

# French-American Innovation Day Northeastern University

March 18, 2019

*Research Initiatives, Testing Infrastructure and the*



*Convening Initiative*

Eric Hines and Dan Kuchma



School of  
Engineering

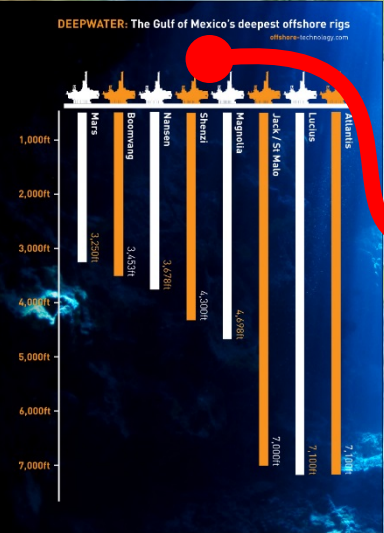




\$



€



This is happening now.



Ten years ago...

# TESTING TOMORROW'S TURBINES

The recently completed Wind Technology Testing Center, in Charlestown, Massachusetts, is the largest facility in the world for testing wind turbine blades. Featuring three posttensioned-concrete stands supported by a massive reaction footing on drilled concrete shafts, the center is capable of testing blades up to 90 m long and is expected to greatly facilitate efforts to increase wind power.

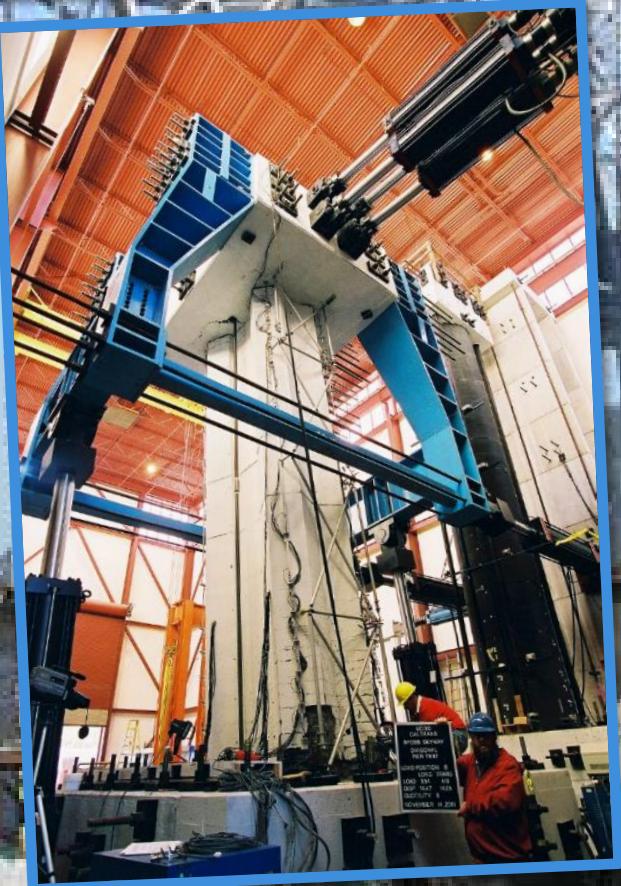
By Eric M. Hines, Ph.D., P.E., M.ASCE,  
and Mysore V. Ravindra, P.E.





# *Design for Durability*

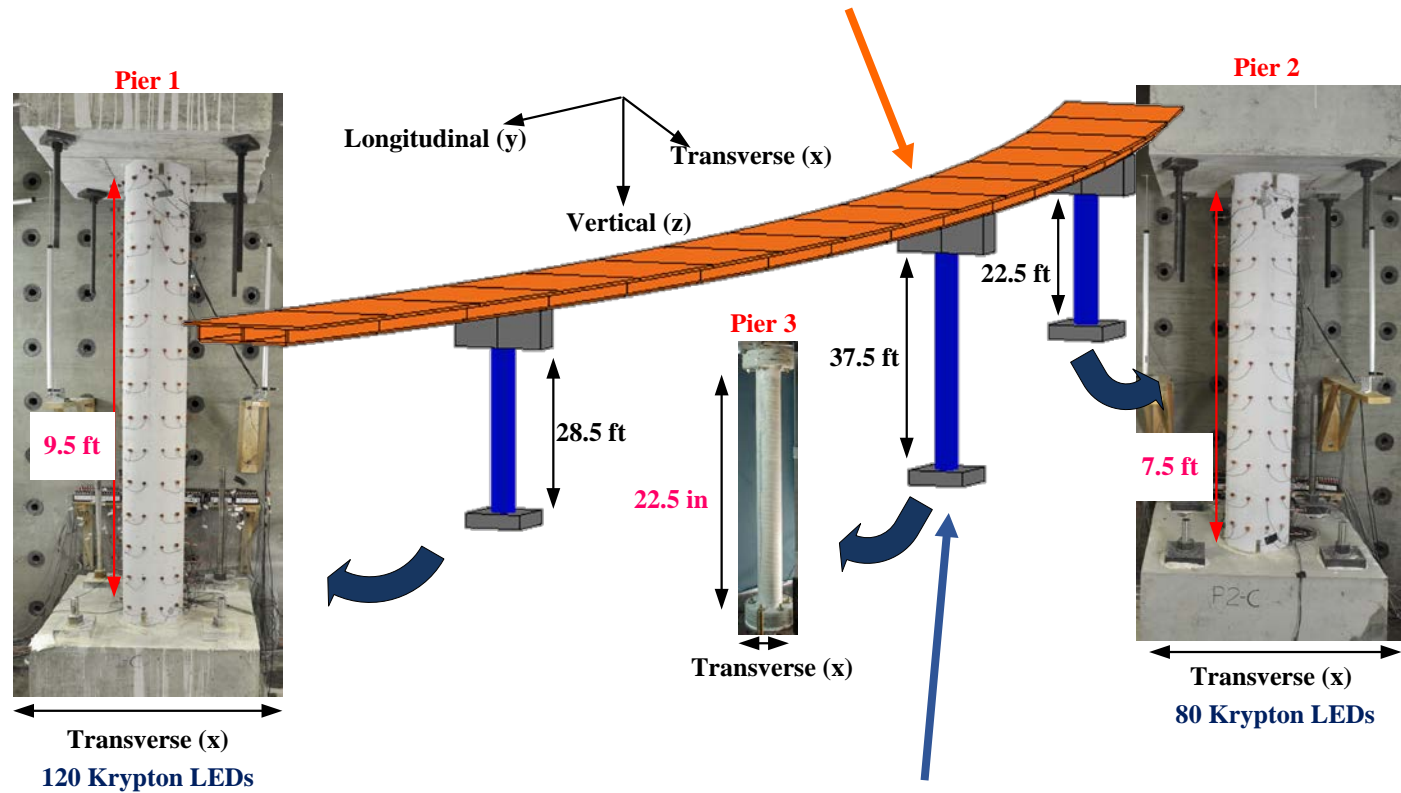
**Twenty years ago...**



150 year life span | 1500 year earthquake

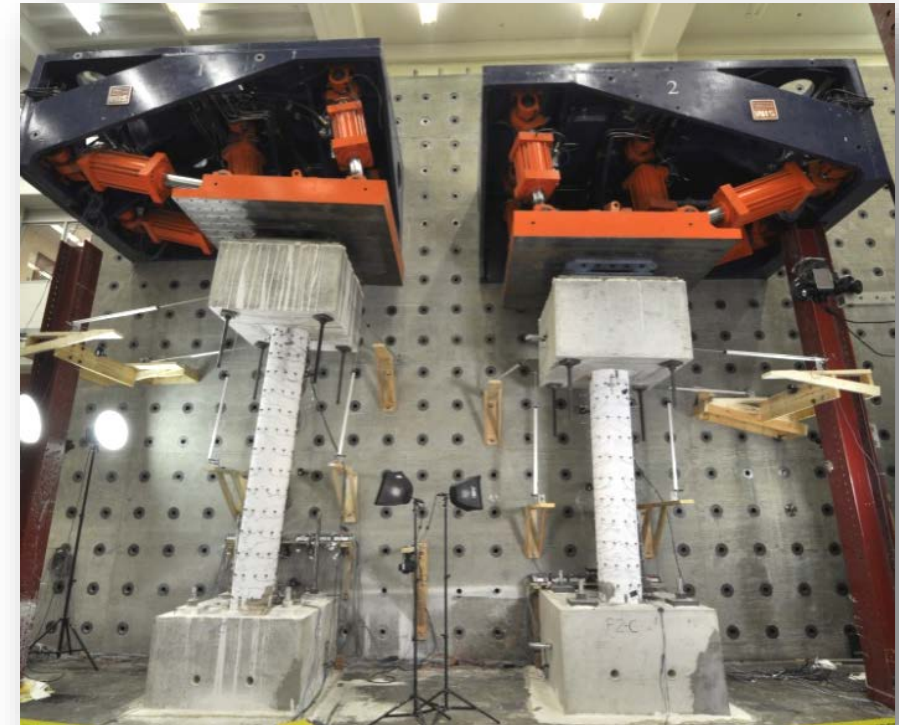
# NEES: Large Scale Testing and Hybrid Simulation

computational model of bridge deck



computational model soil-structure interaction

6-dof loading and boundary condition boxes



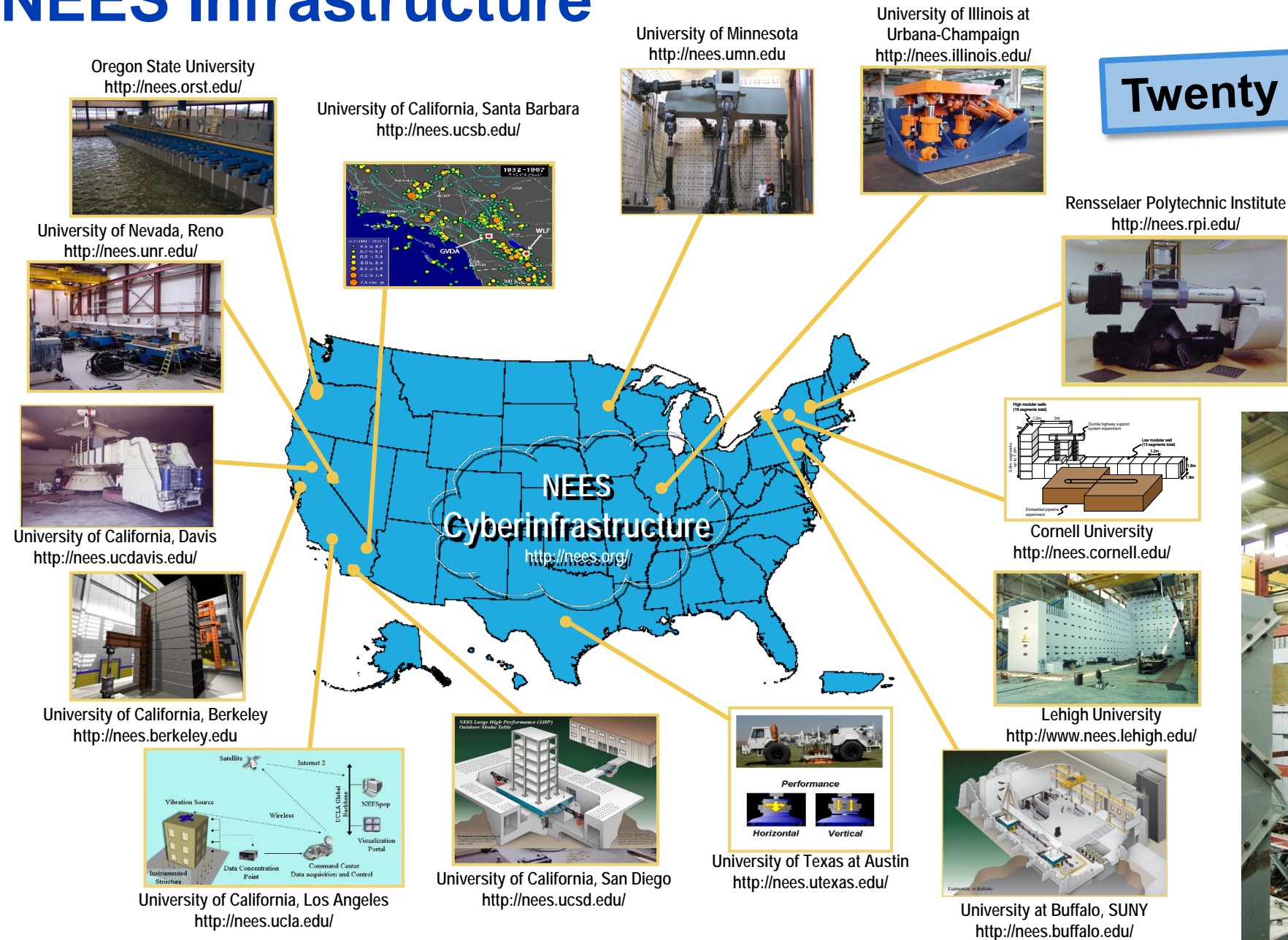
Fifteen years ago...



# NEES Infrastructure

Twenty years ago...

national  
shared research  
assets



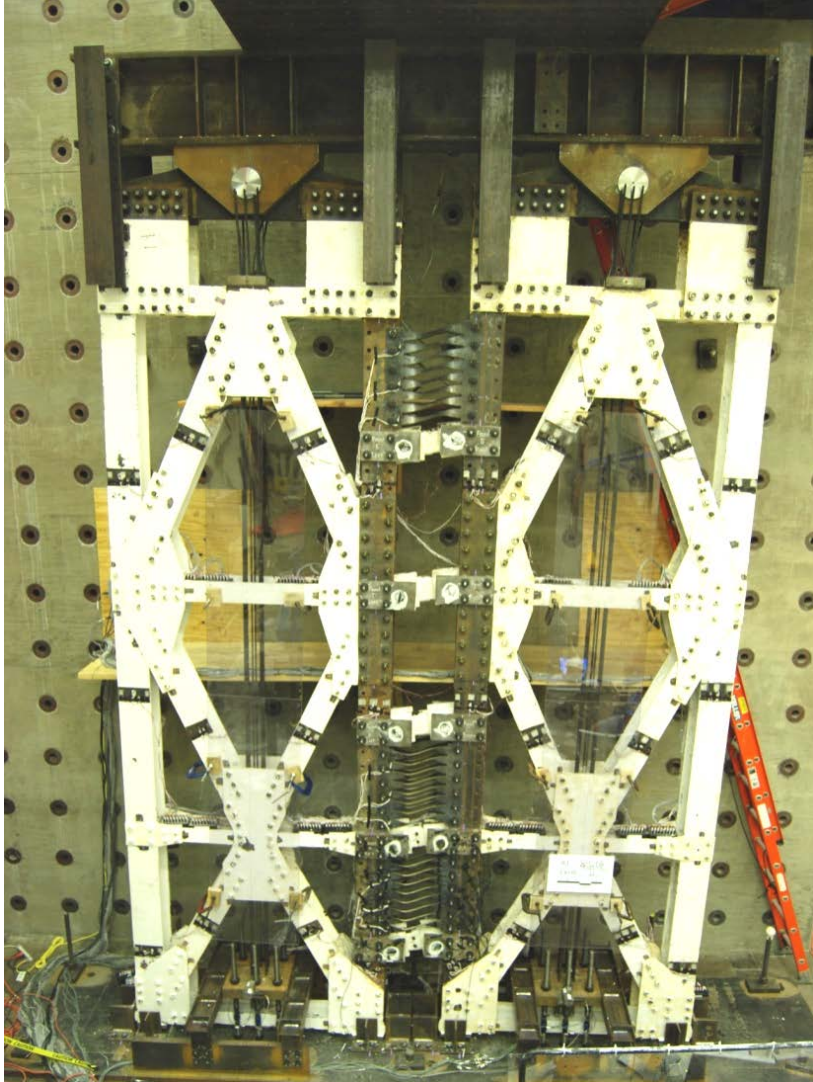


# NEES: International Collaboration

Fifteen years ago...

University of Illinois, Urbana-Champaign

E-Defense, Japan

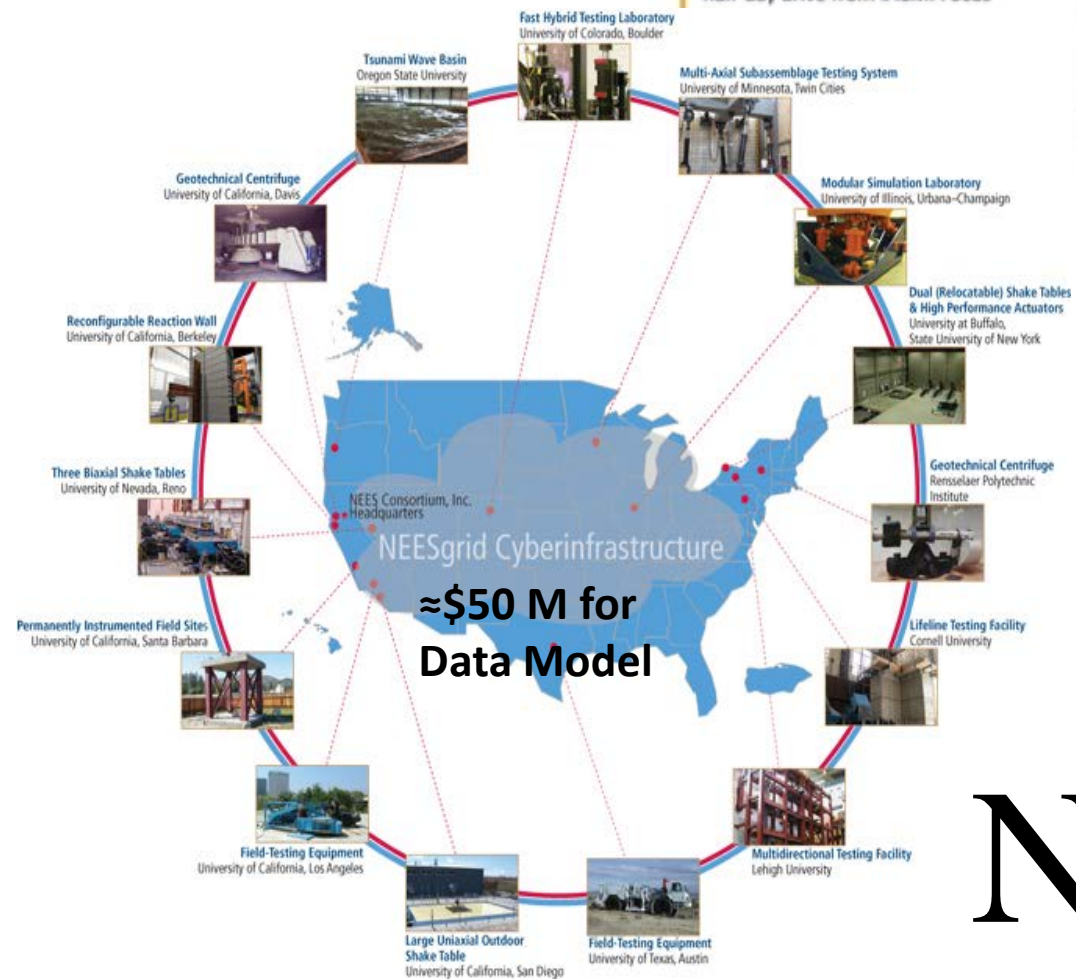
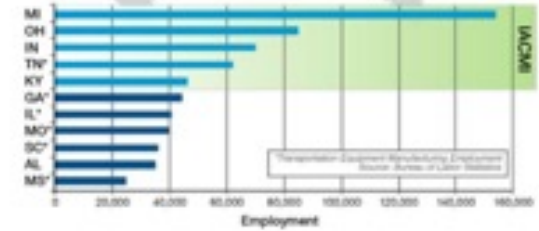






# iacmi

- >70% of automotive production occurs in IACMI states
- >70% of US auto R&D in Michigan alone
- Colorado has more blade facilities (factories plus technical centers) than any other state
- >60% of compressed gas fueled vehicle manufacturers with in half-day drive from IACMI Focus

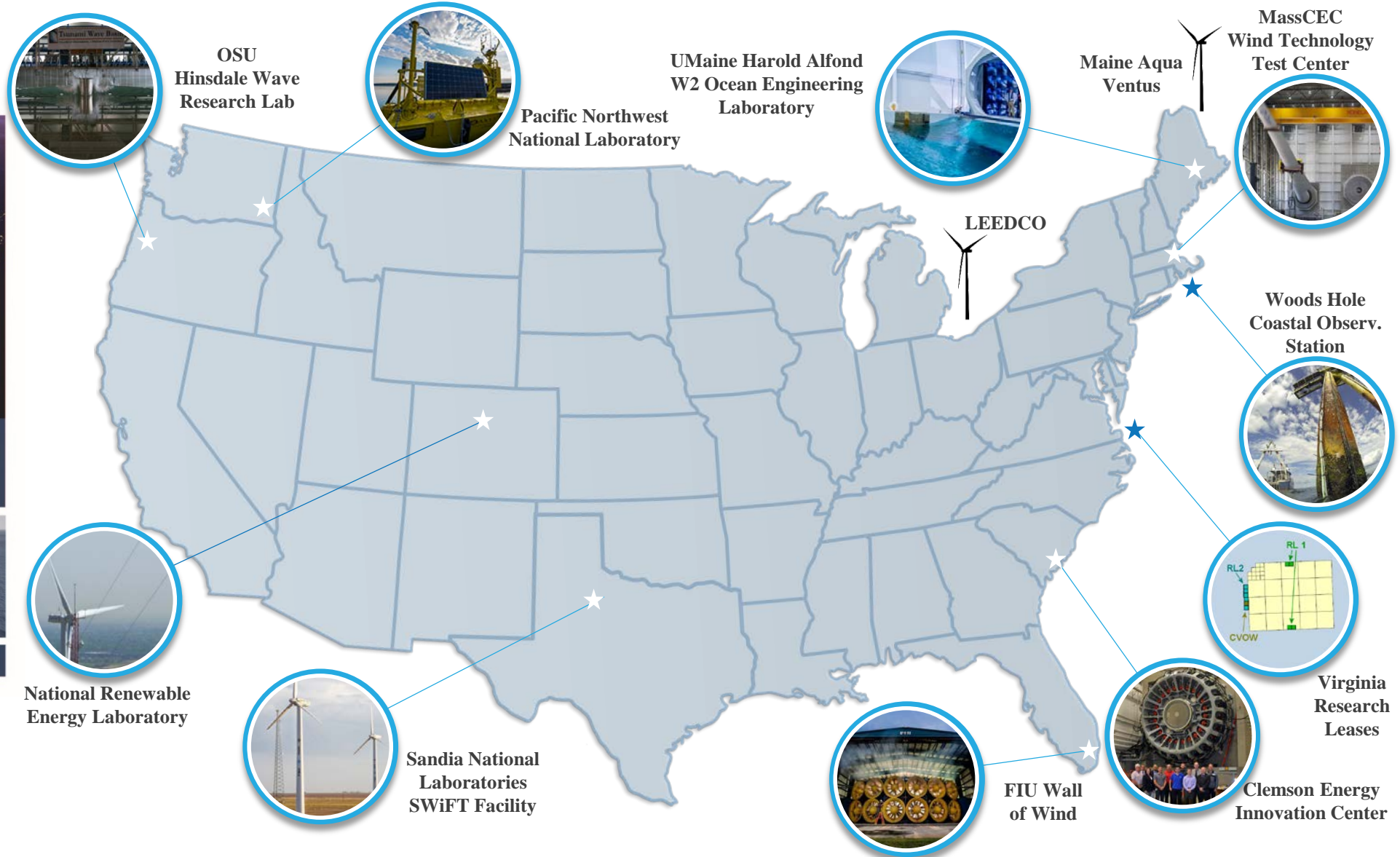
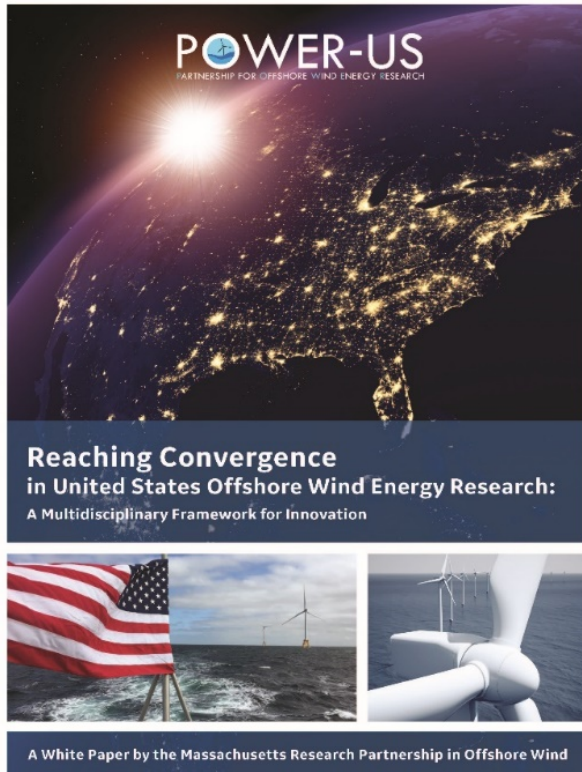


# NEES



# POWER-US

## Key Research Assets





# 20 years in the making, Massachusetts is ready for market scale...

2016 Mar.

2016 Aug.

2016 Sept. 1

2016 Sept. 15

2016 Sept. 20

2016 Dec.

2017 May

2017 Jun.

2017 Sept.

2017 Oct.

2017 Dec.

UMass Lowell/Tufts/NSF/MassCEC Workshop

**Gov. Baker signs 1600 MW legislation**

Massachusetts Research Partnership in Offshore Wind (MRP)

WHOI-MRP Workshop on Site Characterization

Tufts Interagency Workshop in DC

UMass Amherst Workshop to Convene POWER-US

UMass Lowell Workshop and MA Legislative Briefing

Tufts Workshop to Integrate Policy and Engineering

UMass Dartmouth/BCC/MMA Workshop on Fisheries

NREL Workshop to Convene all U.S. Regions

Northeastern Workshop to discuss White Paper



State of the Practice



State of the Art

## The Massachusetts Research Partnership for Offshore Wind Workshop: Development of a National Offshore Wind Research Agenda

In order for our nation to develop its vast offshore wind resource in a manner that respects the ocean environment and its many stakeholders, it is critical that we develop a coordinated, long-term strategic vision for advancing American innovation in this new industry. A data-driven, multi-disciplinary system-level framework for offshore wind research is needed to advance academia, industry, stakeholders, and policy makers, in order to create a resilient, low-risk, productive and world-leading offshore wind infrastructure and portfolio of wind farms.

The Massachusetts Research Partnership in Offshore Wind was established to prepare a national research agenda that will align the efforts of federal, state, and other entities that share a vision for a prosperous and resilient renewable energy future through offshore wind. This research agenda will lay out a clear and adaptive framework, provide a platform of research needs, and suggest how agencies can collectively work together to further develop and support an effective national research program.

The UMass Wind Energy Center and the partners in the Massachusetts Research Partnership in Offshore Wind invite you to attend this important workshop.

### Workshop Goals:

- Convene academic, industry, and agency stakeholders
- Establish priorities for a national offshore wind research agenda
- Discuss mechanisms and models for large-scale research networks

December 15-16, 2016

Begins at 10 a.m. on December 15

Please visit:  
<https://www.umass.edu/windenergy/mrpworkshop>  
for more registration information and agenda updates.

Location: Campus Center,  
Amherst Room, 11th Floor  
University of Massachusetts Amherst  
Amherst, MA 01003



Massachusetts Research Partnership in Offshore Wind members:  
Northeastern University  
Tufts University  
University of Massachusetts Amherst  
University of Massachusetts Dartmouth  
University of Massachusetts Lowell  
Woods Hole Oceanographic Institute



The Massachusetts Research Partnership is funded by:  
MASSACHUSETTS CLEAN ENERGY CENTER

## Agenda

### Presentations by Key Agencies

**José Zayas**, Director  
Wind and Water Power Technologies Office  
Department of Energy

**Barry Johnson**, Acting Deputy Assistant Director  
Engineering Directorate  
National Science Foundation

**Rodney Cluck**, Chief  
Division of Environmental Sciences  
Bureau of Ocean Energy Management

**Andreas Reuter**, Managing Director  
Fraunhofer Institute for Wind Energy  
and Energy System Technology

### Explorations of Research and Innovation Frameworks

Reducing Costs and Technology Risks  
Supporting Effective Stewardship  
Biogeographic Assessment  
Driving Offshore Wind Innovation

### Discussions of Research Grand Challenges

Site Characterization and Environmental Assessment  
Technology Advancement  
National Framework of Innovation

## Advancing American Offshore Wind Research

September 20, 2016

Hyatt Regency Washington on Capitol Hill  
Washington, DC

**Rep. Patricia A. Haddad, Speaker Pro Tempore**  
in conjunction with faculty of the UMass System  
invite you to attend a legislative briefing on  
Offshore Wind Research & Innovation in Massachusetts  
Professors Christopher Niezrecki, Steven E. Lohrenz<sup>2</sup>, James Manwell<sup>3</sup> & David Cash<sup>4</sup>

Four UMass campuses (Amherst<sup>1</sup>, Boston<sup>2</sup>, Dartmouth<sup>3</sup> and Lowell<sup>4</sup>), in collaboration with Northeastern, Tufts and Woods Hole Oceanographic Institution, are leading an effort to advance offshore wind research and innovation in the American offshore wind industry. The Massachusetts Clean Energy Center (MassCEC) provides sustaining sponsorship of this initiative.

The goal of the Partnership for Offshore Wind Energy (POWER-US) is to build capacity and a national framework for offshore wind research, innovation and workforce training. In light of the Commonwealth's pioneering energy legislation and world-class research capabilities, Massachusetts is in a unique position to take a leadership role nationally in driving transformational change in the development and management of this valuable offshore wind energy resource.

**SAVE THE DATE** MAY 10, 2017 10:30AM - 12:30PM MEMBERS' LOUNGE

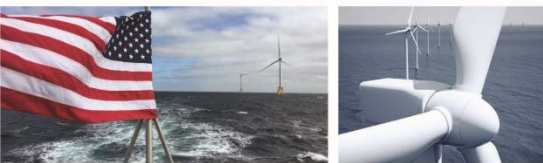
**RSVP DETAILS** SEND EMAIL TO: [AMY\\_ALLEN@UMASS.EDU](mailto:AMY_ALLEN@UMASS.EDU)

**MASSACHUSETTS CLEAN ENERGY CENTER** SUSTAINING SPONSOR





# Reaching Convergence in United States Offshore Wind Energy Research: A Multidisciplinary Framework for Innovation



A White Paper by the Massachusetts Research Partnership in Offshore Wind

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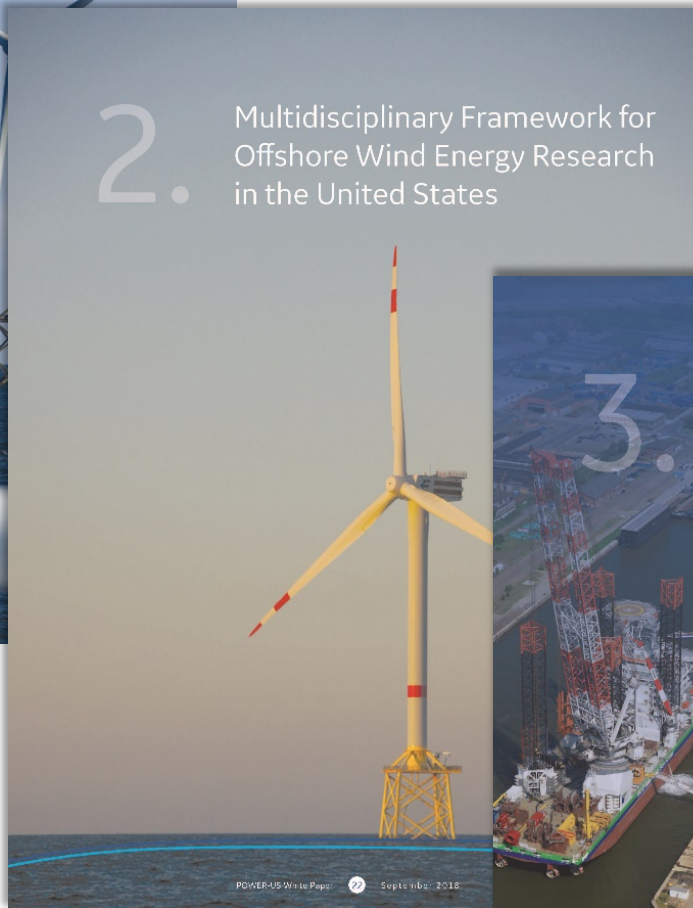
This white paper was funded by a grant from the Massachusetts Clean Energy Center (MassCEC). Views expressed in this white paper are the views of the authors and do not represent an official position or endorsement by the MassCEC. POWER-US is a converging initiative of the Massachusetts Research Partnership in Offshore Wind.

# 1. Introduction



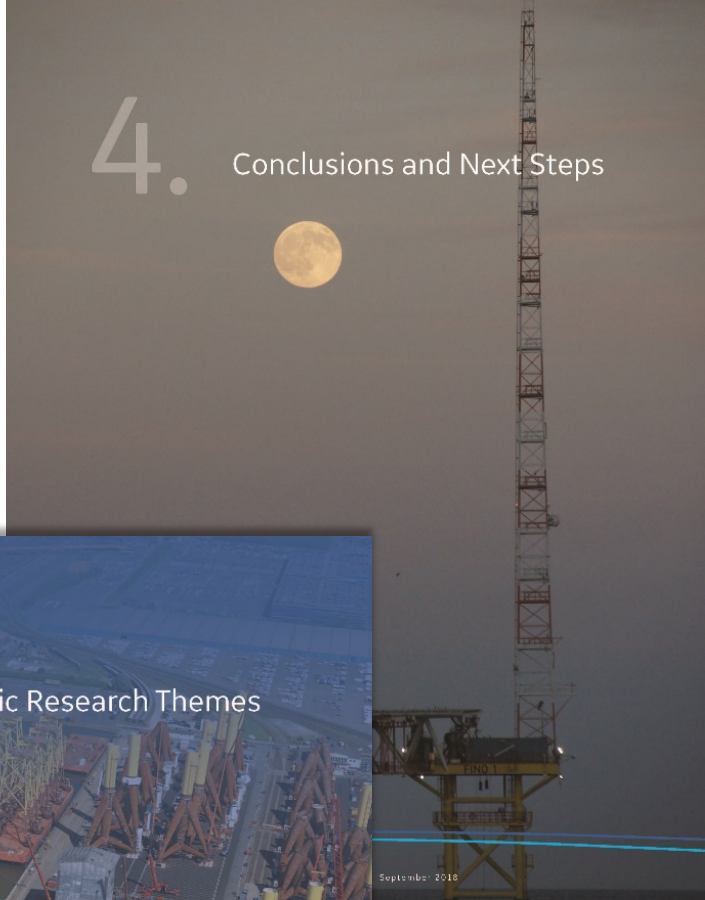
POWER-US White Paper 1 September 2018

# 2. Multidisciplinary Framework for Offshore Wind Energy Research in the United States



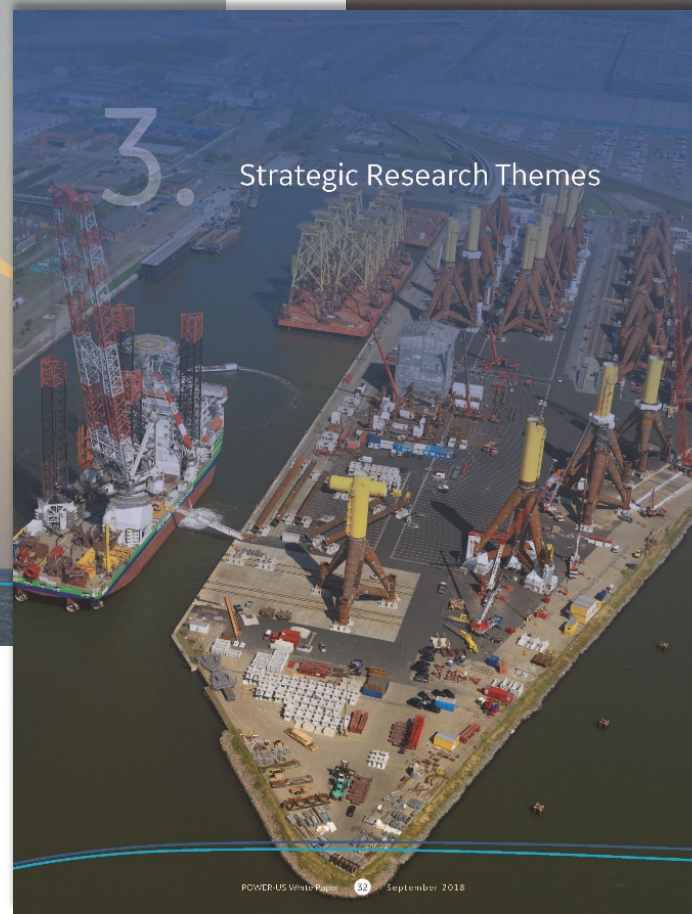
POWER-US White Paper 22 September 2018

# 4. Conclusions and Next Steps



September 2018

# 3. Strategic Research Themes

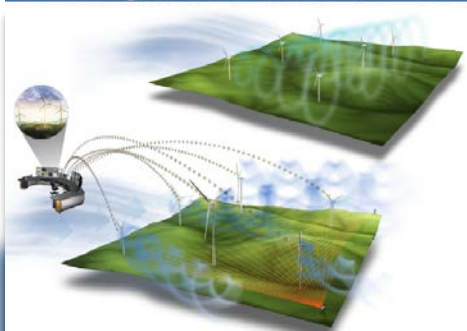


POWER-US White Paper 32 September 2018

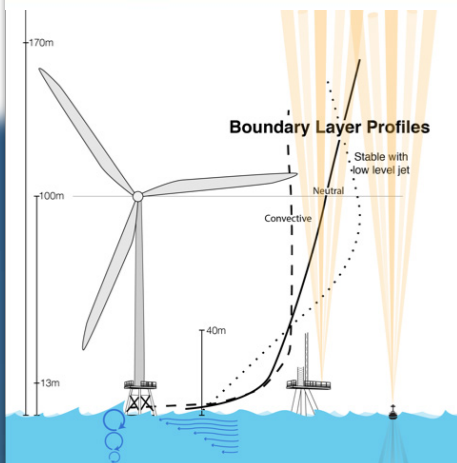


# 5 Strategic Research Themes

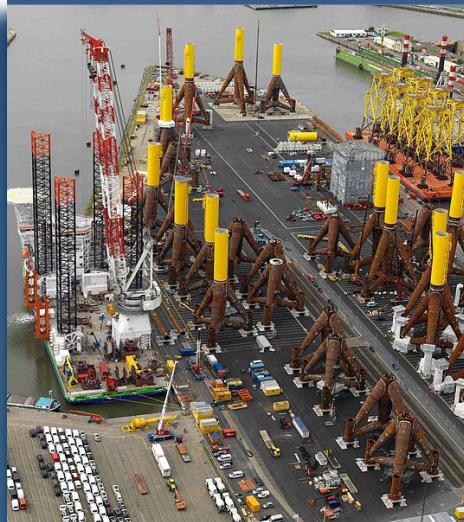
## 3.1 Advancing Near-Term Deployment & Investing in Long-Term Innovation



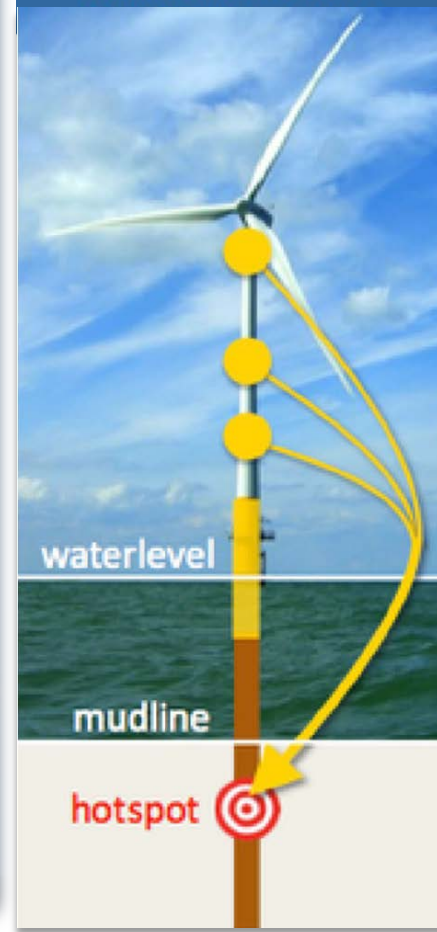
## 3.2 Moving State-of-the-Art to State-of-the-Practice for Resource Characterization



## 3.3 Planning Long-Term for Ports, Supply Chain, and Transmission



## 3.4 Establishing a Data-Driven Engineering Paradigm for Resilient Infrastructure



## 3.5 Pursuing the Public Interest and Adapting to U.S. Conditions



U.S. Vision

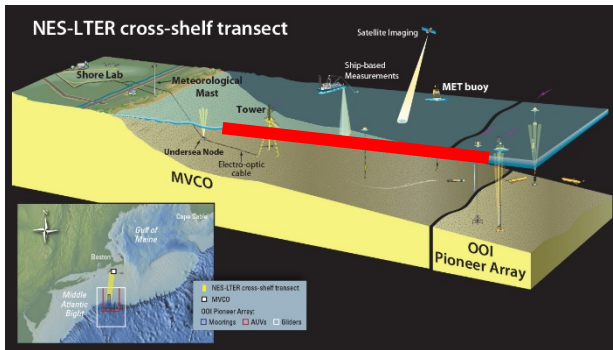


# Theme 2: State-of-the-Art to State-of-the-Practice



Martha's Vineyard  
Coastal Observatory

Air-Sea Interaction Tower



LTER Transect



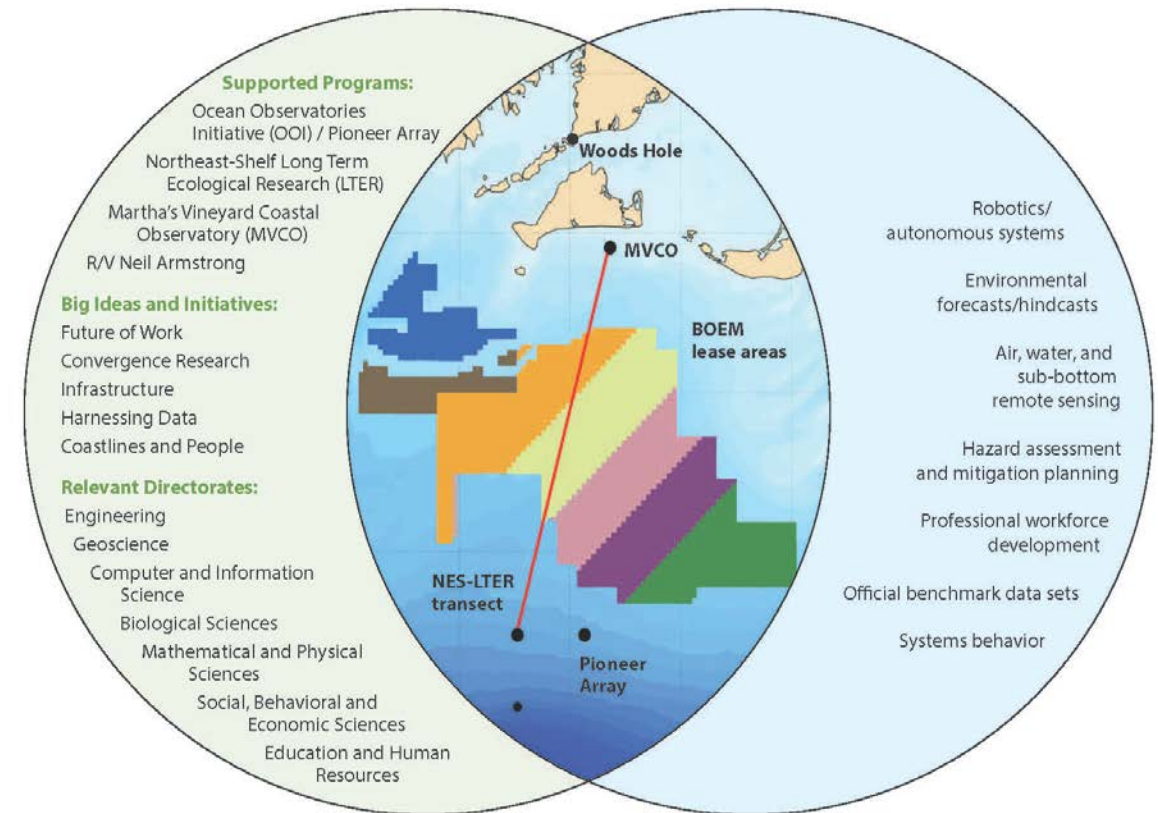
R/V  
Neil Armstrong



## National Science Foundation Opportunities for Connection with Offshore Wind Energy

### National Science Foundation Assets

### Offshore Wind Energy Research Opportunities



An overlap of interests at the ground floor of a new industry.



# Theme 3: Planning Long-Term for Ports, Supply Chain and Transmission



Marine Commerce Terminal  
New Bedford  
July 2010 to  
July 2015

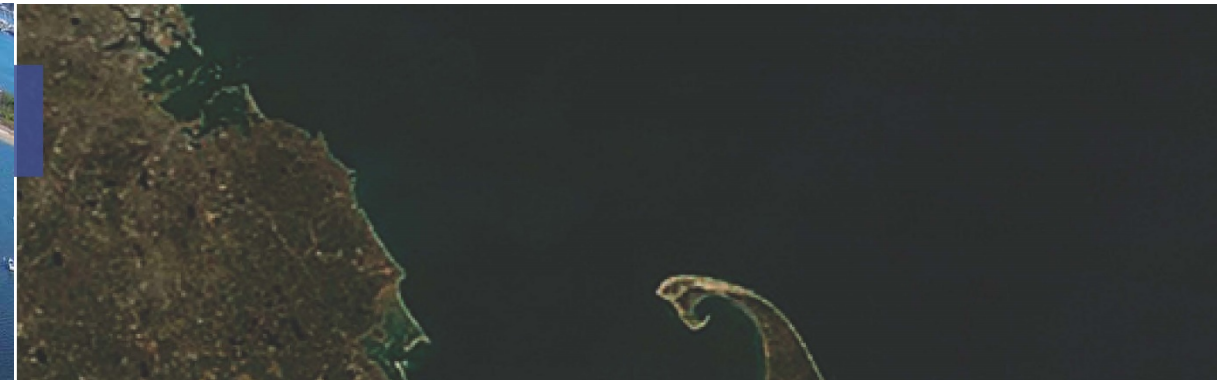
Marine Commerce Terminal, MassCEC completed work on the Wind Technology Testing Center, a massive facility in Charlestown for testing wind turbines (see "Testing Tomorrow's Turbines," *Civil Engineering*, July 2011, pages 64-71).

The Massachusetts Renewable Portfolio Standard, which took effect in 2003, mandates that utilities procure a certain percentage of electricity each year from such approved renewable energy sources as wind, the sun, and small-scale hydro-power facilities. For 2016 utilities were required to procure 11 percent of their electricity from renewable sources. This requirement will increase by 1 percentage point per year until it reaches 15 percent by 2020. As of the end of 2015, the total installed capacity from renewable sources in Massachusetts exceeded legislative mandates by a factor of 2, surpassing 1,000 MW.

Recognizing the direct relationship between greenhouse gases and global warming, as well as the threat that rising sea levels pose to the commonwealth's coastlines, the Massachusetts

legislature passed the Global Warming Solutions Act in 2008. The law commits the commonwealth to a 25 percent reduction of greenhouse gases from 1990 levels by 2020 and an 80 percent reduction by 2050. Meanwhile, a 2016 law entitled An Act Relative to Energy Diversity will further increase the amount of electricity that utilities must purchase from offshore wind and hydroelectric sources. ISO New England, Inc., the entity that operates the regional power system, has announced the possible retirement over the next several years of nuclear and fossil-fueled power plants having a combined capacity of more than 8,000 MW. Against this backdrop, the development of the offshore wind industry along U.S. shores could not be more timely.

Offshore wind represents a significant source of potential energy, one from which New England is well positioned to capitalize. According to the U.S. Department of Energy's National Offshore Wind Strategy, released last September, U.S. offshore wind resources have a gross recoverable power



## Massachusetts Offshore Wind Ports & Infrastructure Assessment



Submitted to: Massachusetts Clean Energy Center  
January 4, 2017



URBAN HARBORS INSTITUTE  
UNIVERSITY OF MASSACHUSETTS BOSTON





## Themes 4 & 5: Systems-Level Thinking – Engineering & Social Science Resilient Offshore Wind Energy Systems (ROWES)

