

The Blue Economy: Potential for Offshore Wind Energy Production in the Southeast



Denmark's Middelgrunden Site



Paul T Gayes

**Executive Director-Burroughs and Chapin Center for Marine and Wetlands Studies
Coastal Carolina University**



Blue Economy III: Local Perspectives
Southeast Coastal Ocean Observing Regional Authority Annual Meeting
Charleston, SC May 23 2018

Overview

Why Wind Energy

Existing Economic Footprint

Economic Potential

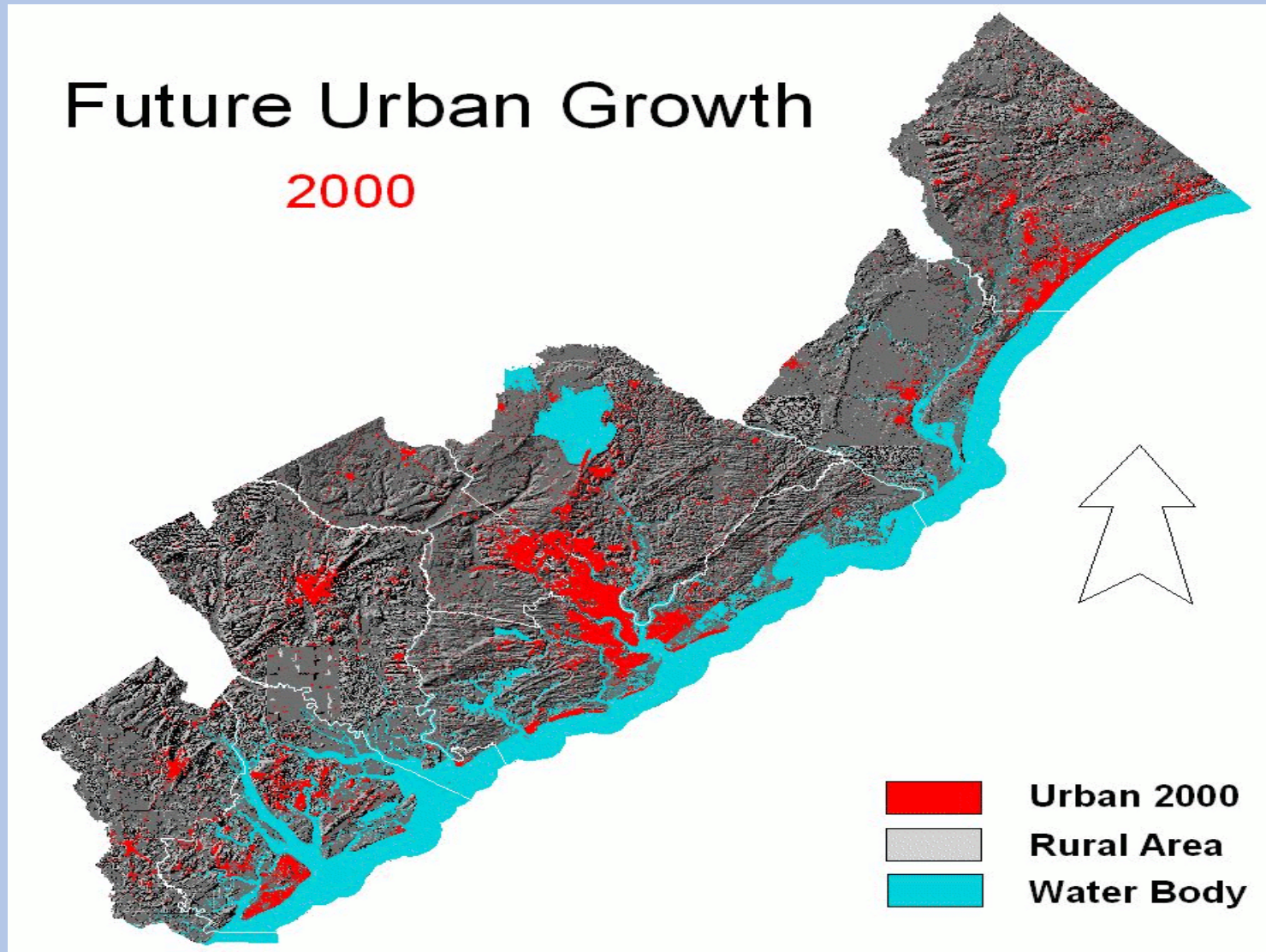
Data / Model Driven Initiatives

Onshore: Stepping Stone to the Offshore
The Value of Actual Measurements

Opportunities for Observing Community



ENERGY DEMAND WILL REQUIRE “ALL THE ABOVE” SOLUTIONS



e.g. Volvo commitment to only produce electric vehicles in the future

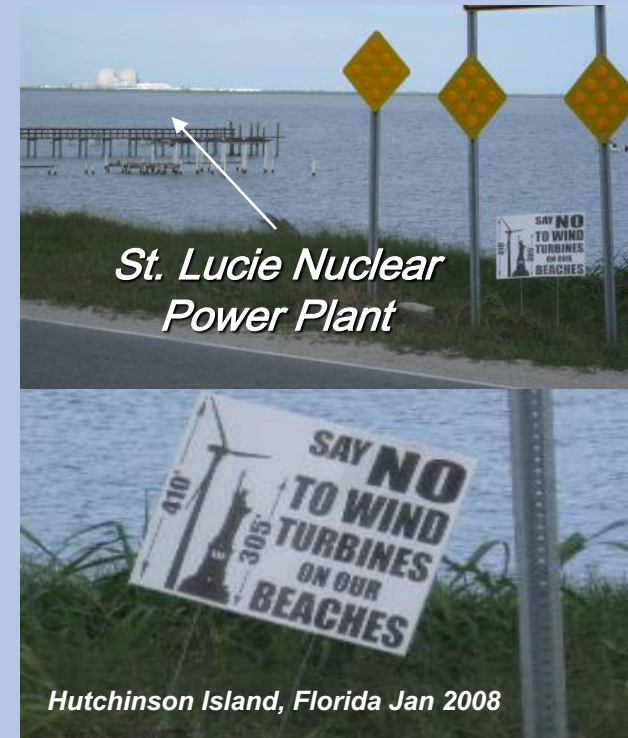
Estimates of increase on demand for electricity from that trend + ~25-30%

Courtesy of N. Rigas, Clemson

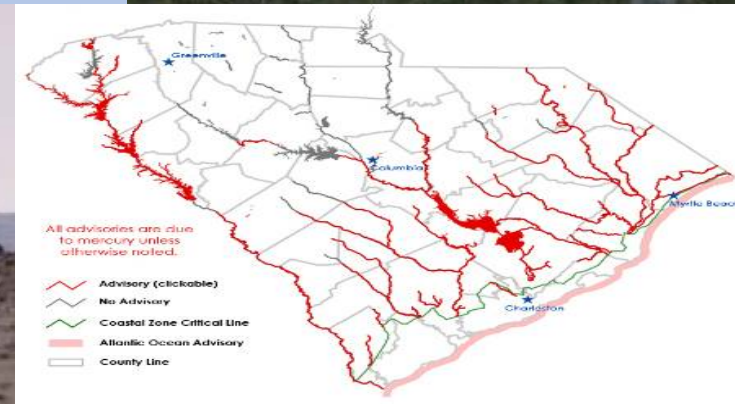
No Magic Energy Solutions

*Wind is a considerable resource for SC
Can be a relevant part of overall solution
Considerable Economic Opportunity for SC
Developing Industries Manufacturing/ Ports etc*

*....We should definitely do this...
...somewhere else...*



Hutchinson Island, Florida Jan 2008



TAKE OUR REAL ESTATE SURVEY

TOP STORY

The moment that helps explain how South Carolina lost its \$9 billion nuclear power bet

By Thad Moore tmoore@postandcourier.com Nov 12, 2017 (6)



The power companies behind South Carolina's failed nuclear construction project piled billions of dollars' worth of risk onto their lead contractor, Westinghouse, even as concerns were raised about whether it could handle the costs. Westinghouse filed for bankruptcy months later, marking the beginning of the end of the V.C. Summer project. File/Staff

GOVERNING

THE STATES AND LOCALITIES

FINANCE | HEALTH | **INFRASTRUCTURE** | MGMT | WORKFORCE | POLITICS | PUBLIC SAFETY | URBAN | EDUCATION | DATA



MAGAZINE | NEWSLETTERS | EVENTS | PAPERS

INFRASTRUCTURE & ENVIRONMENT

South Carolina Spent \$9 Billion on Nuclear Reactors That Will Never Run. Now What?

The legislature must decide whether residents will keep being charged, possibly for decades, for failed project.

BY ALAN GREENBLATT | JANUARY 2018



The unfinished nuclear reactors in South Carolina. (AP)

Estimates of up to 18% SCE&G Customers Residential Bills service to VC Summers failed Nuclear Plant



SC House Speaker says "rate payers should be immune" from SCE&G surcharges



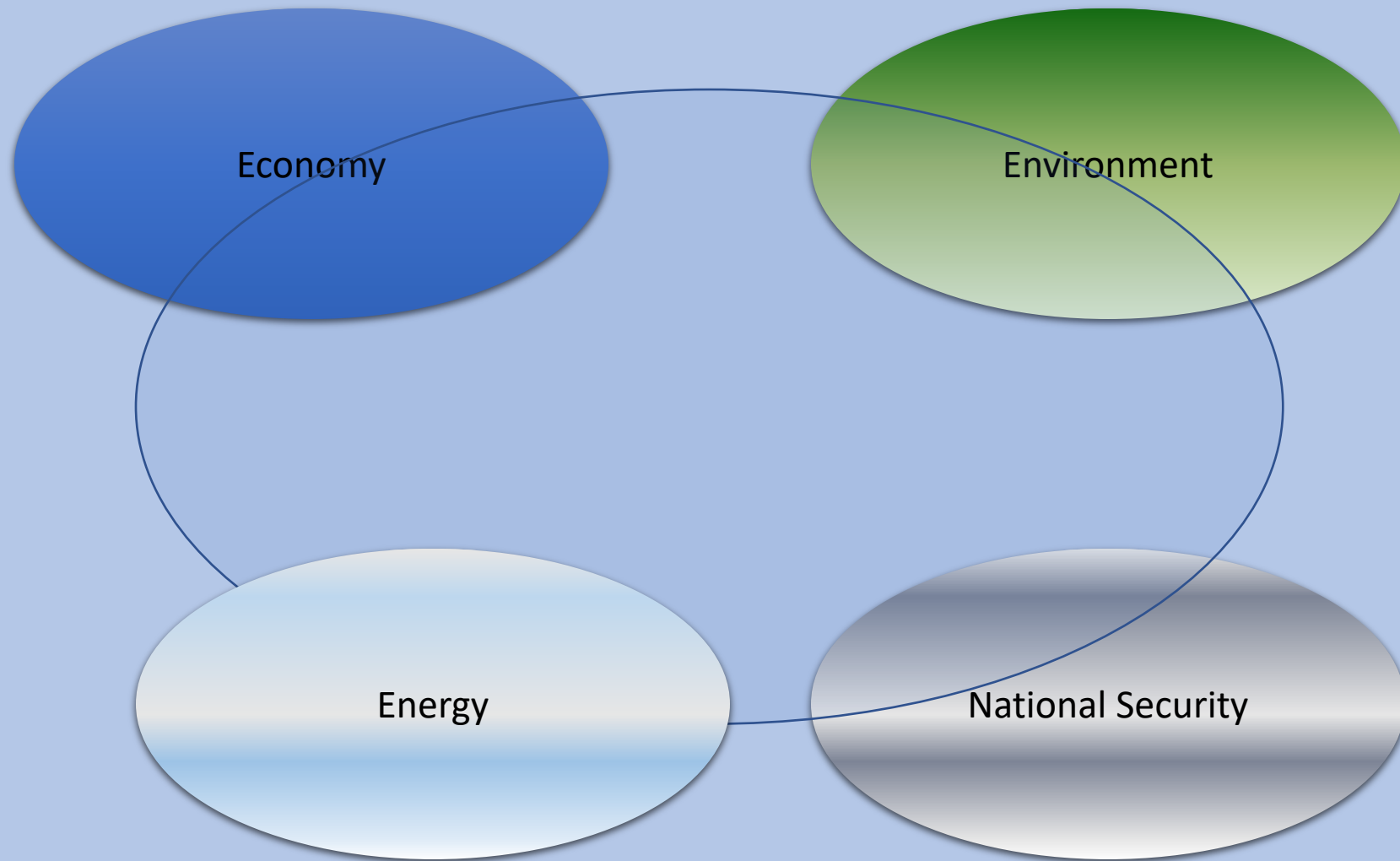
SC House Speaker Jay Lucas believes that "rate payers should be immune" from SCE&G surcharges, in reference to the 2017 nuclear fiasco. South Carolina Legislature Video Archive - lcantos@thestate.com

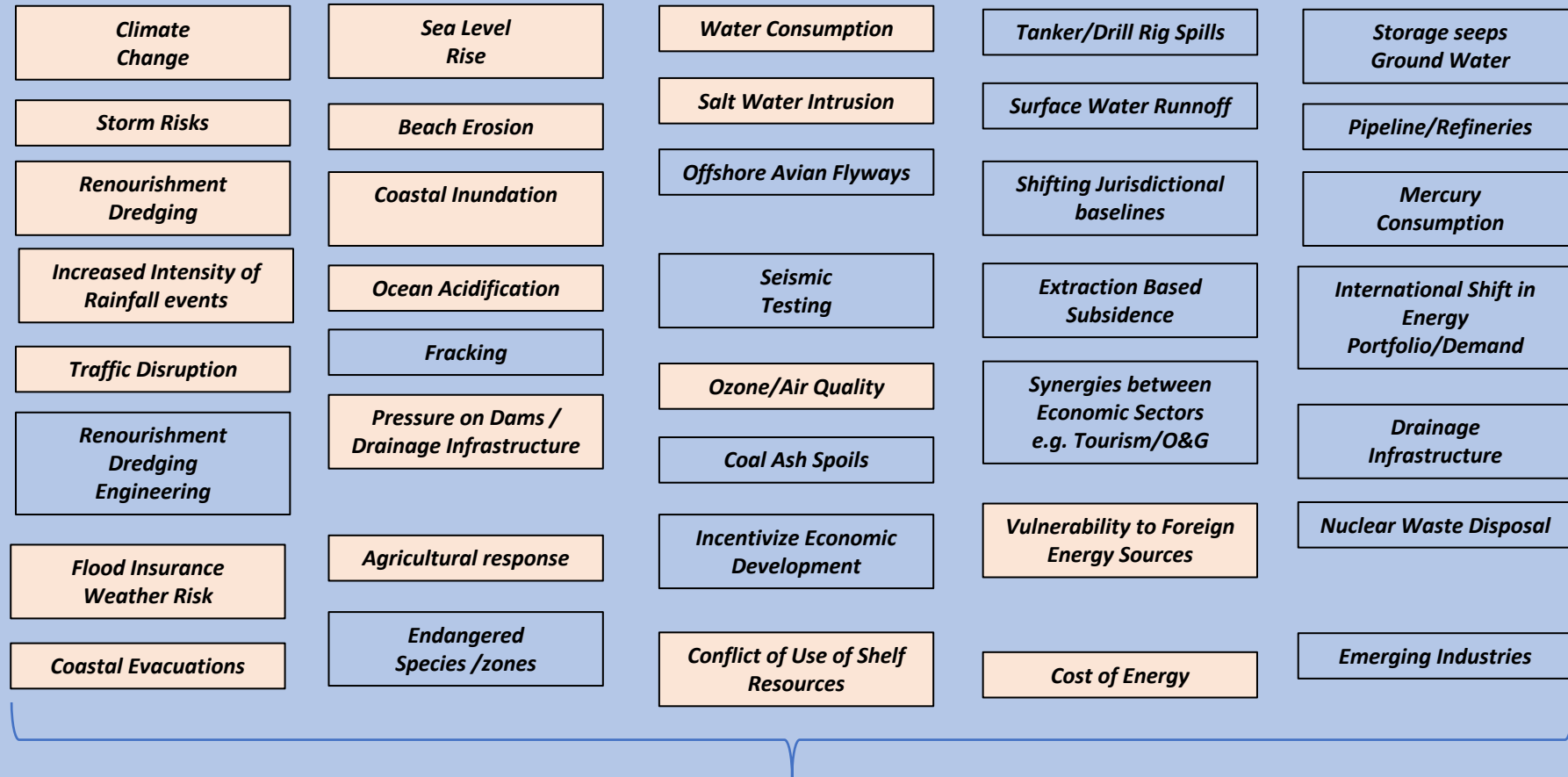
LOCAL

SC residents pay nation's highest electricity bills, report says

Historically independent drivers

.. have merged to drive new thinking





Energy Policy

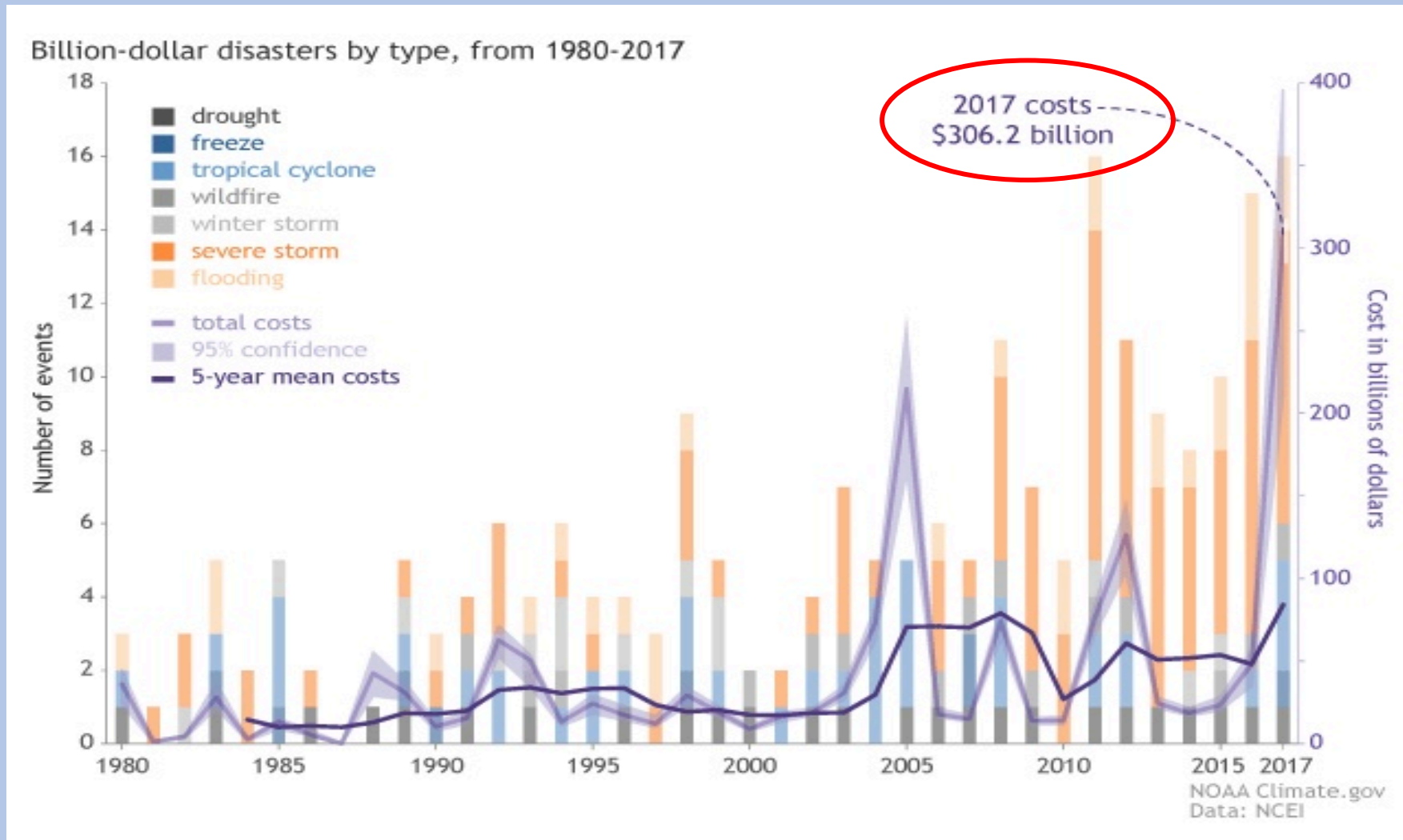
Cost of Addressing Symptoms Vs. Accelerating Drivers

Since 1980's (~30 years)

219 events topping >\$1B.

Cumulative cost \$1.5T

25% of 2017 Annual Discretionary Funding. ~10% of Total 2017 Govt Expenditures (\$1.3T)



Need For Observing Particularly Is Past Behavior Becomes Less Reliable
Predictor Of Future (Risk) From Fundamental Change In The System

Harnessing Wind Power

***Not a novel concept
(from 900 A.D.)***



From: VanKnoingsveld et al., 2008; *Living with Sea Level Rise and Climate Change: a case study of the Netherlands Journal of Coastal Research*, v. 24, n.2



www.rockridgewindmills.com/faq/FAQ4.jpg

***Until just a few years ago...
SC may have been more familiar
with windmills associated with a
different sector of the economy***



<http://minigolfenthusiast.blogspot.com>

***...Regardless where you stand on
the environmental issues...***

...GE is in it...

...because there is money to be made.

J.R. Immelt

Former Chairman of the Board and CEO

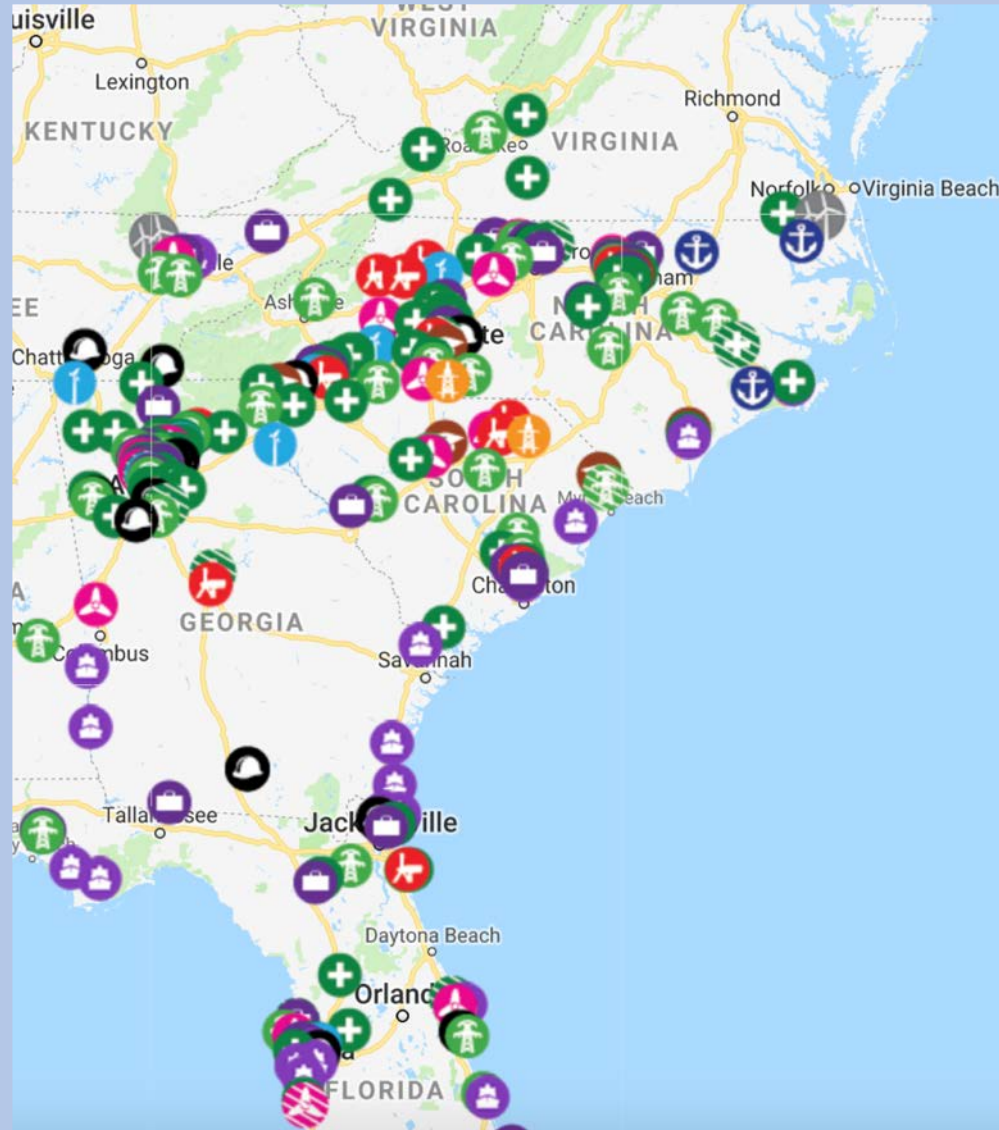
General Electric Corp

Speaking at Summit on Renewable Energy

Clemson-ICAR, Greenville, SC

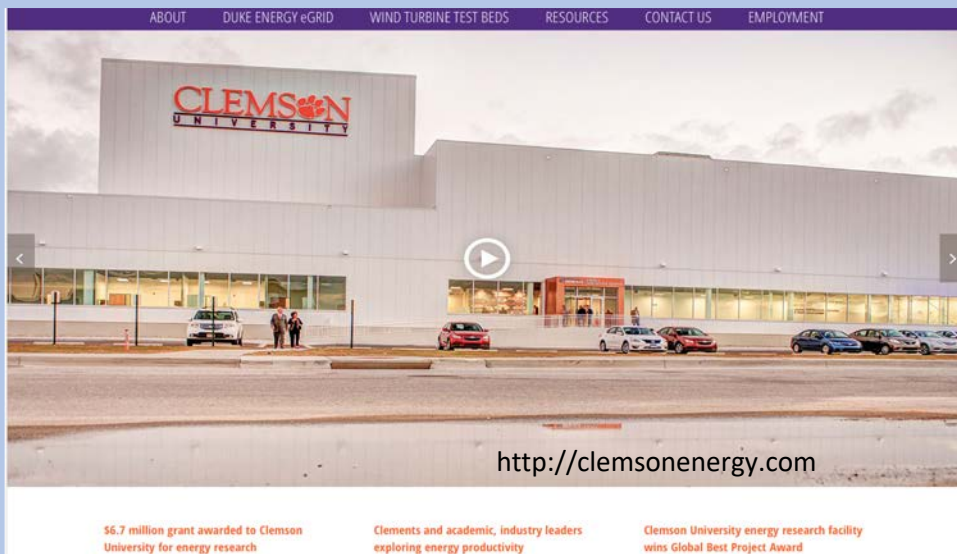
December 8, 2008

Significant Supply Chain Capacity Already Present in Southeast



Filter by		INDUSTRY SECTOR
<input checked="" type="checkbox"/>		Multiple
<input checked="" type="checkbox"/>		Nacelle (43)
<input checked="" type="checkbox"/>		Blade/rotor (43)
<input checked="" type="checkbox"/>		Tower (42)
<input checked="" type="checkbox"/>		Foundation (26)
<input checked="" type="checkbox"/>		Transmission/Electrical (72)
<input checked="" type="checkbox"/>		Offshore Services (17)
<input checked="" type="checkbox"/>		Professional Services (82)
<input checked="" type="checkbox"/>		Field Services (41)
<input checked="" type="checkbox"/>		Research/workforce dev (19)

<http://www.sewind.org/map/find-companies>

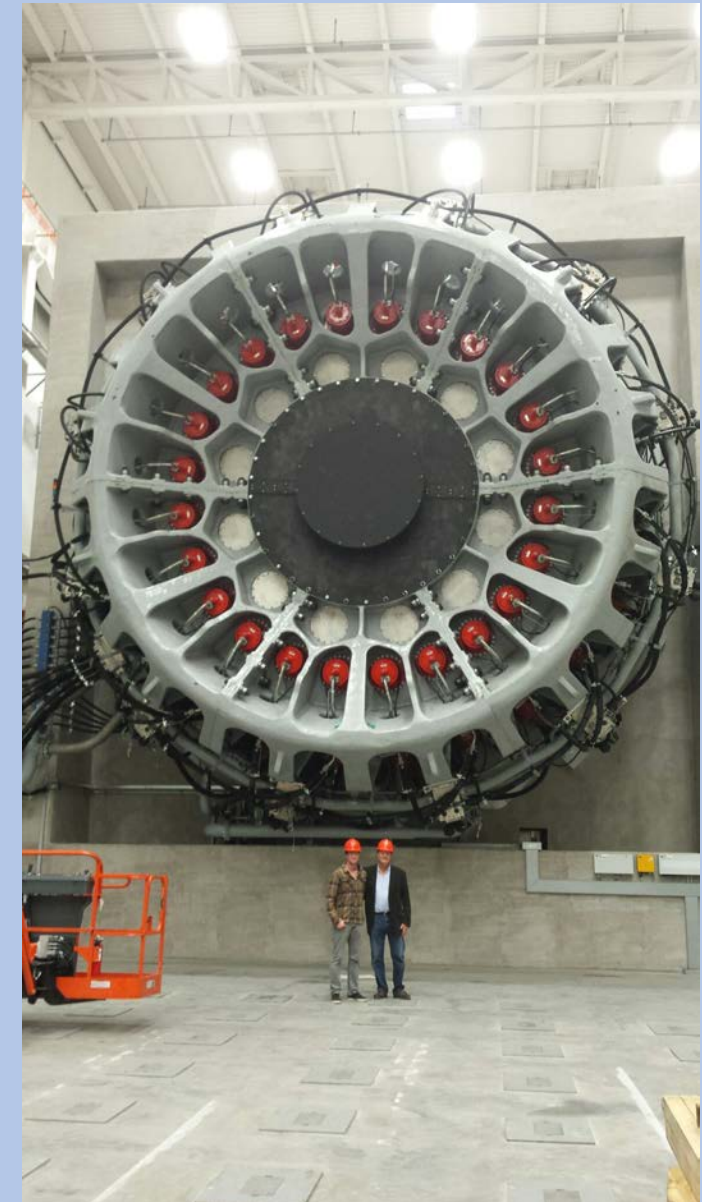


World Class Innovation Center Based in North Charleston

***Clemson's US DOE EERE: DE-FOA-000012
\$98M Project \$45M US DOE EERE, \$52M***

***Matching Funds 30 month construction
Primary Mission: Provide high quality services to
wind turbine industry for testing of up to 15 MW
turbines, drivetrains or gear boxes.***

***Secondary Mission: Establish long term partnerships
with industry for further research and educational
opportunities related to systems engineering,
advanced materials, sensor and predictive failure
analysis.***



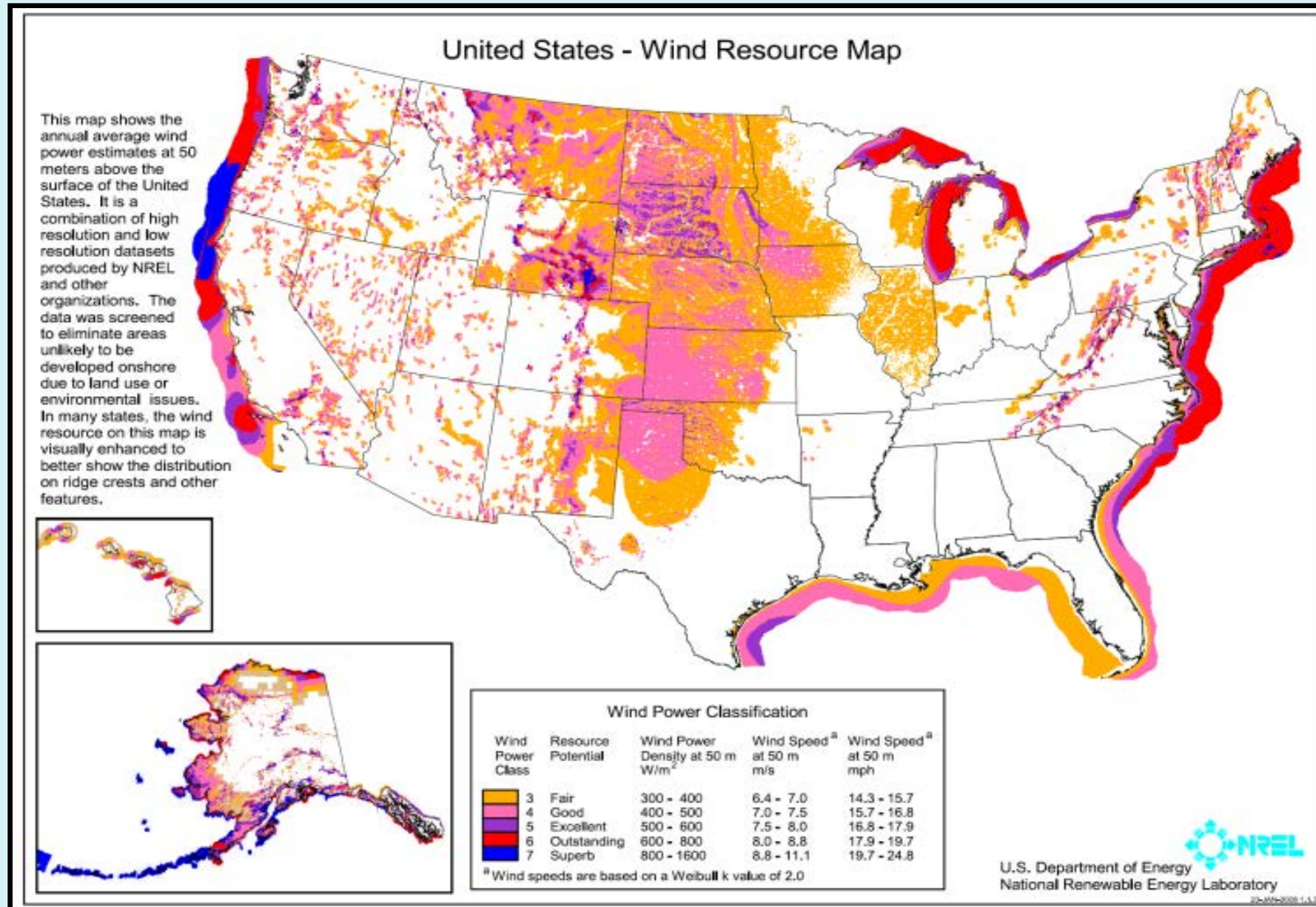
Courtesy of N. Rigas, Clemson Univ

Economic Development: Delaware 450 MW Example

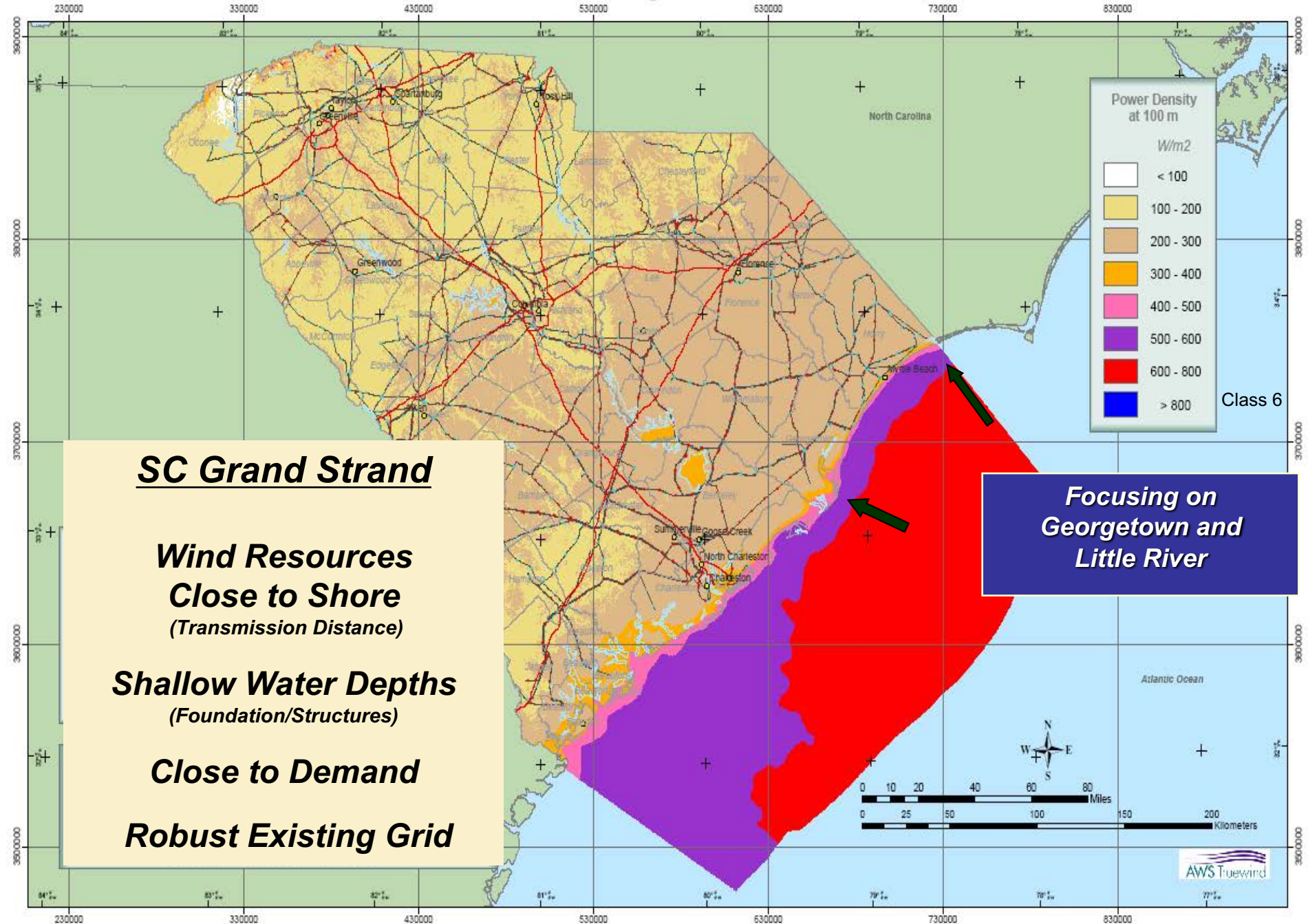
- \$1.6 Billion investment
- 500+ local union jobs to be created during construction
- 80+ union O&M jobs for 25 years
- \$200+ million direct economic impact for the Delaware workers
- Clean, high-tech industry
- Onshore and offshore construction



Midwest Developed Onshore Industry Population and Demand and Better Resources at the Coast

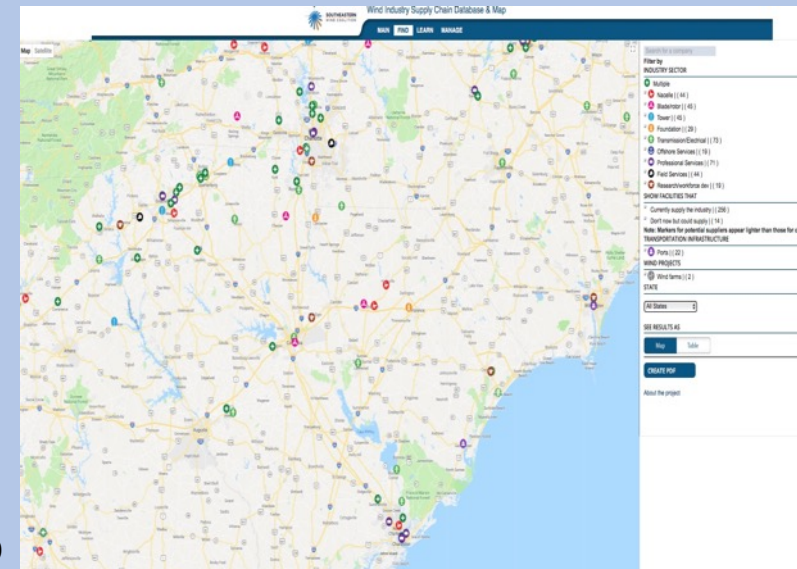
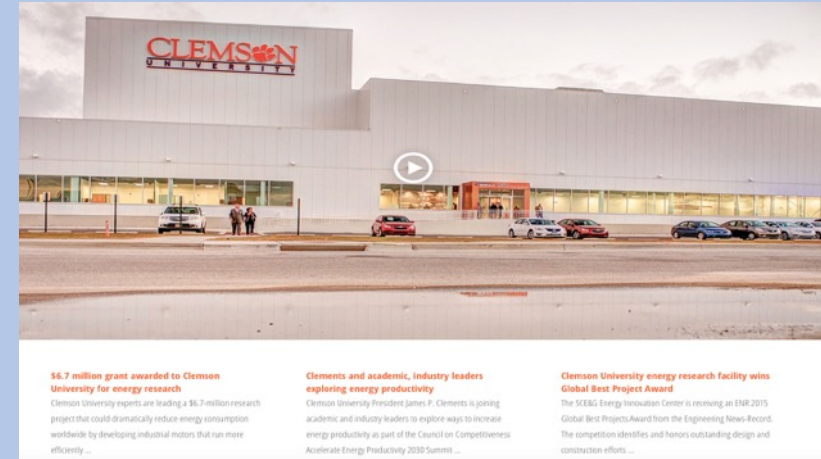
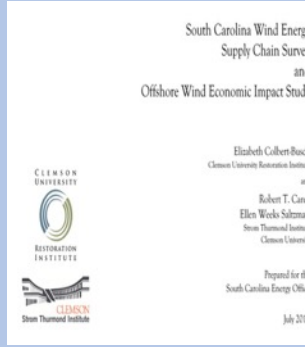
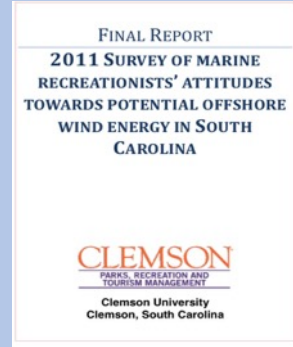


Mean Annual Wind Power Density of South Carolina at 100 Meters

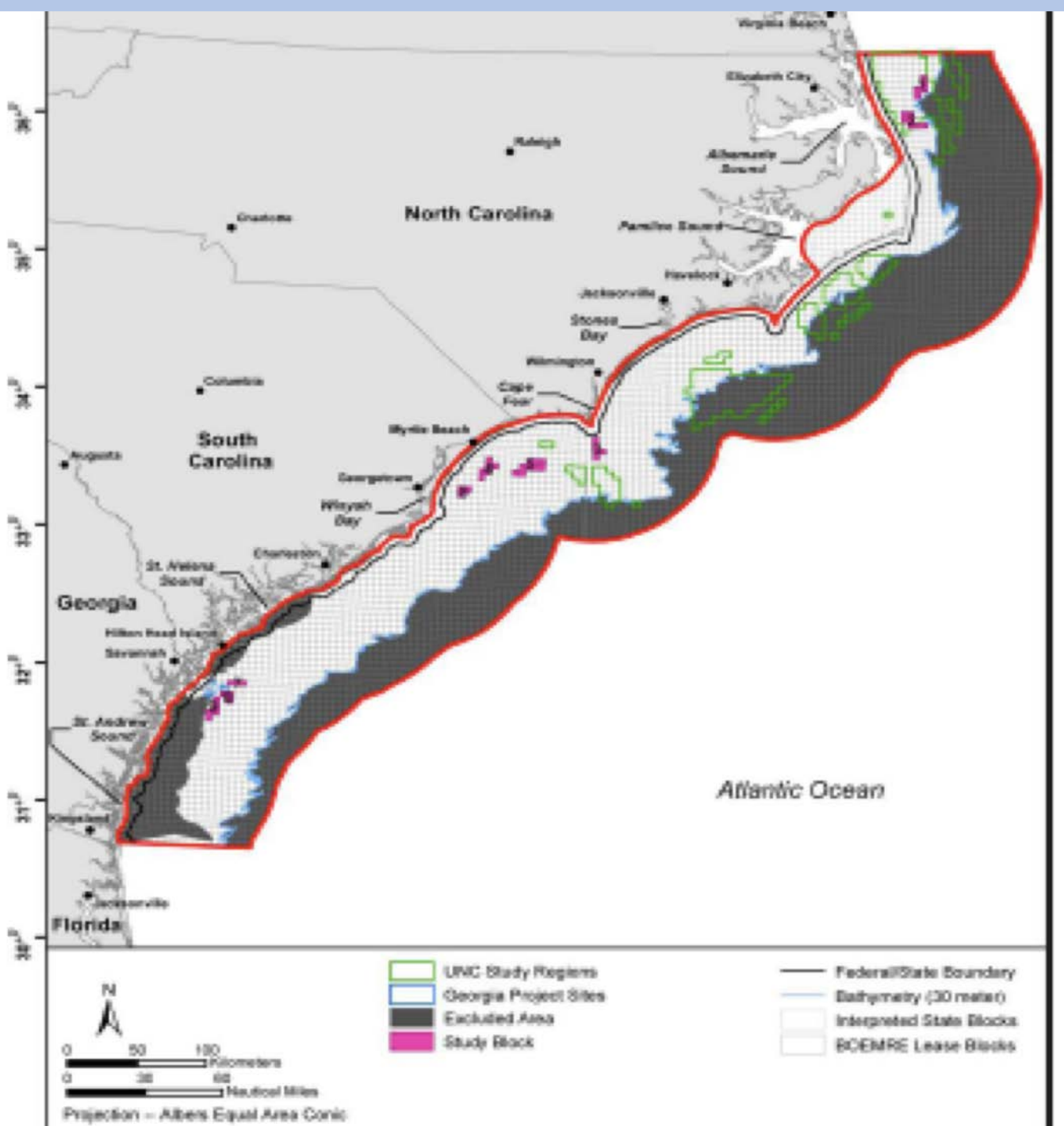


20+ Years of Extensive and Sustained Activity in South Carolina

Local/State/Federal, Utilities, Industry, and Universities/SRNL



- Clemson-DOE-Industry Partnership - \$100M Drive Train Test Facility
- Regulatory Task Force For Clean Energy
- SC Wind Farm Feasibility Study Committee
- SC-BOEM Energy Task Force
- Legislative Wind Farm Committee
- Palmetto Wind Resource Observations/Modeling
- Small Turbine Demonstration Project City of North Myrtle Beach/Santee Cooper/DOE/SEO
- Clemson Grid Study, Public Perception Studies

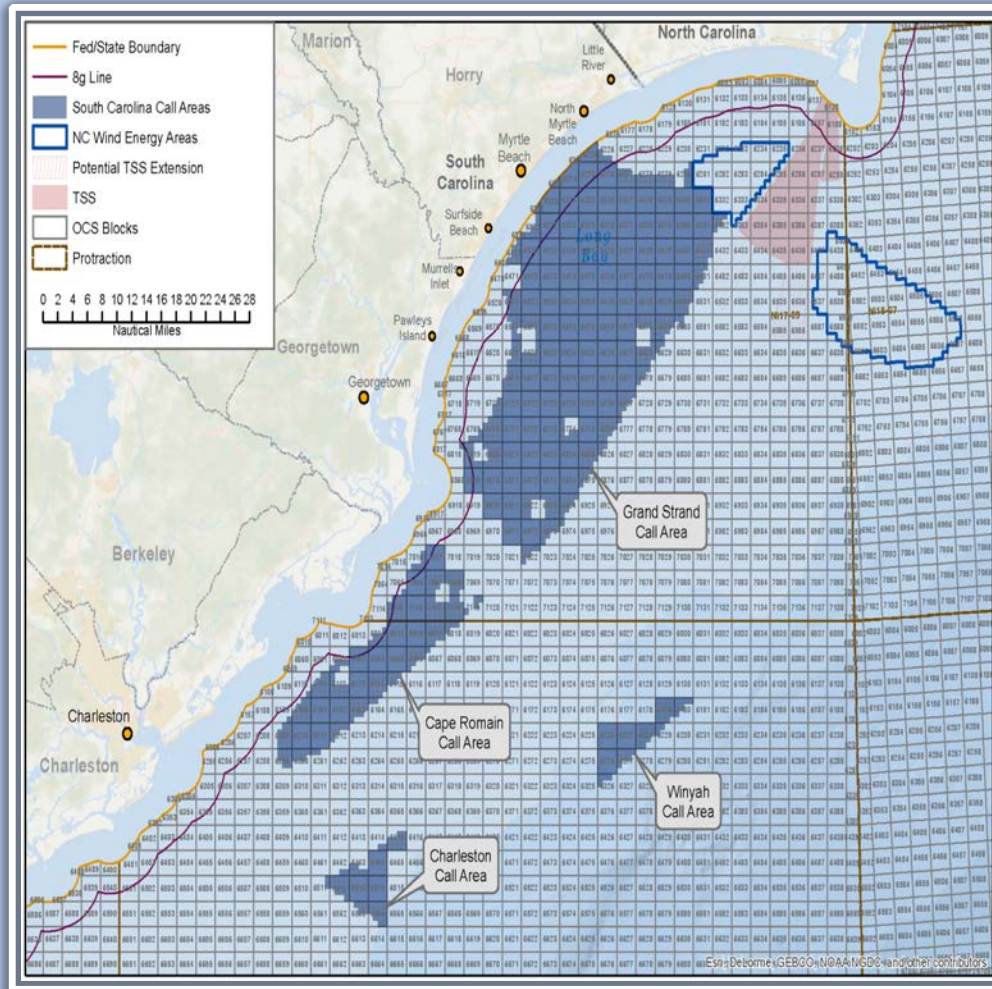


Almost 50% of recommended sites are in Long Bay



Courtesy of South Alliance for Clean Energy

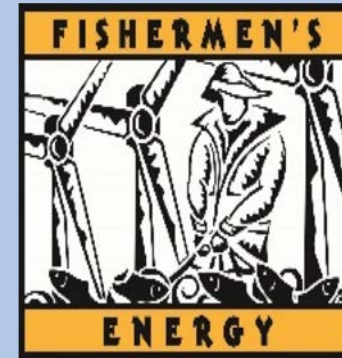
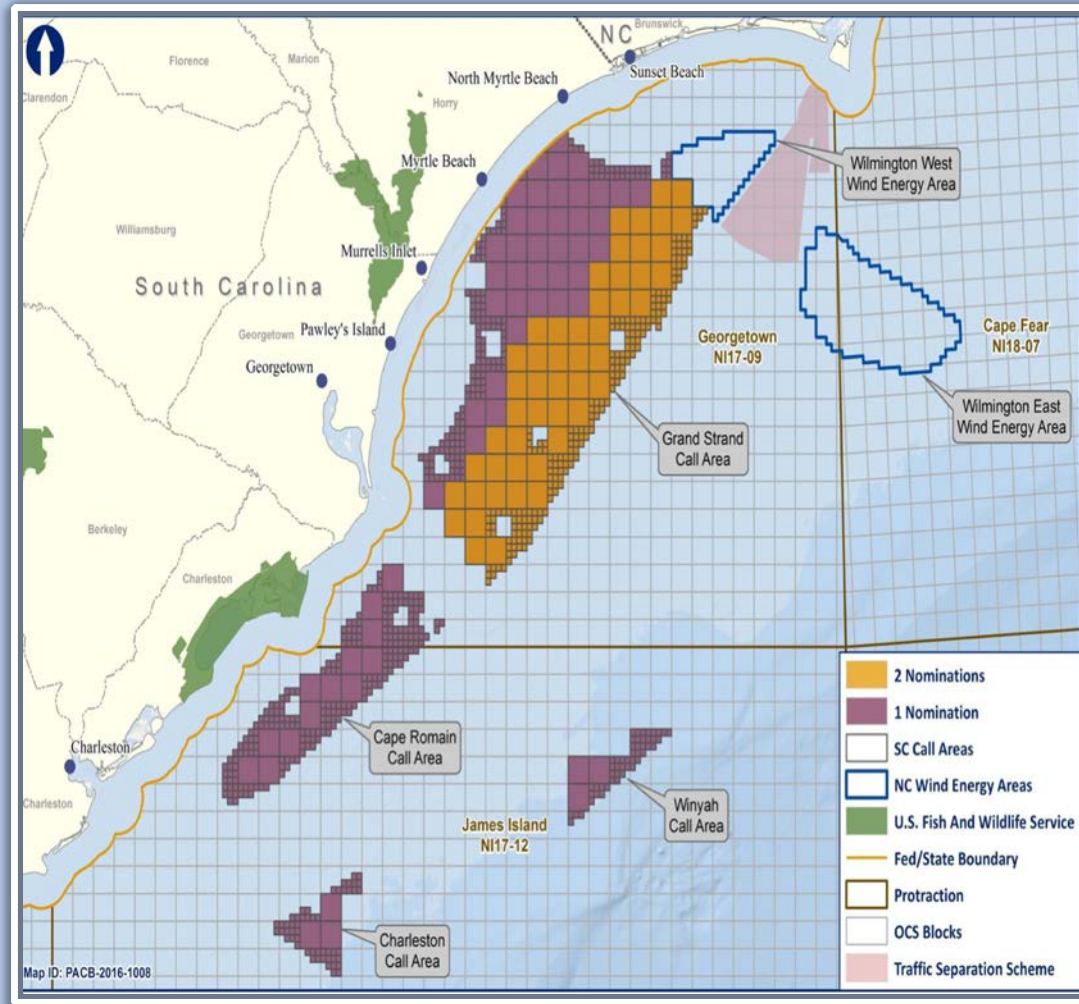
South Carolina Call For Information & Nominations



Parameter:	
Total # OCS Blocks	150
• Grand Strand	110
Total # of Acres	853,956
• Grand Strand	628,003
Distance to Shore (Statute Miles)	3
Average Water Depth (m)	5-42
• Grand Strand	8-24

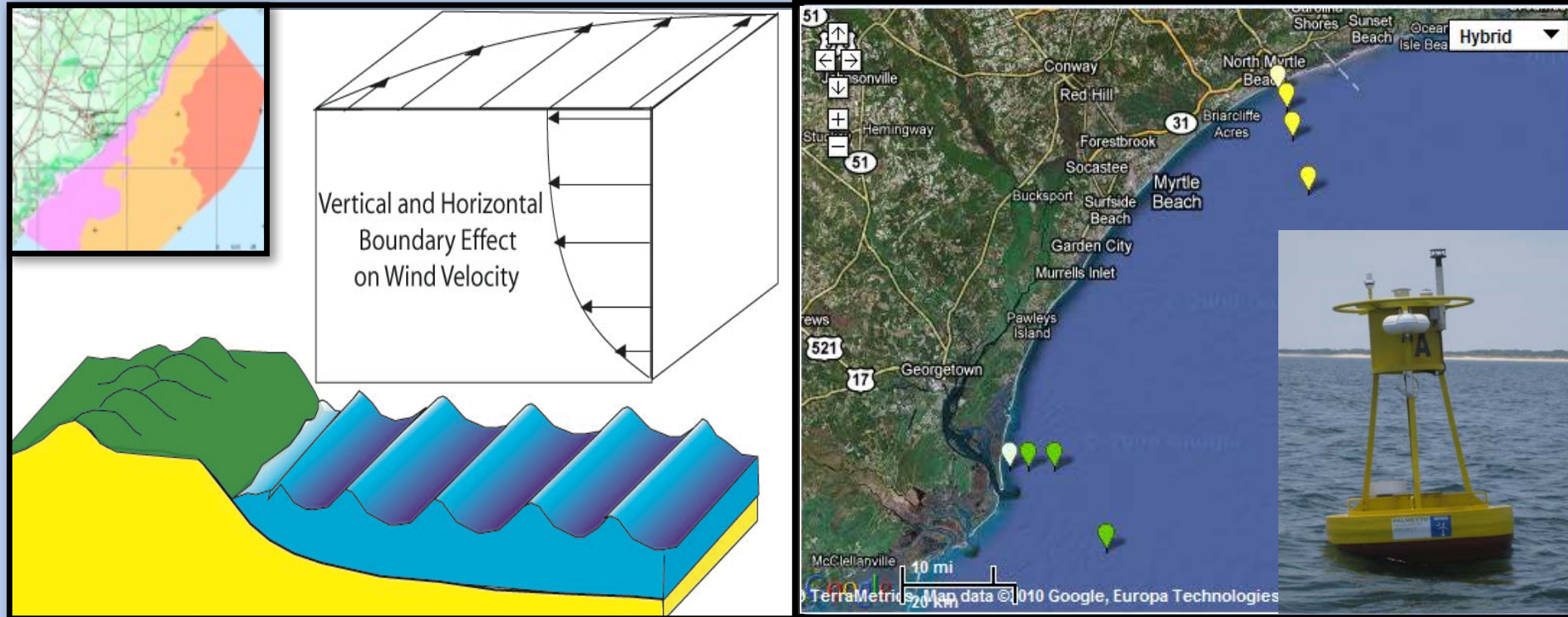
*Call for Information and Nominations
published November 2015*

Nominations Received in Response to South Carolina Call



Courtesy Casey Reeves, BOEM

Coastal Observation Related Initiatives



Spatial and Temporal Characterization of Wind and Hydrokinetic Resource Potential

- Verify initial Regional Model Projects with Observations ($\sim +3m$)
- Interactively Couple Atmospheric and Oceanic Models
- Refine cross-shore gradient –
optimize wind energy vs. distance of transmission



**REPORT ON BSEE CONTRACT NO. E14PC00008
DEVELOPMENT OF HAZARD CURVES FOR WEAS OFF THE ATLANTIC SEABOARD**



SRNL
SAVANNAH RIVER NATIONAL LABORATORY

Advanced Technology for Improving the Design Basis of Offshore Wind Energy Systems

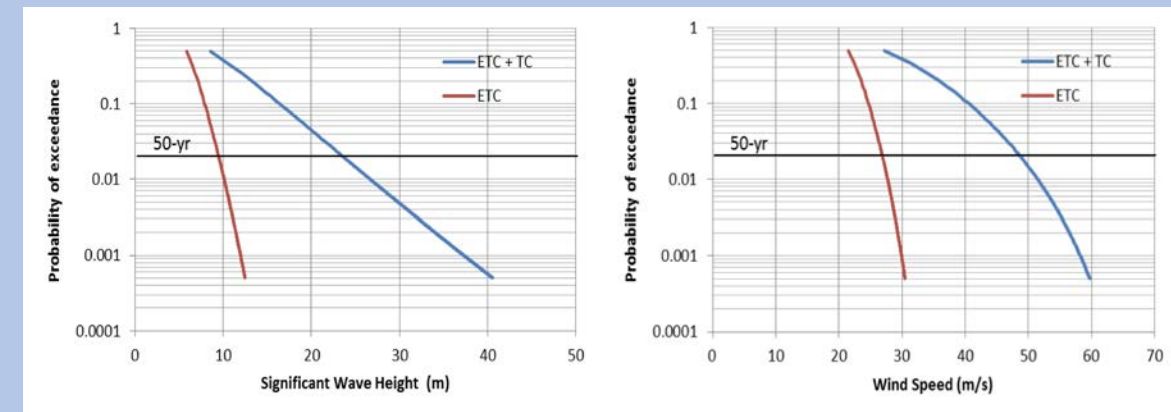
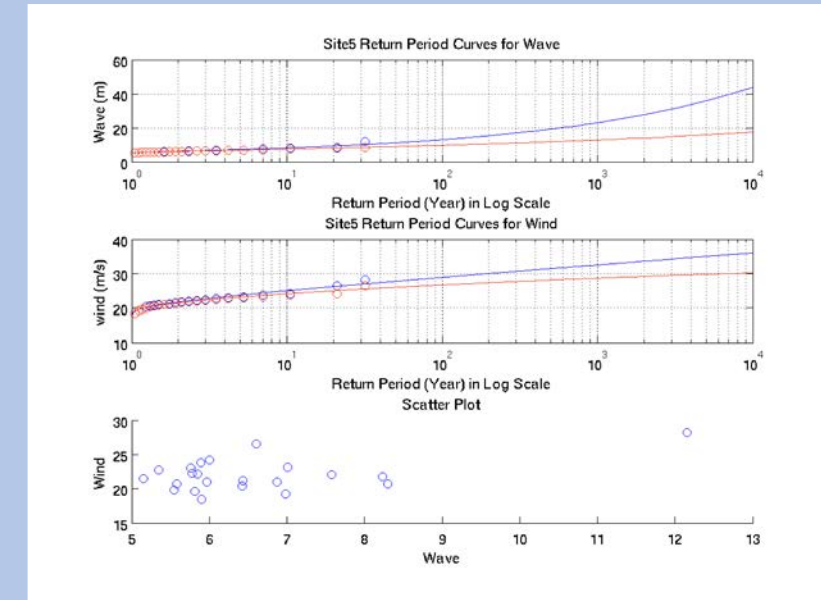


Applicant Information	
Applicant Name	Savannah River National Laboratory
Type of Organization	FFRDC
Topic Area	6.0 Resource Characterization and Design Conditions
Subtopic Area	6.2 Advanced Research Topics

Technical Point of Contact	Business Contact
Ralph Nichols Fellow Engineer SRNL Bldg. 775-41A, Rm. 249 Aiken, SC 29808 803.725.5238 ralph.nichols@srnl.doe.gov	Steve Wack Mgr. SRNL Technology Transfer Bldg. 775-41A, Rm. 249 Aiken, SC 29808 803.725.5620 steve.wack@srnl.doe.gov

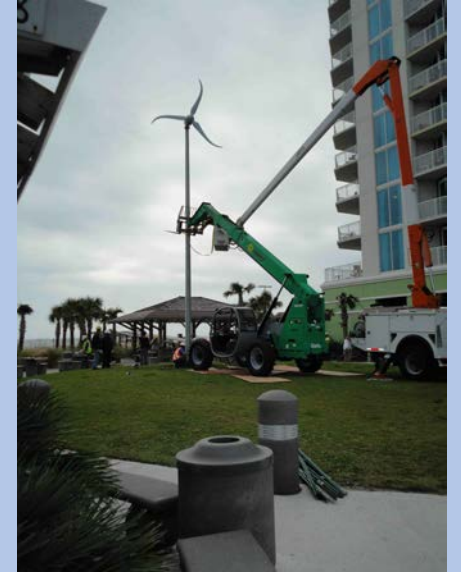
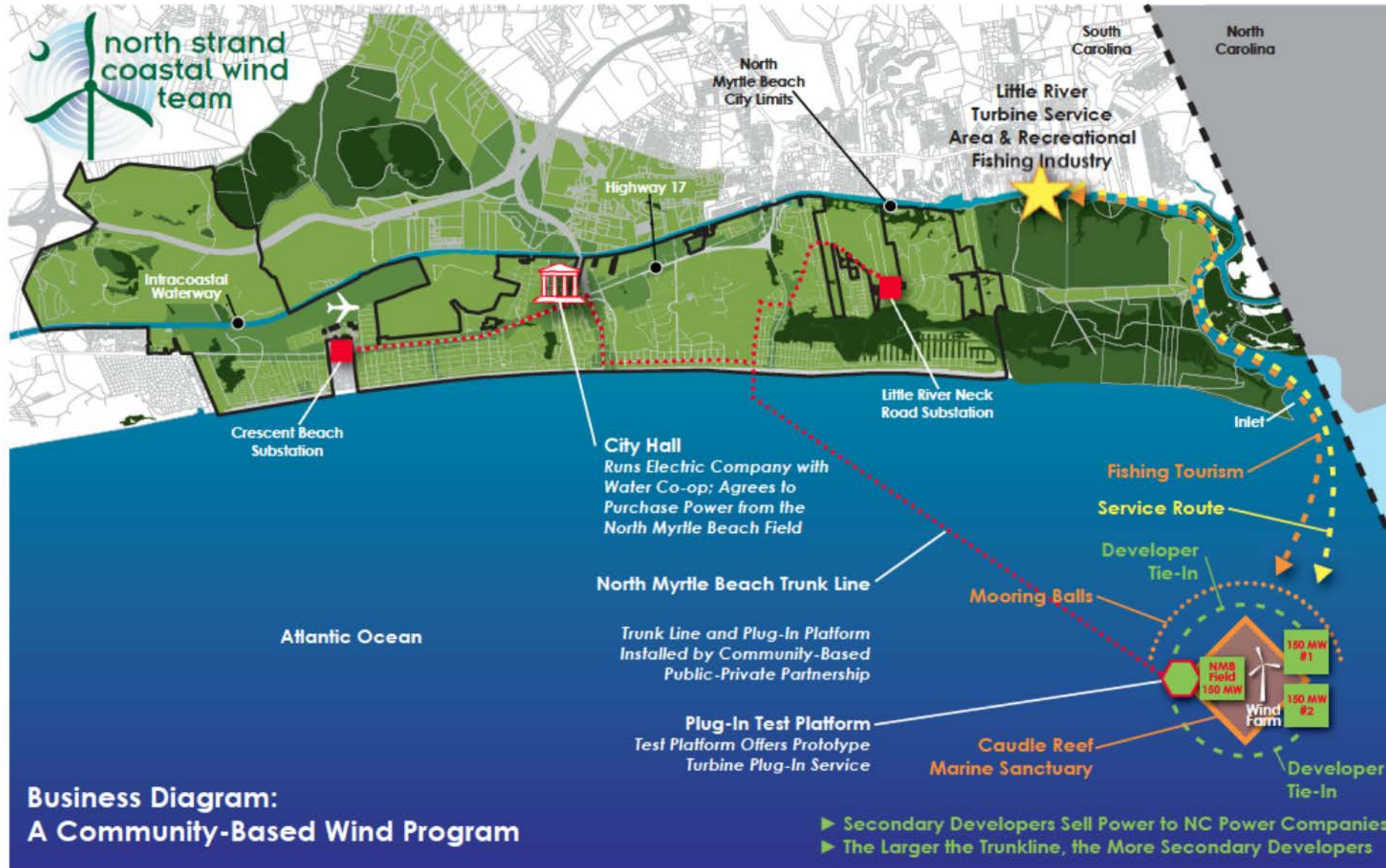
Participants (Funded)	Participants (Cost Sharing)
National Renewable Energy Laboratory Coastal Carolina University MMI Engineering	Coastal Carolina University

U. S. Offshore Wind: Removing Market Barriers
Funding Opportunity Announcement No.: DE-FOA-0000414
CFDA No.: 81.087



- Observation and modeling to refine site specific forcing for foundation design
- Risk Analysis and associate design standards along the east coastal with range of TC and ETC intensities and frequency

City of North Myrtle Beach; Vision and Initiative



NEW MEASUREMENTS in the Southeast

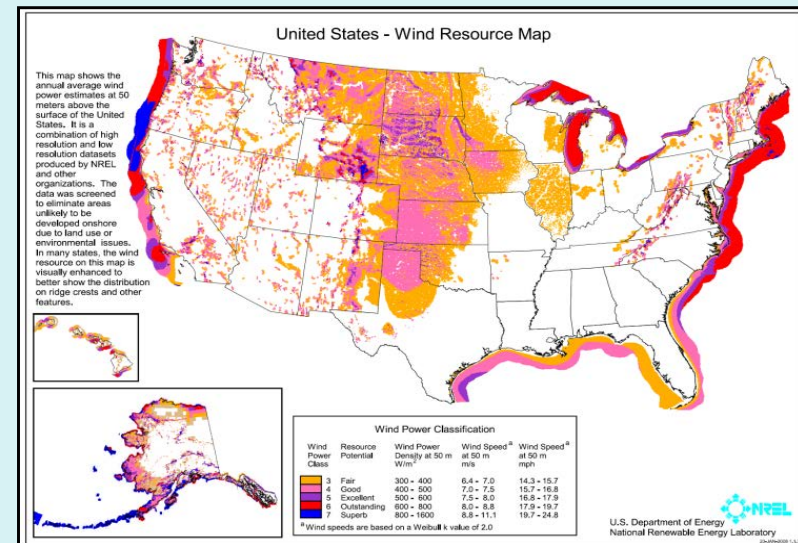
Very Different Model Emerging

- Two sites in South Carolina - Conway and North Myrtle Beach
 - Data duration: more than 4 years since 05/31/2012 while Waties Island started transmitting data in August 2015
 - Conway - 06/01/2012 00:00 – 05/31/2016 23:50 (LST)
 - Waties Island - 08/14/2015 00:00 - 08/13/2016 23:50 (LST)



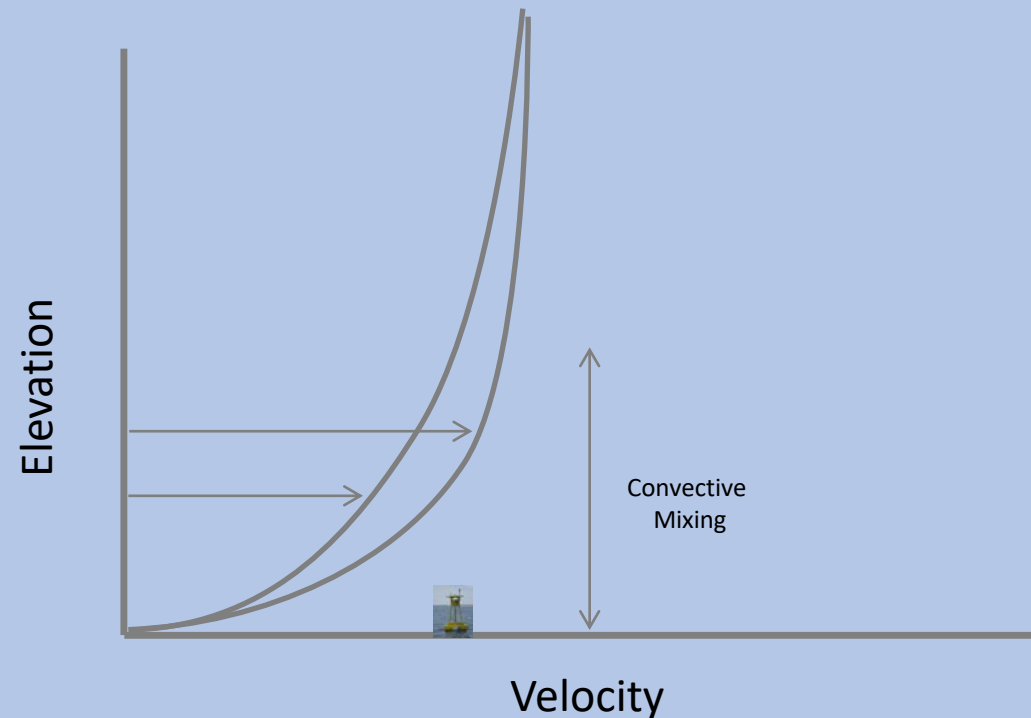
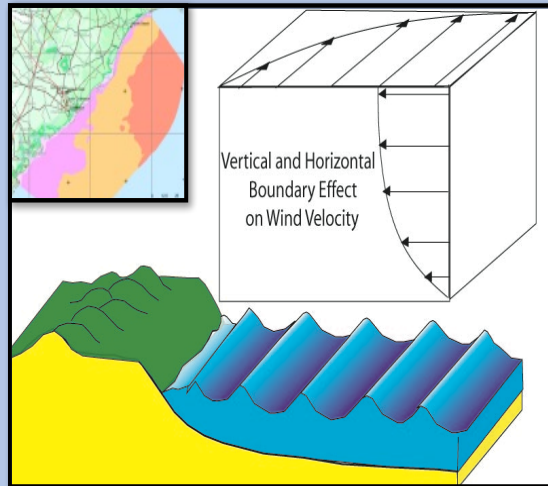
SEA ECONET – MESOUS Program

Midwest Developed Onshore Industry Population and Demand and Better Resources at the Coast



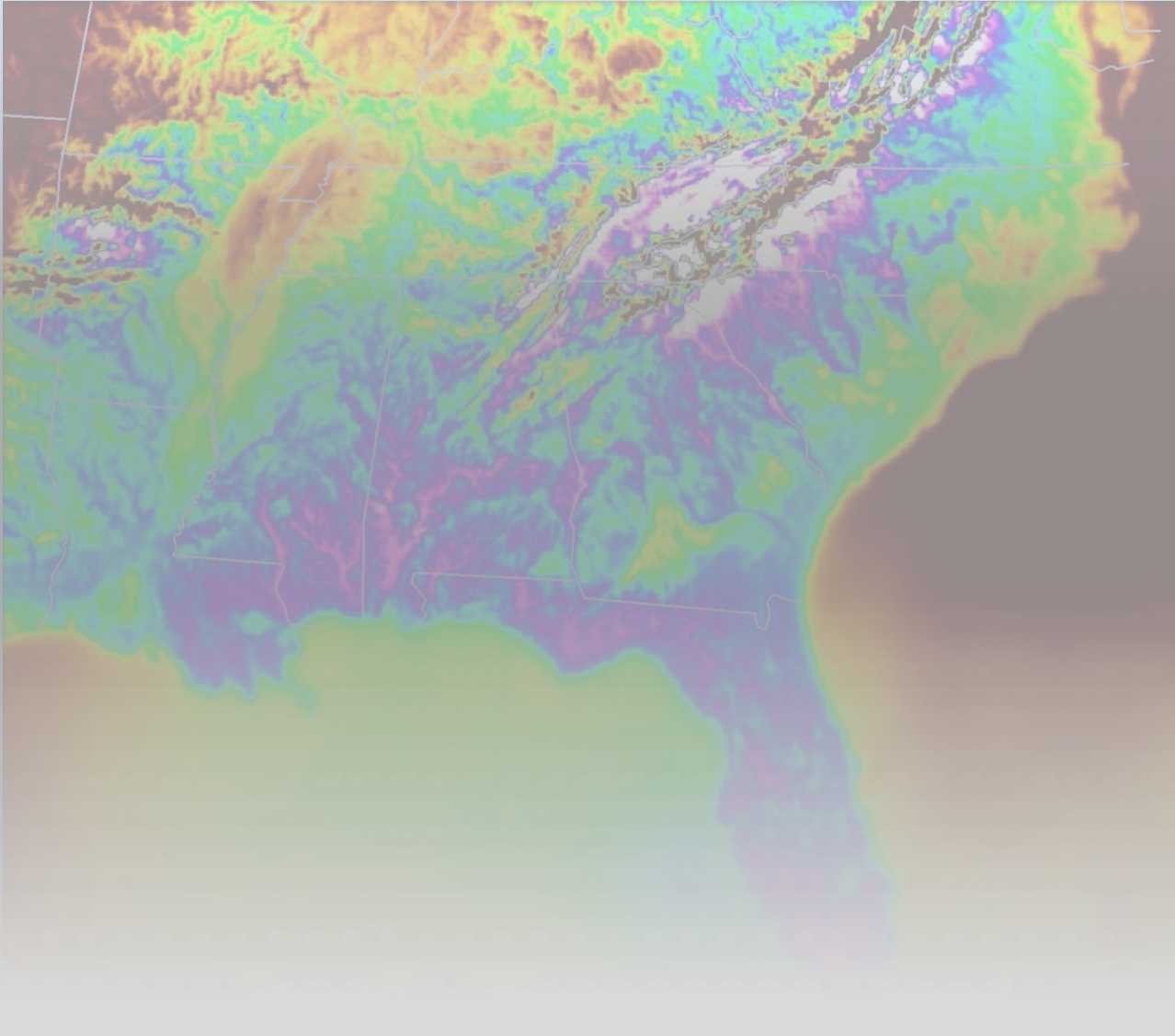


- ***In the Convective Southeast; Higher Wind Speeds Closer to the Ground***
- ***National Resource Assessments at 80m***
- ***New Turbine/Tower 120-140m***
- ***South Carolina Now Has Onshore Potential and Even Greater Offshore Potential***



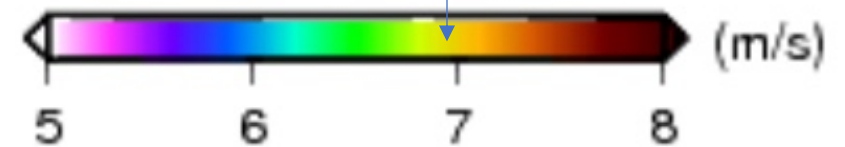
Validated and Corrected* Wind Resource at 140 m above ground level.

*Using 5 Remote Sensing Devices

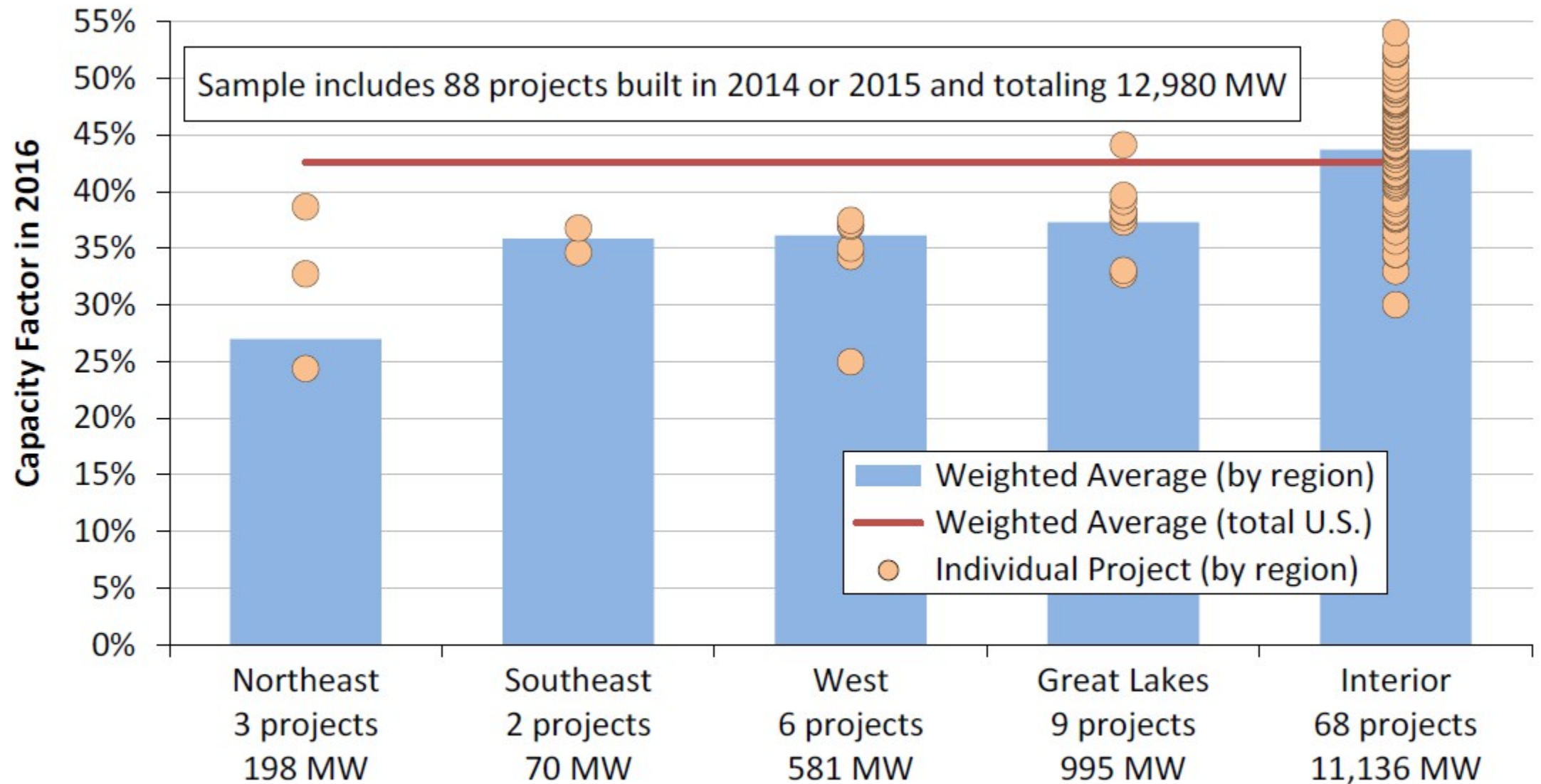


Vaisala Work in Progress

Green/yellow or better is interesting

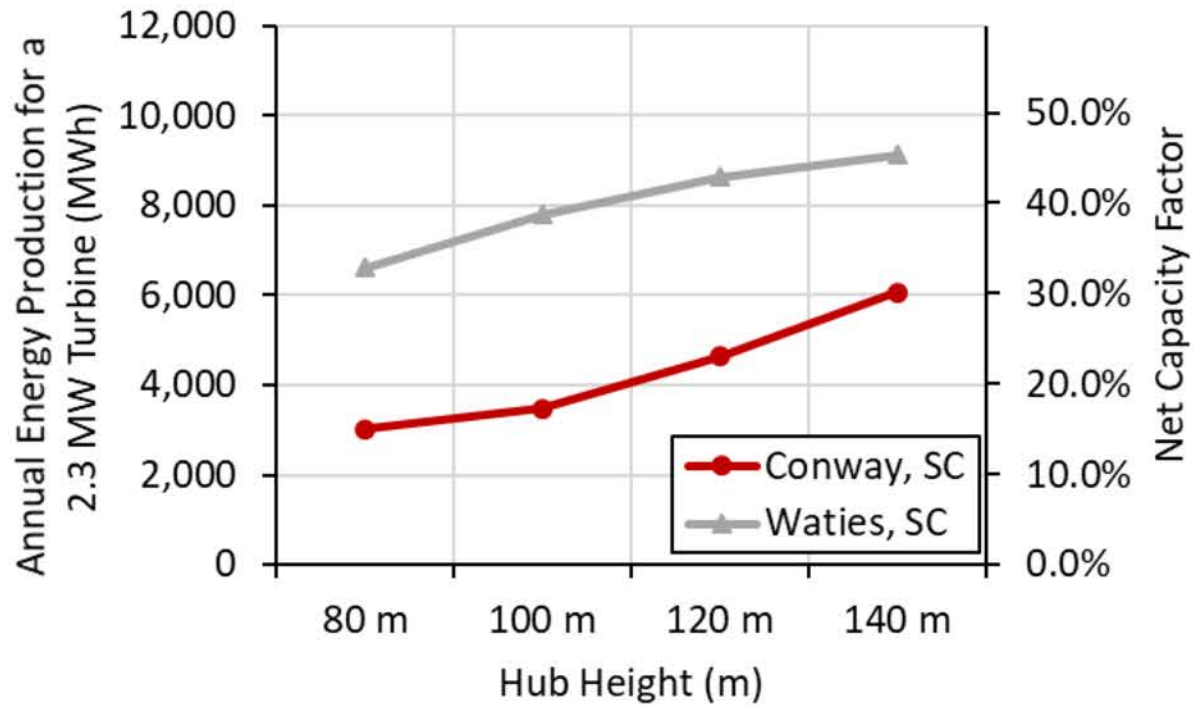


140m Corrected Wind Speed

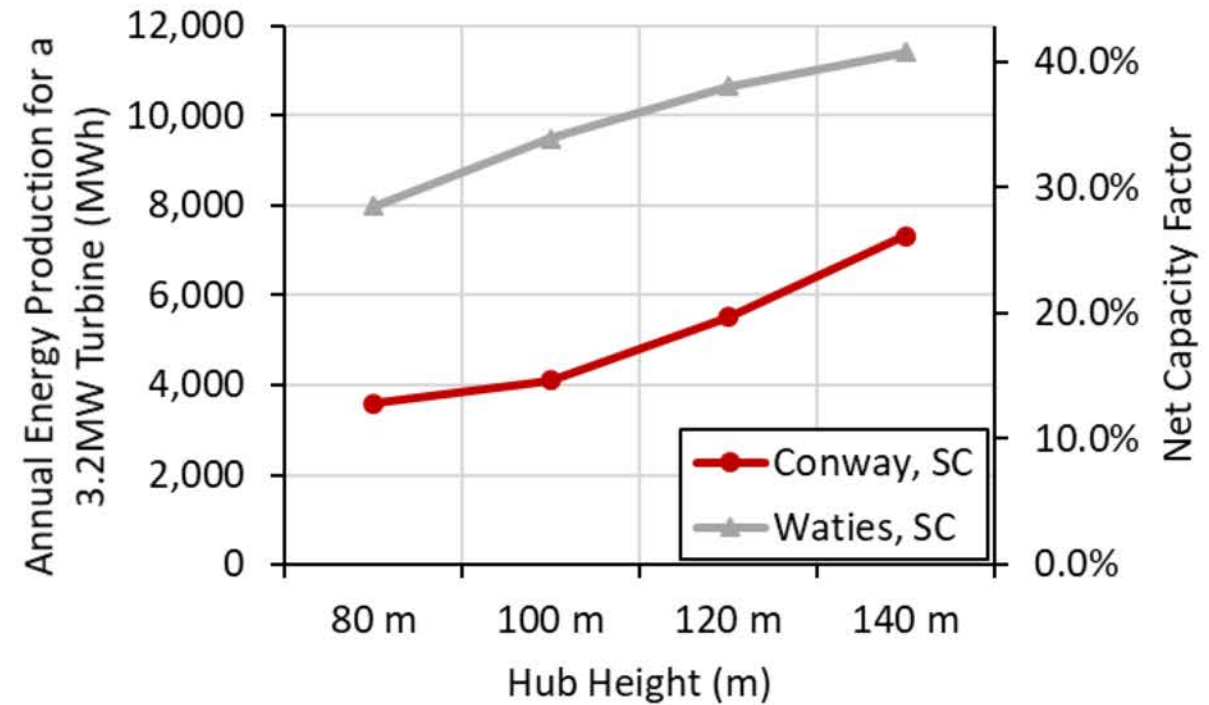


Source: Berkeley Lab

Estimated AEP and Capacity Factor with Hub Heights



2.3 MW



3.2 MW

Developer: Amazon's \$400M North Carolina wind farm is 'days' from powering up

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The Amazon wind farm near Elizabeth City is days away from being fully operational, says a spokesman.
BERKOLA

TABLE OF EXPERTS

Panelists talk funding, innovation repatriation at TBJ's Life Sciences event



Doug Edgerton
North Carolina
Biotechnology
Center



Mike Leary
Clarkston
Consulting
Center

TRENDING

TECHNOLOGY

Silicon Valley startup sets up shop in Raleigh



COMMERCIAL REAL ESTATE

Peek inside The Dillon, downtown Raleigh's newest tower (Photos)



Amazon Wind Farm US East completed in North Carolina

02/09/2017 By Editors of Electric Light & Power/ POWERGRID International



Spanning farm fields in Pasquotank and Perquimans counties, the [Amazon Wind Farm US East](#), powered by Avangrid Renewables at Desert Wind, is now the first commercial-scale wind farm in [North Carolina](#).

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Avangrid makes first tax payments of \$640K on wind farm

By Peter Williams

The Perquimans Weekly

Wednesday, January 10, 2018

HERTFORD — The county governments in Pasquotank and Perquimans have a combined \$640,000 more in revenue to spend on pressing needs next year thanks to the wind farm that straddles the border of both counties.

Avangrid Renewables made its first property tax payments on the 104-turbine wind farm in both counties on Wednesday, presenting checks to county officials at an event at Amazon U.S. Wind Farm.

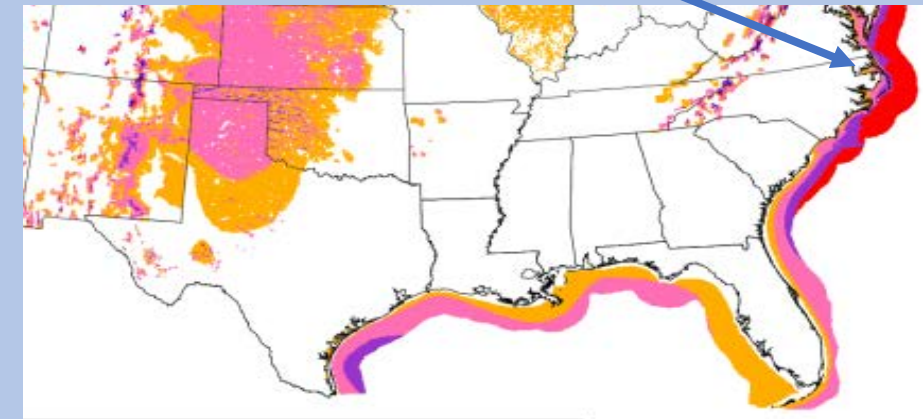
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Walkout for school safety: Students hon...

Economic Benefits

- **\$1.1 million** – annual amount from Avangrid Renewables benefitting the community, consisting of:
 - **\$520,000** – annual taxes, making the wind farm the largest taxpayer in both Perquimans and Pasquotank counties; will increase each year.
 - **\$624,000** – annual lease payments to landowners; will increase each year.
- **30+** – number of North Carolina-based companies that helped build it.
- **500+** – number of workers at the peak of construction.
- **\$18.5 million** – amount spent locally during construction; roughly \$1 million/month.
- **17** – number of full-time workers to operate the wind farm.
- **62** – miles of new roads built and maintained by Avangrid Renewables, at no cost to taxpayers or landowners.



***Presently Exploration Of Onshore Potential In
Northern SC By Midwest Wind Developers***

Sustained Interest In Offshore

***Wind Resource Maps Are Being Updated By Vaisala,
NREL Etc. Reflecting Vertical Measurement
Campaigns And Trend In Tower Technology***

Need For Additional Observations ESPECIALLY Vertical Profiles To:

- Further Refine Resource Potential
- Refine Economic Projections Including Risk And Design Standards
- Integrated Observation – Model Systems Projecting Power in Operational Forecasting

Significant Opportunity for Offshore Wind Farm Infrastructure to Support Integrated Observing Systems

Hydrodynamics

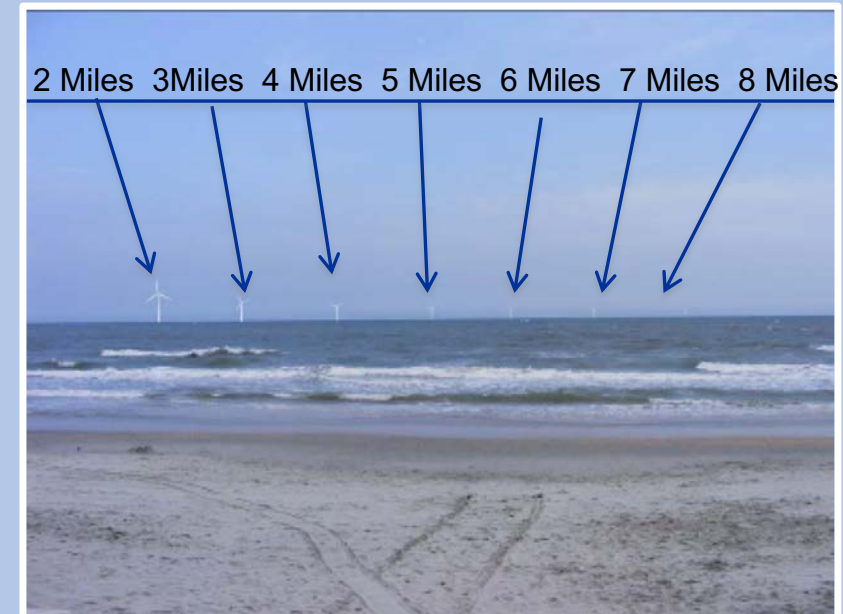
Atmosphere

Sea Bed

Habitat

Scour-Geotechnical

Ecological / Biogeochemical



Many States Positioning To Capture Developing Industry

Manufacturing

Supply Chain

Operations

Ecotourism

Southeast: Suitable Winds, Shallow Shelf, Load Close To Coast

Technology: Drives Suitability And Economics

Observations: Drive Projections And Ultimately Observations

