OFFSHORE WIND ACCELERATOR
PROJECT WEBINAR SERIES

Making History With VolturnUS

Dr. Habib Dagher, University of Maine - Orono

July 11, 2013

Housekeeping

All participants will be placed in "listen-only" mode when joining the webinar. You will be connected to audio using your computer's microphone and speakers (VoIP). Or you may select *Use Telephone* after joining the Webinar: Make sure to enter your phone Audio PIN, shown in the webinar control panel, if you choose the option to join by telephone.

You are encouraged to type in questions regarding today's presentations at any time during the webinar by entering your question in the **Question Box** on the webinar console. Questions will be answered as time allows following all of today's presentations.

This webinar is being recorded and will be made available after the call at **www.cleanenergystates.org** under **Events**. Previous webinar recordings are also posted.

Today's Agenda

- Presentation by **Dr. Habib Dagher**, founding Director of the Advanced Structures and Composites Center at the University of Maine - Orono
- Time for questions

Please Submit Questions

Questions submitted from webinar participants will be addressed following the presentation. Please type your questions in the webinar console's Question box at any time during the broadcast.

Clean Energy States Alliance

CESA is a non-profit organization working with states, federal agencies, and municipalities to advance the renewable energy sector through:

- Information Exchange & Analysis
- Partnership Development
- Networking and Collaboration

www.cleanenergystates.org

Offshore Wind Accelerator Project

OWAP Objective: Address key challenges facing offshore wind in five focus areas

1. Ensure cooperation and communication among stakeholders and government leaders on priority problem-solving.
2. Improve regulatory approaches to support smart siting while reducing review costs & timelines.
3. Advance investment through power procurement collaborative networks and use of new financing mechanisms.
4. Advance opportunities, strategies, and collaboration to build a domestic OSW industry.
5. Implement a communication effort to ensure public education and stakeholder access to objective information.

Stay connected to OWAP!

- Offshore Wind WORKS campaign website: **http://www.offshorewindworks.org**
- Like us on Facebook: **http://www.facebook.com/offshorewindworks**
- Follow us on Twitter: **http://www.twitter.com/OSWindWorks**

Today's Presenter

Dr. Habib Dagher

Dr. Dagher joins us from the University of Maine's Advanced Structures and Composites Center, where he oversees 40 associated faculty and full-time staff and150 graduate and undergraduate students. The University of Maine recently launched the U.S.'s first grid-connected floating offshore wind turbine, the VolturnUS prototype, which Dr. Dagher will discuss today.

Dr. Dagher received his doctorate in structural engineering from the University of Wisconsin-Madison. He holds two masters degrees in structural engineering and in engineering mechanics.

Thank you!

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Making History with VolturnUS

OWAP Webinar

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Director, Advanced Structures and Composites Center
University of Maine
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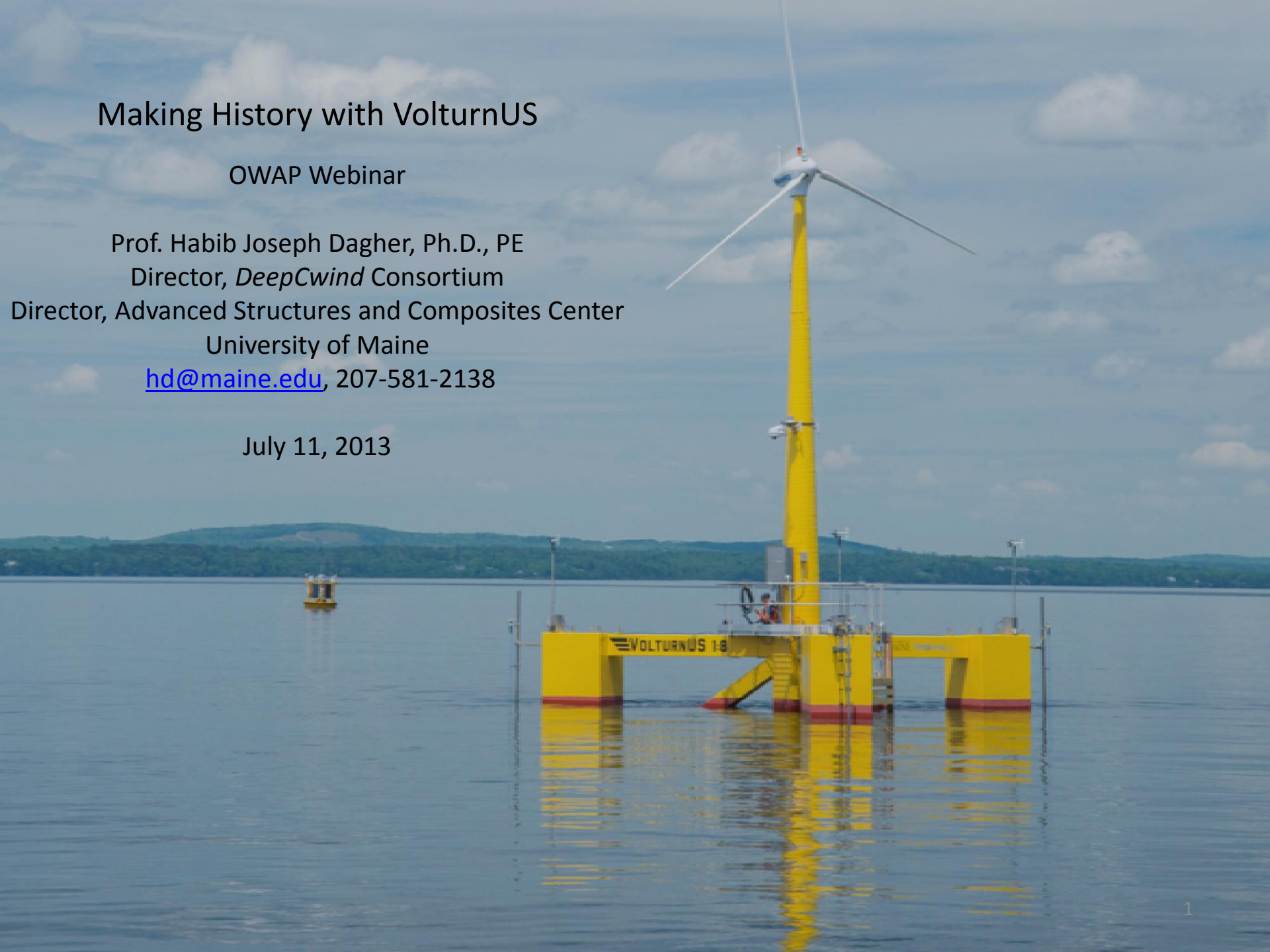
July 11, 2013



Outline

- The UMaine Composites Center
- Maine 5 GW by 2030 Plan
- 1:50 scale testing program
- VolturnUS 1:8 development
- DOE Advanced Technology Demo. Project

Advanced Structures and Composites Center

180 personnel

87,000 ft^2 space

15 years

Composites Industry

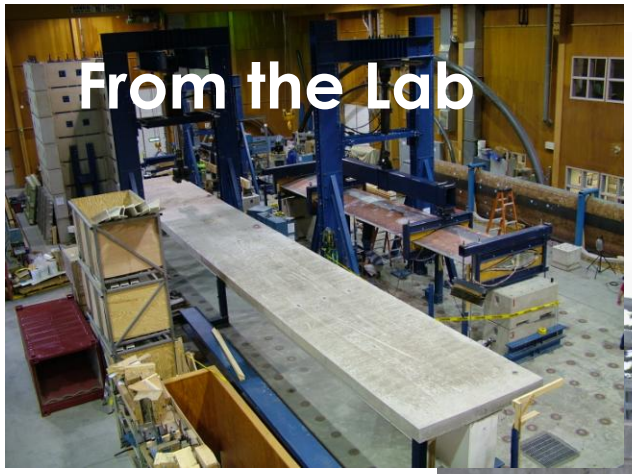
Construction Industry

Advanced Structures and Composites Center

World Leader in Composites Materials Development, Design and Testing

- 2007 ACMA Best of Show
- 2007 ACMA People's Choice
- 2009 ACMA Most Creative Composites Product
- 2010 ACMA Most Creative Composites Product
- 2011 ASCE Pankow Innovation Award

Longest Composite Bridge in the World, 540ft (Maine, 2011)



Composite Pilings

HarborTechnologies, LLC
Marine Composite Solutions

- ✓**Spinoff company:** Harbor Technologies, Brunswick, ME
- ✓**Technology:** FRP tubes designed and developed at UMaine
- ✓**Pilot line:** built and now selling product throughout the world.

“Bridge-in-a-Backpack”

Technology: Hybrid bridge system combining benefits of high-performance composites with cast-in-place concrete

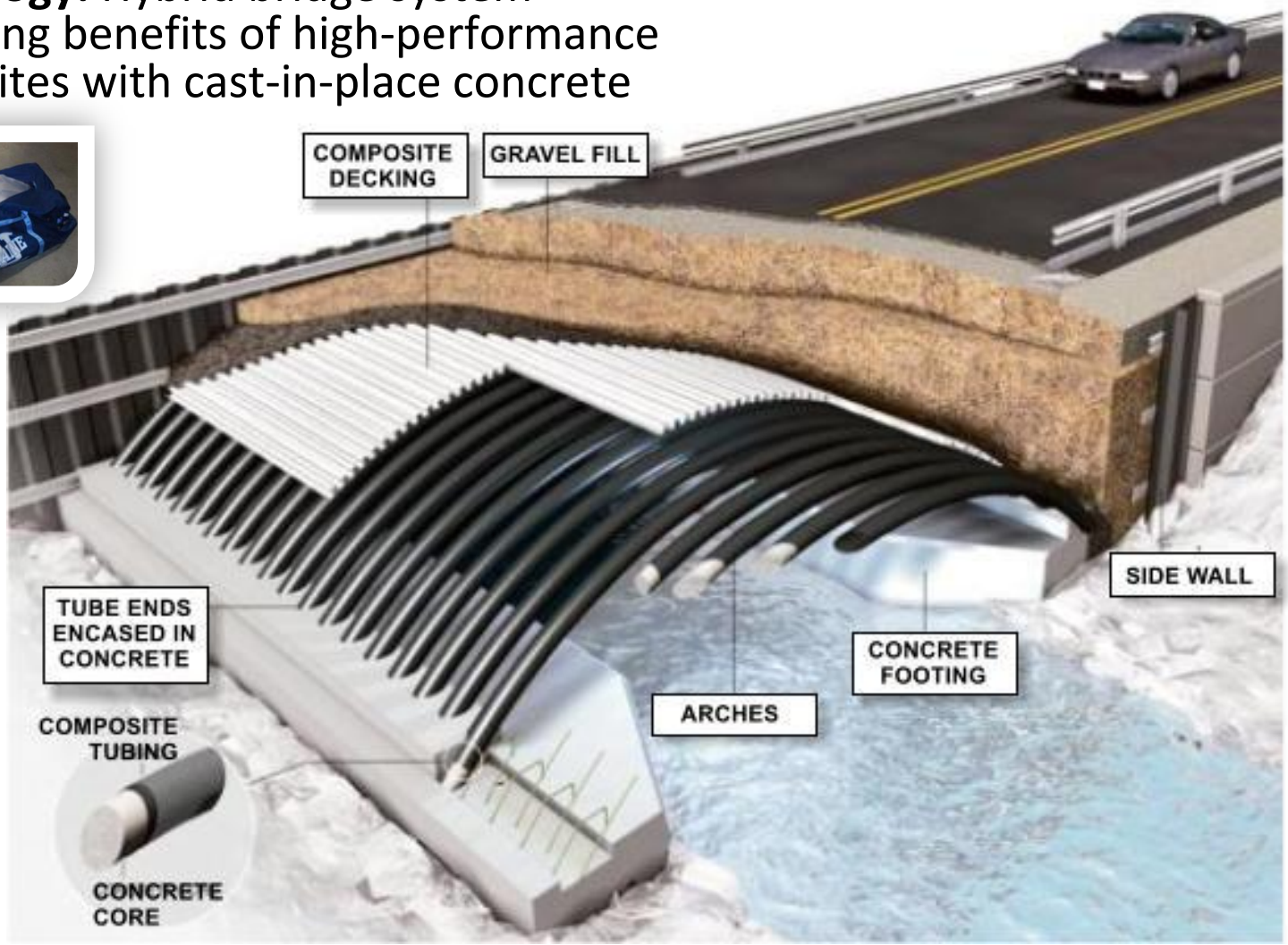


Image Credit – NY Times/University of Maine

AEWC Advanced Structures & Composites Center

1865 THE UNIVERSITY OF MAINE

Penobscot Narrows Bridge, Maine

Composite Ship Structures

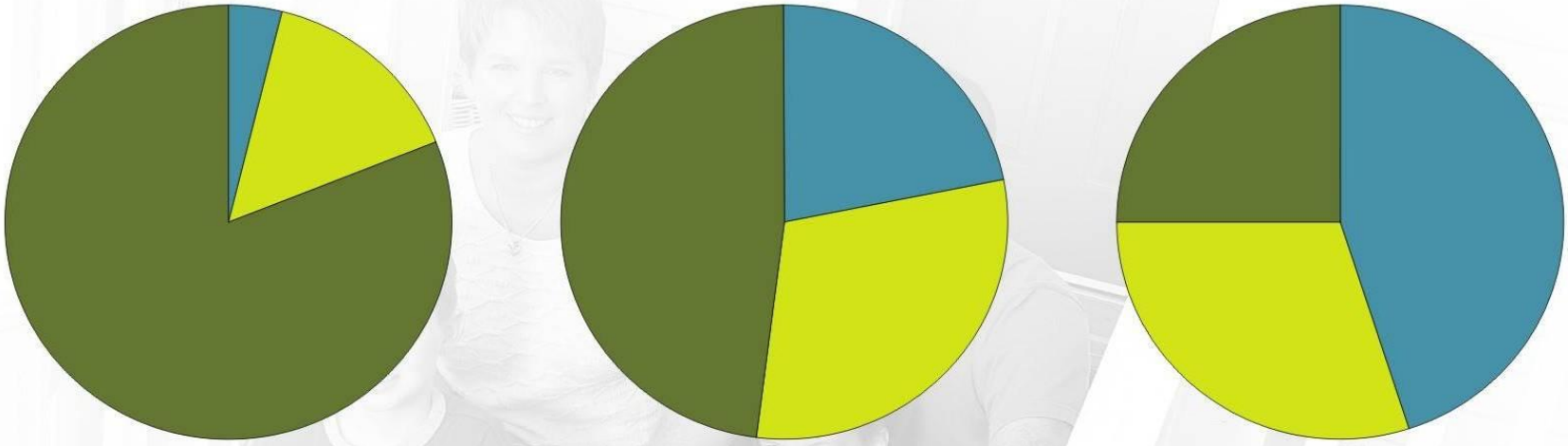
MAKO Composite Patrol Craft

Maine Family Budget

Energy ~5%

Energy ~20%[2] *at $4/gallon*

Energy ~40%[3]



1998 2008, 2012 2018

"Family Energy"[1,2] = 50% Transportation
40% Heating
10% Electric Power

[1] Source:, Dr. George Hart, UMaine
[2] Based July '08 energy costs
[3] Assumes that health care costs do not grow past 30% of the average family budget in 2008-2018

Maine Plan: 5GW Floating 2030

OFFSHORE WIND
$20 billion, 15,000 jobs

5 GW

HOME HEATING

- Save 40-60%
- Weatherize, 30 years
- Heat pumps, 30 years
- $1 Billion revolving loan

Smart Grid

Maine

Export to NE

LAND-BASED WIND
$7 Billion

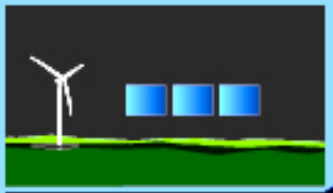
3 GW

TRANSPORTATION
Save 40-60% PEHV, 30 years

Maine Timeline: 5GW Floating by 2030

Maine Just Won 2 of 7 DOE FOAs Pilot Farms.

Phase 2 -
1:8 Prototype



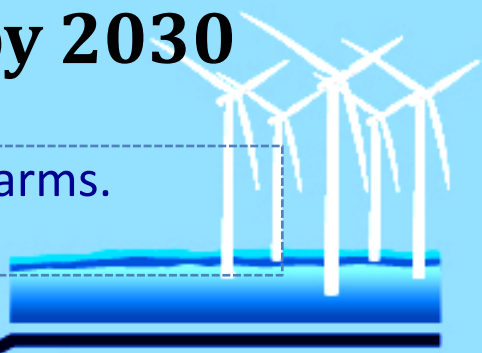
Phase 1 -
1:50 Scale

2011

2013

2017

Phase 3 -
Pilot Farm:
12 MW



2020

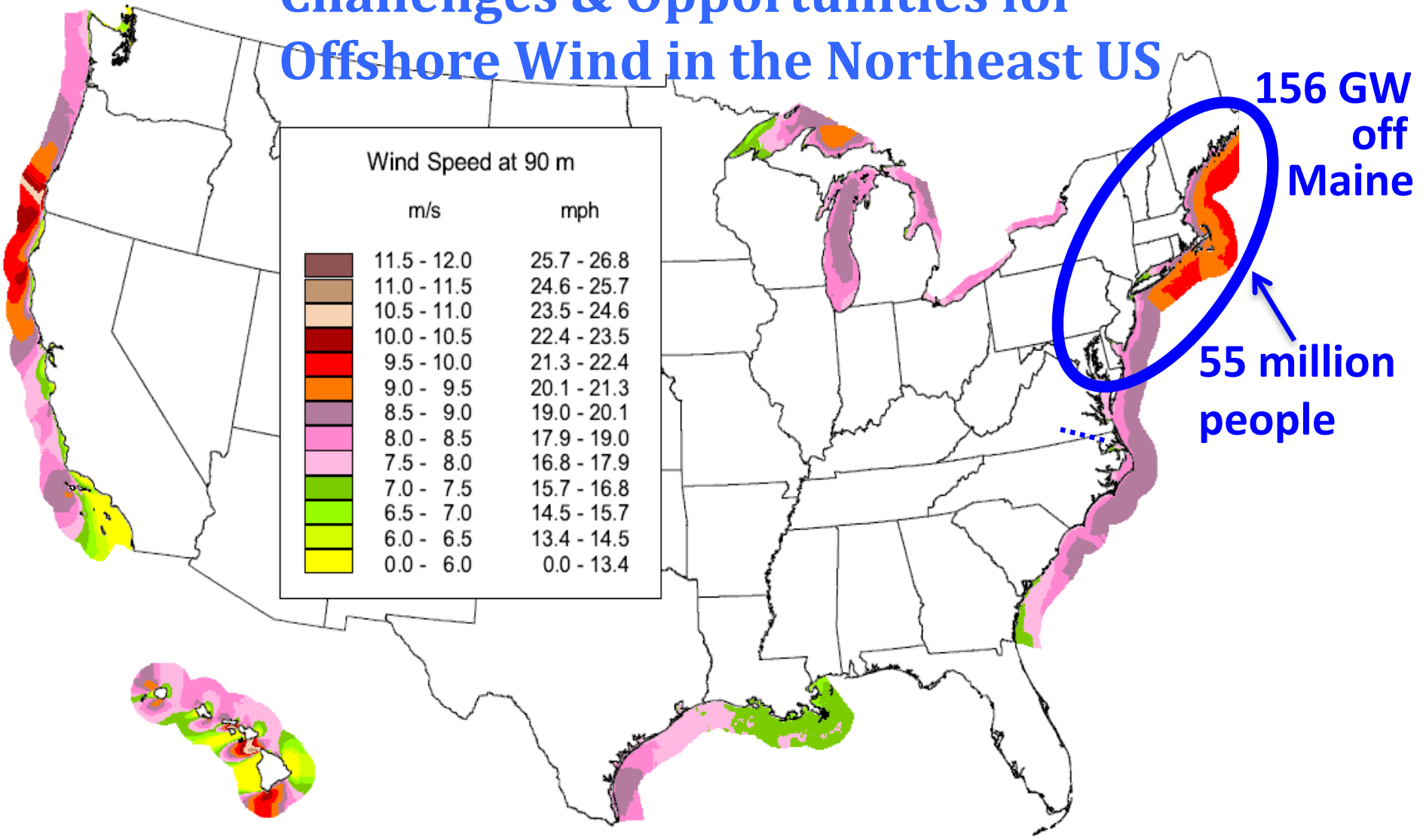
Phase 4 -
500 MW Farm

2030

Phase 5 -
5 GW by 2030

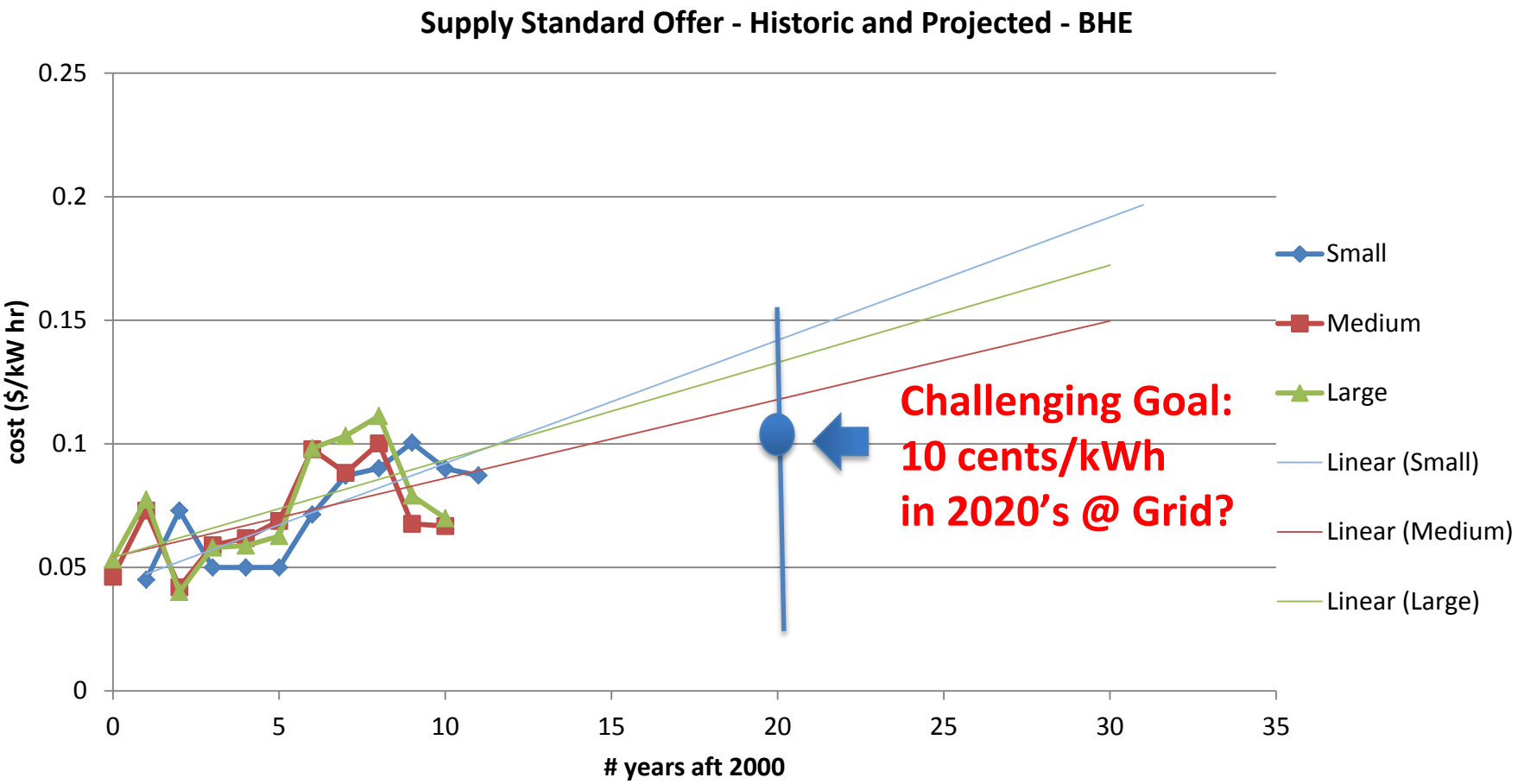
1865 THE UNIVERSITY OF MAINE

Challenges & Opportunities for Offshore Wind in the Northeast US

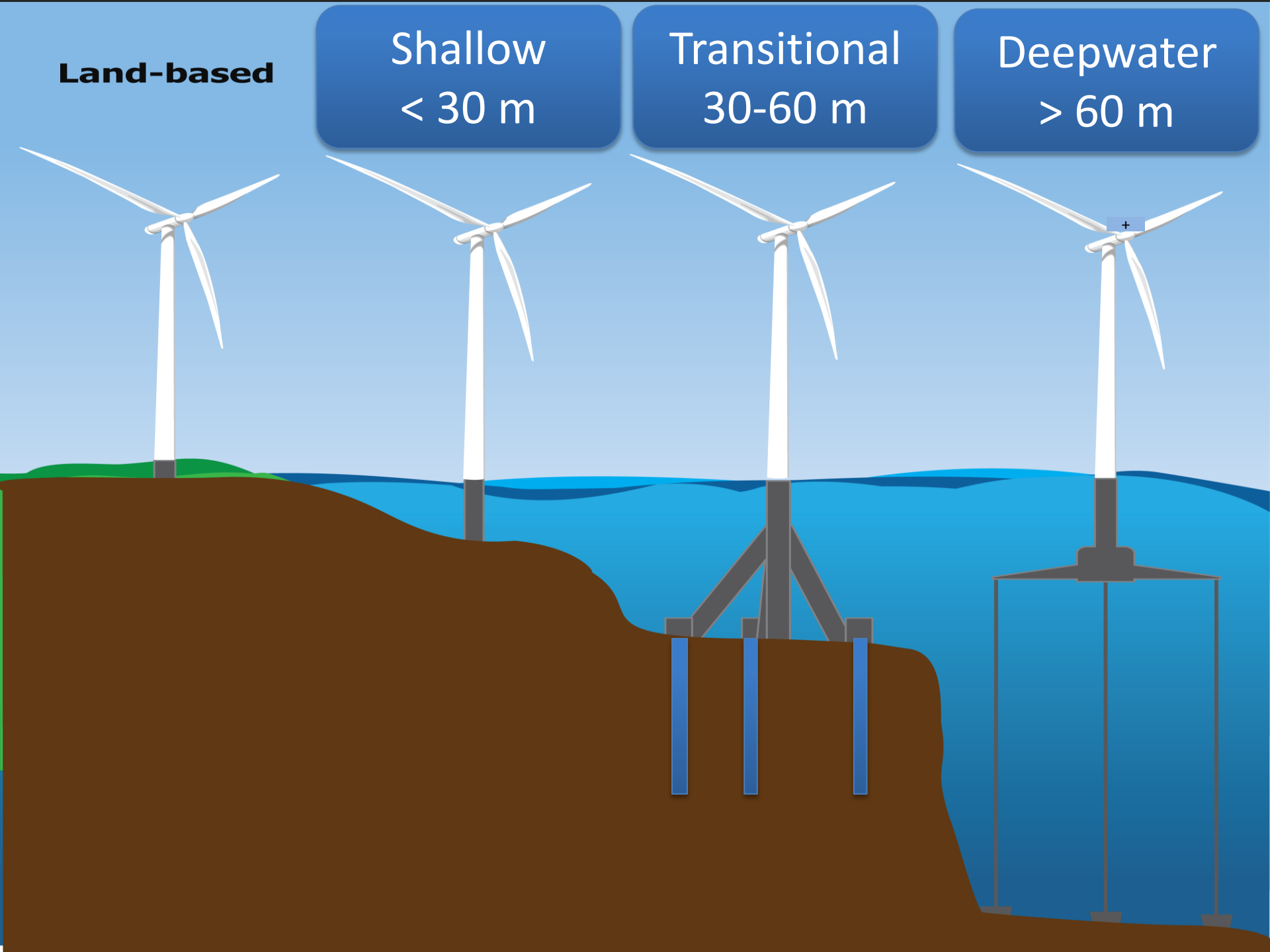


Source: "Assessment of Offshore Wind Energy Resources for the United States", by Marc Schwartz, Donna Heimiller, Steve Haymes, and Walt Musial, Technical Report, NREL/TP-500-45889, June 2010

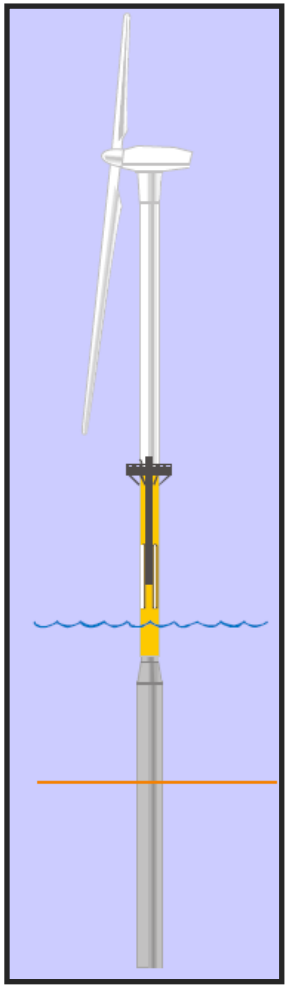
#1 Challenge:
Reduce Cost of Offshore Wind



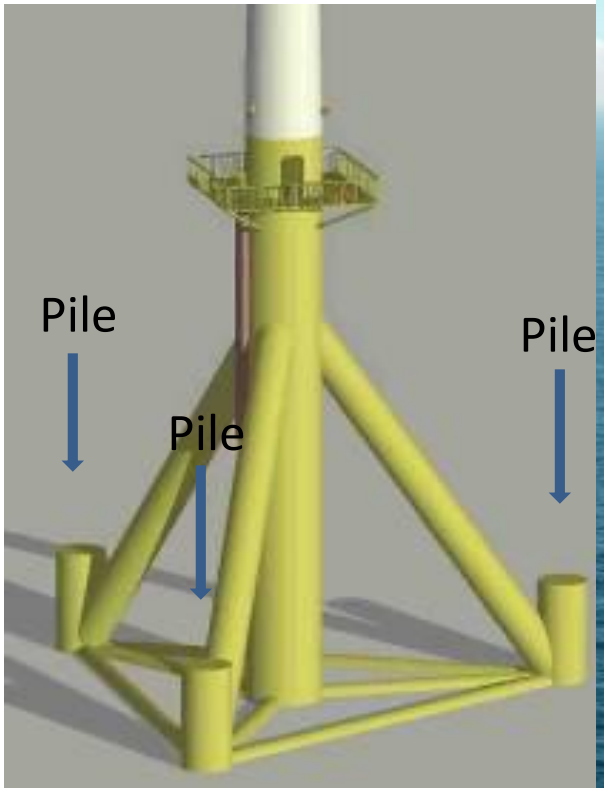
Source: Jake Ward, UMaine
Maine PUC data - Not inflation adjusted


Land-based
Shallow
< 30 m
Transitional
30-60 m
Deepwater
> 60 m

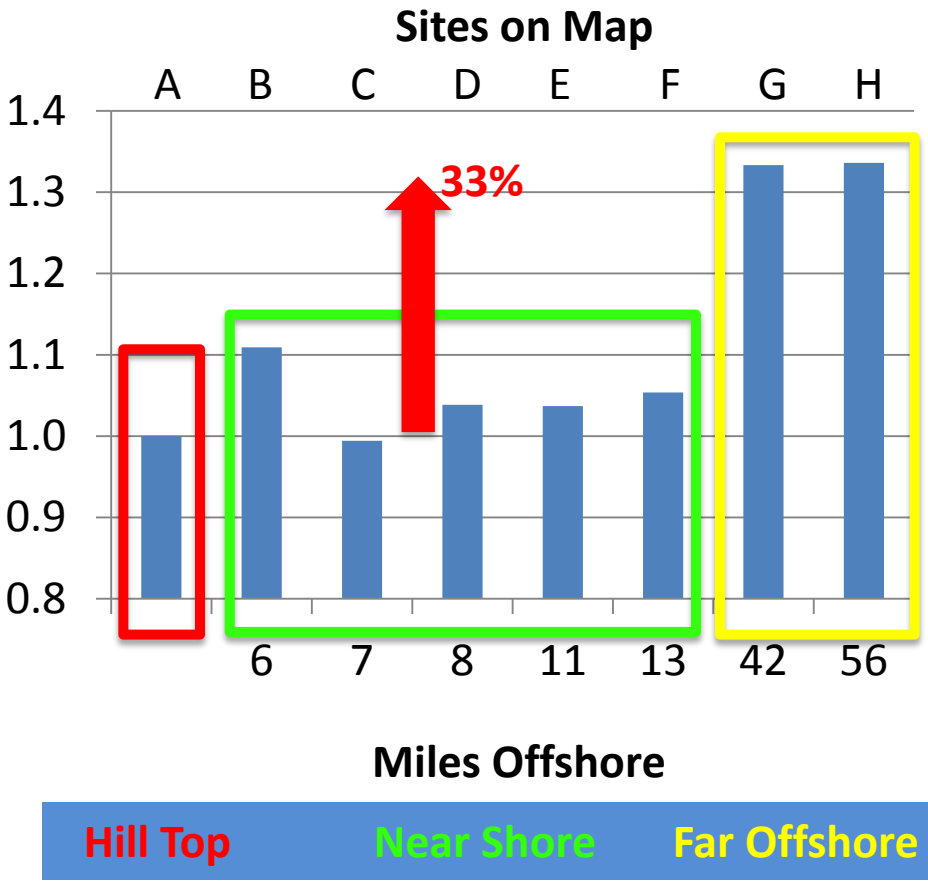
Gulf of Maine Region Lacks Heavy Offshore Construction Assets

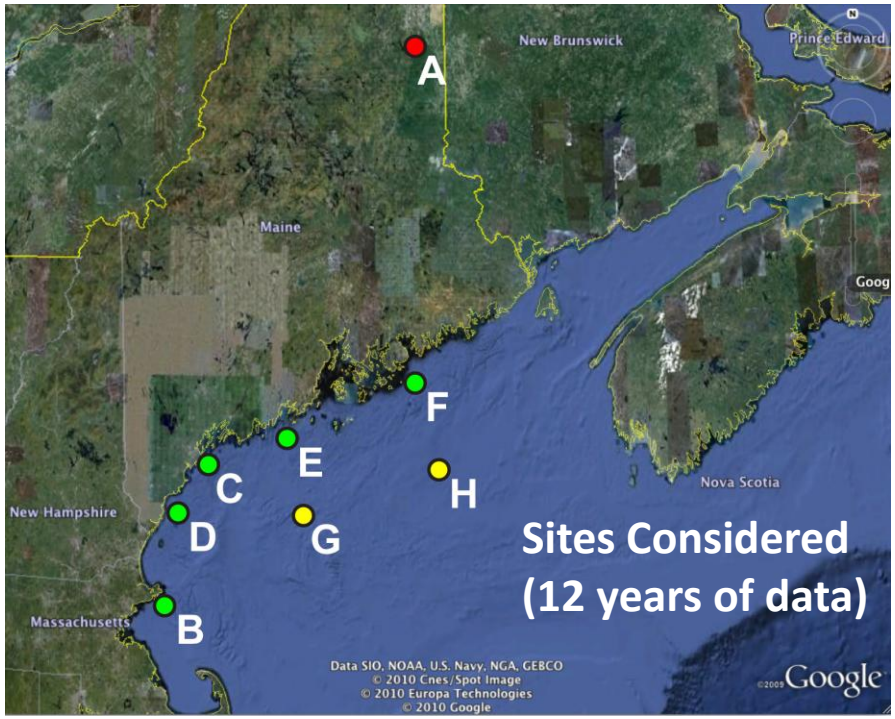


Gulf of Maine Region Lacks Heavy Offshore Construction Assets

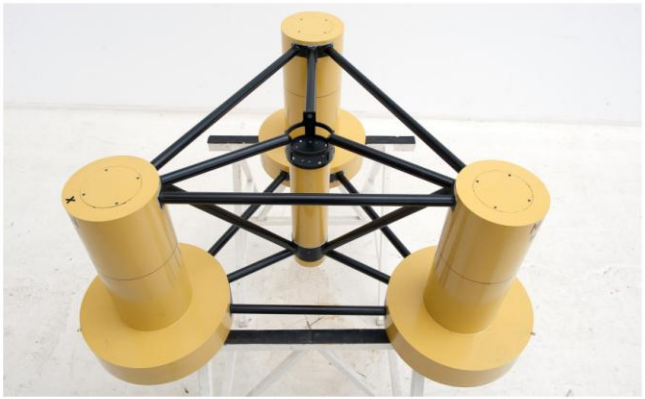


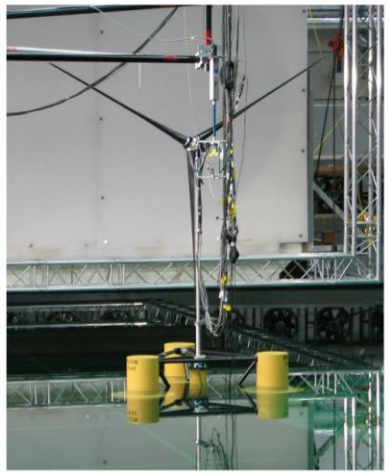
Normalized Annual Production in Gulf of Maine: Hilltop, Near-shore, and Far Offshore Sites





3 Hulls, 60 Metocean Conditions

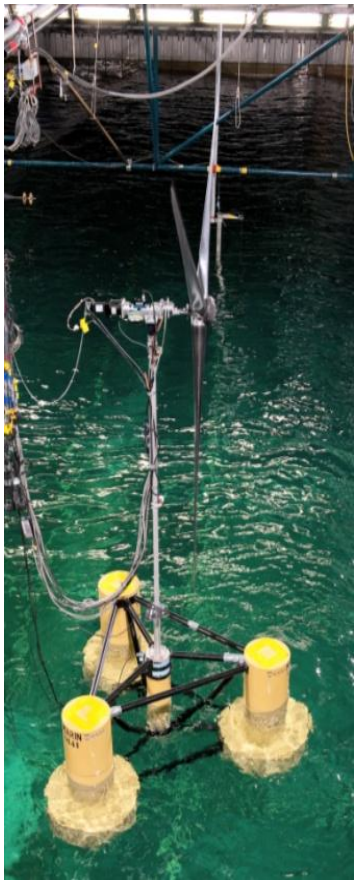




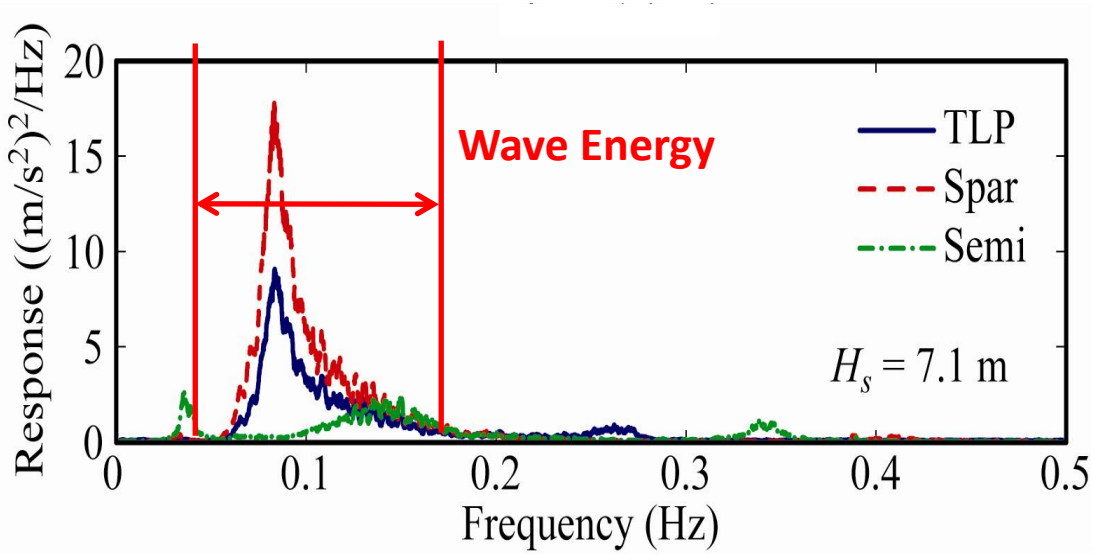
All viable!

Choice depends on local conditions

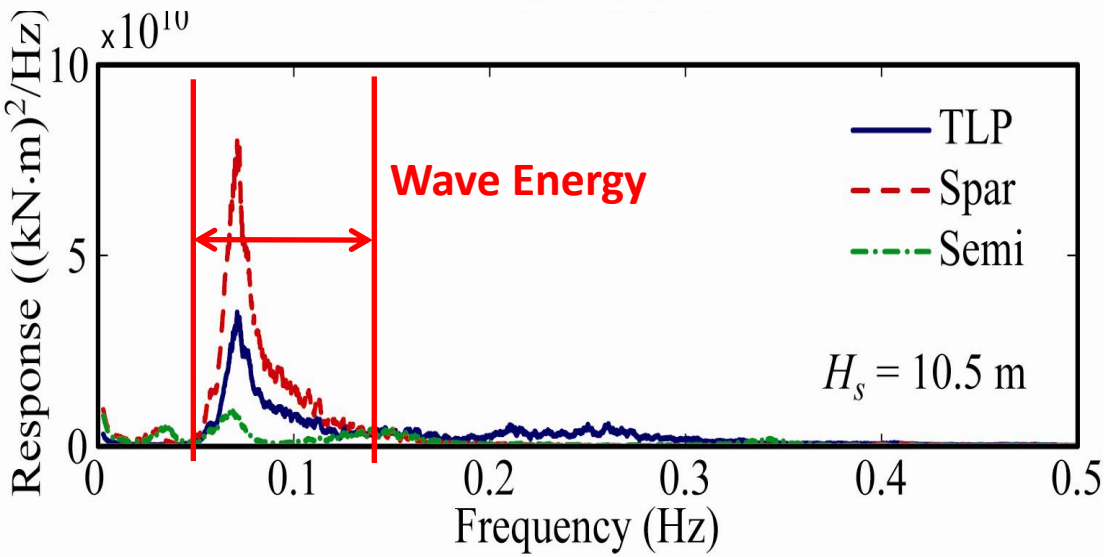
1:50 Scale Test Results



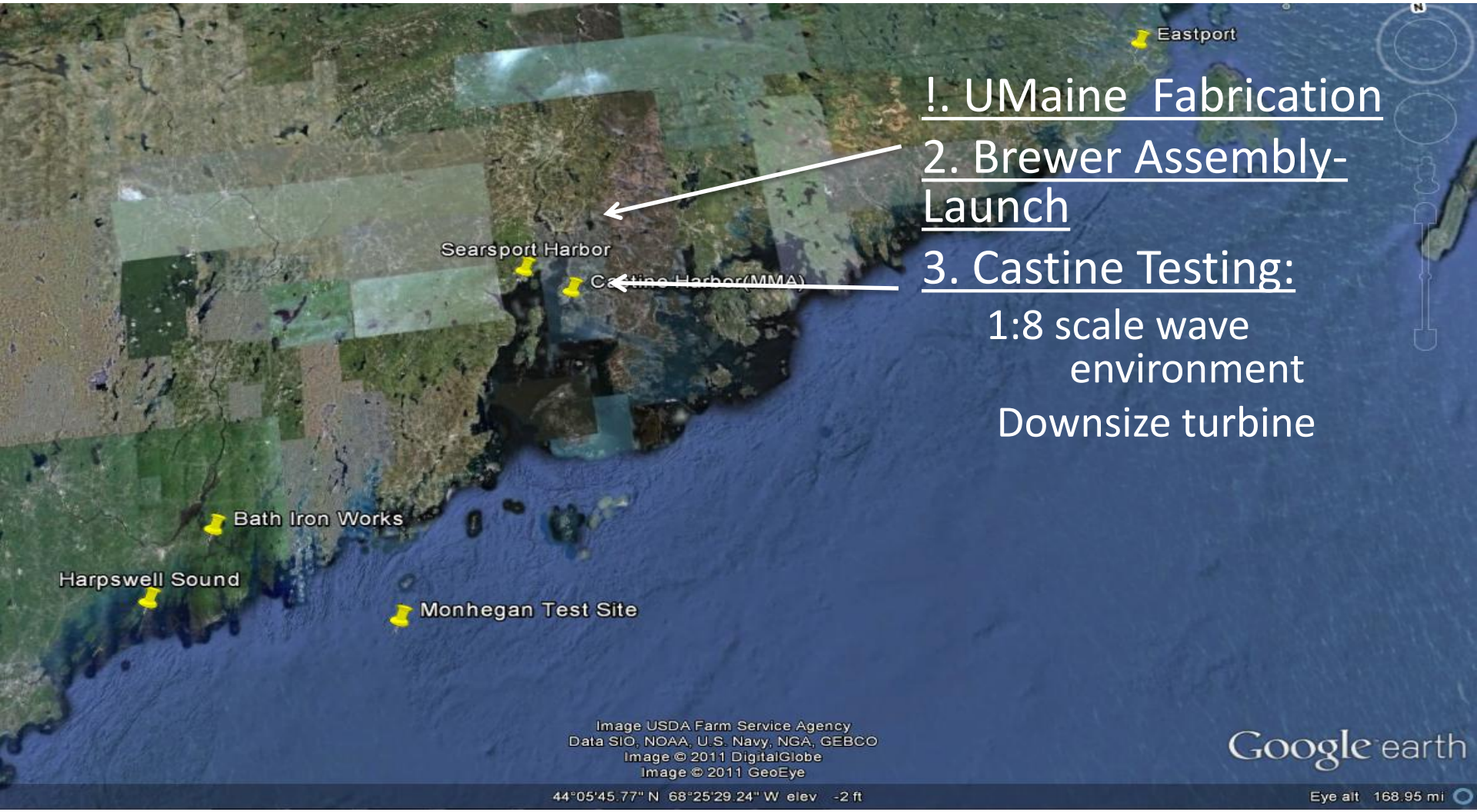
Low Nacelle Surge Acceleration



Low Tower Bending Moment



VolturnUS 1:8 Scale



!. UMaine Fabrication

2. Brewer Assembly-Launch

3. Castine Testing:

1:8 scale wave environment

Downsize turbine

Construction of VolturnUS 1:8 at UMaine Offshore Wind Lab

Completed VolturnUS 1:8 Hull at UMaine Offshore Wind Lab


VOLTURNUS 1:8


VOLTURNUS


VOLTURNUS 1:8
MAINE DeepCwind


VOLTURNUS 1:8


VOLTURNUS
MAINE


VOLTURNUS 1:8
THE UNIVERSITY OF MAINE
DeepCwind


VOLTURNUS 1:8


DeepC LIDAR

DOE FOA DE-FOA-0000410

Advanced Technology Demonstration Projects

Grid Parity Goal

2013 – 50% design
2014 – 100% design, costs
2015 - Start construction
2016 – 1st turbne connect grid
2017 – 2nd turbine connect grid

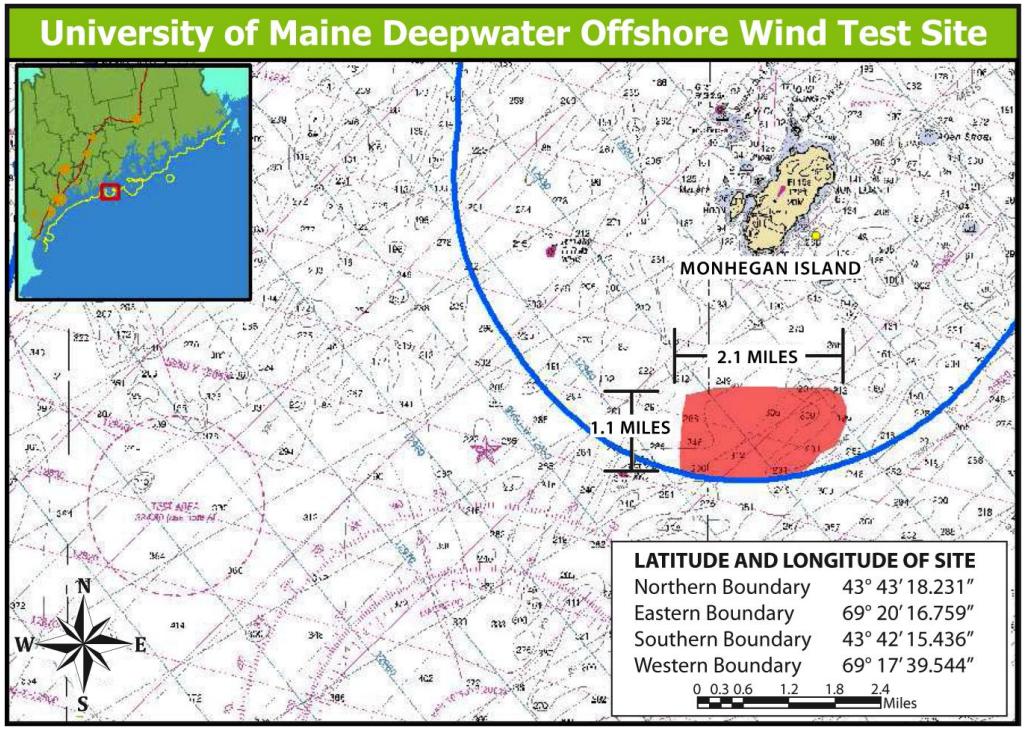
New England

Aqua Ventus I

2x6MW = 12MW

UMaine Monhegan Island Test Site

- Established by Maine Public Law 270
- 9.2 m/s winds at 90 meters.
- 12 years of metocean data.
- Bottom characterization/core sampling.
- Fish, bird, bat, benthic invertebrate and marine mammal pre-deployment monitoring accomplished.
- FONSI received for scale project in 2011.



UMaine Deepwater Offshore Wind Test Site at Monhegan Island in the Gulf of Maine.

Summary

- Maine 5GW by 2030 plan
- VolturnUS:
  - Unique semisubmersible concrete & composite materials
  - Can be manufactured dock-side
  - No jack-up barges, No heavy cranes offshore
  - Reduce O&M costs, extend life beyond typical 20-25 years
- VolturnUS development:
  - 1:50 scale tests of 3 designs (2008-2009)
  - 1:8 scale VolturnUS (2013); *deepC*LIDAR (2013)
  - Full-scale demo 12 MW DOE FOA (2016)
  - Commercial farm 500 MW (2020's)
- Data Collection on VolturnUS 1:8, about 1 year

Acknowledgments

DOE, NSF, UMaine, MTI, State of Maine

In Castine, Maine, on June 13, 2013, at noontime, the first offshore wind electrons started to flow into the US electricity grid.