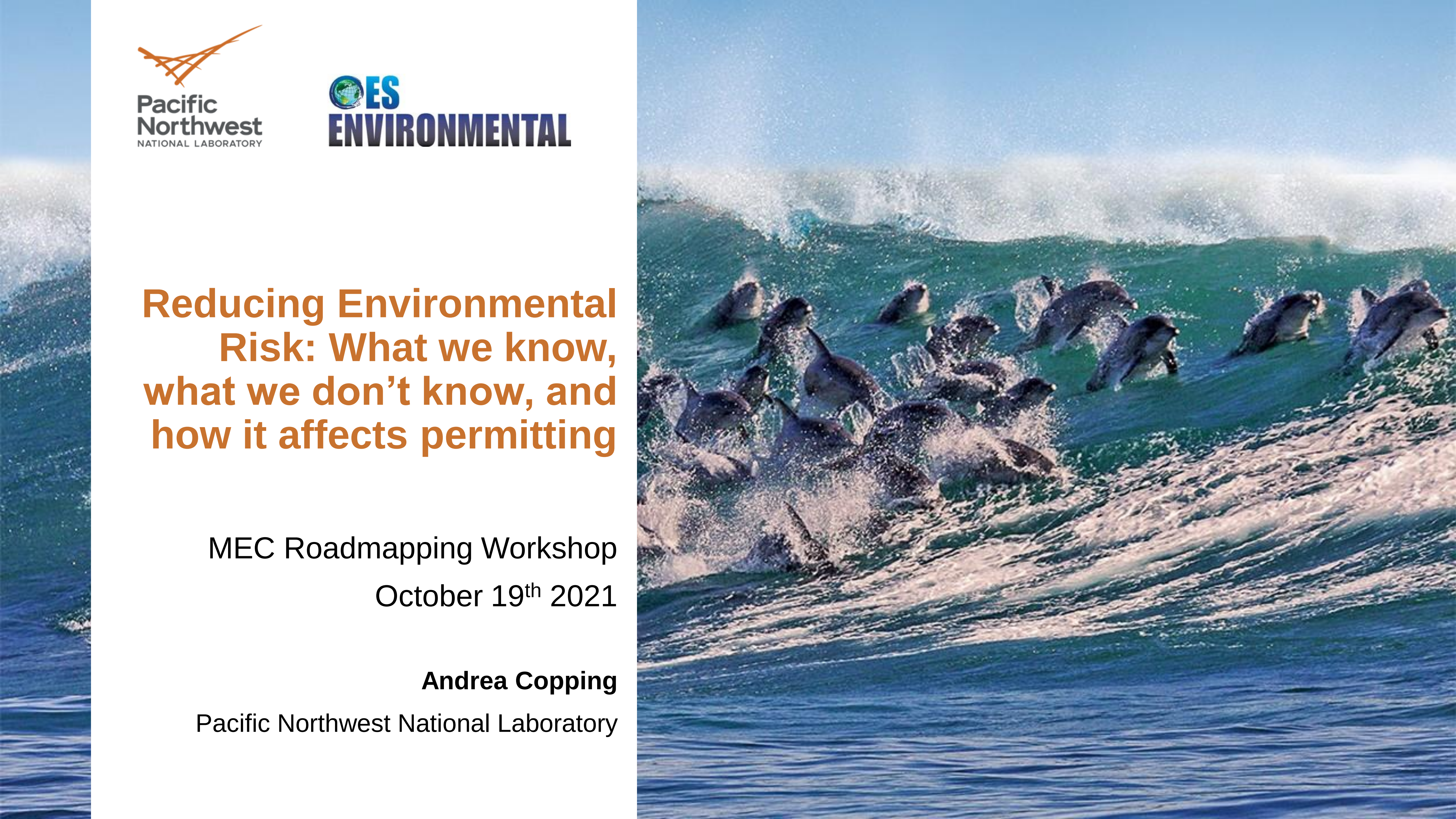
Loads Measurement & Materials R&D





U.S. Land: 3,797,000 mi^2

U.S. EEZ: 4,383,000 mi^2



Reducing Environmental Risk: What we know, what we don't know, and how it affects permitting

MEC Roadmapping Workshop

October 19th 2021

Andrea Copping

Pacific Northwest National Laboratory

What needs to be done to move permitting forward?

Goal: Create smoother, more efficient, and replicable regulatory pathways

Steps:

1. Apply what we know to permitting
    - Providing information in an accessible and appropriate format
    - Take into account new regulators

2. Determine what information is missing, how to collect it
    - Separate questions that require research versus monitoring
    - Parse out responsibilities for collecting missing information (and find funding!)

Environmental Effects of Marine Energy: Stressors and Receptors

- Stressors – marine energy devices, systems that may cause harm
- Receptors – marine animals, habitats, ecosystem processes

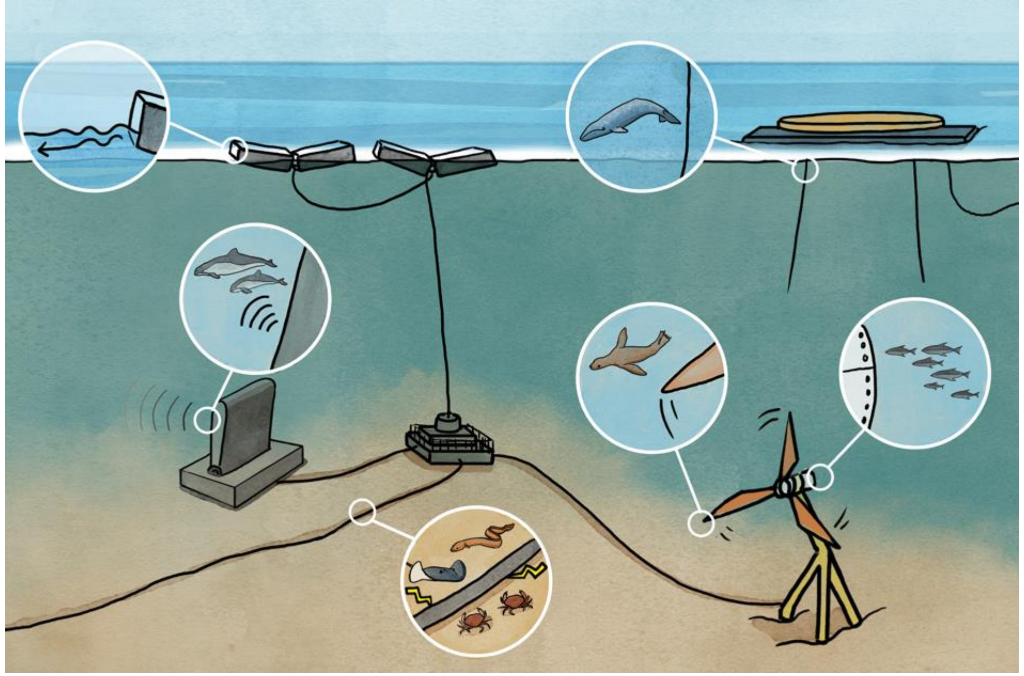


Figure 2.1 in the *2020 State of the Science* Report

- Priority stressor-receptor interactions:

Collision risk

Underwater noise

Electromagnetic fields

Habitat changes

Mooring line encounter

Changes in oceanographic systems

Displacement / barrier effects

Environmental Effects of Marine Energy: Stre d Receptors

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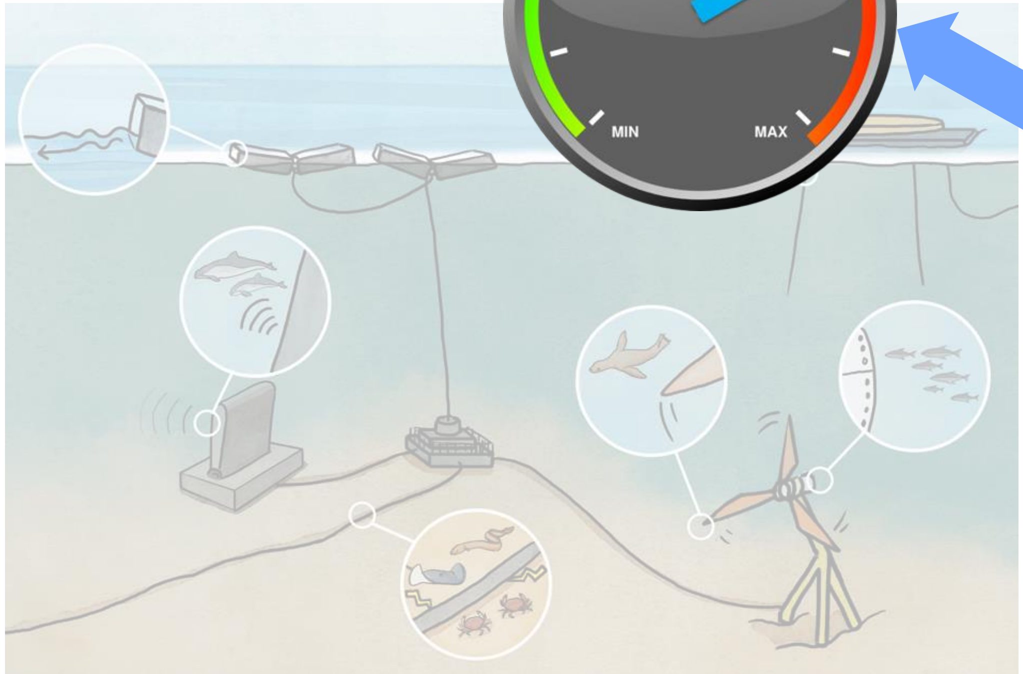

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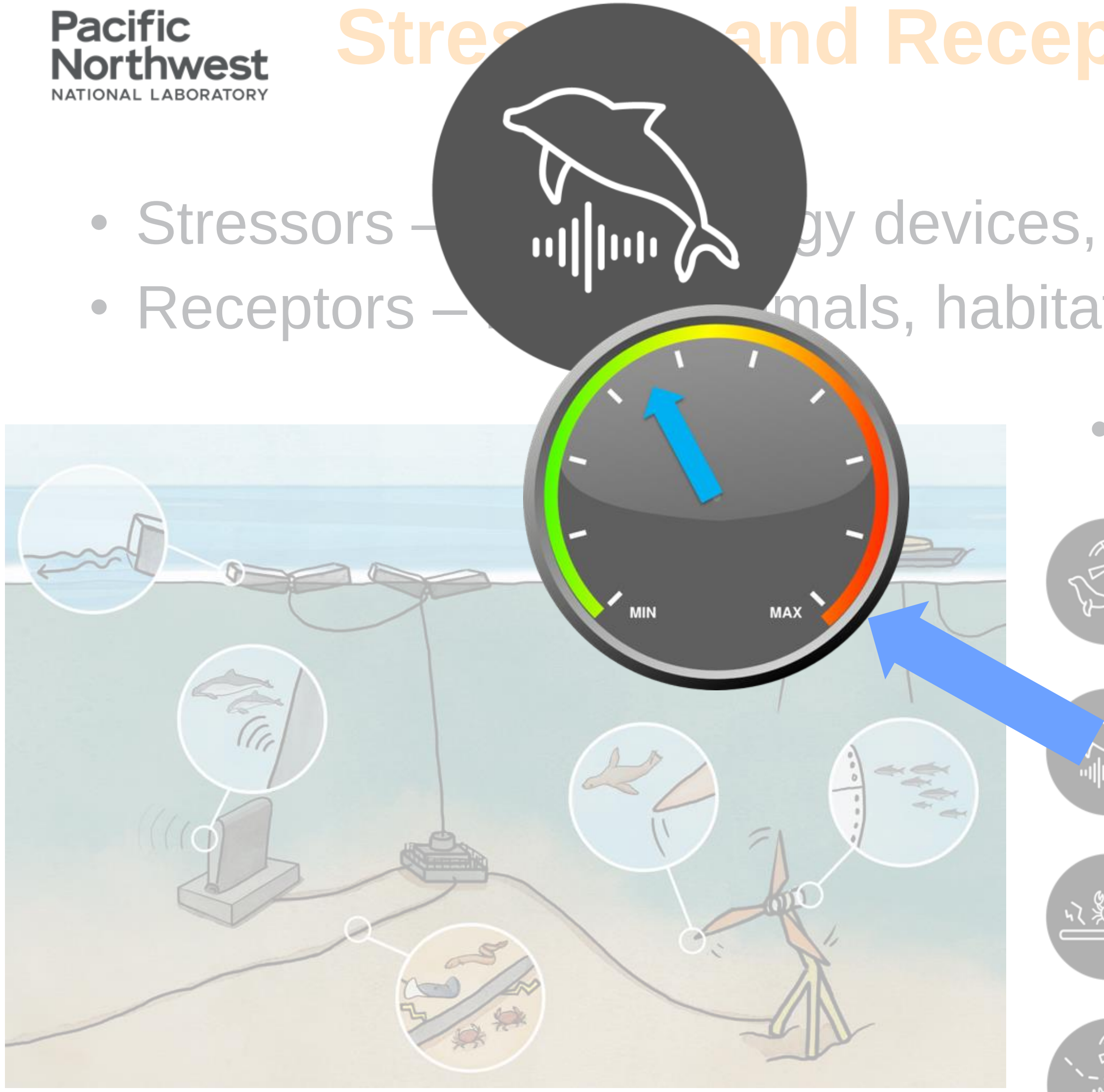

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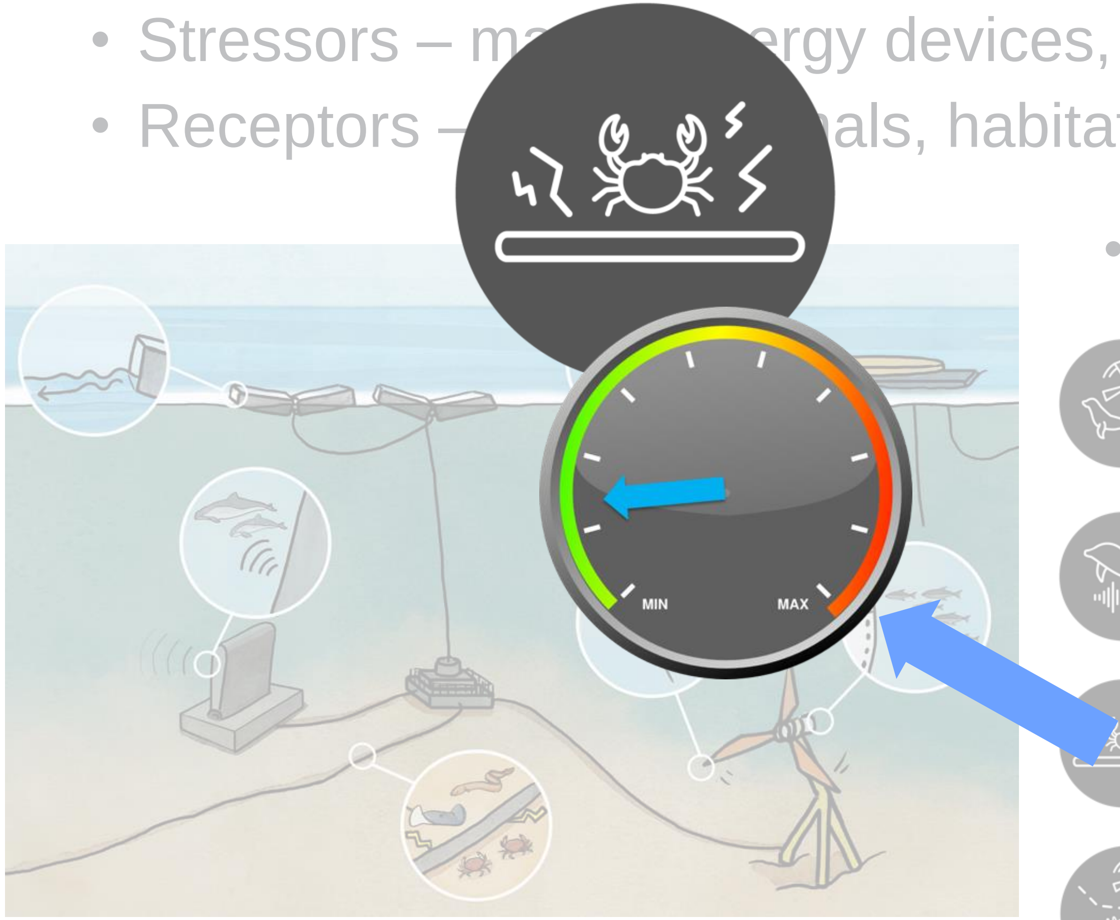

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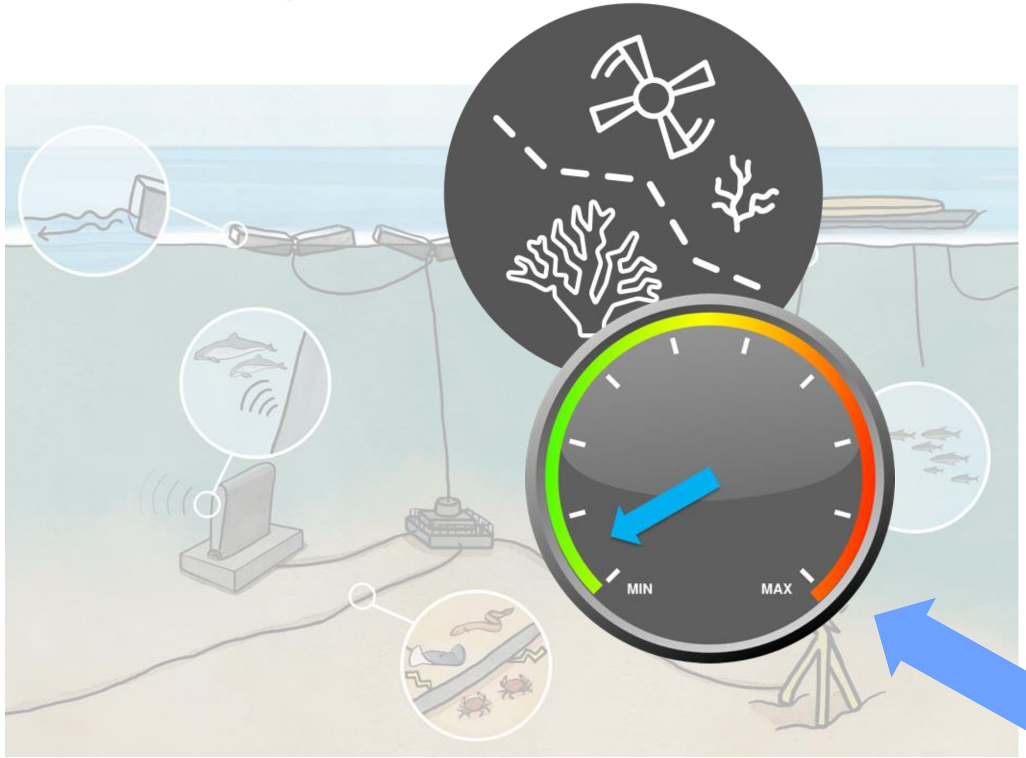

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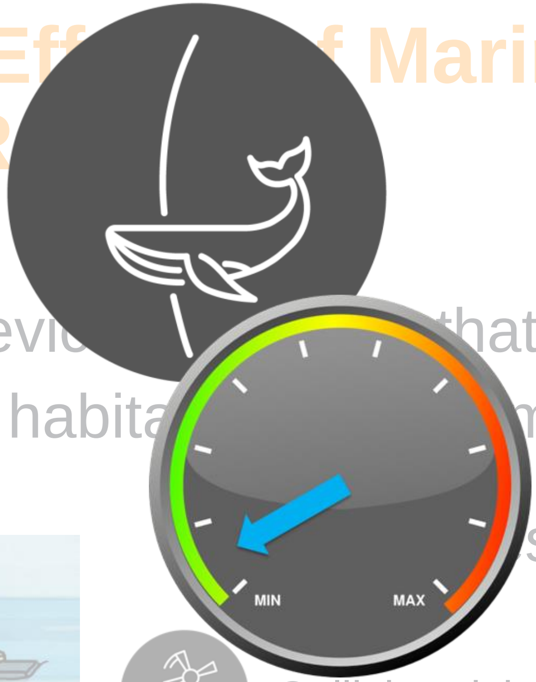

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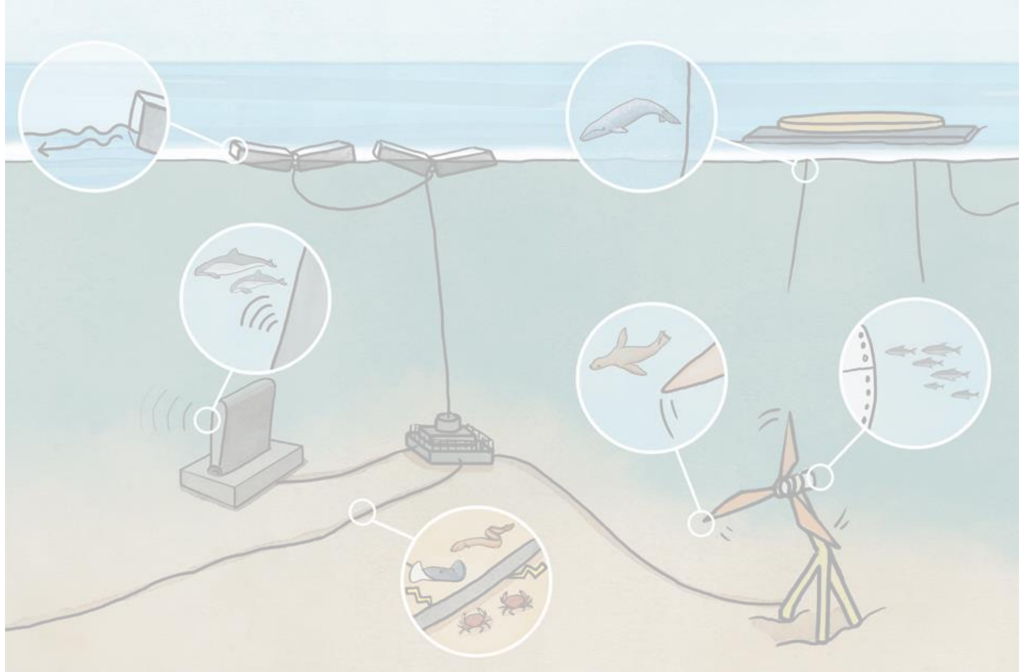

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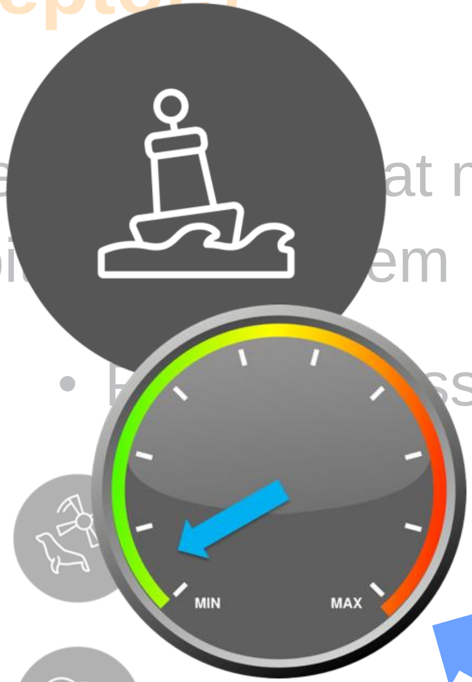

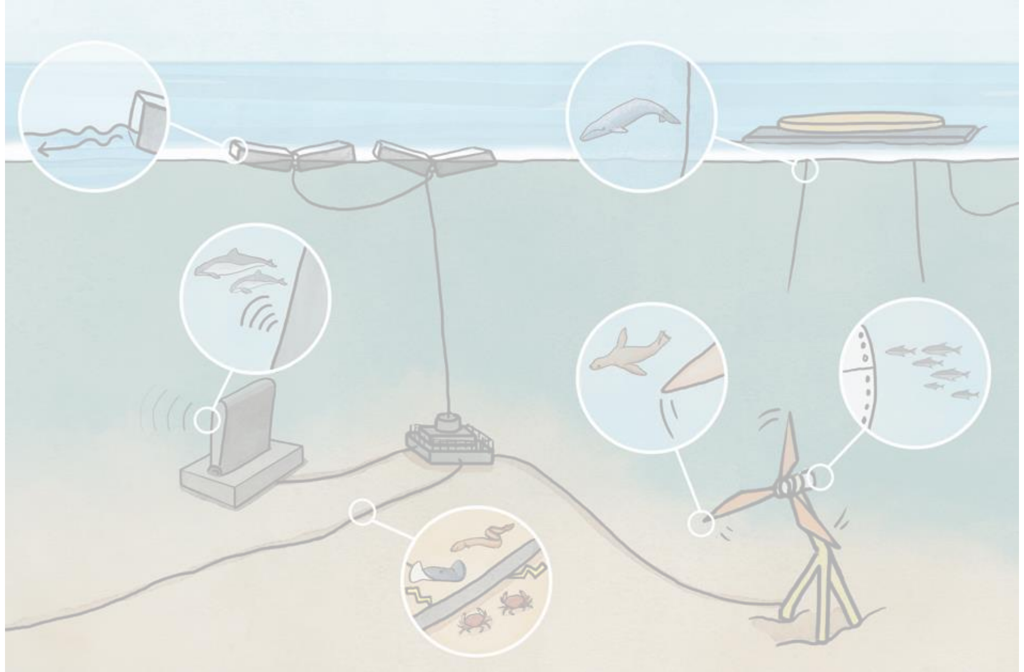

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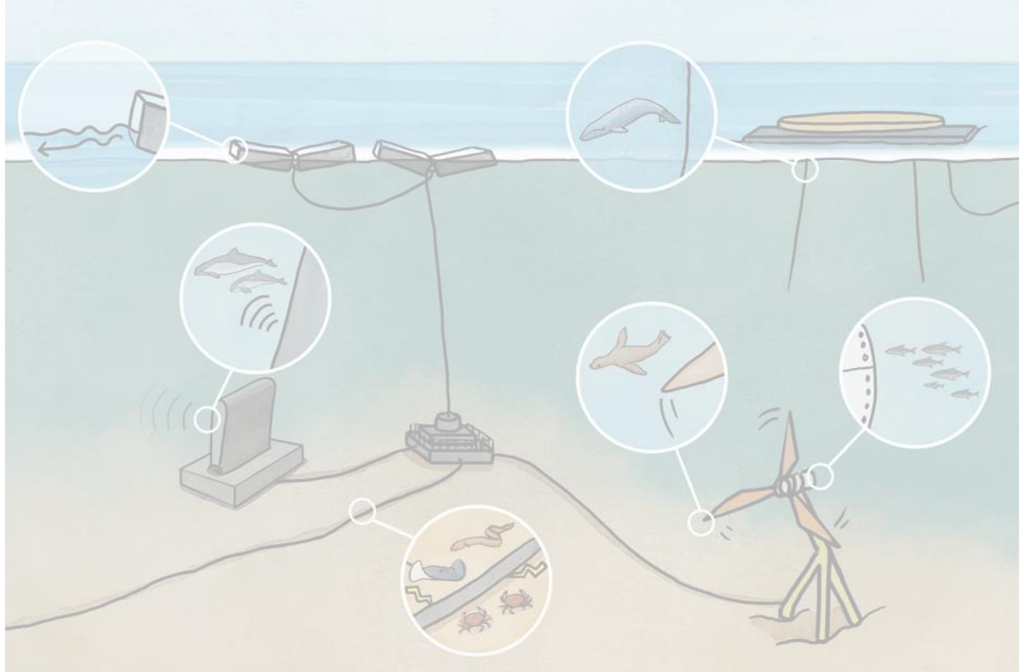

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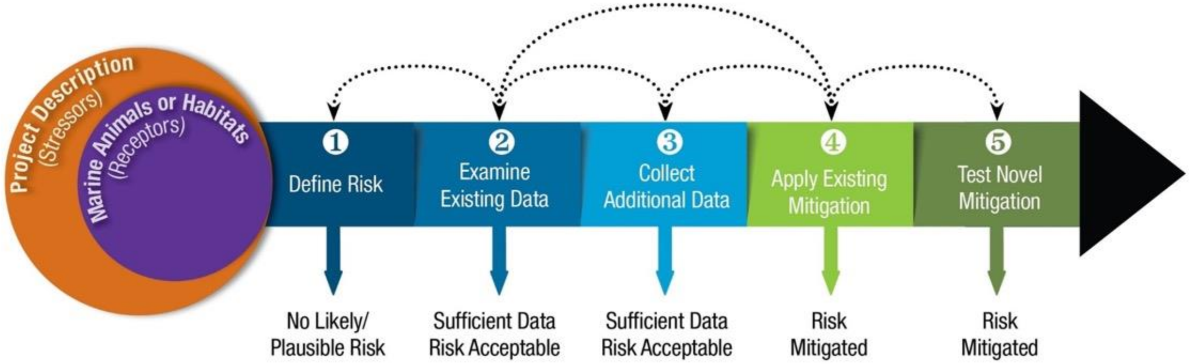
?

What needs to be done to apply what we know to permitting?

- Get existing info into the hands of regulators
- Special need to educate new regulators (lots turnover at agencies)
- Work towards systematic means of applying existing data to simply scoping of baseline and monitoring needs
- The *Risk Retirement*, *Data Transferability*, *Guidance Document* process we have developed under OES-Environmental is an example



https://tethys.pnnl.gov/risk-retirement

Risk Retirement

- For certain interactions, potential risks need not be fully investigated for every project for small developments (1-4 devices)
- Rely on what is already known – already permitted projects, research, or analogous industries
- A “retired risk” is not dead and can be revived in the future as more information becomes available for larger arrays
- Risk retirement does not replace or contradict any regulatory processes



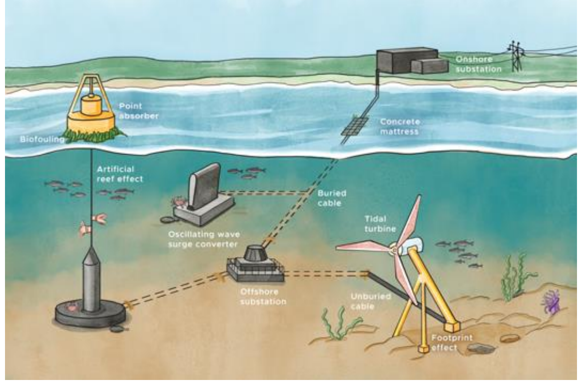
What else do we need to do to accelerate permitting and deployments?

- Community-wide agreement on priorities for environmental effects
  - (this has been done, lots)
- Determine which questions can be answered by targeted research projects
  - Give research community the problem
  - Fund research outside of developer budgets, at test centers, deployment sites
- Remaining monitoring questions:
  - Compliance monitoring – on the project developer
  - Long term monitoring – must be funded outside
  - Both must be question-driven, clear use of the data – no wasted effort, time, or funds!
- Ensure environmental data collection for:
  - Every open water test
  - Pilot project
  - Deployment of a device including

Status of Risks

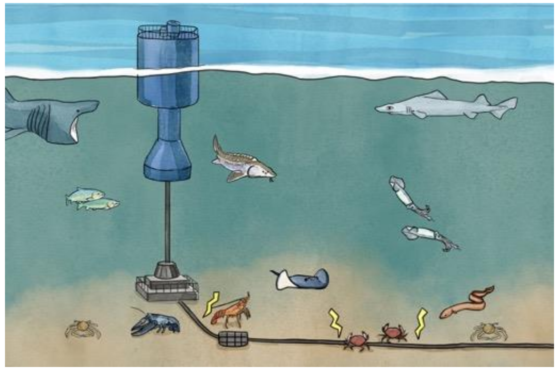
Based on these efforts, the following risks are considered "retired“ for small numbers of devices:

Habitat Change

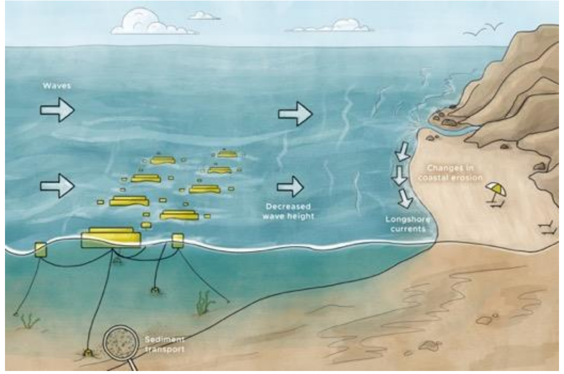


Underwater Noise

EMF



Changes in Oceanographic Systems



Thank You!

Andrea Copping

andrea.copping@pnnl.gov

Pacific Northwest National Laboratory

NREL
Transforming ENERGY

R&D investments to support the commercialization of marine energy technologies

Michael Lawson
NREL Marine Energy Lead

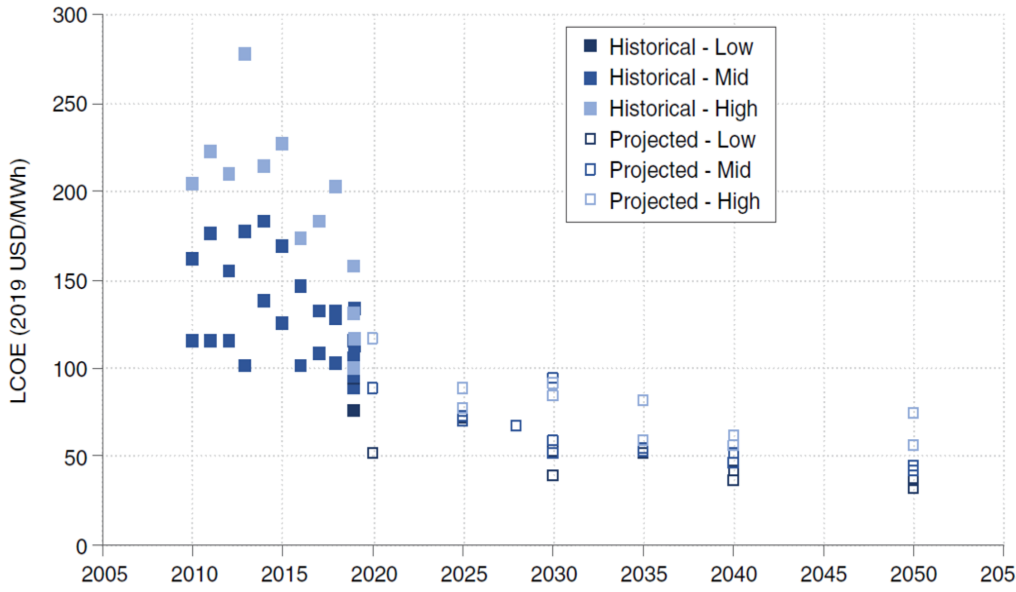
An ambitious and accelerated R&D program is needed for marine energy to contribute to carbon reduction goals in the next decade

Today << 1 MW installed in the US

US deployment goals:

2030 – 500 MW (Marine Energy Council)
2035 – 1 GW (Marine Energy Council)
2050 – 50+ GW to support a net-zero carbon economy (presenter's suggestion)

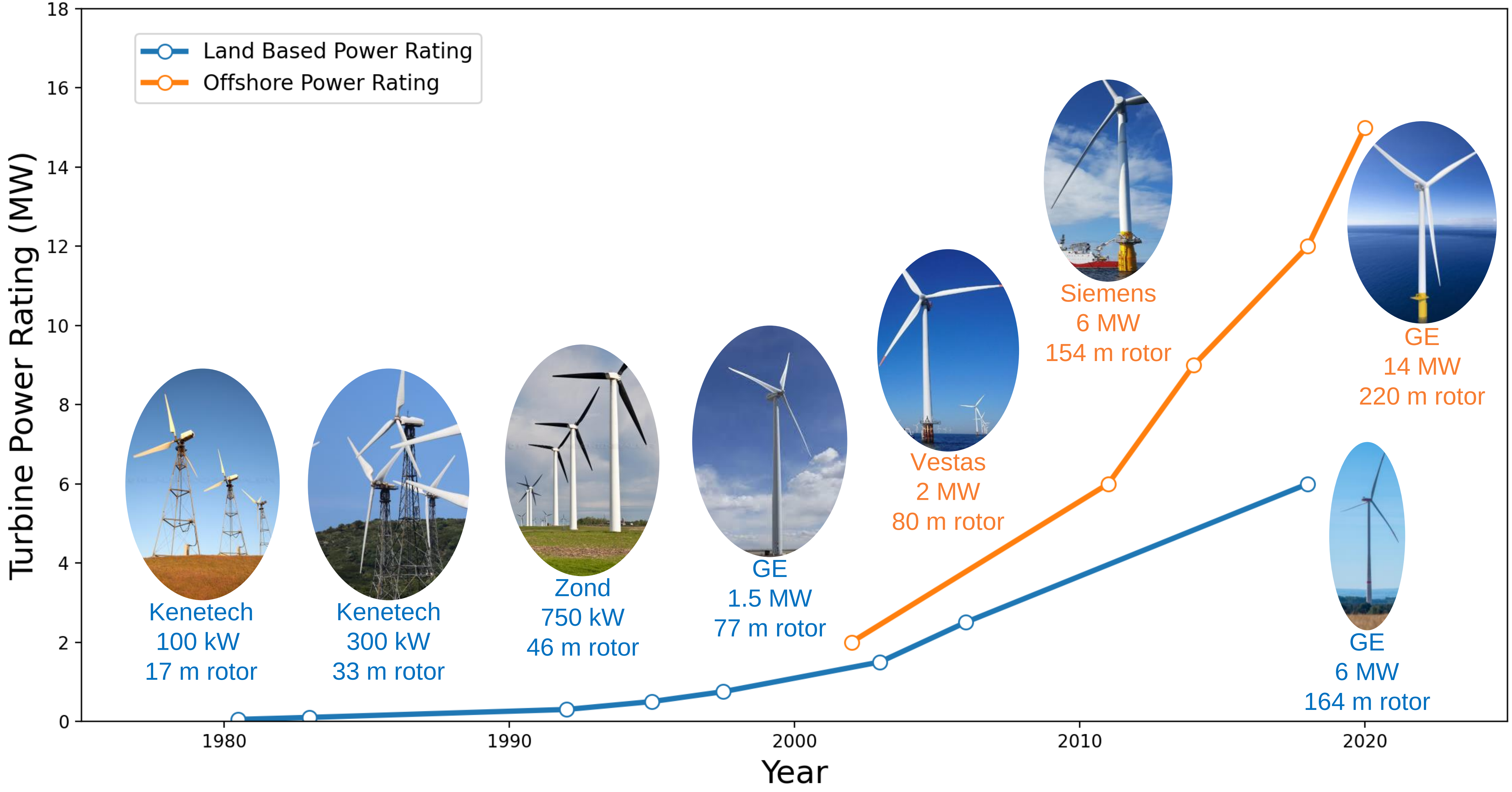
- Offshore wind will likely set the market price for ocean-based electricity -> LCOE $50-80 $/MWh by 2035.
- To compete, ME must achieve cost parody or provide characteristics that strengthen the energy system
- Significant increases in R&D activities and investments are needed to achieve deployment goals

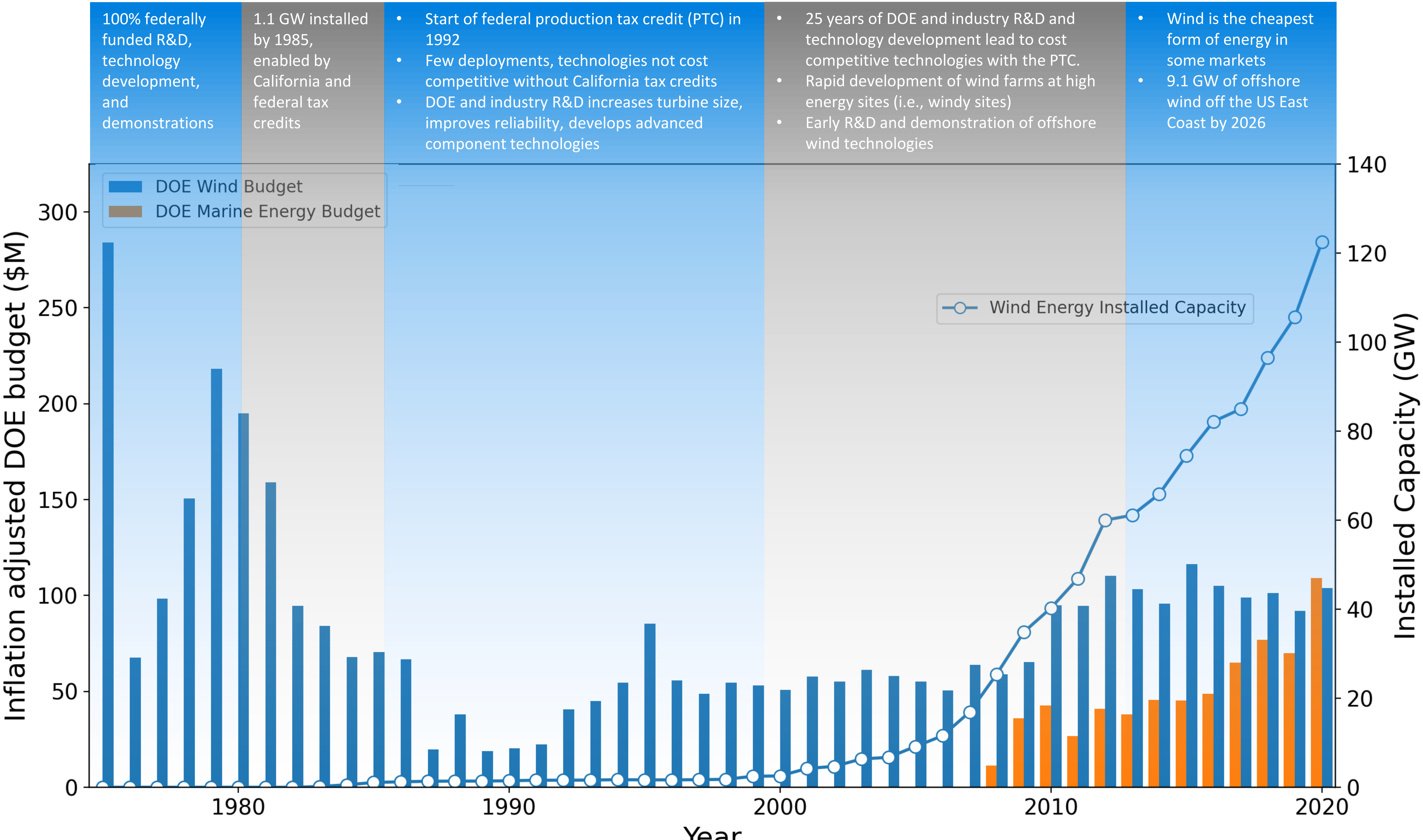


Projections for offshore wind LCOE

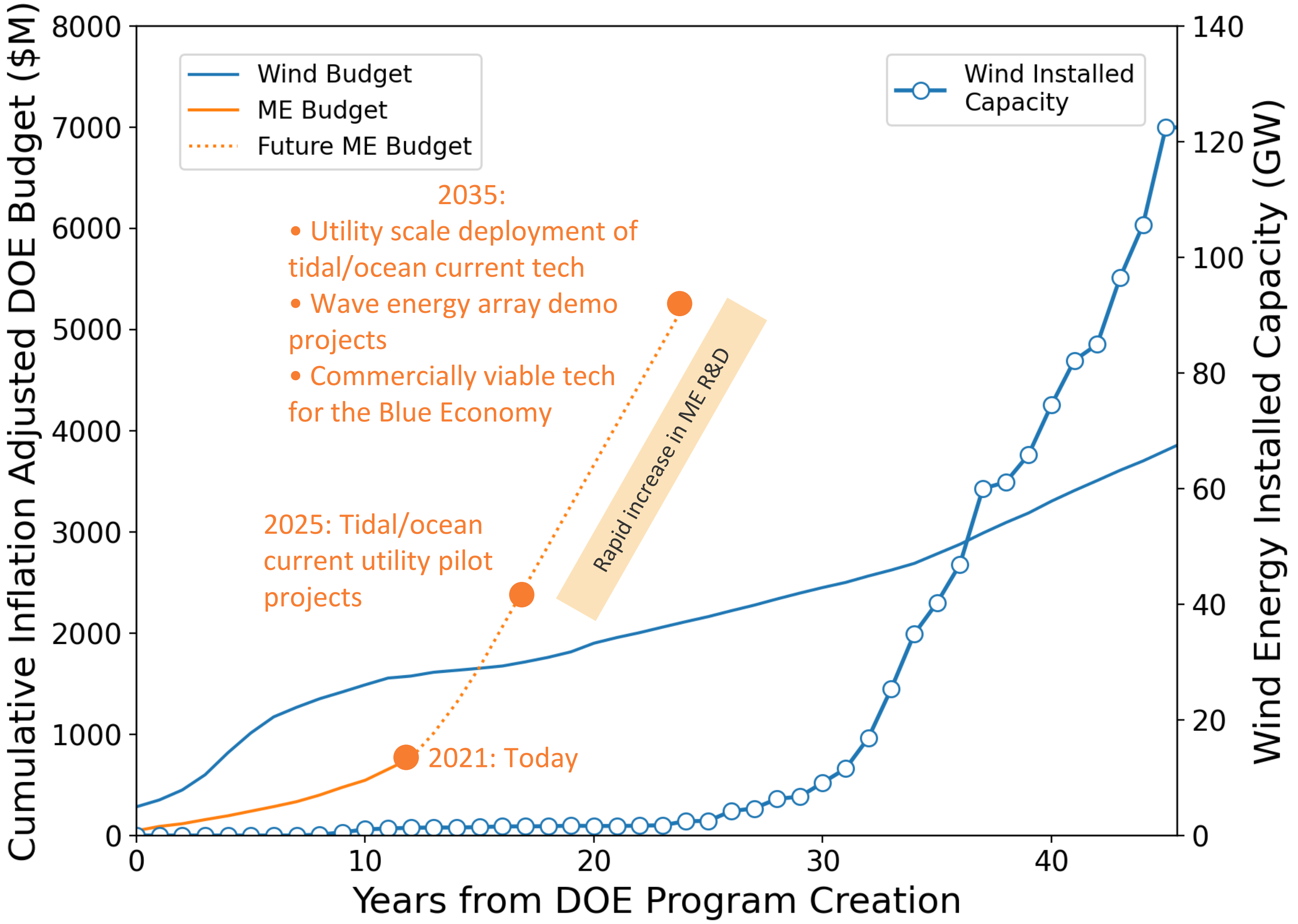
https://doi.org/10.1002/wene.398

What can we learn from the wind energy sector?





Increasing R&D activities and budgets **now** will enable marine energy to contribute to US energy needs by 2035



- A larger R&D budget is needed:
  - Budget is supporting 4 technologies (current, wave, OTEC) – wind had only 1
  - Complex marine environment compared to terrestrial technologies = expensive R&D
- If ME does not contribute by 2035, market penetration will become more challenging
- ME has attributes that complement other renewables and support the administration's decarbonization and energy justice goals

There is more to this story and more work is needed to quantify the benefits of ME

- This presentation focused on utility scale technologies to support large scale decarbonization. There are meaningful “blue economy” contributions for ME as well!

- Development of renewable technologies is global effort that requires govt. and private sector support, with early-stage R&D typically driven by govt. funding – Herein, we only considered the US govt. funding component.

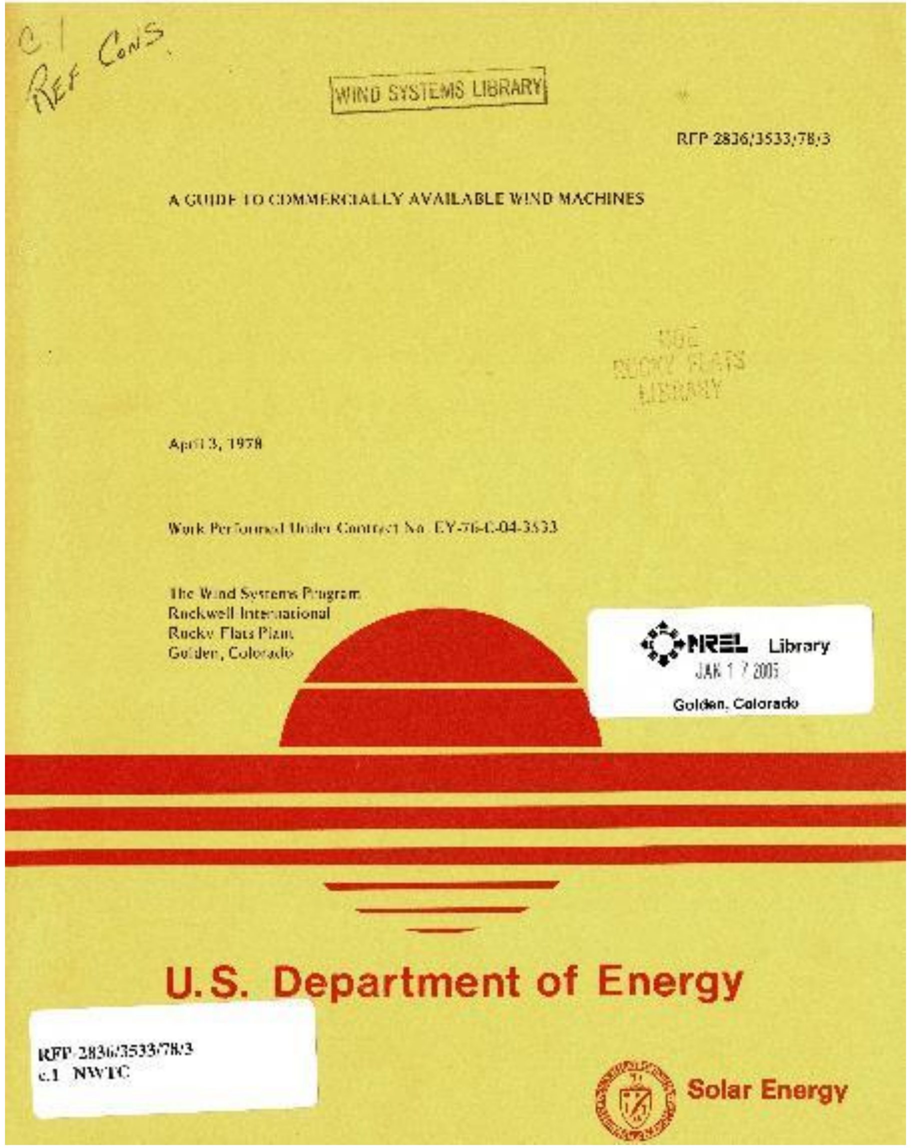
- The ME community needs to quantify ME’s unique value proposition to justify large scale investment. For example:
  - What are the benefits of ME in high penetration renewable energy scenarios?
    - Baseload power, predictability, reliability, system resilience, supply chain, etc.
  - What are the relevant land use and view-scape benefits that ME provides?
  - What are the economic and energy justice benefits ME can provide?

Early Non-grid Wind Energy Development Experience: Parallels for Powering the Blue Economy

Bob Thresher, NREL Senior Research Fellow Emeritus

October 19, 2021

Guide to Commercially Available Wind Turbines in 1978



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RFP 2836/3533/78/3

A GUIDE TO COMMERCIALLY AVAILABLE WIND MACHINES

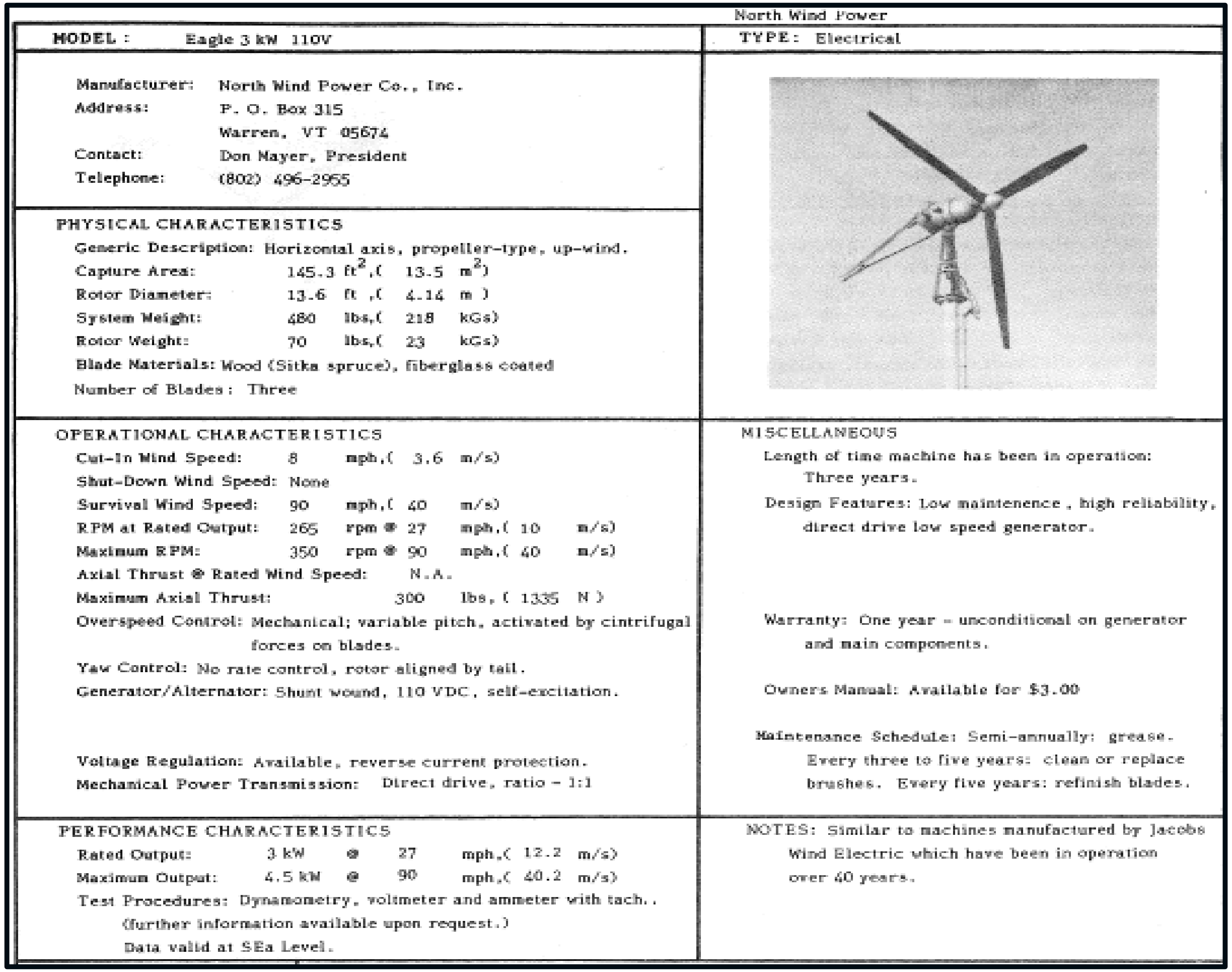
April 3, 1978

Work Performed Under Contract No. EY-76-C-04-3533

The Wind Systems Program
Rockwell International
Rocky Flats Plant
Golden, Colorado

U.S. Department of Energy

Solar Energy



North Wind Power

MODEL : Eagle 3 kW 110V

TYPE: Electrical

Manufacturer: North Wind Power Co., Inc.
Address: P. O. Box 315
Warren, VT 05674
Contact: Don Mayer, President
Telephone: (802) 496-2955

PHYSICAL CHARACTERISTICS

Generic Description: Horizontal axis, propeller-type, up-wind.
Capture Area: 145.3 ft^2,(13.5 m^2)
Rotor Diameter: 13.6 ft ,(4.14 m)
System Weight: 480 lbs,(218 kGs)
Rotor Weight: 70 lbs,(23 kGs)
Blade Materials: Wood (Sitka spruce), fiberglass coated
Number of Blades : Three

OPERATIONAL CHARACTERISTICS

Cut-In Wind Speed: 8 mph,(3.6 m/s)
Shut-Down Wind Speed: None
Survival Wind Speed: 90 mph,(40 m/s)
RPM at Rated Output: 265 rpm @ 27 mph,(10 m/s)
Maximum RPM: 350 rpm @ 90 mph,(40 m/s)
Axial Thrust @ Rated Wind Speed: N.A.
Maximum Axial Thrust: 300 lbs, (1335 N)
Overspeed Control: Mechanical; variable pitch, activated by cintrifugal forces on blades.
Yaw Control: No rate control, rotor aligned by tail.
Generator/Alternator: Shunt wound, 110 VDC, self-excitation.

Voltage Regulation: Available, reverse current protection.
Mechanical Power Transmission: Direct drive, ratio - 1:1

PERFORMANCE CHARACTERISTICS

Rated Output: 3 kW @ 27 mph,(12.2 m/s)
Maximum Output: 4.5 kW @ 90 mph,(40.2 m/s)
Test Procedures: Dynamometry, voltmeter and ammeter with tach.,
(further information available upon request.)
Data valid at SEa Level.

MISCELLANEOUS

Length of time machine has been in operation:
Three years.
Design Features: Low maintenence, high reliability,
direct drive low speed generator.

Warranty: One year - unconditional on generator
and main components.

Owners Manual: Available for $3.00

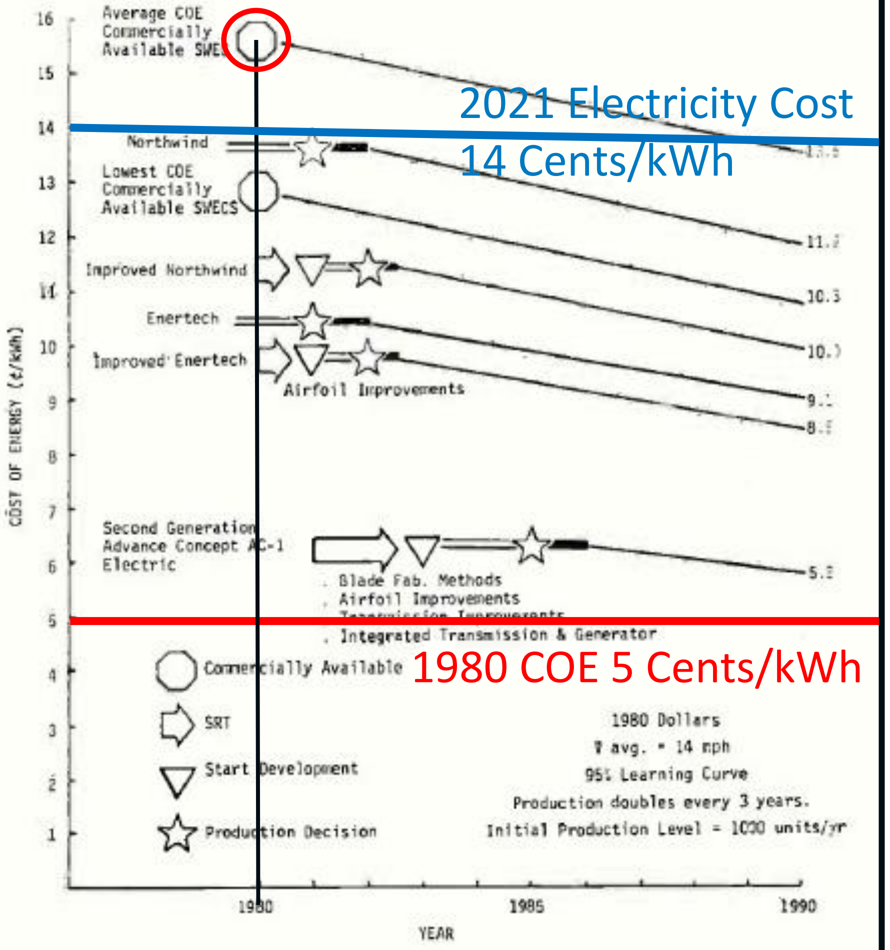
Maintenance Schedule: Semi-annually: grease.
Every three to five years: clean or replace
brushes. Every five years: refinish blades.

NOTES: Similar to machines manufactured by Jacobs
Wind Electric which have been in operation
over 40 years.

State-of-the-Art Assessment of Small Wind Energy Converters

Figure 13

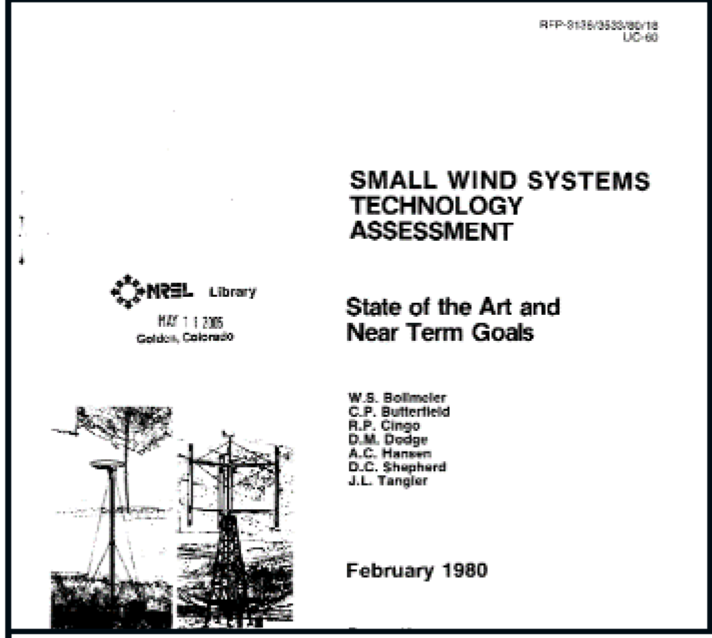
Projected SWECS Cost of Energy (3-6 meter)



LCOE of Commercial Turbines 1980

2021 Electricity Cost
14 Cents/kWh

1980 COE 5 Cents/kWh



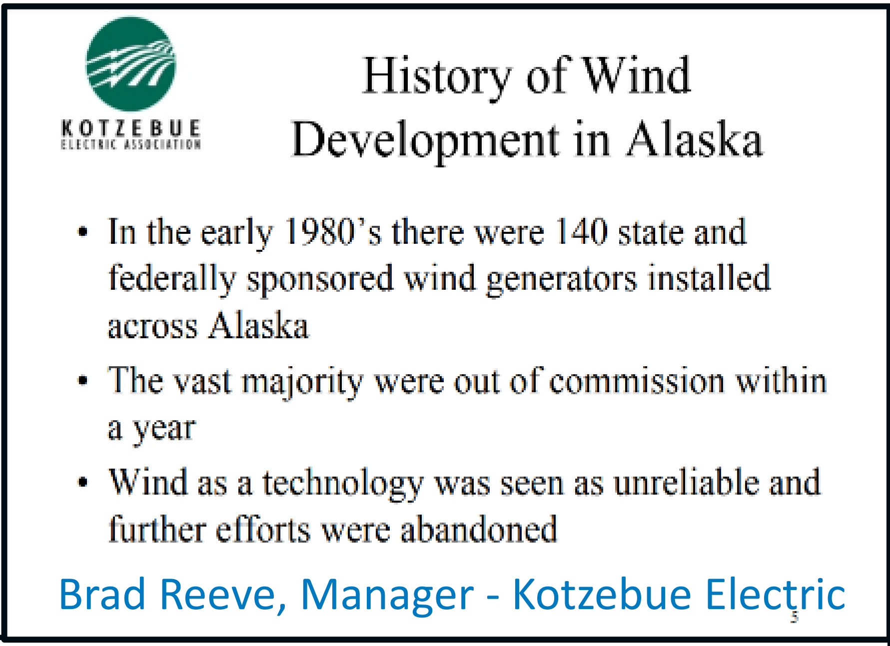
RFP-3135/3533/80/18
UC-60

SMALL WIND SYSTEMS
TECHNOLOGY
ASSESSMENT

State of the Art and
Near Term Goals

W.S. Bollmeier
C.P. Butterfield
R.P. Cingo
D.M. Dodge
A.C. Hansen
D.C. Shepherd
J.L. Tangler

February 1980



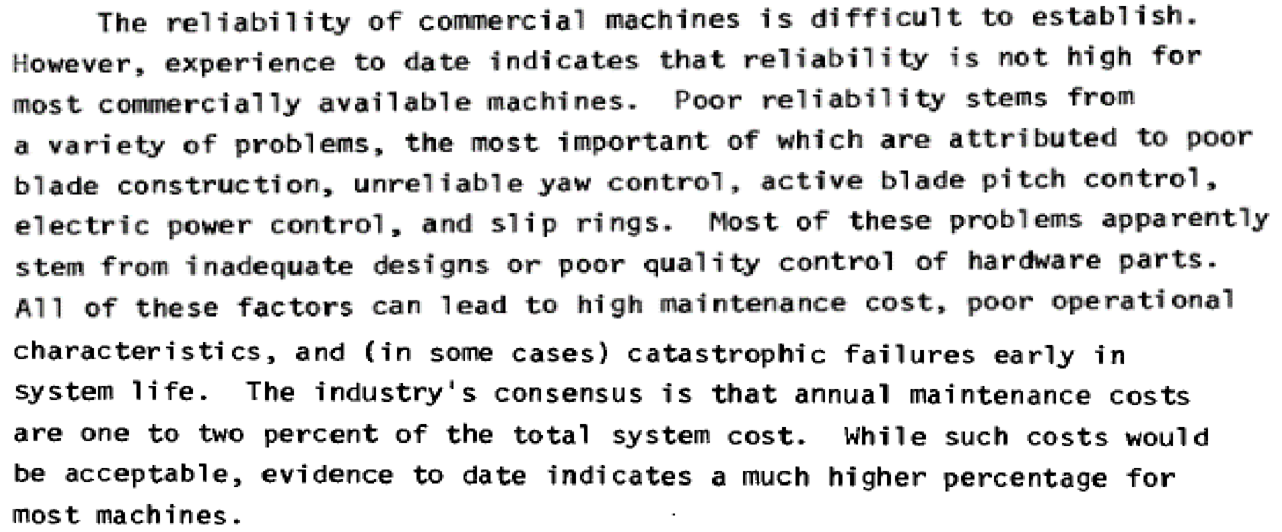
KOTZEBUE
ELECTRIC ASSOCIATION

History of Wind
Development in Alaska

- In the early 1980's there were 140 state and federally sponsored wind generators installed across Alaska
- The vast majority were out of commission within a year
- Wind as a technology was seen as unreliable and further efforts were abandoned

Brad Reeve, Manager - Kotzebue Electric

Excerpt from Small Wind System Technology Assessment



The reliability of commercial machines is difficult to establish. However, experience to date indicates that reliability is not high for most commercially available machines. Poor reliability stems from a variety of problems, the most important of which are attributed to poor blade construction, unreliable yaw control, active blade pitch control, electric power control, and slip rings. Most of these problems apparently stem from inadequate designs or poor quality control of hardware parts. All of these factors can lead to high maintenance cost, poor operational characteristics, and (in some cases) catastrophic failures early in system life. The industry's consensus is that annual maintenance costs are one to two percent of the total system cost. While such costs would be acceptable, evidence to date indicates a much higher percentage for most machines.

DOE - RFP High Reliability Project | Phase 1 – 1978-79

North Wind Power Company, Inc
Warren, Vermont

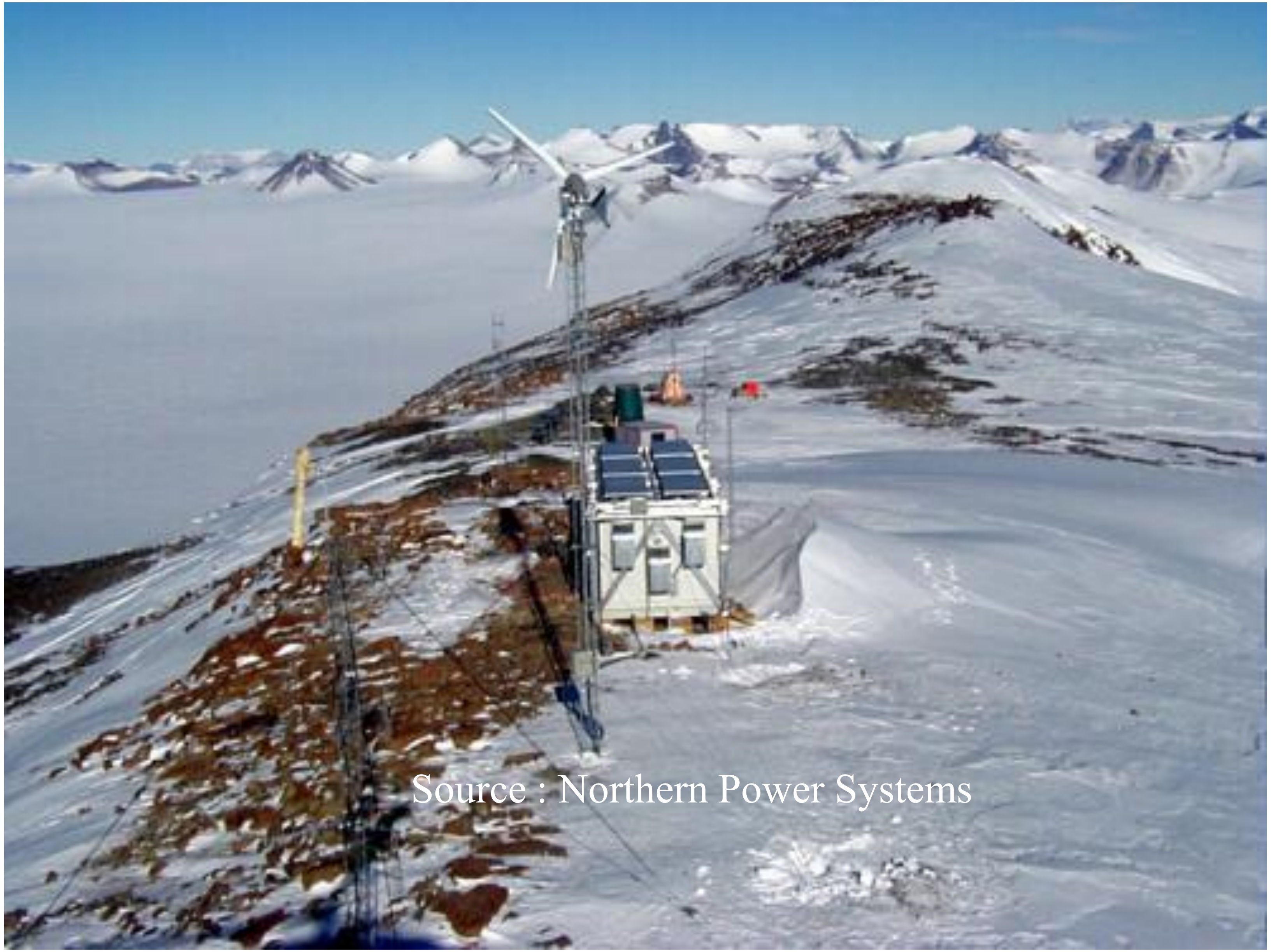
- 2 kW Development Prototype
- 5 m rotor Diameter
- Sitka Spruce Blades
- Tilt-up rotor power control
- Tip speed ratio 7.5
- Tail yaw control
- Fixed pitch
- Truss tower

North Wind 2 Kilowatt High Reliability Prototype
(1980 Photo)

Source: North Wind Power Company 2 - Kilowatt High Reliability Wind System Phase 1 – Design and Analysis Report. RFP-3310/1, July 1981

Mt. Newall, Antarctica

- Science Foundation Station project
- Repeater and Seismic monitoring station
- Power System
  - 3.3 kW PV array
  - Diesel generator
  - HR3 wind turbine



Source : Northern Power Systems

NPS 100 – Artic Turbine Development SBIR (NASA) & CRADA (DOE)

Northern Power Systems

Barre, Vermont

- 100 kW
- Direct drive permanent magnet
- Variable speed
- 21-24 Meter diameter rotor
- Fiberglass blades
- Fixed pitch
- Yaw control
- Tubular tower
- Designed for –40C

http://www.northernpower.com/

Development Tests NWTC

Alaskan Village Coop

Byers Auto 2012

NREL PICs 14406 &18221

DOE - RFP Development Project Phase 1 – 1979-80

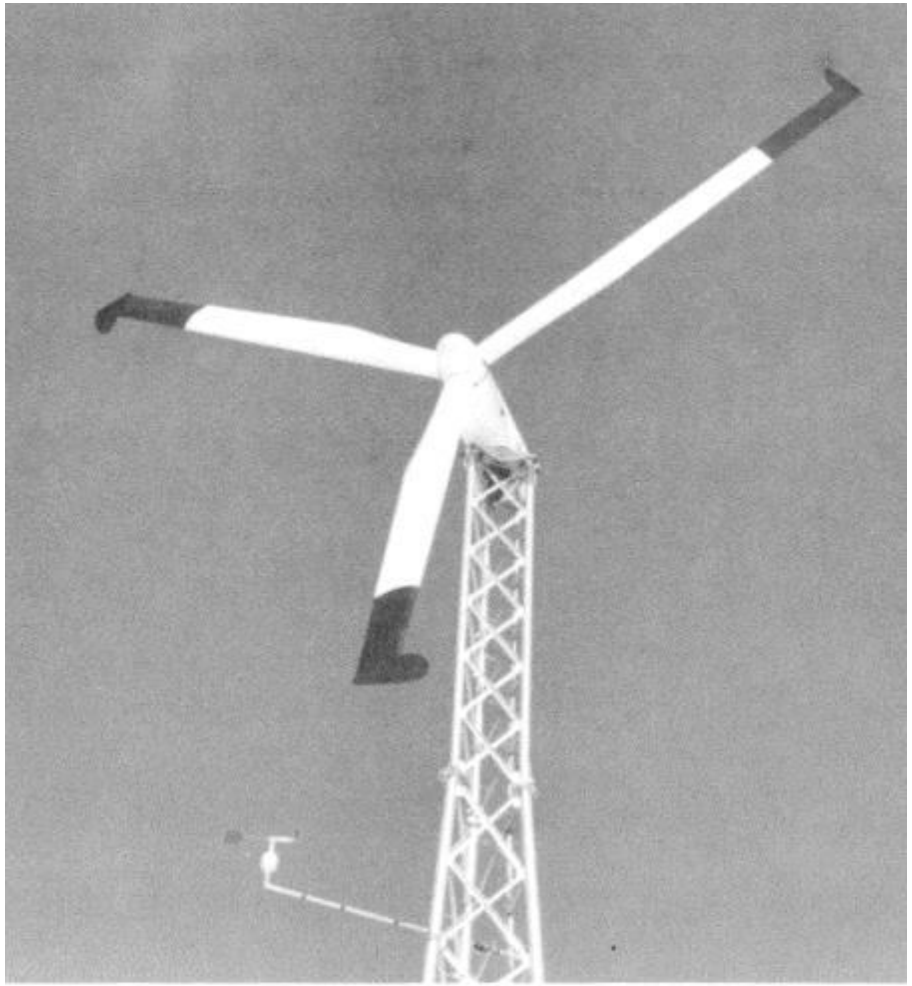
Enertech Corporation

Norwich, Vermont

- 15 kW Development Prototype
- 44 - foot rotor diameter
- Laminated wood blades
- Tip brakes for overspeed control
- Downwind
- Free yaw
- Fixed pitch
- Truss tower

Figure 53

Typical Operation in Wind Speeds Below 11 m/s
(Good Alignment)



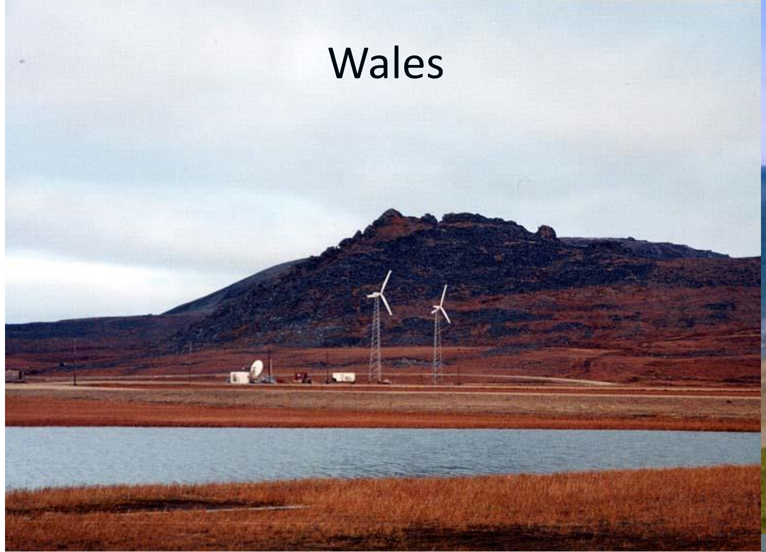
Source: Enertech 15 kW Wind System
Phase 1 Development Report
RFP-3341/2, September 1981

Enertech 15 kW Wind System Prototype (1981 Photo)

Remote Communities in Northern Alaska

Wales, Alaska ~ 2002

- 80kW average load with 2 AOC 15/50 wind turbines
- Short term battery storage with rotary converter
- Resistive loads used for heating and hot water
- Operation with all diesels turned off
- Problems with maintenance and operation
- AVAC, KEA and NREL
- https://www.nrel.gov/docs/fy02osti/31755.pdf



Wales

Wales

Kozebue, Alaska

The first turbines to be installed were three Atlantic Orient Corporation (AOC) 15/50, 50-kW wind turbines on lattice towers on a location south of the main town and airstrip. Since that time, the wind farm has grown to an installed capacity of 915 kW comprised of 17 turbines: 15 AOC 15/50 or Entegrity EW50 (50 kW); one remanufactured Vestas V17 (65 kW); and one Northern Power Systems Northwind 100/19 (100 kW) wind turbine.

https://www.youtube.com/watch?v=4xna4-PSlUU

Brad Reeve
Kotzebue Electric
Association

Wales

Summary Message

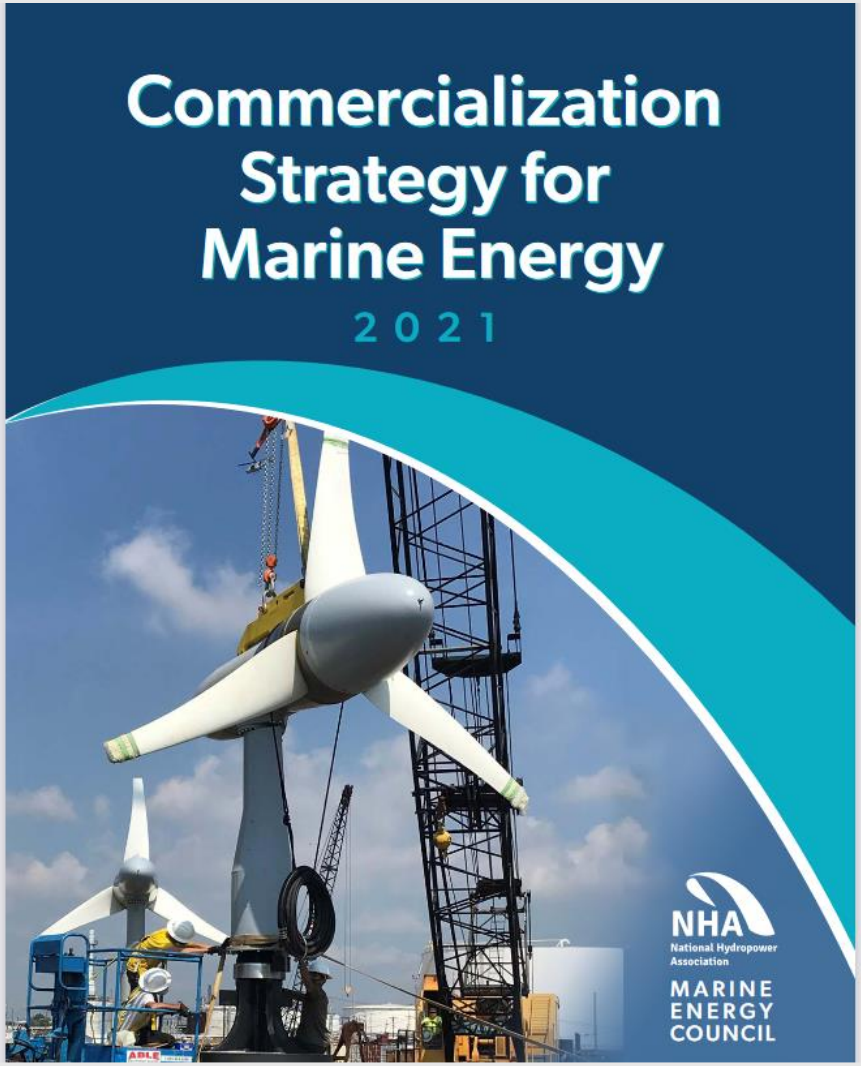
- Non-grid energy users can provide early adopter markets for ocean energy technologies due the higher energy costs
- High-force, low-speed energy generation concepts can be designed to be cost effective in these markets
- Innovation, design evolution, and concept refinements are less costly at smaller scales
- Prototypes units can and should be built and rigorously reliability tested prior to deployment in a remote location
- Non-grid energy users expect a reliable power system that is customized, installed, and maintained to meet their needs
- Scaling small devices to enter the bulk utility market is possible, but concepts need to be adapted, redesigned and tested

Thank you!

www.nrel.gov

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

BREAK
Please return at 2:30 PM



Commercialization Strategy for Marine Energy

2021

NHA
National Hydropower Association

MARINE
ENERGY
COUNCIL

Deployment Targets

U.S. marine energy technology deployments of at least:

- **50 MW by 2025**
- **500 MW by 2030**
- **1 GW by 2035**

Federal Actions to Accelerate Marine Energy Deployment

1. **System Design, Fabrication, and Demonstration**
2. **Fostering Distributed Generation Capabilities**
3. **Emerging Opportunities for Off-Grid Power**
4. **Foundational Research and Engineering Assistance**
5. **Testing Infrastructure and Validation Support**
6. **Financial Incentives for Deployment**
7. **Leveraging International Experience and Standards**
8. **Streamlining Permitting and Reducing Regulatory Barriers**
9. **Workforce Development**
10. **Federal Planning, Staffing, and Industry Engagement**

Breakout 1: PATHWAY TO WHERE?

U.S. marine energy technology deployments of at least:

- **50 MW by 2025**
- **500 MW by 2030**
- **1 GW by 2035**

Breakout Questions:

- **Are targets correct?**
- **Are the 10 actions correct?**
- **What needs to change to get endorsement?**

Federal Actions to Accelerate Marine Energy Deployment:

1. **System Design, Fabrication, and Demonstration**
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9. **Workforce Development**
10. **Federal Planning, Staffing, and Industry Engagement**

Federal Actions to Accelerate Marine Energy Deployment

1. **System Design, Fabrication, and Demonstration** – Increased funding to support research, design advancement, testing, and validation of marine energy systems, sub-systems, and components. These innovation efforts are critical to increasing demonstration and deployment opportunities and reducing overall Levelized Cost of Energy (LCOE).
2. **Fostering Distributed Generation Capabilities** – New investments related to identifying and initiating infrastructure upgrades are needed to support high-value, near-term distributed market generation opportunities at scale for marine energy.
3. **Emerging Opportunities for Off-Grid Power** – Increased funding for the DOE "Powering the Blue Economy" initiative, which will expand the near-term commercial value of power generated by marine energy devices and related services.
4. **Foundational Research and Engineering Assistance** – Expansion of the research, engineering support, and workforce development activities underway at university-based National Marine Energy Centers, the National Labs, and other qualified non-profit institutions.
5. **Testing Infrastructure and Validation Support** – Additional funding to expand existing and establish new testing infrastructure (including grid connection and deployment equipment) for marine energy devices along with support for technology validation activities.

Federal Actions to Accelerate Marine Energy Deployment

6. **Financial Incentives for Deployment** – Implementation of an aggressive and innovative incentive regime that facilitates rapid development and deployment of marine energy technologies and related services.
7. **Leveraging International Experience and Standards** – Increased Federal agency coordination and stakeholder education related to global lessons learned on technology innovation, deployments, and environmental interactions. The U.S. must also continue to support development and usage of global technology standards and certifications which will provide confidence to customers and financial markets.
8. **Streamlining Permitting and Reducing Regulatory Barriers** – A clear, timely, and predictable regulatory framework is required for siting and permitting marine energy testing and demonstration projects.
9. **Workforce Development** – Increased funding for programs that build a strong, diverse, and inclusive marine energy workforce.
10. **Federal Planning, Staffing, and Industry Engagement** – The programs and investments outlined above must be informed by the needs of the domestic marine energy sector to sustain and accelerate a long-term approach to commercialization efforts.

CLEAN CURRENTS 2021

Where Waterpower Moves Forward | Powered by NHA

NHA-MEC Industry Priorities Working Group

Summary and Survey Results

History

- NHA-MEC established Industry Priorities Working Group (IP WG)
  - Co-Chairs Tim Mundon (Oscilla Power) and Jonathan Colby (Verdant Power)
- Good participation and membership
  - 4 wave developers
  - 2 tidal developers
  - POET & UW
- Monthly meetings
- Agreed on Vision and Scope
- Conducted a survey with IP WG members to prioritize needs

IP WG: Vision

1. Support the NHA-MEC in providing a common voice and platform regarding the needs of the Marine Energy industry in the US.

2. Provide direct feedback to the NHA-MEC regarding technical areas for funding and/or clear gaps in knowledge.

3. Identify common priorities for technology developers across the range of Marine Energy resources.

IP WG: Scope

1. Report to NHA-MEC
2. Develop position papers
3. Provide prioritized lists of funding and research areas of interest
4. Survey industry members regularly regarding priority areas
5. Maintain a broad range of industry stakeholders on the Working Group as best possible

Priorities Survey Results – HIGHEST PRIORITY

1. Continued support of processes that will retire environmental risk
2. Export cables; Anchoring; Mooring
3. Controls/Power Take-off optimization
4. Installation, Operation, Maintenance
5. Standards supported and based development of MEC's suitable for the utility-scale market

Priorities Survey Results – MEDIUM PRIORITY

1. Health monitoring of dynamic elements including predictive maintenance
2. Non-electrical applications such as direct desalination
3. Manufacturing
4. Personnel/electrical safety
5. Power aggregation of multiple MEC

Priorities Survey Results – LOWER PRIORITY

1. Basic Research
2. Circular economy
3. Advanced materials development
4. Alternative power carriers to eliminate the export cable
5. Technology Qualification at earlier TRL
6. Array testing facilities
7. Data Issues
8. Hybrid systems

Scale Considerations – Definitions for Discussion

Micro-scale: MEC for powering isolated oceanographic instrumentation or similar.

Community-scale: MEC that could be installed individually to support a facility or community (may or may not be grid-connected)

Utility-scale: MEC that are intended to be installed in arrays to provide commodity power to a distribution network (i.e., implies grid-connected).

Breakout 2: HOW DO WE GET THERE?

Priorities Survey Results – HIGHEST PRIORITY:

1. Continued support of processes that will retire environmental risk
2. Export cables; Anchoring; Mooring
3. Controls/Power Take-off optimization
4. Installation, Operation, Maintenance
5. Standards supported and based development of MEC's suitable for the utility-scale market

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5. Technology Qualification at earlier TRL
6. Array testing facilities
7. Data Issues
8. Hybrid systems

Breakout Questions:

- **Are the top priorities the right ones?**
- **What are we missing?**

Thank you

Join the Marine Energy Council

Contact Luciana Ciocci at

Luciana@hydro.org