French-American Innovation Day
Northeastern University

March 18, 2019

Research Initiatives, Testing Infrastructure and the

POWER-US

PARTNERSHIP FOR OFFSHORE WIND ENERGY RESEARCH

Accelerating Discovery, Innovation, and Job Creation

Convening Initiative

Eric Hines and Dan Kuchma

Tufts UNIVERSITY | School of Engineering

$

€

This is happening now.

Ten years ago...

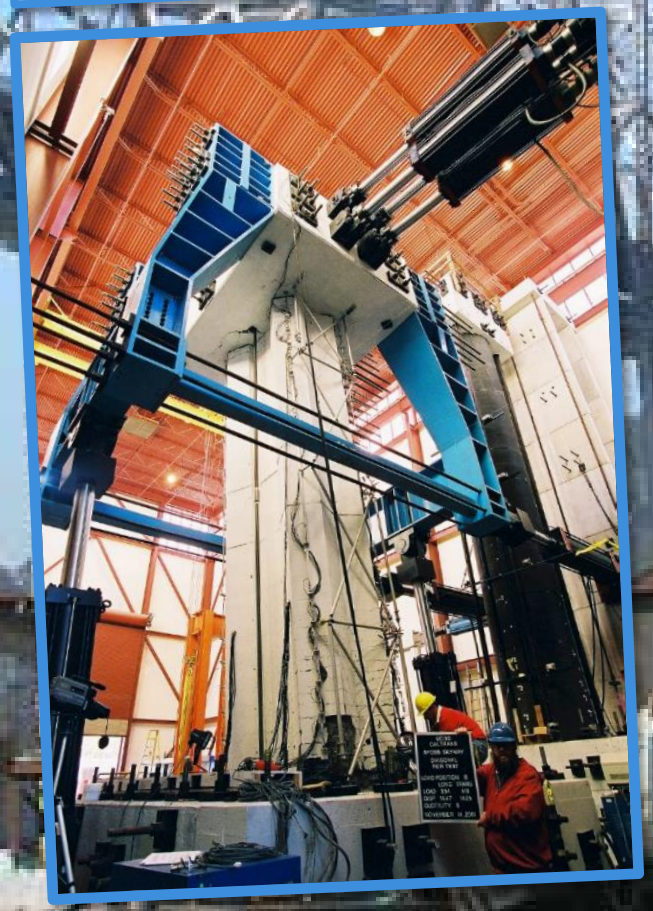
TESTING TOMORROW'S TURBINES

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

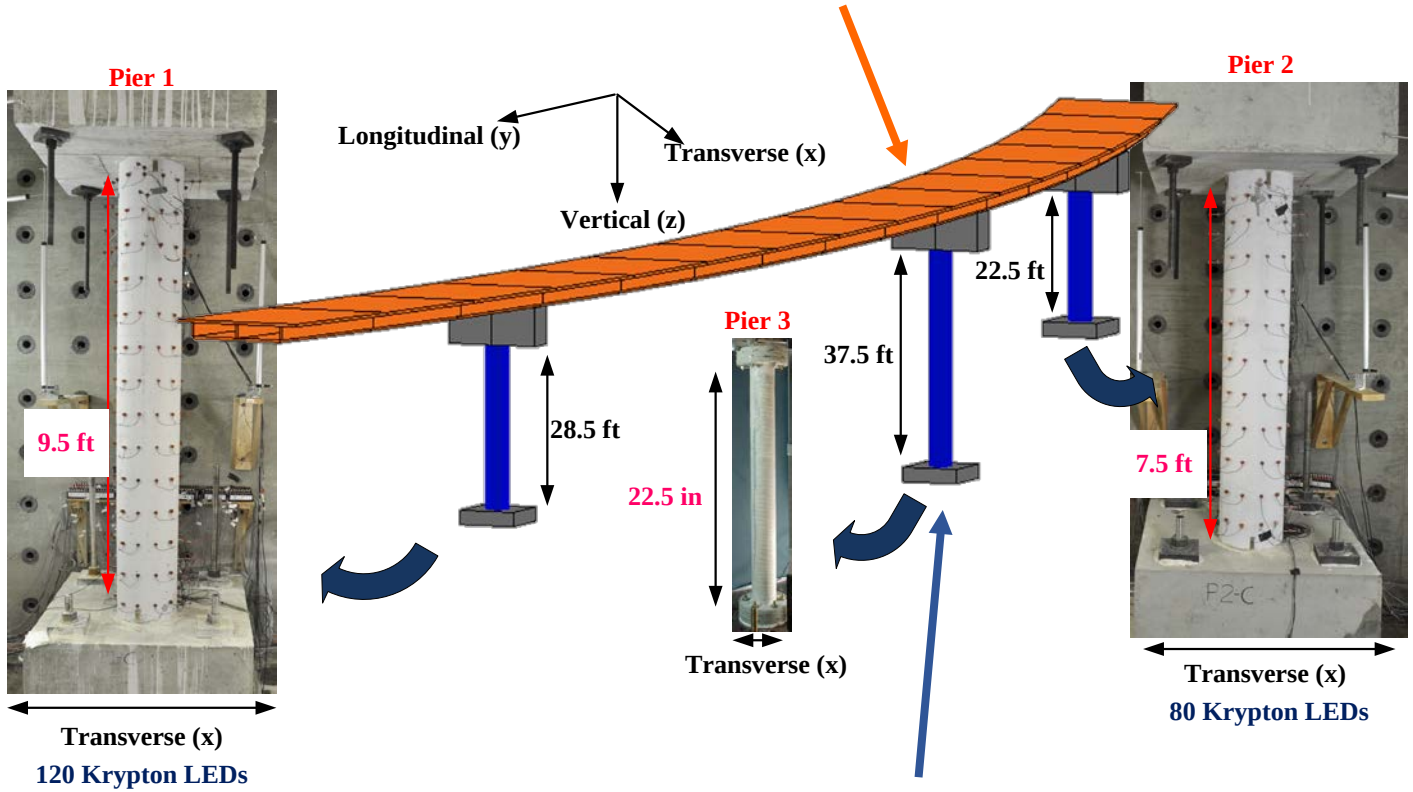
Twenty years ago...



150 year life span | 1500 year earthquake

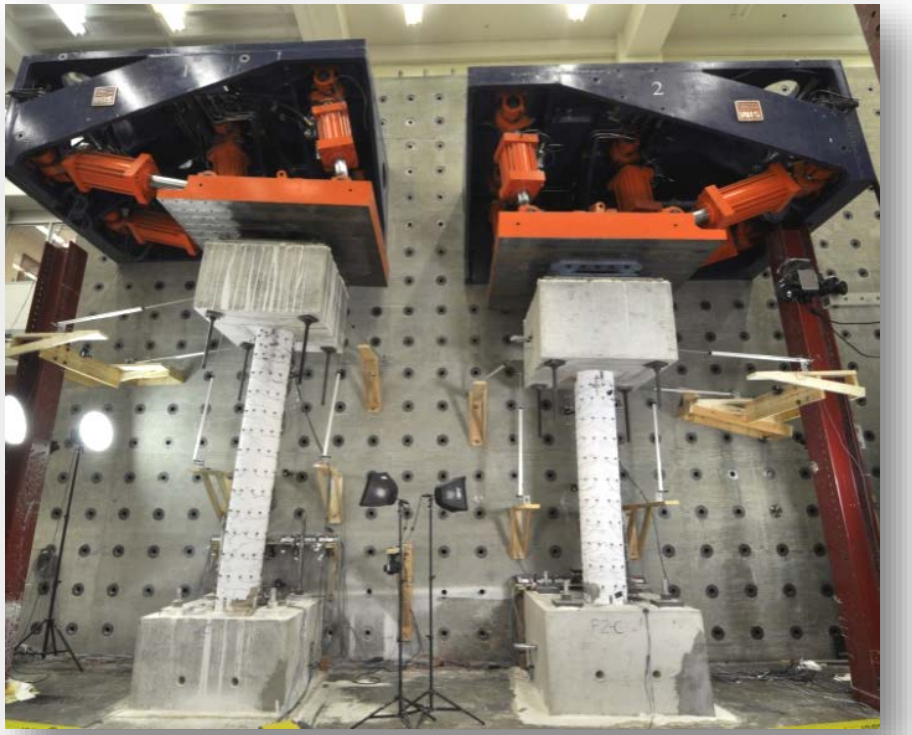
NEES: Large Scale Testing and Hybrid Simulation

computational model of bridge deck



computational model soil-structure interaction

6-dof loading and
boundary condition boxes

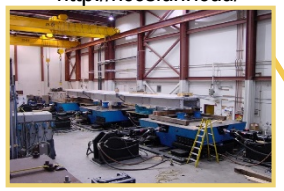


Fifteen years ago...

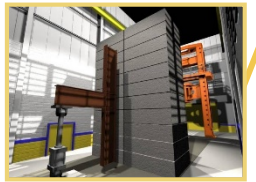
NEES Infrastructure

Oregon State University
http://nees.orst.edu/

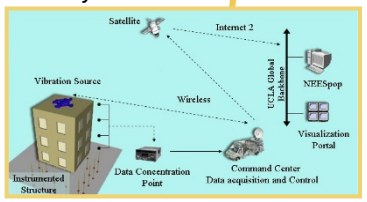
University of Nevada, Reno
http://nees.unr.edu/



University of California, Davis
http://nees.ucdavis.edu/

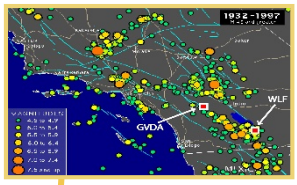


University of California, Berkeley
http://nees.berkeley.edu

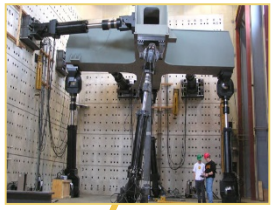


University of California, Los Angeles
http://nees.ucla.edu/

University of California, Santa Barbara
http://nees.ucsb.edu/

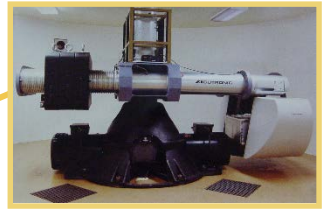


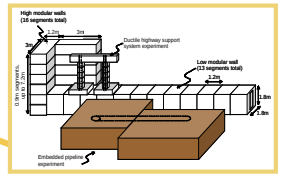
University of Minnesota
http://nees.umn.edu



University of Illinois at
Urbana-Champaign
http://nees.illinois.edu/

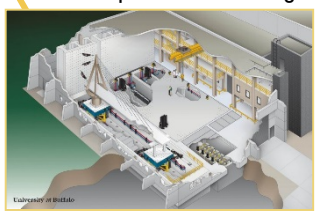
Rensselaer Polytechnic Institute
http://nees.rpi.edu/



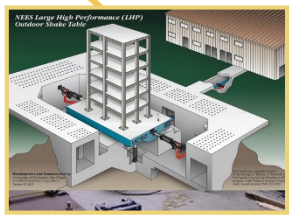


Cornell University
http://nees.cornell.edu/

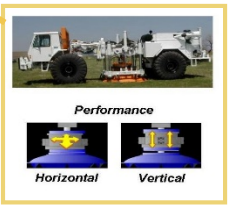
Lehigh University
http://www.nees.lehigh.edu/



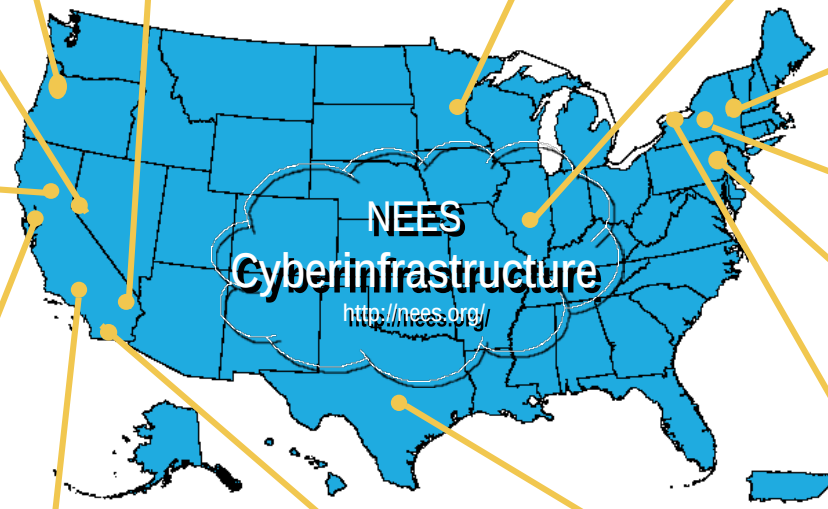
University at Buffalo, SUNY
http://nees.buffalo.edu/



University of California, San Diego
http://nees.ucsd.edu/



University of Texas at Austin
http://nees.utexas.edu/



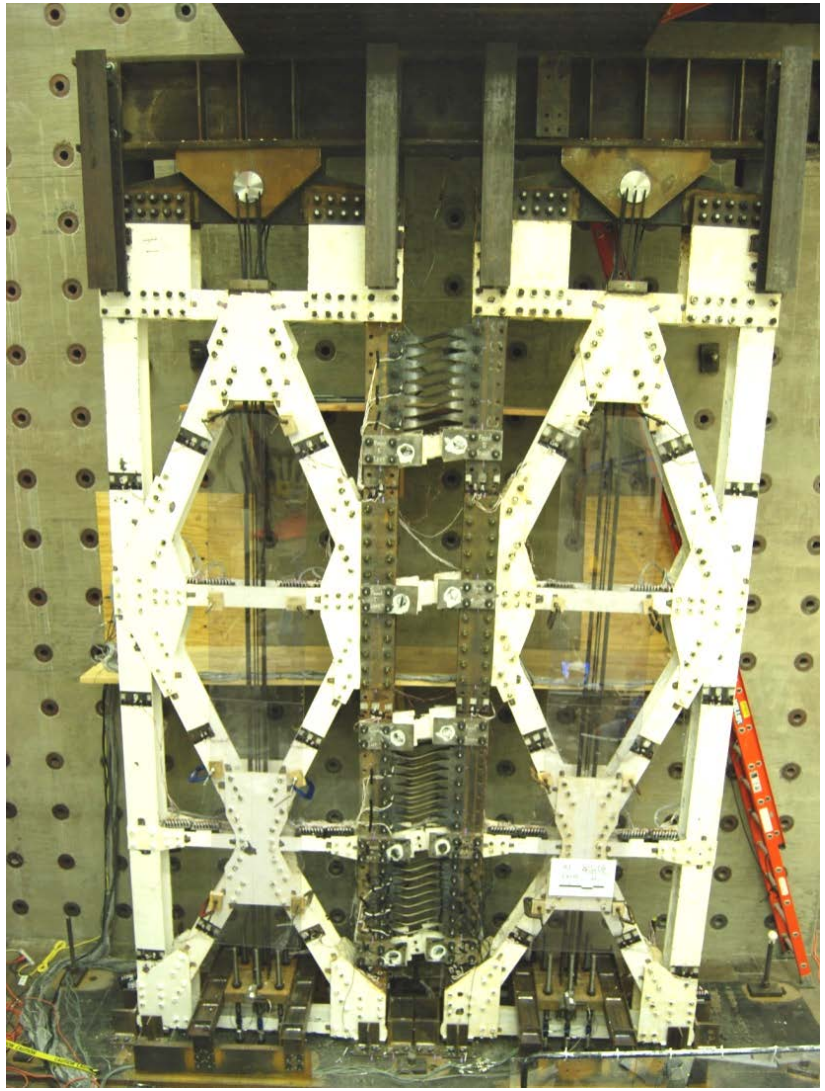
Twenty years ago...

national shared research assets

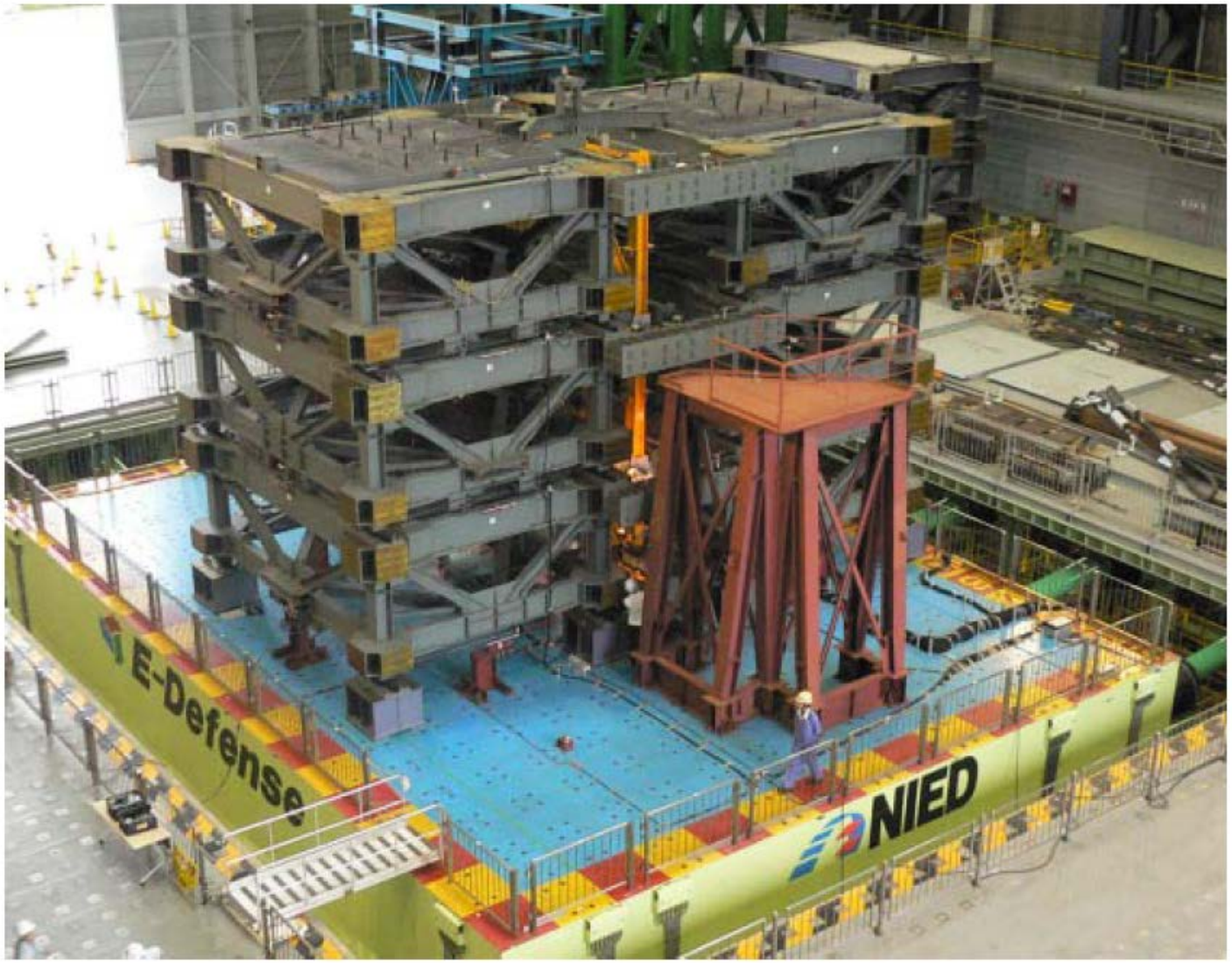
NEES: International Collaboration

Fifteen years ago...

University of Illinois, Urbana-Champaign



E-Defense, Japan



OOI

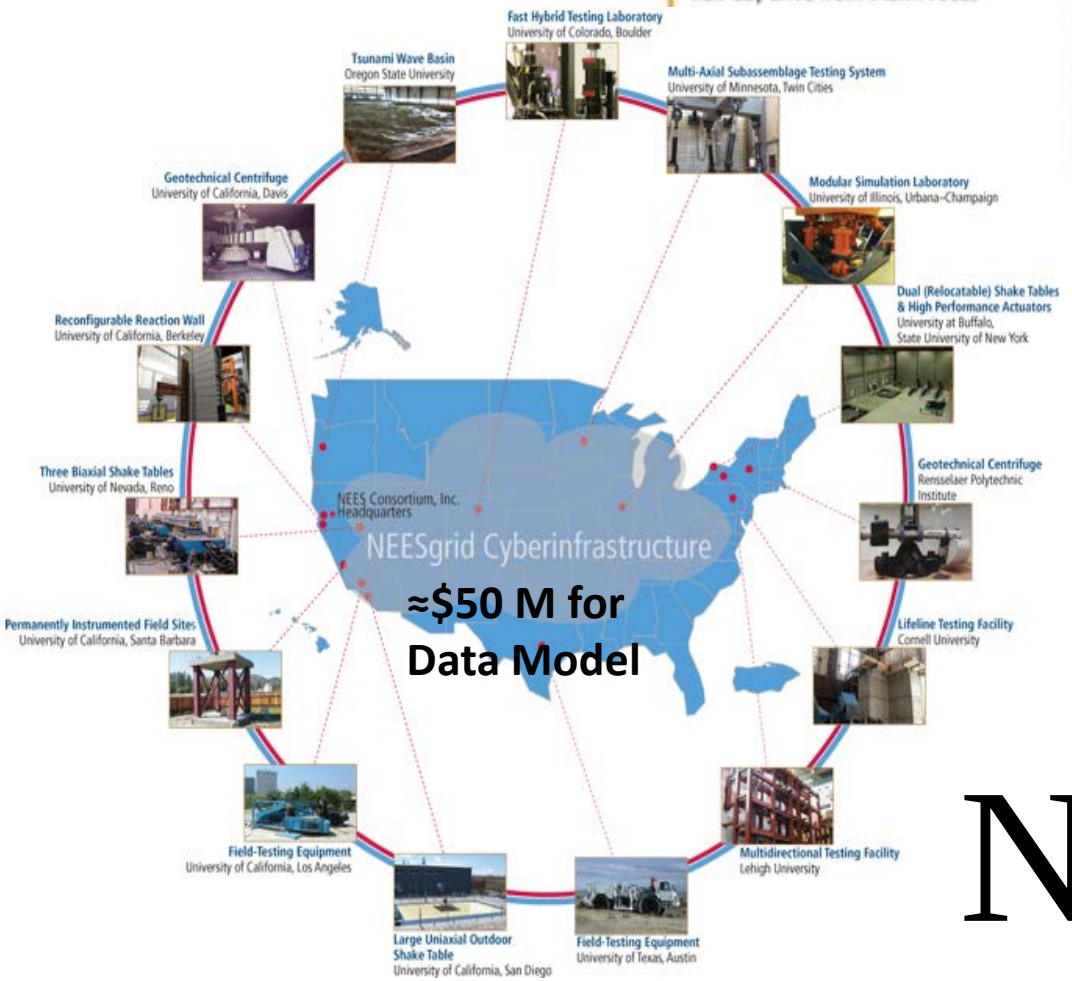
iacmi

>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

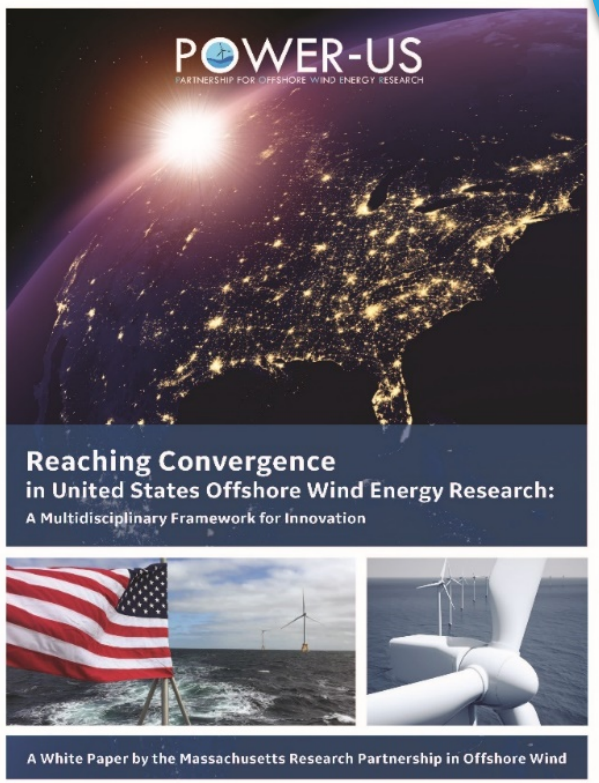


≈$50 M for Data Model

NEES

POWER-US

Key Research Assets



OSU Hinsdale Wave Research Lab

Pacific Northwest National Laboratory

UMaine Harold Alfond W2 Ocean Engineering Laboratory

Maine Aqua Ventus

MassCEC Wind Technology Test Center

LEEDCO

Woods Hole Coastal Observ. Station

National Renewable Energy Laboratory

Sandia National Laboratories SWiFT Facility

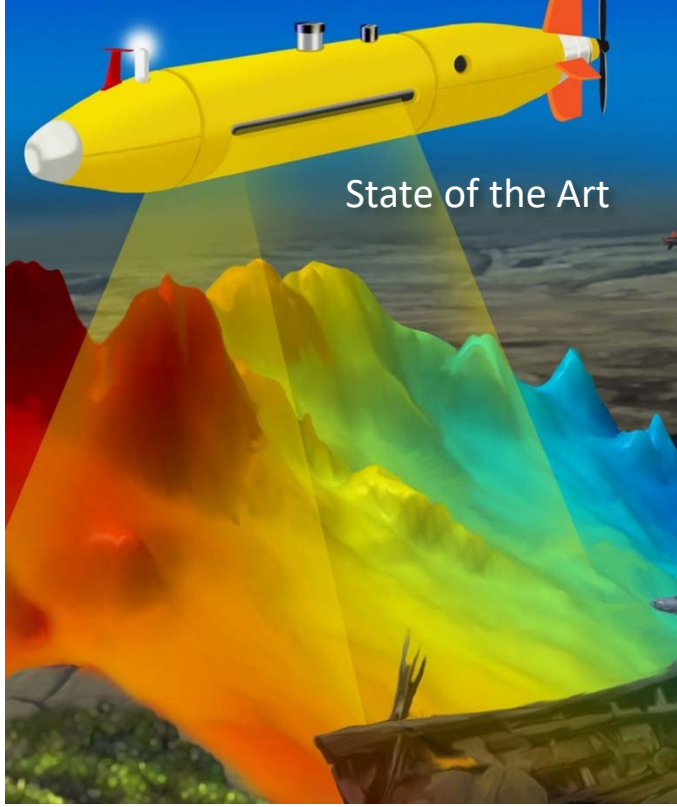
Virginia Research Leases

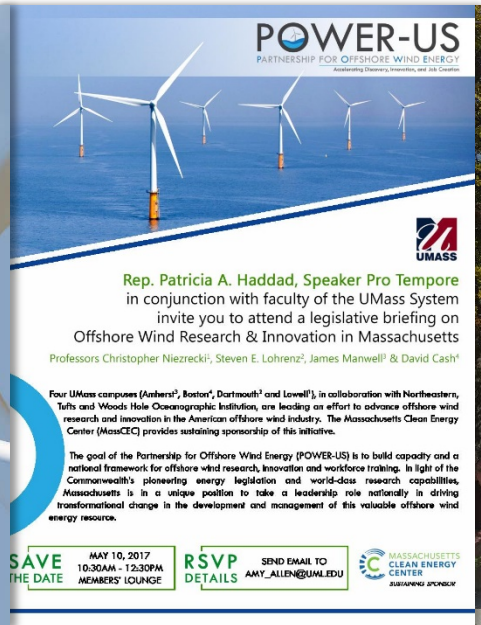
FIU Wall of Wind

Clemson Energy Innovation Center

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

2016 Mar.	UMass Lowell/Tufts/NSF/MassCEC Workshop
2016 Aug.	**Gov. Baker signs 1600 MW legislation**
2016 Sept. 1	Massachusetts Research Partnership in Offshore Wind (MRP)
2016 Sept. 15	WHOI-MRP Workshop on Site Characterization
2016 Sept. 20	Tufts Interagency Workshop in DC
2016 Dec.	UMass Amherst Workshop to Convene POWER-US
2017 May	UMass Lowell Workshop and MA Legislative Briefing
2017 Jun.	Tufts Workshop to Integrate Policy and Engineering
2017 Sept.	UMass Dartmouth/BCC/MMA Workshop on Fisheries
2017 Oct.	NREL Workshop to Convene all U.S. Regions
2017 Dec.	Northeastern Workshop to discuss White Paper





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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September 2018

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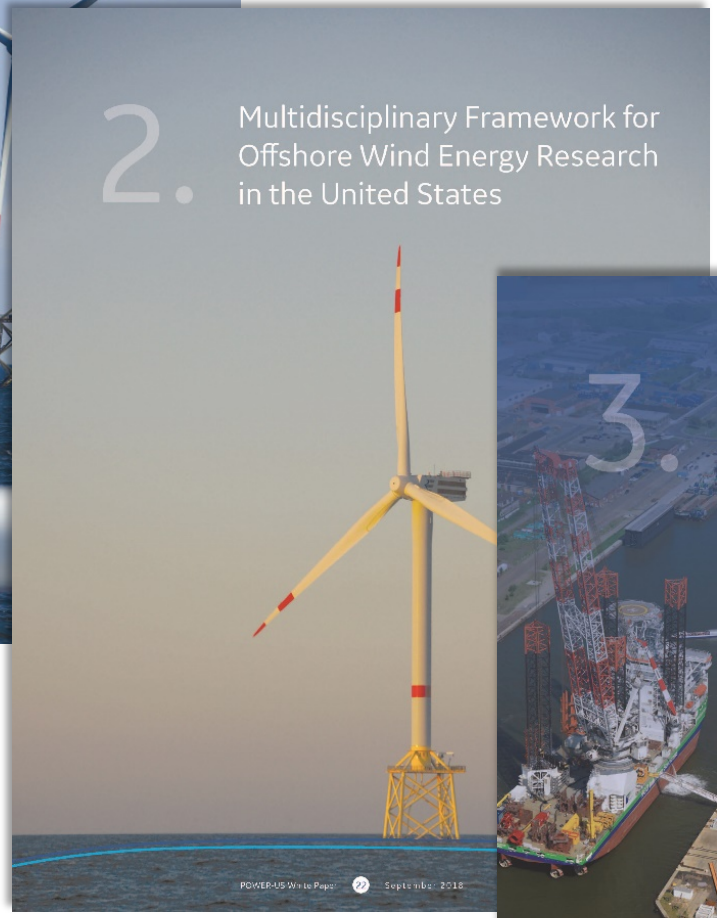
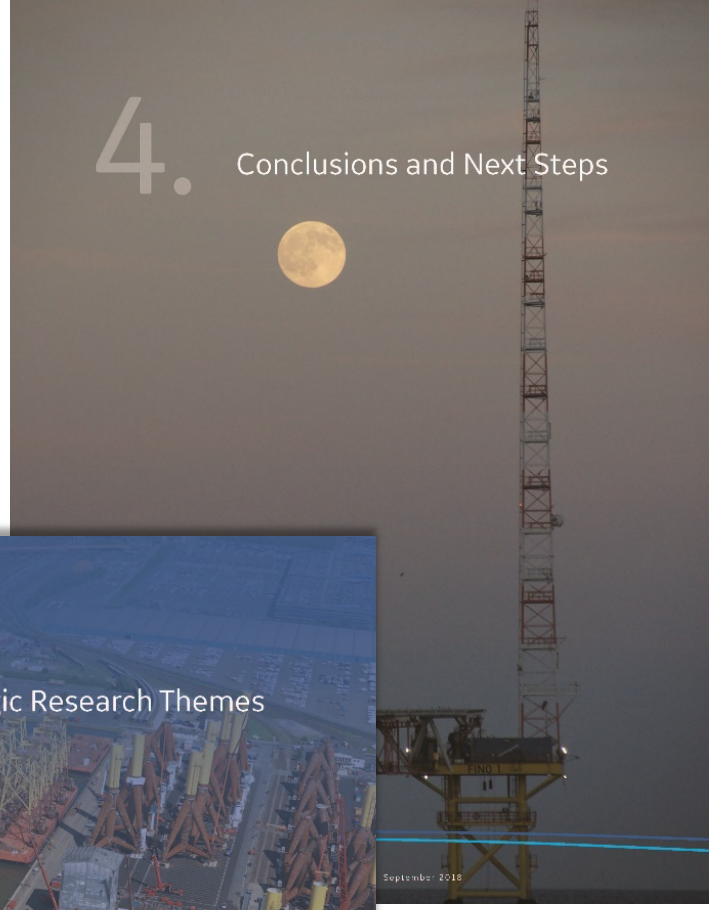
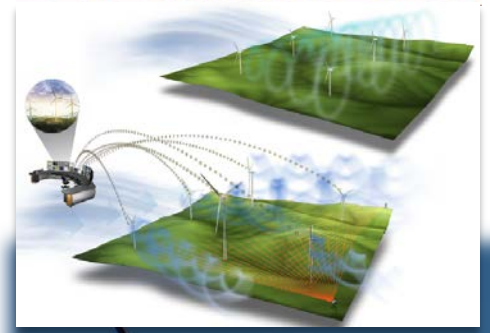


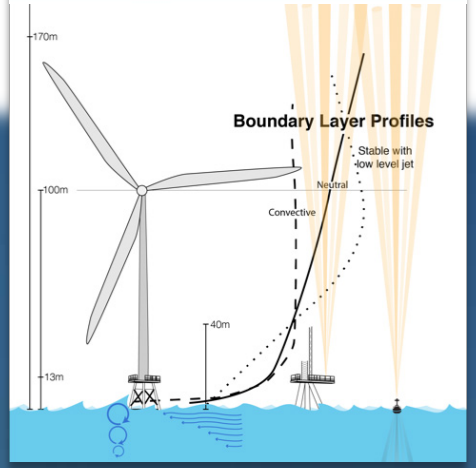


5 Strategic Research Themes

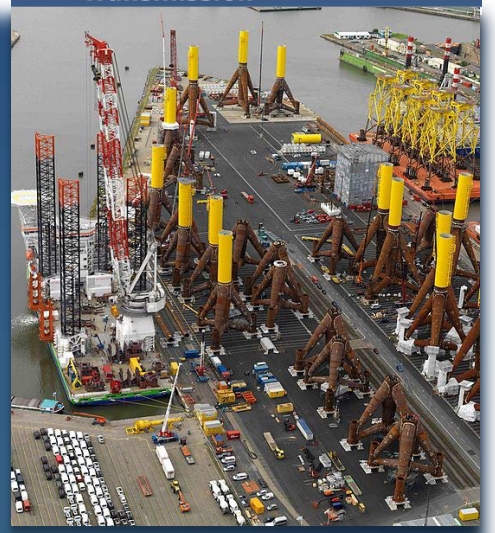
3.1 Advancing Near-Term Deployment & Investing in Long-Term Innovation



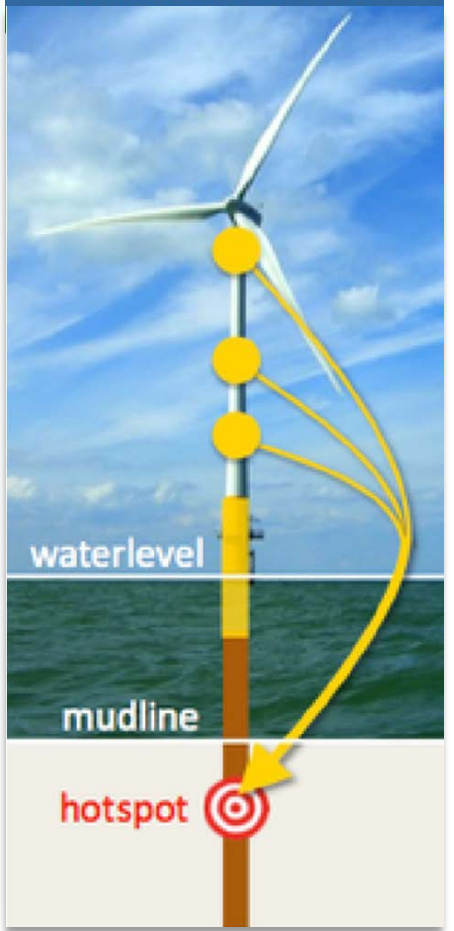
3.2 Moving State-of-the-Art to State-of-the-Practice for Resource Characterization



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



3.4 Establishing a Data-Driven Engineering Paradigm for Resilient Infrastructure



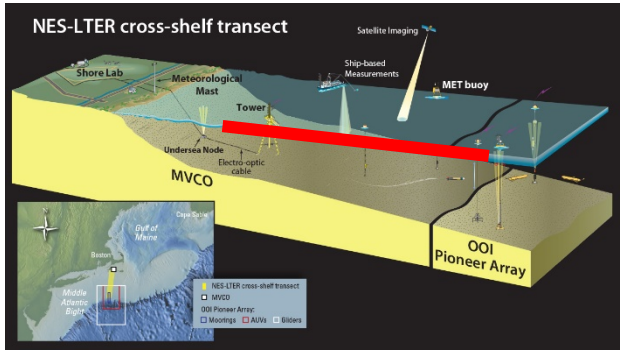
3.5 Pursuing the Public Interest and Adapting to U.S. Conditions

U.S. Vision

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

Martha's Vineyard Coastal Observatory

Air-Sea Interaction Tower

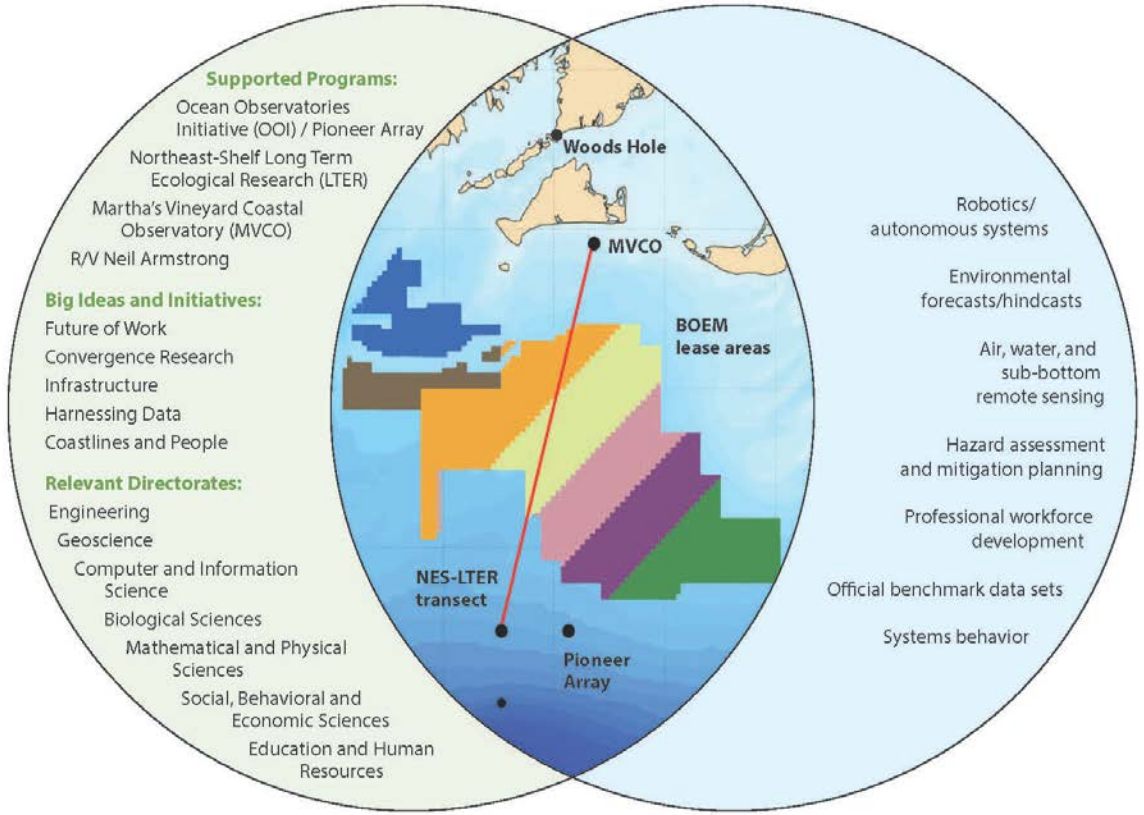


LTER Transect

R/V Neil Armstrong

WOODS HOLE OCEANOGRAPHIC INSTITUTION
1930

National Science Foundation Opportunities for Connection with Offshore Wind Energy



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

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

Designed to facilitate the use of mobile cranes, the 21-acre facility forming the main storage area for the New Bedford Marine Commerce Terminal will be able to sustain uniform loads of 4,100 psf and concentrated loads nearly five times that amount.

Marine Commerce Terminal
New Bedford
July 2010 to
July 2015

POWERFUL UPGRADE

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 hydropower 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

UMASS BOSTON
URBAN HARBORS INSTITUTE
UNIVERSITY OF MASSACHUSETTS BOSTON

RAMBOLL

APEX

Tufts UNIVERSITY

Layout & design prepared by VillariDesign.com

Tufts UMassAmherst UTEP University of Colorado Boulder

CLEMSON UNIVERSITY JOHNS HOPKINS UNIVERSITY Northeastern University UNIVERSITY OF Rhode Island

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