New England Aqua Ventus I

DOE Advanced Technology Demonstration Program for Offshore Wind

March 18, 2019

FAID

by

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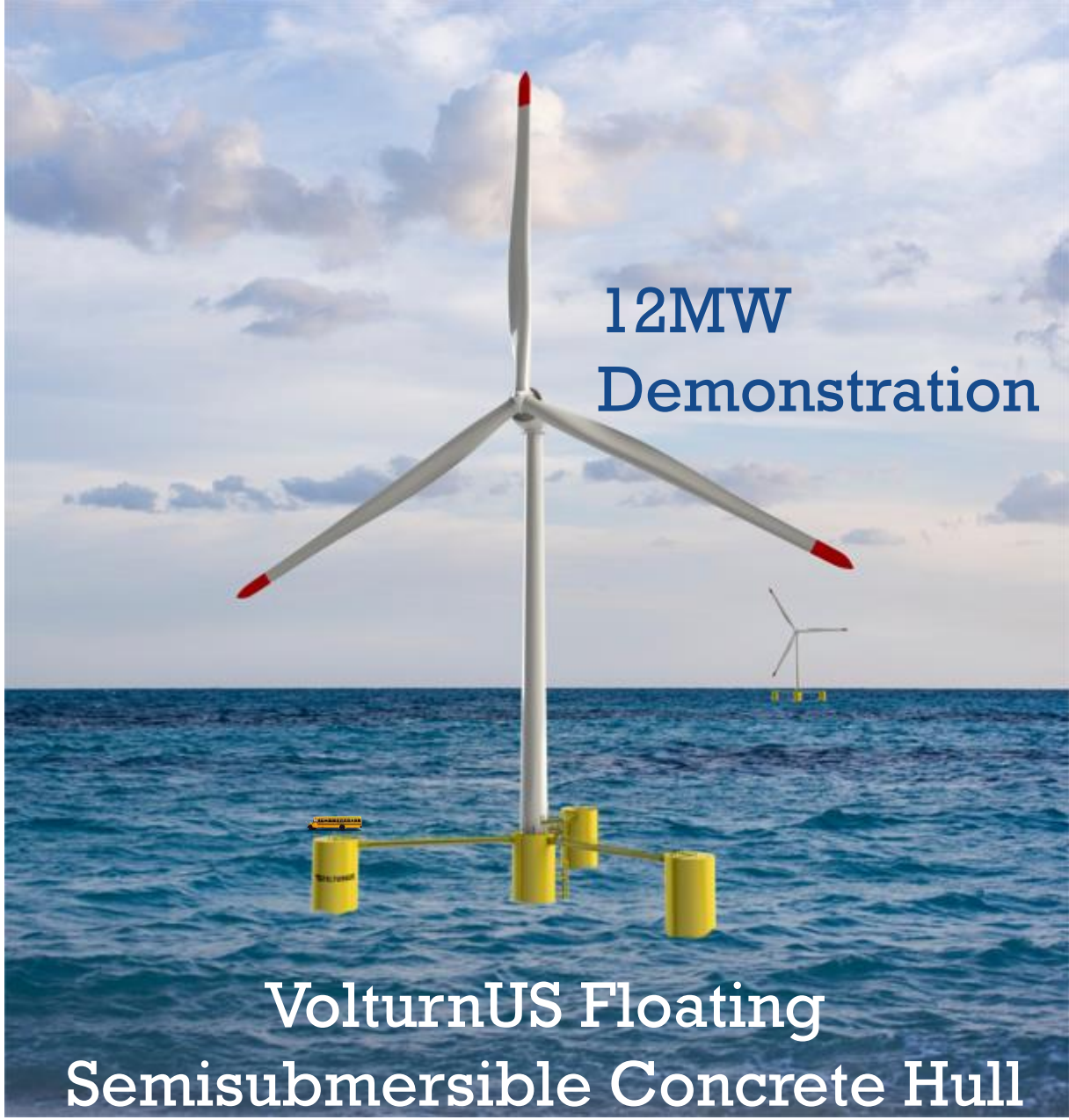
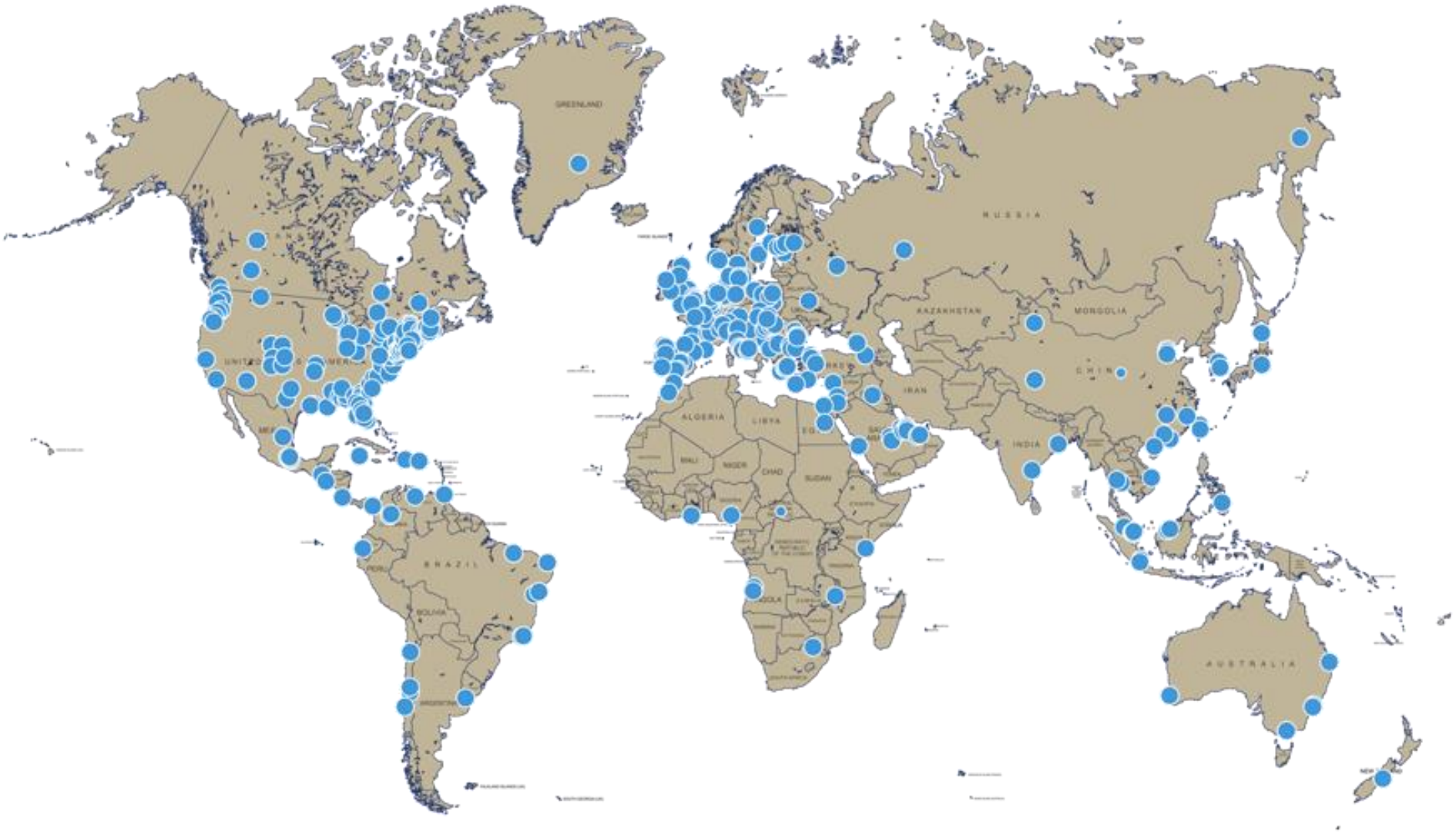


Bringing Advanced Materials into Construction

- Founded though the NSF in 1996
- 200+ faculty, staff and students
- 100,000 ft^2 lab
- 2,200+ students funded from 35+ majors at UMaine
- 10 Spinoff companies

ASCC Partners and Clients



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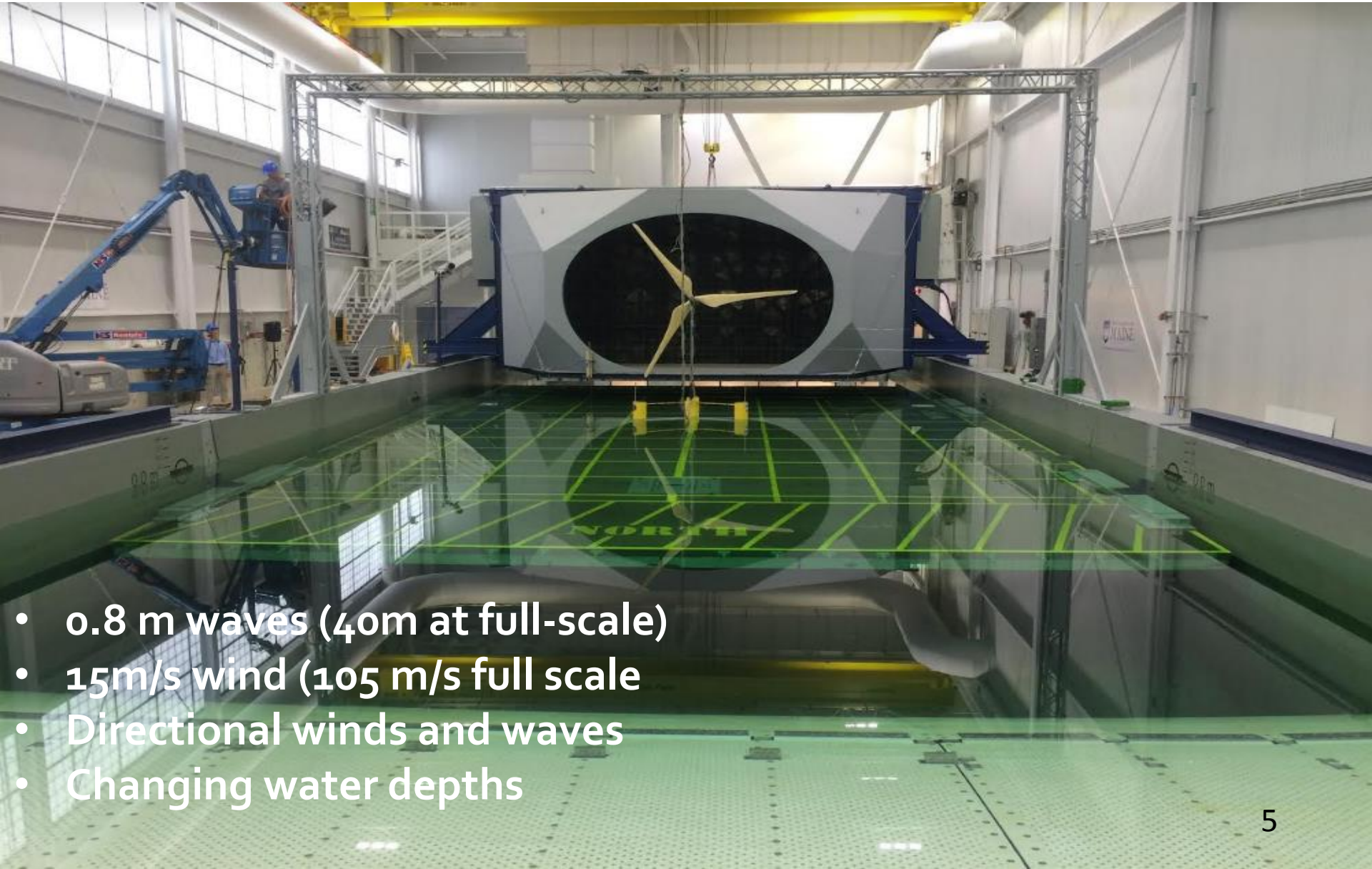
The W2 Wind-Wave Basin



- 0.8 m waves (40m at full-scale)
- 15m/s wind (105 m/s full scale
- Directional winds and waves
- Changing water depths

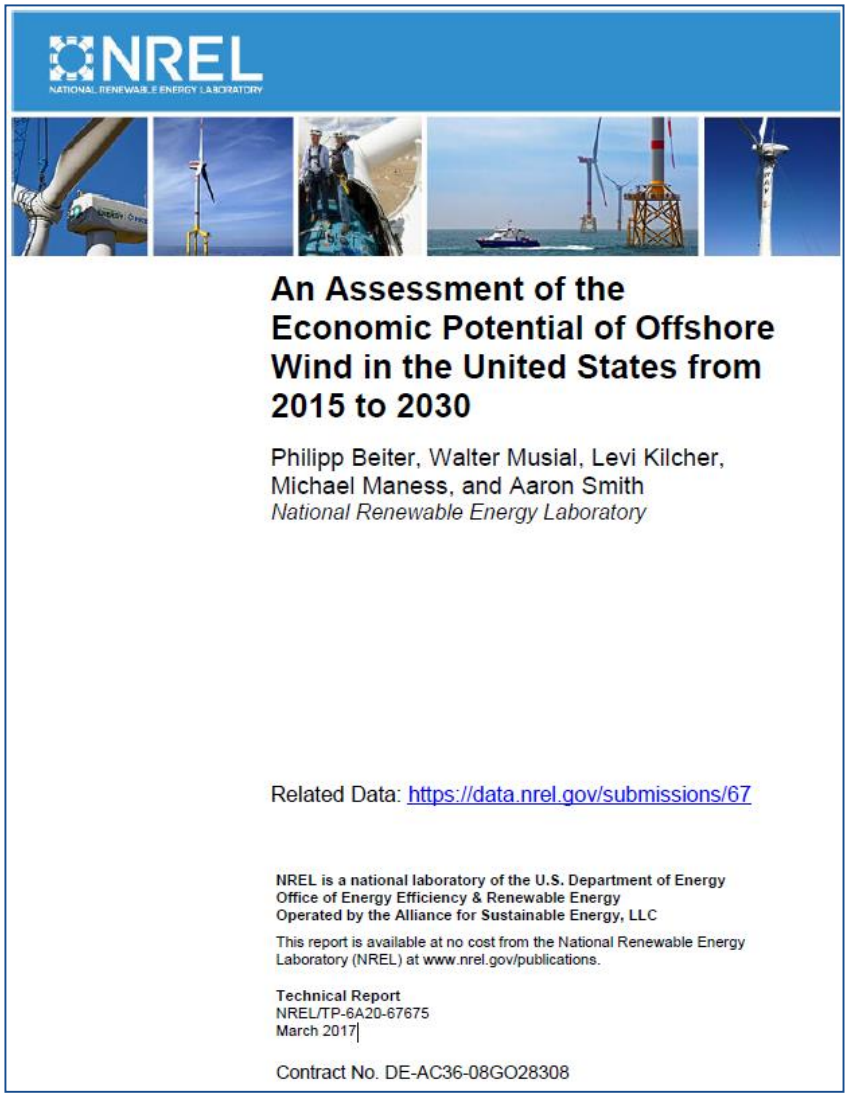
Maine Fossil Fuel Expenses = $3.6-5.8 billion/yr

Additional Capacity Needed to Heat Homes and Electrify Transportation = 5 GW

Maine Leads in Economic Potential for Offshore Wind Along the East Coast

Offshore Wind Economic Potential

State	Economic Potential (in gigawatts [GW])
Maine	65
Massachusetts	55
Rhode Island	16
Virginia	4
New Hampshire	2
New York	1
Connecticut	1


NREL
NATIONAL RENEWABLE ENERGY LABORATORY

An Assessment of the Economic Potential of Offshore Wind in the United States from 2015 to 2030

Philipp Beiter, Walter Musial, Levi Kilcher, Michael Maness, and Aaron Smith
National Renewable Energy Laboratory

Related Data: https://data.nrel.gov/submissions/67

NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

This report is available at no cost from the National Renewable Energy Laboratory (NREL) at www.nrel.gov/publications.

Technical Report
NREL/TP-6A20-67675
March 2017

Contract No. DE-AC36-08GO28308

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Floating Technology Roadmap

Past

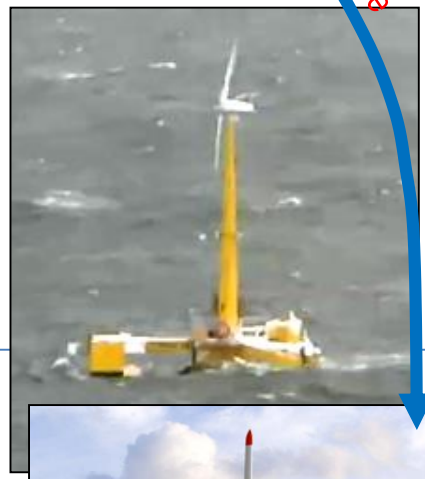
Phase 1: (2008-2012)

Modeling & 1:50 scale Lab Work

Phase 2: (2013-2014)

Deployed 1:8 Scale Project

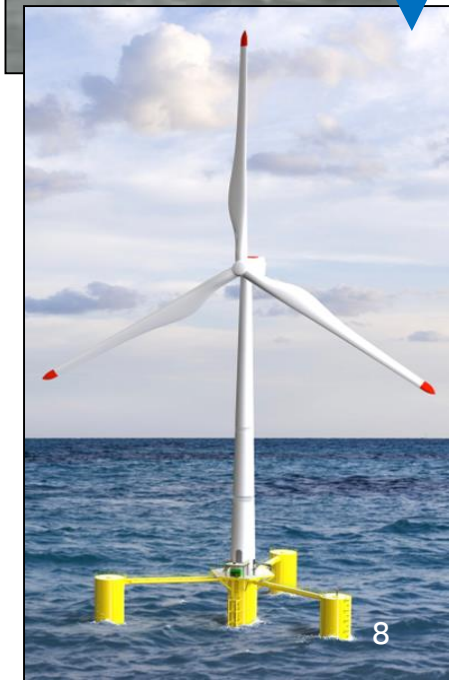
>$25 million invested to date



Future

Phase 3: (2014-2022)

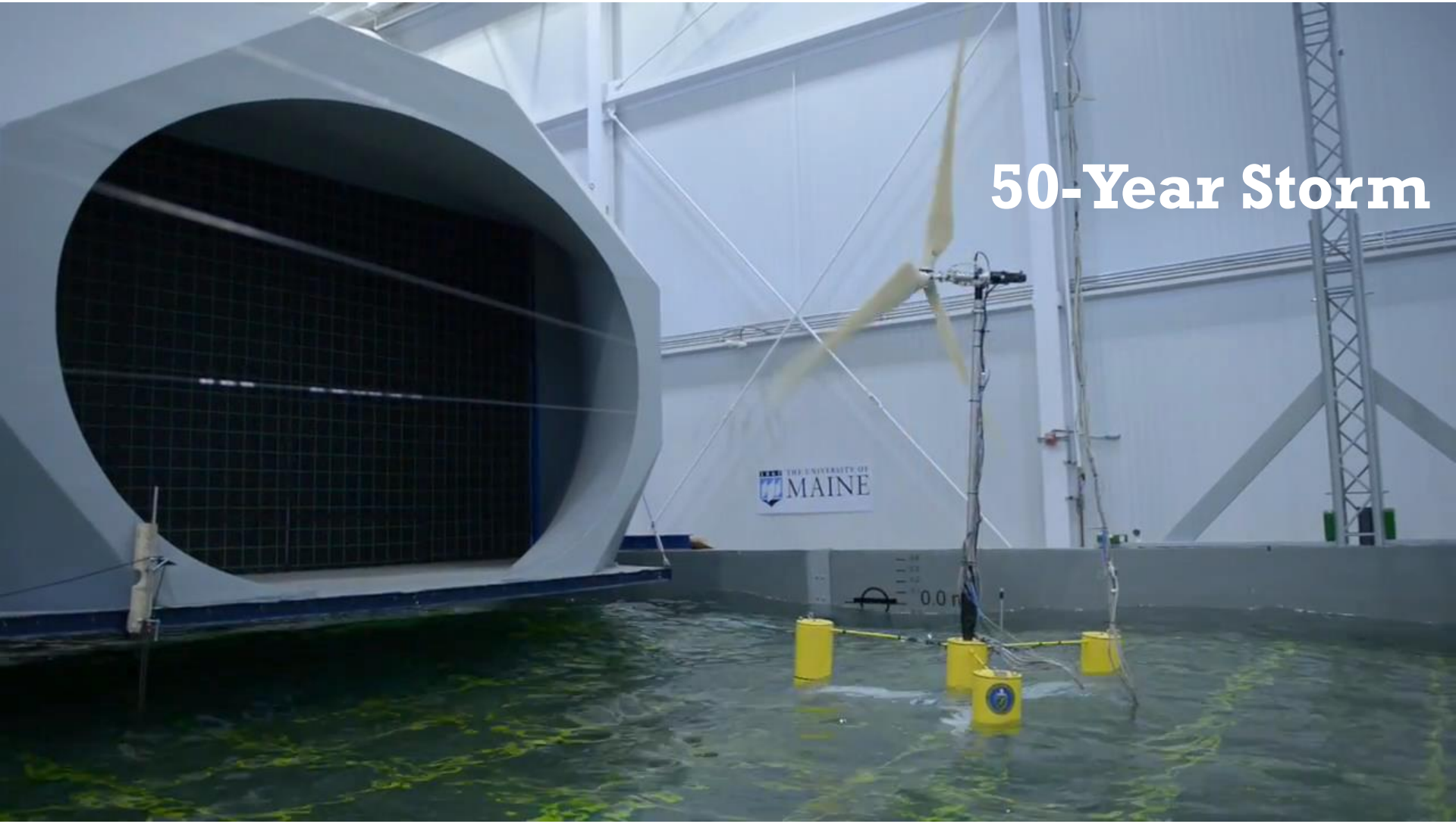
Aqua Ventus I: Build 12 MW demonstration project to prove out the technology full scale



Phase 4: (2024)

Commercial scale projects

Phase 1: Design and Modeling



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Initial Funding by the National Science Foundation

Phase 2: 1/8 Scale Project Operating at Sea

- **Heavily instrumented pilot unit operated for 18 months at sea**

- Experienced 40 scaled 50 to 500-year return period storms:
  - ✓Max nacelle acceleration < 0.2g
  - ✓Max heel angle < 7degrees
- **Results validated design**

VolturnUS 1:8 Launch

1,600 Attended on May 31, 2013

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Tow-Out Testing, Penobscot Bay

Castine, Maine (2013-2014)
60 Onboard Sensors

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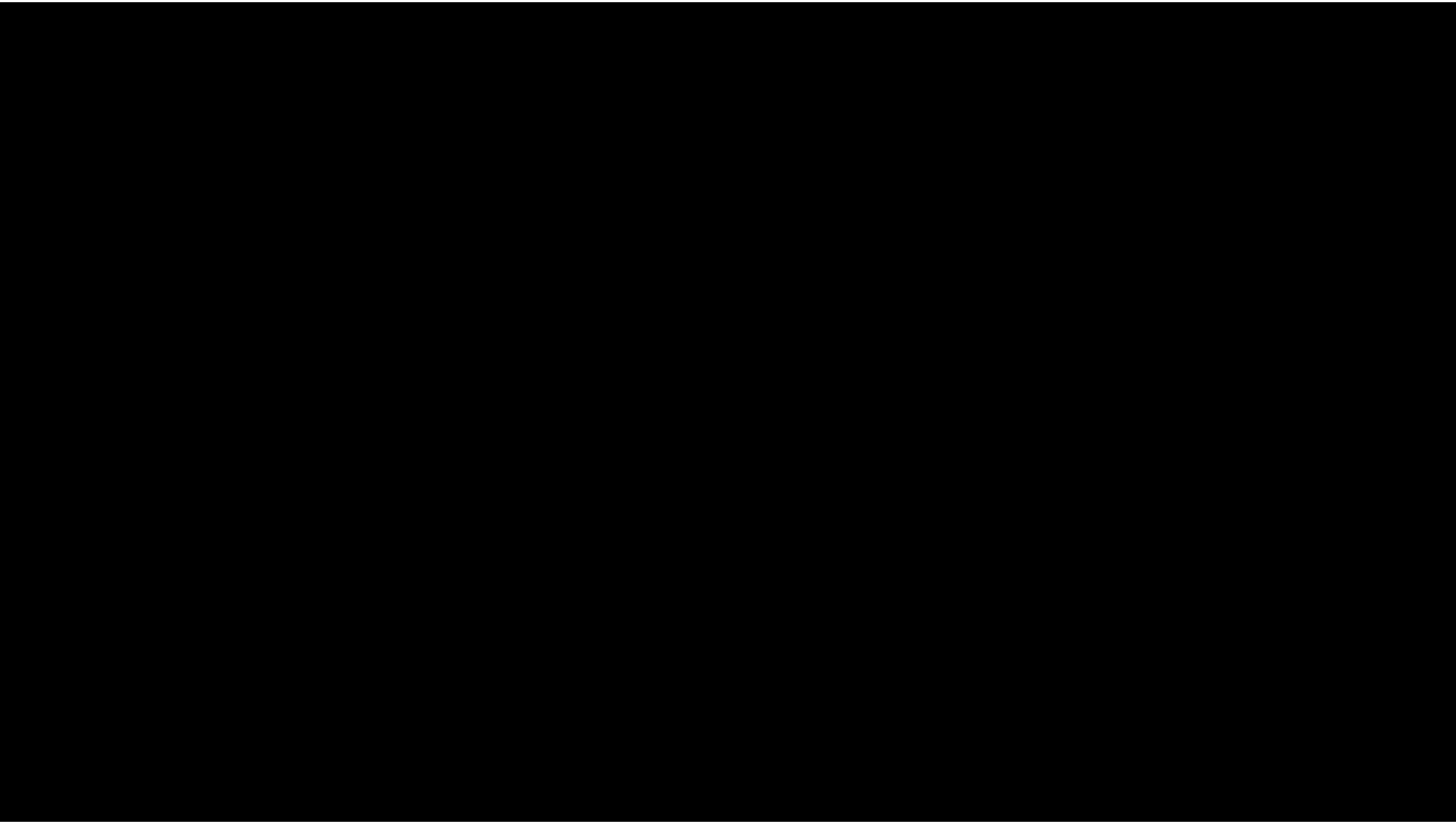
50-Year Return Period Storm

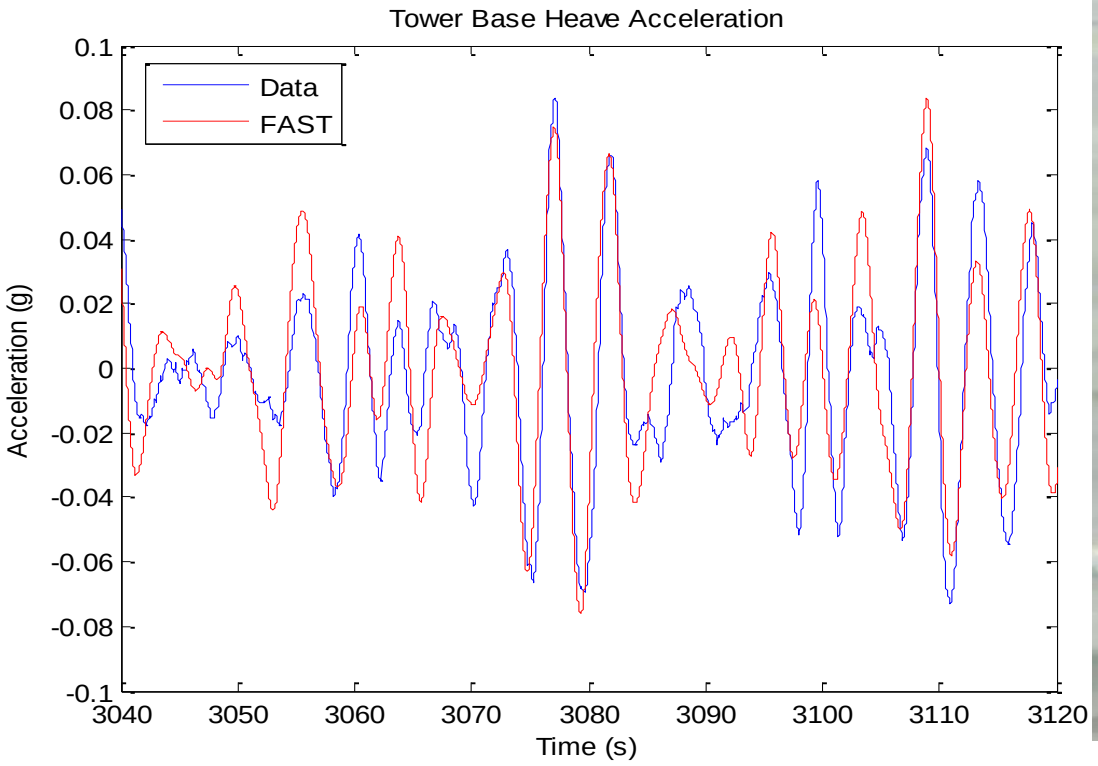


Lessons from VolturnUS 1:8 Pilot Deployment

Validation of Technology Performance

Saw forty scaled 50 to 500-year return period storms:

- ✓Max nacelle acceleration < 0.2g
- ✓Max heel angle < 7degrees



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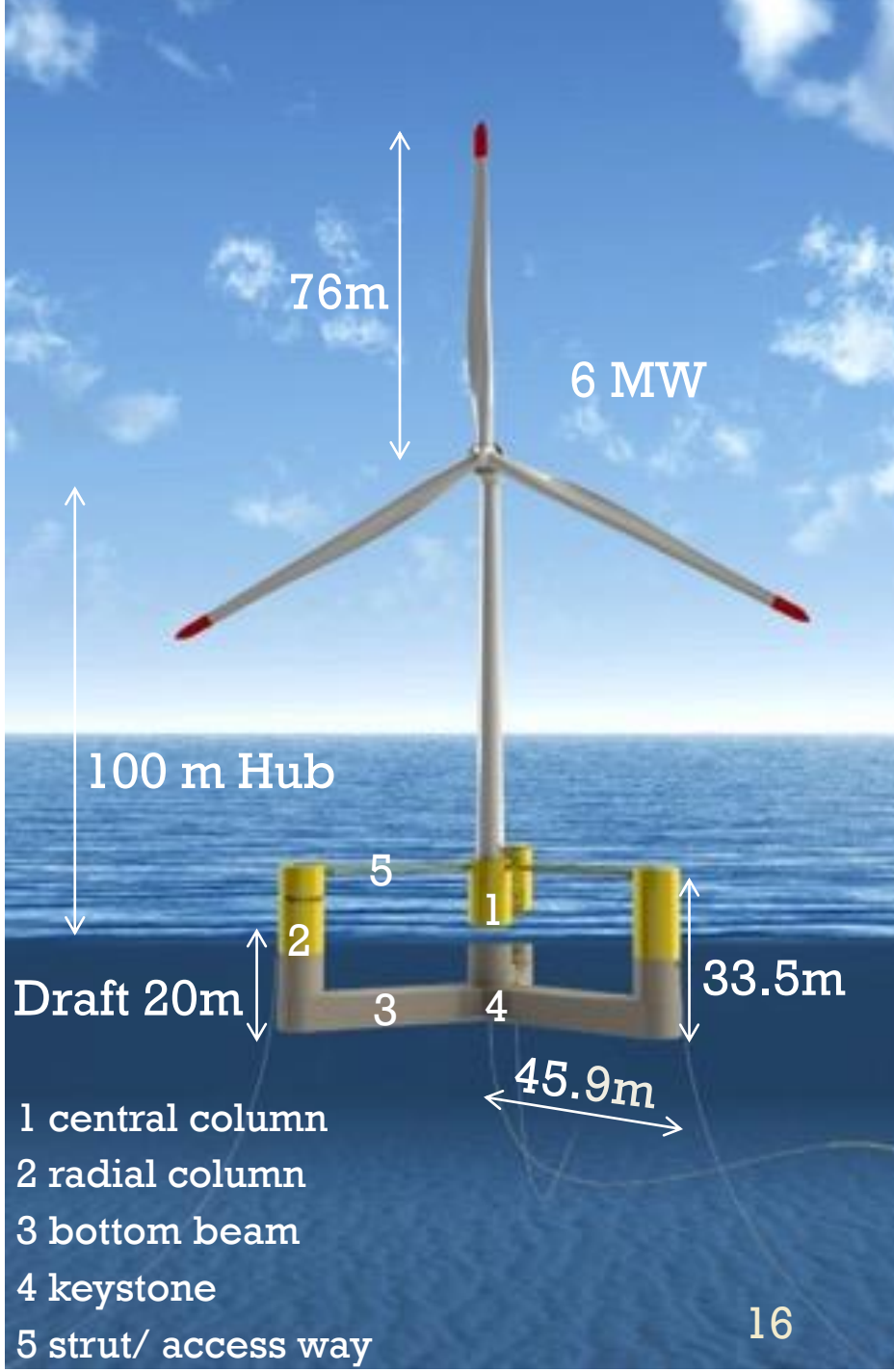
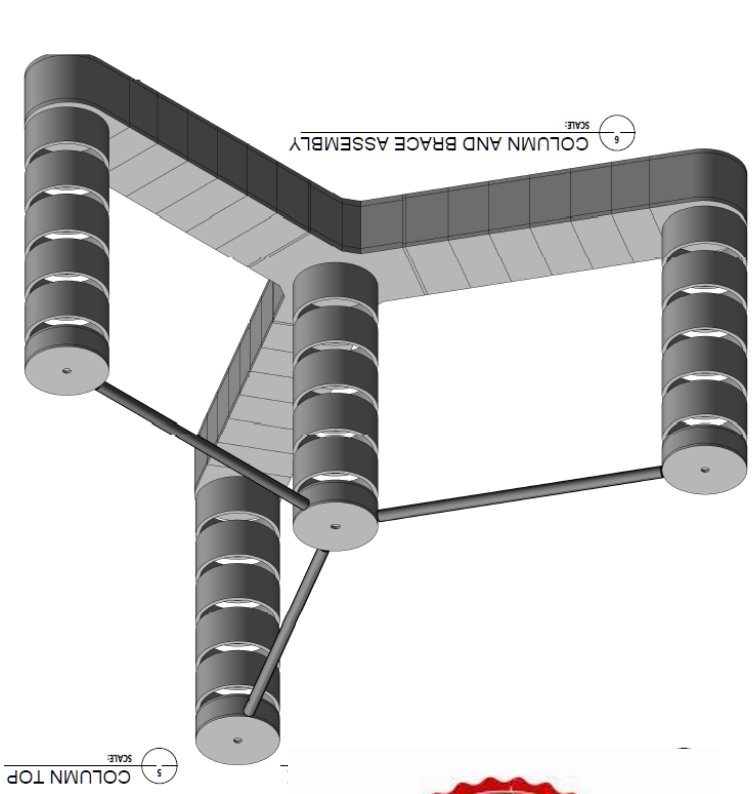
Phase 3: New England Aqua Ventus I

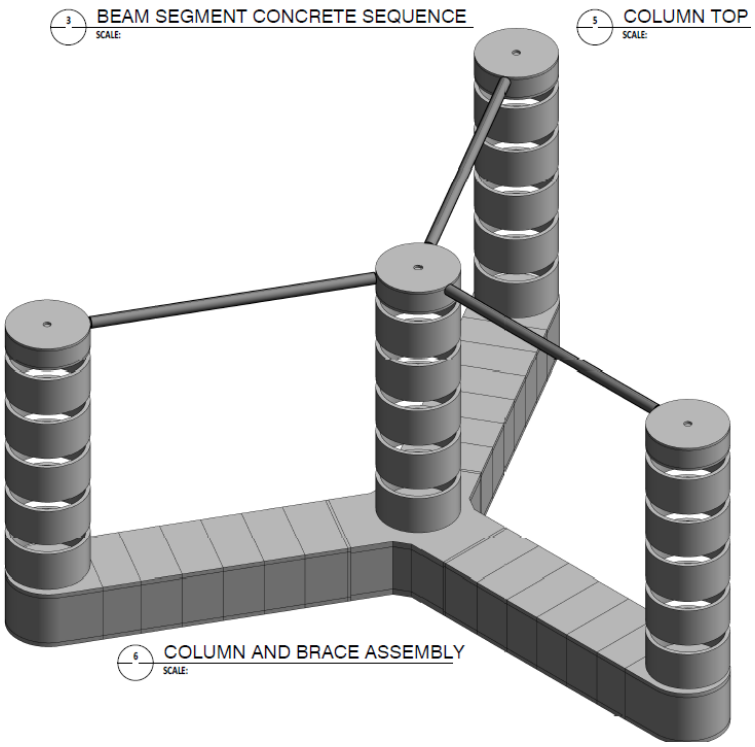
1. 12 MW demonstration projec
2. Site control – State waters
3. Environmental and ecological data collected
4. 15 years metocean data
5. Geophysical investigations completed
6. 100% FEED approved by ABS
7. $40 Million grant from US DOE



Easier to Build than a Bridge:

Built Like a Bridge, Upside-Down





Industrialized floater production:
1 floater per week

7 Issued Patents

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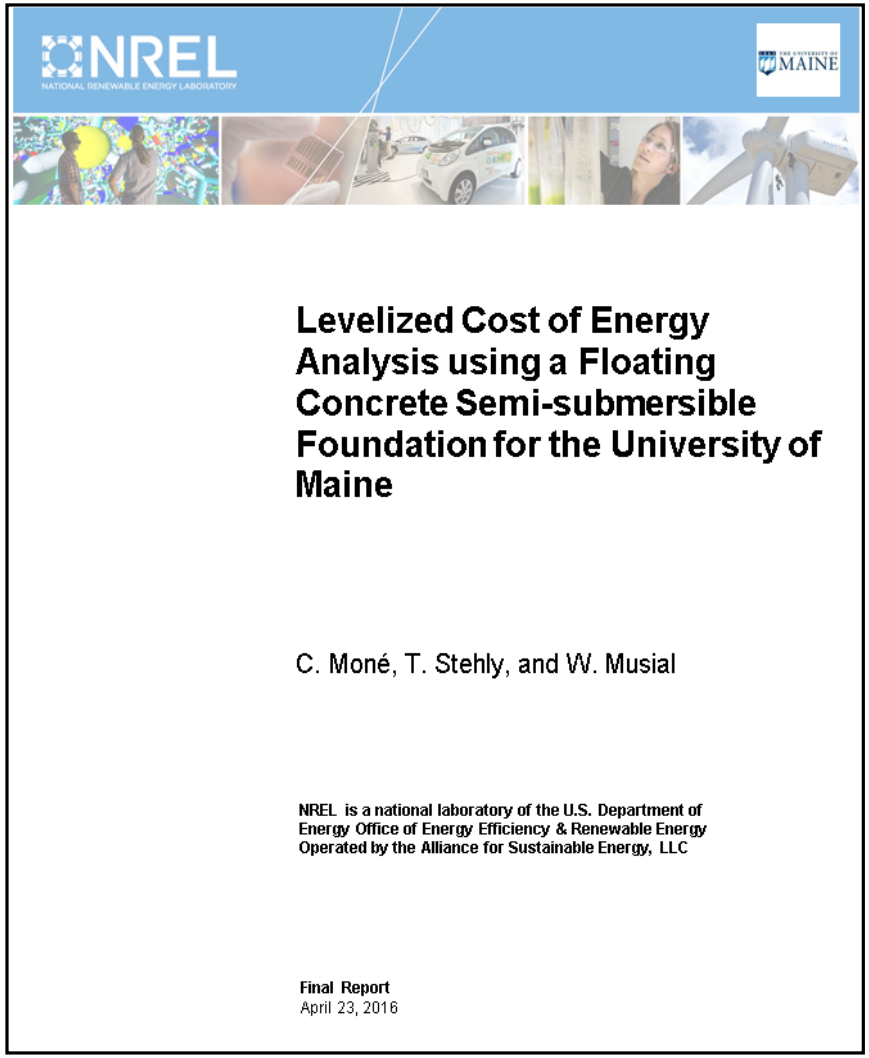
NREL Cost Reports (2016, 2018)

- *"… the LCOE for utility-scale projects using the UMaine concrete hull could be reduced to 7.7 cents/kWh."*


NREL
NATIONAL RENEWABLE ENERGY LABORATORY
MAINE

Levelized Cost of Energy Analysis using a Floating Concrete Semi-submersible Foundation for the University of Maine

C. Moné, T. Stehly, and W. Musial

NREL is a national laboratory of the U.S. Department of Energy Office of Energy Efficiency & Renewable Energy Operated by the Alliance for Sustainable Energy, LLC

Final Report
April 23, 2016

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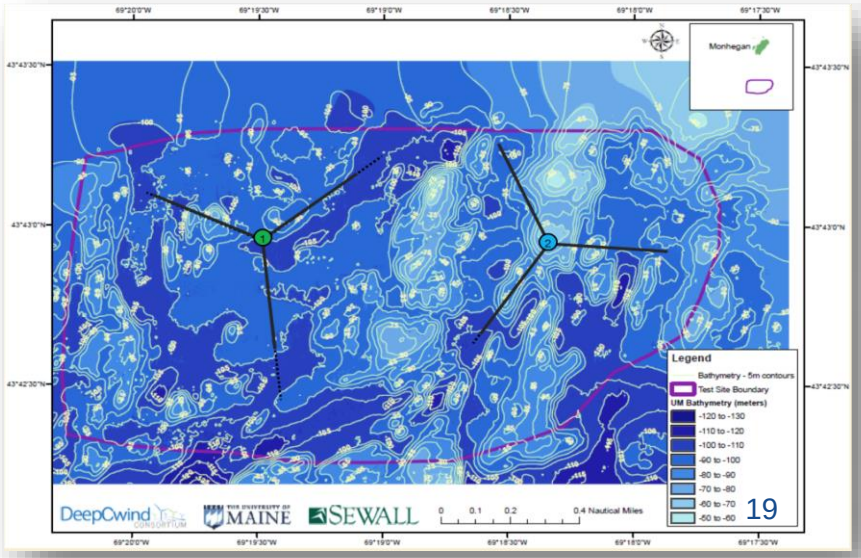
Environmental and Geophysical Studies

Extensive ecological, geotechnical, and cultural studies have been completed:

- Benthos: 2010-13, 2015
- Fish: 2010-15
- Marine Mammals: 2010-15
- Birds: 2010-15
- Bats: 2010-13, 2015
- Noise and Vibration: 2011, 2013
- Electromagnetic Fields: 2011, 2013
- Geophysical: 2010, 2013, 2015
- Terrestrial: 2014
- Aesthetics/Visual: 2013
- Cultural/Historic: 2010, 2014, 2015
- Seismic surveys

Ecological surveyor deploying equipment for surveys, 2012.



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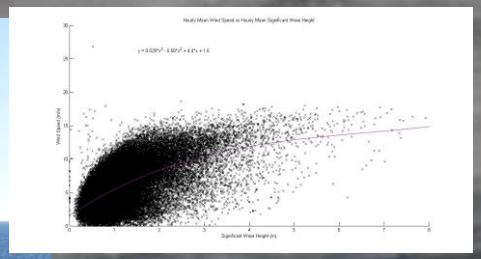
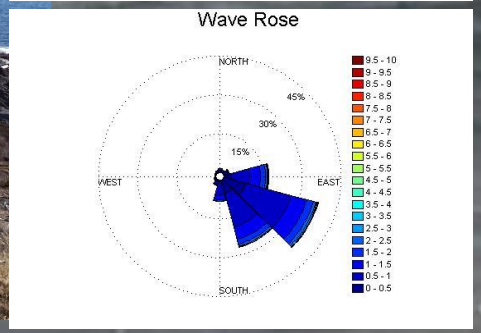
15 Years of Metocean Data Collected

- **Metocean Buoy (15 years)**
  - Waves
  - Wind
  - Currents
  - Temp, pressure
- **Land-based LiDAR on Monhegan (2014)**
- **DeepCLiDAR**





Aqua Ventus I - Schedule

2019	Design, permitting
2020	Financial Close
2021	Construction
2022	Grid connection
5 Years	Monitoring

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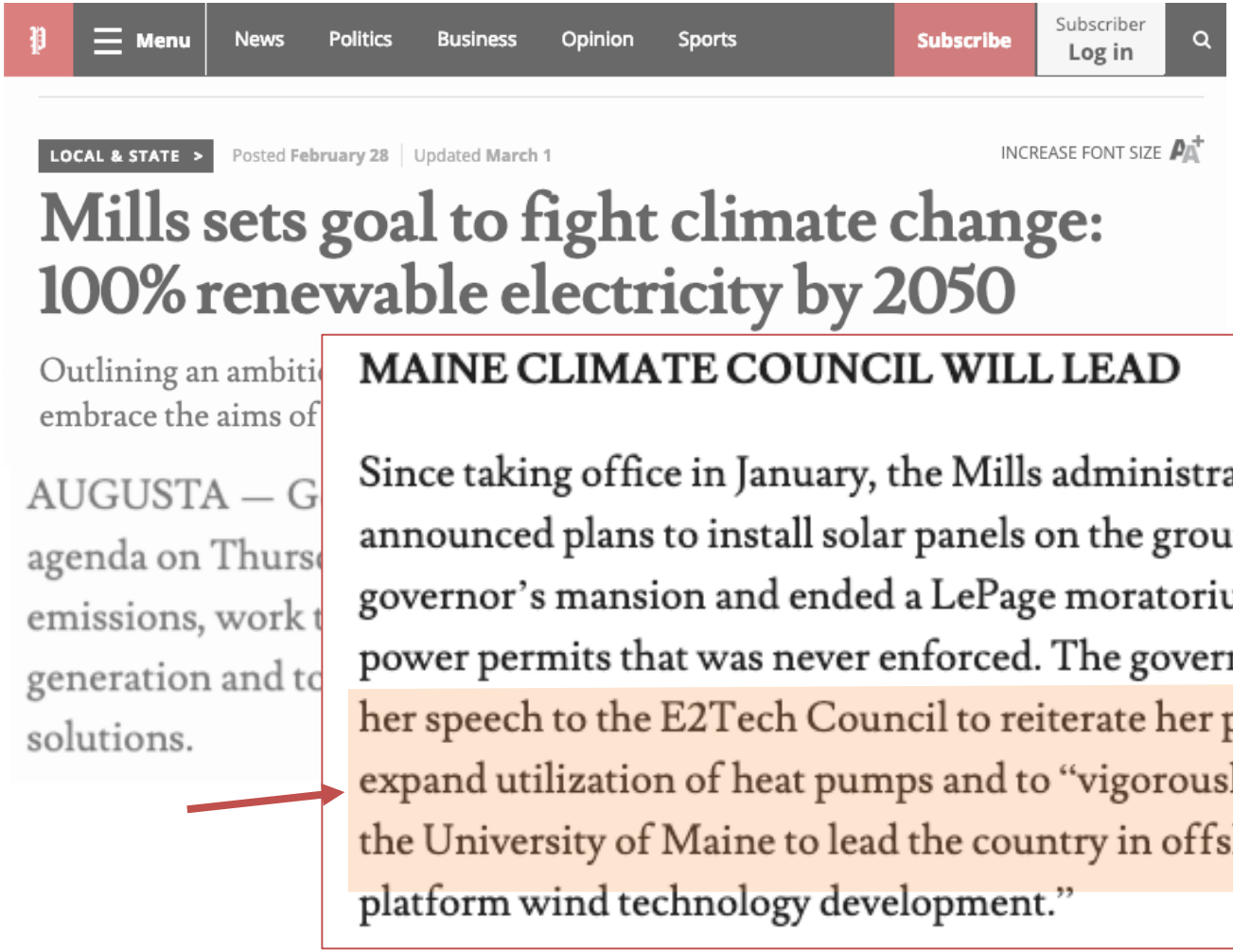
Thank you!



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INCREASE FONT SIZE

Mills sets goal to fight climate change: 100% renewable electricity by 2050

Outlining an ambiti
embrace the aims of

AUGUSTA — G
agenda on Thurs
emissions, work t
generation and to
solutions.

MAINE CLIMATE COUNCIL WILL LEAD

Since taking office in January, the Mills administration has announced plans to install solar panels on the grounds of the governor's mansion and ended a LePage moratorium on wind power permits that was never enforced. The governor also used her speech to the E2Tech Council to reiterate her pledges to expand utilization of heat pumps and to "vigorously support the University of Maine to lead the country in offshore floating platform wind technology development."