South Carolina's Role in Offshore Wind Energy Development

Prepared in response to Act 318 of 2008

A Joint Resolution Requiring Recommendations from the Wind Energy Production Farms Feasibility Study Committee

Committee Members:

Senator Paul Campbell, Jr. - Chair
Senator C. Bradley Hutto
Senator Daniel Verdin III
Representative Paul Agnew
Representative McLain "Mac" Toole
Representative Nelson Hardwick
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Mr. Roger Schonewald
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I: Executive Summary

Figure 1: This photo simulation published by Santee Cooper in November 2009 compares the visibility of wind turbines placed at varying distances from shore. Specifically, the turbines are depicted at distances, left to right, of 2 miles, 3 miles, 4 miles, 5 miles, 6 miles, 7 miles and 8 miles from the shore. Different light, wind and haze conditions could make them more or less visible.

South Carolina Act 318 of 2008 created the Wind Energy Production Farms Feasibility Study Committee to review, study, and make recommendations regarding the feasibility of wind farms in the state including, but not limited to, whether South Carolina is a suitable site for wind production on land or in offshore areas, the economic and environmental impact to the state, and the cost of wind farm installation and operation in the state.

The Committee prepared these recommendations regarding how the state could respond to an increasing interest in developing wind power in South Carolina. In compliance with the law, these recommendations are presented to the General Assembly and the Governor. To generate the recommendations, the committee held four public committee meetings in Columbia throughout 2009 and one public comment hearing in Georgetown.

The Committee was staffed by the South Carolina Energy Office, Senate Agriculture and Natural Resources Committee, and the House Agriculture, Natural Resources and Environmental Affairs Committee.

The Committee formulated 18 recommendations to prepare and promote opportunities for future wind power generation and the growth of a wind power manufacturing and construction industry in South Carolina. The recommendations have been subdivided into three categories – (1) general recommendations, (2) recommendations that support the generation of clean power from the state's abundant offshore wind resources, and (3) the growth of an wind turbine manufacturing and construction industry within the state that will support new wind farms along the entire US East Coast and Great Lakes, as well as in Europe. The Committee emphasizes the need to develop South Carolina wind and other renewable energy resources in a strategic manner through the development of a Renewable Energy Task Force. The recommendations below should be encompassed in a broader clean energy roadmap for the state that would be developed and carried forward by the Task Force.

GENERAL RECOMMENDATIONS

Recommendation #1: The SC General Assembly should issue a joint resolution stating the State's commitment to the development of offshore wind energy.

Recommendation #2: The Wind Energy Production Farms Feasibility Study Committee should reconvene in March 2010 to follow-up on the recommendations and see if additional changes or instructions are required.

RECOMMENDATIONS SUPPORTING CLEAN POWER PRODUCTION FROM OFFSHORE WIND

Recommendation #3: The Committee recommends that the State establish a clean energy portfolio standard with a target of 40-80 MW for generation capacity from offshore wind by 2013, and 1000 MW by 2018. The portfolio should also include targets for other renewable energy sources, energy efficiency, and nuclear energy. Legislation should contain either a carve-out or a renewable energy credit multiplier for offshore wind energy.

Recommendation #4: The Coastal Clean Energy Regulatory Task Force should establish a leasing framework for offshore coastal ocean activities in state waters. A leasing system would allow the state to evaluate and develop offshore resources, minimize use conflicts, reduce risks to the state and to the user, and result in more certainty for the state and investors.

Recommendation #5: South Carolina should establish a permit facilitation office through the SC Department of Health and Environmental Control and the SC Energy Office to coordinate the permitting and leasing of offshore wind projects.

Recommendation #6: South Carolina should develop a marine spatial plan for its offshore coastal ocean waters through the SC Department of Health and Environmental Control to allow predictability in decision making and protection of existing ocean uses. Additionally, DHEC should actively engage in the CEQ Ocean Policy Task Force and solicit input from other relevant state agencies, federal agencies and stakeholders.

Recommendation #7: Provide 'revenue certainty' for offshore wind power production sufficient for non recourse financing for a fixed number of years which would balance utilities, rate payer advocates, banks and profitability. The program could be equivalent to a feed-in tariff as seen in other states and countries.

Recommendation #8: The Governor should establish a Memorandum of Understanding (MOU) with North Carolina and Georgia to collaborate on future offshore wind projects, promote federal policies, transmission strategies, and joint demonstration projects.

Recommendation #9: Develop an offshore wind anemometer loan and/or rebate program available to utilities or private investors to obtain accurate offshore wind measurements.

Recommendation #10: Expand and increase existing renewable energy tax credits to include wind installations and increase the amount of credit to accommodate large-scale commercial projects such as offshore wind energy.

Recommendation #11: Establish a Wind Working Group through the SC Energy Office to promote the education and awareness of offshore wind activities and prepare a strategic roadmap for wind energy. Additionally, the SC Energy Office should develop a Wind Energy Cluster to coordinate with existing and new wind industry members in the state, working closely with the SC Department of Commerce and other economic development organizations to develop materials to assist in the recruitment of wind supply chain manufacturers.

Recommendation #12: The SC Sea Grant Consortium should engage its member institutions and federal partners to develop strategic options to establish an umbrella marine institute in South Carolina.

Recommendation #13: The State should negotiate with Santee Cooper to purchase wind energy from an offshore wind demonstration project and develop two test towers for research.

RECOMMENDATIONS TO PROMOTE A WIND POWER INDUSTRY IN SOUTH CAROLINA

Recommendation #14: The SC Energy Office should establish a Wind Energy Cluster within South Carolina to bring together existing wind industry members and develop a strategy to recruit others.

Recommendation #15: The SC Department of Revenue should review existing in-state incentives for manufacturing to ensure compatibility for wind component manufacturing and prepare draft legislation for the SC General Assembly if modifications are required.

Recommendation #16: Reinstate the SC Renewable Energy Infrastructure Development Fund to provide funding for wind research and demonstration activities.

Recommendation #17: The State Port Authority should fund a Refurbishment Study of the Charleston and Georgetown Ports to identify the refurbishment needs of both ports and develop a strategy to finance their redevelopment to encourage the establishment and manufacturing of offshore wind farms in the Mid-Atlantic and Southeastern United States. equipment and encourage the growth of new manufacturing.

Recommendation #18: The State should promote offshore wind interests through public relations and activities, and should be represented at major wind energy trade conferences and events.

II: South Carolina Wind Energy Landscape

South Carolina does not possess conventional energy resources (coal, oil, gas, or uranium). However, South Carolina does have plentiful supplies of renewable offshore wind energy. Data from the US Department of Energy indicates that South Carolina's offshore wind resources have the potential to produce over twice the amount of electricity that we consume today. While offshore winds offer the greatest potential for renewable electricity production in South Carolina, our coastal areas also have promise.

In 2005, the South Carolina Energy Office, in partnership with Santee Cooper, produced a comprehensive set of wind maps across the state. This study, conducted by AWS Truewind, used the MesoMap system in order to map annual mean wind speeds across South Carolina at heights of 30, 50, 70, and 100 meters above ground, as well as annual wind power at 50 and 100 meters. Wind speeds increase with height and vary based on ground cover and topography. Because power in a turbine is related to the cube of wind speed, an increase in wind speeds by 33% increases power output by 135%. Therefore, it is essential to know the wind speed at "hub" height. The AWS study demonstrates that offshore wind is a viable resource rivaling many of the existing wind farms already installed around the country. However, the wind resource in the rest of South Carolina is less than desirable for commercial scale development. The map below shows the wind resource at 100m from the surface with ideal conditions for offshore power (wind speeds greater than 7.5 m/s) between Charleston and Little River.

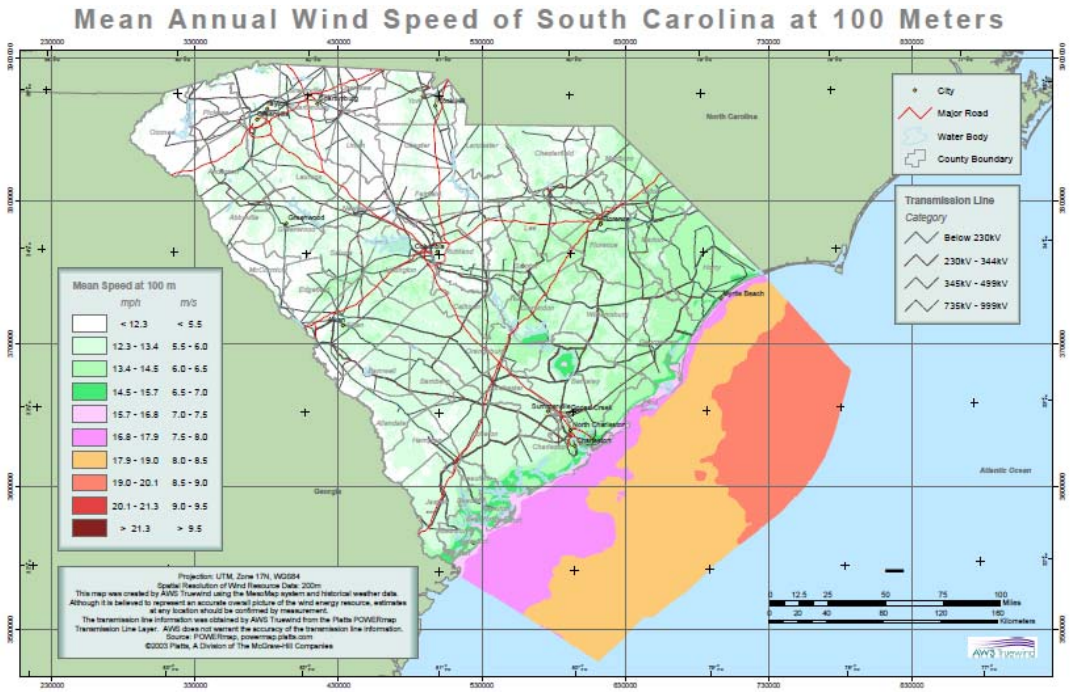

Figure 2: Mean Annual Wind Speed of South Carolina at 100 meters. AWS Truewind, *Wind Energy Resource Maps of South Carolina*, June 2005.

According to the American Wind Energy Association (AWEA), the United States installed 8,358 MW of wind power in 2008, setting another record for annual growth. This increased total wind capacity to more than 25 GW, enough to power 7 million households and stimulate $17 billion of investment in the economy.[1] To date, all of the new capacity has been onshore, driven by the lower cost compared to offshore development. However, Europe has seen significant growth of offshore wind and there is a growing discussion around offshore opportunities in the United States, particularly along the eastern seaboard.

South Carolina is one of the eastern states with ideal conditions for offshore wind energy: favorable winds, shallow Continental shelf for 10 to 30 miles off the coastline, large port facilities, and one of the preeminent wind turbine manufacturers. However, similar potential exists in other east coast states and nine other states have formally announced projects. A list of announced or planned offshore wind projects in the United States is below:

Project	Developer	Jurisdiction	State	MW
Capewind	Cape Wind Associates	MMS	MA	468
Hull Municipal	Town of Hull MA	MA State	MA	15
Buzzards Bay	Patriot Wind	MA State	MA	300
RIWinds	Deepwater Wind	RI State	RI	20
RIWinds	Deepwater Wind	MMS	RI	380
Winergy Plum Island	Deepwater Wind	NY State	NY	12
New Jersey	Fisherman's Energy	MMS	NJ	20
New Jersey (BPU)	Deepwater Wind	MMS	NJ	350
Delmarva	Bluewater Wind	MMS	DE	350
Pamlico Sound	Duke Energy	NC State	NC	10
Savanna GA	Southern Company	MMS	GA	10
Galveston Offshore Wind	W.E.S.T.	TX State	TX	150
Cuyahoga County	Cuyahoga CO. Task Force	OH State	OH	20
Total				2105

Table 1: List of offshore wind energy projects announced as of July 2009. Information provided by the National Renewable Energy Laboratory in a presentation by Sandy Butterfield to the Committee on July 13, 2009.

While offshore wind for South Carolina is potentially viable in the future, South Carolina is benefiting today from the onshore wind energy business. General Electric's (GE) Greenville

[1]American Wind Energy Association, "Wind Energy Grows by Record 8,300MW in 2008", January 27, 2009

facility produces wind turbine nacelles that are shipped across the United States. It also serves as GE's center for its wind engineering team. GE is the leading wind turbine supplier in North America with nearly one out of every two installed wind turbines produced by GE. Today GE employs more than 3,000 people in Greenville, with several hundred in the wind energy division. Additionally, a number of companies in the local area produce parts for GE's wind turbines, including Kaydon. Continued growth of the US wind industry will benefit the Greenville area and has the potential to lead to more component suppliers locating in South Carolina.

A complete list of offshore wind projects around the country as compiled by the US Offshore Wind Collaborative is listed in Appendix D.

III: South Carolina Wind Energy Activities

On April 20, 2009, the Committee held its first meeting to review the purpose of Act 318 of 2008 and learn about current wind energy related activities around the state. Committee members heard from Mr. Roger Schonewald with GE Energy, Ms. Elizabeth Kress and Eric Boessneck of Santee Cooper, Dr. Paul Gayes with the Burroughs and Chapin Center for Marine and Wetland Studies at Coastal Carolina University, Mr. Thomas French from the Savannah River National Laboratory, and Ms. Catherine Vanden Houten with the South Carolina Energy Office.

The first formal discussion of offshore wind energy in the state was in 2007 when South Carolina hosted the Southeast Regional Off-shore Wind Symposium, which brought together the leading offshore wind energy experts from research institutions, government agencies, utilities, and private industry. The meeting inspired many citizens and spurred several research initiatives.

Past and current research includes state-of-the-art wind mapping, five active anemometer stations, SODAR development for offshore use, the Costal Wind for Schools program, and extensive study of offshore wind potential through a consortium of researchers and industry. These efforts by the consortium of wind researchers have been able to secure nearly $46,000,000 of competitive federal funding for wind energy research and public outreach.

In 2008, the South Carolina Energy Office (SCEO), the Clemson University Restoration Institute, Coastal Carolina University, Santee Cooper and North Carolina State University partnered to submit a competitive grant through the US Department of Energy, State Energy Program. The SCEO was able to secure nearly $500,000 of competitive funding from the US Department of Energy. The grant, along with funding from Santee Cooper and the other partners, has three major offshore energy deliverables, including:

1) a transmission infrastructure study;
2) a wind, wave, and tidal energy study; and the
3) establishment of a Regulatory Task Force to develop an in-state permitting process.

The data being compiled by the wind, wave and tidal energy study by Coastal Carolina University and Santee Cooper is confirming the accuracy and credibility of the projections made during the wind mapping project. This includes data from six buoys and two onshore observations stations located at Winyah Bay and Little River. This data will be used to verify wind models and determine the ideal location of an offshore wind anemometer platform During the first phase of this study, researchers will look for the horizontal boundaries that are most optimal through atmospheric/oceanographic buoys. The second phase will include vertical instrumentation offshore to determine optimal areas based on actual data at hub height. South Carolina's Grand Strand provides the most potential for several reasons: wind resources are closer to shore which enables a closer transmission distance (this portion of the coast has very shallow water depths, which are better for foundations and the structures) and it

is close to the energy demand centers. These factors improve the economics and feasibility of an offshore wind farm.

The South Carolina Regulatory Task Force, staffed by the SC Energy Office, hosts monthly meetings to discuss the regulatory hurdles for permitting and developing offshore wind farms. The Regulatory Working Group is composed of representatives from the US Fish and Wildlife Service, SC Department of Health and Environmental Control, SC Department of Natural Resources, the National Oceanic & Atmospheric Administration, SC Department of Archives and History, and the US Minerals Management Service (MMS), a division of the US Department of the Interior.

The Savannah River National Laboratory (SRNL) has also contributed to the development of offshore wind in South Carolina through the coordination of the Wind for Schools program that is studying the potential for utilizing wind energy in coastal area schools. The SRNL is also studying the use of Sonic Detection and Ranging (SODAR) for offshore siting, which is currently recognized by the finance and research sectors for accurate use in measuring wind speeds onshore. This device "chirps" and reflects the sound with a transceivers array. These devices are beneficial because they are less expensive than Light Detection and Ranging (LIDAR), operate in adverse weather conditions, use little power, and are portable and rugged. SODAR equipment has been purchased and is being tested at the Baruch Institute in Georgetown, and will eventually be placed at a US Coast Guard platform.

In August 2009, the SC Energy Office was awarded a $109,000 grant by the US Department of Energy to generate market acceptance for offshore wind energy development in South Carolina and Georgia. This grant will be a collaborative effort with the Southern Alliance for Clean Energy, Georgia Environmental Facilities Authority, utilities and other in-state partners. The project will focus specifically on an outreach effort to educate the public about onshore and offshore wind energy potential. It will also provide technical assistance on wind policy options, aid economic development efforts and facilitate collaboration between state and regional partners, utilities and trade associations.

In November 2009, Clemson University received the largest competitive grant ever awarded to the University, over $45,000,000, from the US Department of Energy for a Wind Drivetrain Testing Facility at the former Navy Base in North Charleston to test the next generation of offshore wind turbines in the 5 MW to 15 MW size range. In addition, the University will receive $53,000,000 in private and public funding contributions through cash and in-kind services for a total of $98,000,000. This five year grant will make South Carolina a major hub for testing and is projected to attract new manufacturing industry to the state.

Future research efforts include a permit application for an offshore anemometer, a port refurbishment study, public outreach and education of offshore wind development, a wind workforce development strategy in SC, recruiting new industry, and an environmental study.

IV: Economic Analysis of Offshore Wind Farms

On July 13, 2009, the Committee held its second meeting to discuss the economic impacts of offshore wind energy for South Carolina. The first presentation was provided by Mr. Larry Flowers and Mr. Sandy Butterfield of the National Renewable Energy Laboratory, which is part of the US Department of Energy in Golden, Colorado. Flowers and Butterfield operate the Wind Powering America program which actively promotes the development of both onshore and offshore wind projects around the country. Wind energy is a steadily emerging and increasingly important energy source for our nation as referenced by a recent US Department of Energy Report, *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply*, published in July 2008. Over the last ten years, more than 25 states have installed wind turbines. The United States has now become the world leader for wind energy with 8,000 MW of onshore wind installed in 2008, a $16 billion dollar investment in one year. According to the National Renewable Energy Laboratory, 42% of the new generating capacity installed in the United States in 2008 was from wind energy.

Committee members were curious to know how much wind energy costs compared to coal and nuclear energy. According to Flowers, new wind generation costs are 6-8 cents/kWh, which is comparable to coal, and $90-120/MWh. Offshore wind is estimated to cost about 50-100% ($.10-.14/kwh) more for generation.

Flowers indicated that to reach the goal of 20% wind by 2030, 300 GW of wind power will need to be installed in the US, which is estimated will create a total economic benefit, including all direct, indirect and induced effects associated with the construction and operation of these turbines over the 24 year period from 2007-2030 of $1.4 trillion dollars. By 2030, it is estimated that this 300 GW of wind power will have created a total of 500,000 jobs – 180,000 direct jobs associated with the manufacture, installation and operation of wind power, and the remaining 320,000 jobs indirectly created or induced by the wind industry. In South Carolina, it is estimated that 3.3 GW of wind power will be installed in support of the 20% by 2030 scenario, which will result in 15,500 temporary (1-2 year) direct, indirect, and induced jobs associated with wind farm construction and an additional 3,200 permanent direct, indirect and induced jobs associated with the operation of these turbines. Nationally, the 20% scenario would also reduce water consumption by 4 trillion gallons by 2030 with a 17% reduction in total electric sector water consumption. Total savings would be over $205 billion not including water savings.

Mr. Butterfield discussed opportunities for developing offshore wind projects and cited examples of European projects. European officials anticipate offshore wind to be the dominant renewable energy source in Europe. Over 40,000 MW of offshore wind power are expected to be installed by 2015 across the globe, including the United States. Approximately 30 offshore wind projects have been announced in North America.

The Committee inquired about the operations and maintenance issues for offshore versus onshore wind and the viability of these systems long-term. Butterfield responded that onshore turbines are fairly reliable and previous issues encountered have not been design flaws. However, offshore wind is still in the formative stage and engineers are exploring opportunities for remote diagnostics. Maintenance costs are more variable for offshore projects and difficult to estimate.

The next presentation was provided by Ms. Rhonda Jackson with Fisherman's Energy out of New Jersey. Fishermen's Energy is a community-based offshore wind developer that allows the fishing industry to invest and participate in the offshore wind industry off the waters of New Jersey. In New Jersey the Governor's Initiative Energy Master Plan has the goal of installing 1,000 MW offshore wind by 2012 and 3,000 MW by 2020. The State of New Jersey would purchase the electricity. To incentivize the development of the project the State of New Jersey established an anemometer rebate program and an Offshore Wind Renewable Credit Program, which is designed to provide revenue certainty for offshore wind projects. Fishermen's Energy is forecasting 100 long-term operations jobs for the 350 MW wind farm the developer will build.

The next presentation was from Mr. Ed McCallum of McCallum Sweeney Consulting to discuss the economic opportunities for South Carolina. McCallum discussed the logistical challenges represented by wind turbine components since they are so large. Transportation infrastructure is critical to moving the components, which will grow even larger as new technologies develop and South Carolina has an original equipment manufacturer and suppliers. However, freight and labor is the needle mover. Transportation accounts for about $1,000,000 per unit. Training is also important. Most labor needed is unskilled or semi-skilled. The gas turbine business presence in South Carolina is probably why we have an offshore opportunity. Additionally, access to the Port of Charleston is imperative and the State must focus on how to provide better rail access to the port. The economy slowing down has provided an opportunity for South Carolina to catch up in the wind business.

The next presentation was from Mr. James Meadors from the City of Charleston Green Committee. Meadors provided information about Charleston's plans to integrate in the offshore wind sector. Meadors cited information that South Carolina could generate 210% of its energy needs from offshore wind. According to the US Department of Energy, manufacturing wind turbines and their components in South Carolina could result in 10,000 to 20,000 new manufacturing jobs. Meadors cited South Carolina's strong manufacturing base, existing pro-forma for a community college program for training technicians, and key wind industry players such as GE, Fluor, Nucor Steel, and others are already established in SC as reasons why expanding this industry is a major opportunity. Meadors cited the United States dependence on foreign energy and a vulnerability with an estimated $1.5 billion per day spent on foreign oil imports. The trend toward plug-in electric vehicles will require increased demand for electricity in order to move away from foreign imports. An offshore wind industrial cluster could potentially capture locally up to 50% of the costs associated with building a wind farm and prevent the need for companies like GE, Fluor and others to relocate to areas more invested in

the technology. Vestas, the world leader in turbine manufacturing, established their industrial hub to service land-based wind farm development in Denver due to its rail infrastructure, access to Midwest markets, and manufacturing base. Mayor Riley understands the challenges that come with this mission and is committed to meeting them head on.

The final presentation was provided by Mr. Monroe Baldwin with the North Myrtle Beach Economic Development Council. Baldwin informed the Committee about North Myrtle Beach's efforts to study onshore wind energy potential from rooftops along the ocean front. The Grand Strand has hundreds of ocean front hotels and condominiums which could be used to produce energy from a special type of turbine called a vertical axis wind turbine with a capacity of 5 – 15 kW each, that would not only benefit building owners but also attract new businesses to the region. North Myrtle Beach is interested in establishing a Wind Energy Incubator Program to attract vertical axis turbine companies and upstart wind installation and maintenance companies, with many opportunities for new areas in architecture, electrical engineering, and structural engineering. North Myrtle Beach is conducting tests to monitor wind speeds on rooftops and establishing a wind index (Apache pier) which allows for shorter survey periods, easy comparative analysis between buildings, and an academic framework from a business perspective.

Other Economic Analysis Information

According to Jeffery Beacham's recent study, *A Feasibility Analysis of SC Wind Resources for Electric Power*, offshore wind technology has just as much potential for success as onshore and since it is relatively new, there is a possibility for decreasing costs with technology improvements. Europe has led the way with wind energy infrastructure installed offshore.[2] The European Commission's proposal to dedicate €500 million to help finance offshore wind will provide various social and economic benefits.[3] It is expected to create vast sources of wind-generated electricity that can be quickly integrated into the existing grid, provide new research and development opportunities, and speed up economic growth.[4] It will help make the power sector less expensive and more efficient, while improving current operations.

Currently, 26 projects are installed in the North and Baltic Seas, in eight nations with a combined capacity of more than 1,200 MW.[5] Members of the European wind energy community and other stakeholders have largely mitigated risks related to wind energy or decided that the local siting risks are less of a concern than other factors, such as air emissions

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[2] Beacham, Jeffery. *A Feasibility Analysis of South Carolina Wind Resources for Electric Power Generation*, http://www.ipspr.sc.edu/ejournal/ejnov08/Renewable%20Portfolio%20Standard.pdf (last visited December 10, 2009) pg. 3.
[3] European Wind Energy Association (EWEA), *Offshore wind power to contribute to Europe's economic recovery*, http://www.ewea.org/index.php?id=60&no_cache=1&tx_ttnews%5Btt_news%5D=1439&tx_ttnews%5BbackPid%5D=1588&cHash=3eb12bb4d4 (last visited December 4, 2009).
[4] EWEA
[5] US Department of Energy, *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply*, July 2008, pg.124.

and the larger global risks of climate change. Those issues that should be discussed with each siting include:

- Fish and benthic communities, marine mammals;
- Electromagnetic fields;
- Human intrusion on seascape environments;
- Competing commercial and recreational uses of the ocean; and
- Other socioeconomic effects, including tourism and property values

Europe has big expectations for its wind industry, which is "expected to contribute towards delivering 12-14% of EU electrical demand within 12 years, with more than one-quarter of that coming from offshore wind."[6] In addition, by 2030, the "contribution of offshore wind alone is expected to reach close to 15 percent of total EU electrical production."[7]

According to Roger Flynn's article, *The Potential Economic Impact of an Off-Shore Wind Farm to the State of South Carolina,* there are opportunities for economic growth from wind energy in this state.[8] The study estimates the economic and fiscal impacts in South Carolina to manufacture, install and operate a 480 MW find farm off the coast of South Carolina.[9] In the manufacturing and installation phase approximately 2,000 jobs would be created.[10] During the operational phase of the project, predicted economic and fiscal impacts will result from the employment of workers "to operate and maintain the power generation equipment, as well as, from revenue generated by tourism of the off-shore wind farm."[11] The analysis predicts that employment will permanently increase by the equivalent of up to 155 full-time jobs.[12] There would be an increase in state economic output by $114-$287 million[13], which would increase annual disposable income by $42-$93 million.[14] This would result in an increase in state income tax by up to $2.8 million, and up to $190,000 increase in corporate income tax.[15]

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[6] European Wind Energy Association (EWEA), *Offshore wind power to contribute to Europe's economic recovery*, http://www.ewea.org/index.php?id=60&no_cache=1&tx_ttnews%5Btt_news%5D=1439&tx_ttnews%5BbackPid%5D=1588&cHash=3eb12bb4d4 (last visited December 4, 2009).
[7] EWEA
[8] Flynn & Carey, Clemson University, *The Potential Economic Impact of an Off-Shore Wind Farm to the State of South Carolina*, available at http://www.clemson.edu/scies/wind/Paper-Flynn.pdf (last visited December 4, 2009).
[9] Flynn & Carey, pg. 4
[10] Flynn & Carey, pg. 3
[11] Flynn & Carey, pg. 3
[12] Flynn & Carey, pg. 3
[13] Flynn & Carey, pg. 9
[14] Flynn & Carey, pg.3, 9
[15] Flynn & Carey, pg.3

V: Environmental Impacts and Regulatory Issues of Offshore Wind Farms

On September 21, 2009 the Committee held a meeting to discuss the environmental impacts and regulatory issues of permitting offshore wind farms and the Committee received presentations from five individuals. The first presentation was from Mr. Bob Perry with the South Carolina Department of Natural Resources**.** Perry spoke on behalf of the Coastal Clean Energy Regulatory Task Force. The objective of his presentation was to further introduce a list of potential natural resource impacts that may be associated with a wind energy production farm located off the northern upper coast of South Carolina. Variations in location would greatly vary the environmental impact of an offshore wind farm.

Potential environmental impacts would be assessed under existing federal or state environmental laws or regulations through a process outlined in the National Environmental Policy Act (NEPA). Under a good scenario, such a process should take two to three years and would include analysis of the marine environment (from site location to the high water mark, areas above the surface, the surface, the water column, and the bottom), the near-shore environment (from the high water mark to inland connections), the upland environment (from the nearshore to inland connections). The greatest impact will be on marine life and above the surface for avian species. This will affect both breeders and migratory birds such as the scaup duck, scoters, and pelicans. Perry also described the potential impacts of transmission and cabling for endangered loggerhead turtles that nest on SC beaches. Perry stressed that the North Island and Hobcaw Barony are wildlife sanctuaries by deed restriction. North Island is a wilderness area of about 4,000 acres only accessible by boat. Perry indicated that there were probably no “show stoppers” but that is still uncertain at this time. Many unwanted impacts could probably be avoided by a change of location.

Next, Mr. Doug Heatwole with Ecology and Environment, Inc. spoke about the National Environmental Protection Act and Environmental Impact Statement compliance procedures. Within three miles of shore, the State has authority and from 3 to 200 miles offshore, the US Minerals Management Service (MMS) has authority (conveyed by Energy Policy Act of 2005 (EPACT 2005). MMS issues renewable energy leases, easements, and rights-of-way under Outer Continental Shelf Lands Act. The Federal Energy Regulatory Commission (FERC) is responsible for wave and current energy leases. Heatwole spoke in great depth about the extensive NEPA process that permitting a wind farm entails. NEPA was passed in 1969 and requires federal agencies to consider the environmental consequences of their actions. There are two types of NEPA investigations:

1) Environmental Assessments (EA)
2) Environmental Impact Statements (EIS)

The EIS is a much more thorough process and would be required for any offshore wind farm.

The EIS requires public input and involvement from stakeholders including coastal states, agencies, fishermen, recreational boaters, commercial shipping, waterfront landowners, marine/coastal advocacy groups, and utilities/power generators. The leasing process can take between two to three years. There are different time levels of leases, but the two most common include the limited lease often used for research for six years and a commercial lease. Either of these can be competitive or noncompetitive. Information required under the MMS regulatory framework includes water quality, biological resources, threatened and endangered species, sensitive biological resources or habitats, archaeological resources, socioeconomic information, coastal and marine uses. MMS adopted a policy of adaptive management, which would allow developers to adapt as they develop a project.

Heatwole suggested that NEPA needed to address the cumulative impacts and effects of offshore wind parks as opposed to looking at projects individually. For example, while one wind farm may not have a huge impact, once there are numerous farms up and down the east coast they could have a significant impact on mammals with large migratory paths such as whales.

The next presentation was from Mr. Steve Kopf with Pacific Energy Ventures, Inc., which discussed the federal aspects of Marine Spatial Planning and Territorial Sea Planning and how state policy could align with federal polic*y.* Kopf discussed industry imperatives to balance new and existing ocean uses, establish consistent and appropriate regulatory process, understand project effects, both environmental and socioeconomic, coordinate industry needs, prioritize research and development, identify resource gaps, develop workforce and maritime infrastructure, and develop market support. The cost for offshore wind for a project in Delaware is estimated to be 18 cents/kWh.

Kopf suggested methods to encourage offshore wind such as:

- The establishment of a renewable portfolio standard with a carve outs for offshore wind energy;
- State investment tax credits;
- Quantifying aggregate market costs;
- A roadmap showing where state and federal processes overlay;
- A territorial sea plan; and
- A clawback provision for environmental studies.

The final presentation was provided by Ms. Catherine Vanden Houten of the South Carolina Energy Office and Mr. Blair Williams with the Office of Coastal Resource Management at the South Carolina Department of Health and Environmental Control with recommendations from Coastal Clean Energy Regulatory Task Force (heretofore known as the Regulatory Task Force), which was established as an objective of a 2008 grant from the US Department of Energy titled, *The South Carolina Roadmap to Gigawatt-Scale Coastal Clean Energy Generation: Transmission, Regulation & Demonstration*. The goal of the grant is to identify and overcome existing barriers

for coastal clean energy development for wind, wave and tidal energy projects in South Carolina.

The mission of the Regulatory Task Force is to foster a regulatory environment conducive to wind, wave and tidal energy development in state waters and is comprised of the full spectrum of state and federal regulatory and resource protection agencies, universities, private industry and utility companies. One of the first tasks undertaken by the Regulatory Task Force was an analysis of how the existing state and federal regulatory framework would apply to a potential offshore wind project in state waters. The Regulatory Task Force first reviewed the MMS Programmatic Environmental Impact Statement, which includes a listing of the potential resource impacts from offshore wind projects. The Regulatory Task Force reviewed each resource impact and identified relevant existing regulations and the responsible agency(ies). Then, the group identified lead permitting authorities and timeframes associated with each of those regulations.

As a result of this analysis, the Regulatory Task Force concluded that no major regulatory gaps currently exist for permitting an offshore wind project in state waters. While recognizing that certain aspects of offshore projects may benefit from new regulation development such as standards and procedures for transmission lines, siting, etc., the Regulatory Task Force was also able to identify a regulatory path and clarify the timeframes associated with the existing regulatory process. While the Regulatory Task Force concluded that these initial findings provide a strong foundation for possible wind energy developments in state waters, it identified four recommended actions that South Carolina should take in order to facilitate the development of offshore wind energy in the state.

Although the work of the Regulatory Task Force is scheduled to continue through 2011, there was consensus among its members to present the following four preliminary recommended actions to the Wind Energy Production Farms Feasibility Study Committee for consideration. These recommendations are summarized in the recommendations section of the report.

Recommendation #1:
South Carolina should establish a policy of support for renewable energy development.
When the Regulatory Task Force began its work, it set out to identify possible hurdles in permitting offshore wind projects in state waters. The Regulatory Task Force quickly concluded that one of the largest hurdles to the successful permitting of an offshore wind project may be dependent more on a strong state policy in support of renewable energy development for South Carolina than on the regulatory process itself. In short, there was consensus that the regulatory process cannot be viewed entirely separate from the policy context. According to research conducted by the American Wind Energy Association, a supportive siting process and consistent public support for renewable energy are essential to the success of offshore wind projects. Strong supportive renewable energy policies can provide the certainty needed for companies to ramp-up investments – especially the large investments that are needed for offshore projects – and minimize risks.

The state has various options for developing policies that support renewable energy development, including actions by the executive branch (e.g., proclamation or executive order signed by the Governor) and legislative branch (passage of resolutions and/or legislation). Further, the adoption of renewable portfolio standards (RPS) can provide additional momentum in support of renewable energy development. In the United States, 29 states have developed renewable portfolio standards and an additional six states have established nonbinding goals for renewable energy. Of the nine states currently with active offshore wind initiatives, eight have established renewable portfolio standards.

The consensus of the Regulatory Task Force is that state-level support for renewable energy development through the establishment of supportive statewide policies or the pursuit of renewable portfolio standards is critically important to renewable energy development in South Carolina. Otherwise, South Carolina may miss out on the opportunity to attract renewable energy investors, new renewable energy industry and related jobs and the academic/private sector development that goes along with it.

Recommendation #2:
South Carolina should establish a leasing framework for offshore coastal ocean activities in state waters.
While the Regulatory Task Force has concluded that existing regulations are in place that would allow for the permitting of an offshore wind energy project in state waters, other issues remain. There is consensus among the Regulatory Task Force that permitting alone may not be sufficient to address the entirety of issues that are of interest and concern to the State and to potential investors/energy developers in South Carolina. Relying solely on permits to provide for offshore activities has significant limitations. For the energy operator, permits are typically short-term (less than five years in duration), do not protect permittee investments, do not provide any degree of exclusivity of use, and can be withdrawn with little notice. For the State, permits do not address issues of conflicting uses, do not include provisions for companies to provide compensation for the use of public resources, do not provide the resources necessary for the removal of structures should an operation be terminated or go out of business, and do not provide additional safeguards that would protect the State's interests in the operation and its resources. The result is uncertainty and risk for both the State and for investors/operators.

A leasing framework could address these issues by including the following provisions that might otherwise be lacking in the standard permitting process:

- *Eligibility* – The eligibility of applicants could be stated. For instance, to be eligible to obtain a lease for a wind energy facility, an applicant may be required to be (a) a United States citizen or a permanent resident 19 years or over; (b) a corporation registered in the State or incorporated under the laws of the United States; (c) a registered partnership; or (d) a non-US citizen who owns the adjacent upland.
- *Scope* – Leasing provisions could include considerations for the "three-dimensional" use (or any subset thereof) of the ocean environment by energy operations: (a) the ocean floor, (b) the water column, and/or (c) the sea surface.

- *Aerial coverage* – Leasing provisions could identify locations in the coastal ocean and establish guidelines (minimum and maximum) for those locations where offshore energy firms could obtain leases.
- *Lease duration* – The term of the lease could provide the firm with enough time to plan, initiate, and establish its wind energy operation and, at the same time, provide the state government with the flexibility to be able to reassign, suspend, or terminate leases for just cause. Criteria for such action could be established.
- *Exclusivity* – Leasing programs for offshore energy could include provisions to require South Carolina to assess the extent to which the applicant needs exclusive use of the site and, to the maximum extent possible, could reserve to the public the right to use the leased lands for all public trust purposes that will not unreasonably interfere with the offshore energy operation.
- *Performance* - Leasing programs for offshore energy could include minimum performance measures to ensure that the site is being used for its intended purpose and at its highest potential. Performance bonds might be required as well.
- *Compensation* – Provisions to require the lessee to pay for the (semi-)exclusive use of public trust resources associated with the lease could be established in an offshore wind energy leasing program. These payments could take the form of compensation on a per-acre basis, rentals, fees, royalties, and/or other means.

Leases are already required for any proposed wind energy project in federal waters and the state of Texas has developed a leasing program for its state waters. Both the federal and Texas leasing programs incorporate the above elements.

In light of these considerations, the Regulatory Task Force recommends that South Carolina develop and implement a leasing framework for state offshore waters that could be applied to all potential uses of state waters offshore, including wind energy development. Such a leasing system would provide for the orderly evaluation and development of our offshore resources, minimize use conflicts, reduce risks to the state and to the user, and result in more certainty for the state and investors. It should be noted, however, that the Regulatory Task Force strongly recommends that current offshore wind projects not be delayed for the implementation of leasing. Current work and projects should continue unimpeded under current regulations with provisions to accommodate these under any future leasing plan.

Recommendation #3:
South Carolina should establish a permit facilitation office to coordinate the permitting and leasing (if established) of offshore wind projects.
While the Regulatory Task Force identified and documented the regulations and permits that would be required for an offshore wind project, it also recognized that the regulatory process is complicated, cumbersome, time-consuming and, at times, costly. The Regulatory Task Force concluded that identifying one agency as having a coordinating function would make the process more efficient and potentially less daunting to a prospective applicant. A model for a permit facilitation office already exists in South Carolina, specifically for aquaculture through the establishment in law of the Permit Assistance Office within the SC Department of

Agriculture (Section 46-51-10). The Regulatory Task Force proposes that a similar permit facilitation office be established to provide the regulatory coordination - a function that could be housed in a non-regulatory agency - and offer assistance to investors as they navigate through the leasing/permitting process. At this early phase in offshore development, it may even be possible to eliminate duplication and develop a highly efficient flow for the permitting process which would be beneficial to both government and industry.

The Regulatory Task Force examined closely what other states and the federal government have done so far regarding the regulatory process for offshore wind. For example, the Commonwealth of Virginia concluded in a study released in December 2008 that obstacles to offshore alternative energy development in some states arise from the lack of straightforward path for planning, evaluation and permit coordination. They also recommended that a single administrative process be established that coordinates the development and review of energy facilities in state and federal coastal waters. The state of North Carolina released a study in August 2009 that concluded a new statute should be enacted to specifically address the multitude of issues associated with leasing state-owned submerged lands for wind projects in order to provide a clear, consistent legal framework for investors and developers. The state of Michigan published a report in September of 2009 that included a recommendation that there should be a single agency to facilitate the permitting, leasing, construction and monitoring of offshore wind projects.

In summary, as evident in the examples of Virginia, North Carolina and Michigan, other states have all grappled with these and issues have come to similar conclusions: that there to be a streamlined, straightforward system to facilitate the efficient permitting of offshore wind projects. South Carolina should follow suit and create a "one-stop" permit coordination process for offshore wind developments.

Recommendation #4:
South Carolina should begin to develop a marine spatial plan for its offshore coastal ocean waters.
South Carolina's economy relies heavily on coastal and ocean-related industries. Coastal tourism, fisheries, and energy production facilities generate (or have the potential to generate) more than 50 percent of our State's revenues and jobs. Today, there are new and expanding opportunities for ocean-sector industries in South Carolina, so it is critical that our State begin the process of ocean resource planning and management. Such an effort would lead to reasonable predictability in decision making and protection of existing ocean uses, including tourism, fisheries, sand resources, marine transportation, and military operations, among others.

Comprehensive ocean planning, which relies on high-resolution, integrated mapping of ocean resources and uses, in concert with a state leasing program for use of its coastal ocean waters, would improve our State's capacity to make informed decisions about locating sites for new energy infrastructure and offshore aquaculture operations; identifying available sand resources and how they would be allocated to communities for nourishment projects; sustaining

commercial and recreational fisheries; and supporting commerce, marine transportation, and other ocean ecosystem services valued by South Carolina residents and visitors. The development of a South Carolina Ocean Plan would allow our state to actively engage a broad range of stakeholders in developing a comprehensive plan and then implement it to proactively manage ocean uses and resources.

Several coastal states have initiated comprehensive ocean planning efforts. Marine spatial planning is now a widely recognized practice that can help states identify the most suitable locations for various ocean activities and uses. To engage in marine spatial planning, a state must invest in several core capacities, including seafloor mapping, data and basemap integration, research and extension, and community-based planning. This clearinghouse of ocean information will require strong partnerships among state and federal agencies, local communities, industry and stakeholders.

Given the considerations discussed above, the Regulatory Task Force suggests that South Carolina initiate a statewide ocean spatial planning effort. The state should appoint a lead agency to coordinate this effort and require other entities and a broad range of stakeholders to provide input into a final adopted plan.

VI: Summary of Public Comments

The Committee received 50 public comments regarding wind energy in South Carolina. Every comment was either in favor of or neutral about wind energy development. The overwhelming positive support of wind development was unexpected given previous assertions that there would be lack of support from coastal communities due to viewshed concerns.

The support for wind energy development was grouped into three major themes:
1) Importance of clean energy that would reduce pollution from traditional energy generation and reduce greenhouse gas emissions
2) Development of new jobs along the coast and educational opportunities
3) Reduced dependence on foreign oil and imported energy

All of the comments are included in Appendix A, but below are some highlights of the major themes mentioned above.

“As a SC resident and a property-owner on the coast, I wanted to speak in favor of wind energy for South Carolina. Wind is clean, renewable, and practical for our state--far superior to other sources of energy.” - Nancy Kreml

“South Carolina could prove to be the Saudi Arabia of offshore wind. Recent studies have estimated that the wind industry could bring tens of thousands of jobs and tens of billions of dollars to this state over the next couple of decades… It is time we stop sending our dollars to other states and other countries to purchase their fossil fuels, and start taking advantage of the opportunities we have here in the Palmetto State. Respectfully Submitted, Col (ret) Paul J Sykes”

“Offshore wind energy offers a hedge against the impact of rising fuel costs and can help stabilize and reduce electricity prices by displacing the need for more expensive power plants. It is anticipated that there will be a reduction in energy costs as new technology is developed and as the offshore wind industry advances in this county." – Toni Reale, Southern Alliance for Clean Energy

“The Coastal Conservation League encourages this study committee to make clear, substantive recommendations to the General Assembly in the 2010 session. Recommendations that will allow South Carolina to capitalize on wind energy now.” – Nancy Cave, SC Coastal Conservation League

“I live in Georgetown so therefore have a vested interest in the “windmills” that might be built off our coast. I am very, very much pro this happening. The first reason is that (1) wind does not quit, (2)does not cost anything for it to blow, (3)we have an unused steel mill that could be converted into a “windmill factory” thus creating new jobs in Georgetown, (4) once they are

built(way in the future) our power bill could be reduced, (5) We have a port that could be used for shipping the product to and from the construction site and a railroad to bring the equipment to Georgetown, and (6) It is clean, green energy. The low country and the grand strand need to push the Governor and the legislator to fund this project. Other states are getting ahead of us and we will again lose out if we drag our feet." - John Geiger

"SC has companies that make wind turbines, a coastline that is conducive to wind farm placement, transportation infrastructure and many authoritative reports that indicate SC will gain economically from pursuing wind technology. Yes let's move forward in an expeditious manner so SC can become a national leader in wind technology and wind energy production." - Peter Zalka

VII: Recommendations

The Committee formulated 18 recommendations to prepare and promote opportunities for future wind power generation and the growth of a wind power manufacturing and construction industry in South Carolina. The recommendations have been subdivided into three categories – (1) general recommendations, (2) recommendations that support the generation of clean power from the state's abundant offshore wind resources, and (3) the growth of an wind turbine manufacturing and construction industry within the state that will support new wind farms along the entire US East Coast and Great Lakes, as well as in Europe. The Committee emphasizes the need to develop South Carolina wind and other renewable energy resources in a strategic manner through the development of a Renewable Energy Task Force. The recommendations below should be encompassed in a broader clean energy roadmap for the state that would be developed and carried forward by the Task Force.

GENERAL RECOMMENDATIONS

Recommendation #1:
Statement of support for offshore wind energy
The SC General Assembly should issue a joint resolution affirming the State's commitment to the development of offshore wind energy and a vibrant wind manufacturing and construction industry within the state. The resolution should specifically state, "Offshore wind development for electricity production and the growth of a wind manufacturing and construction industry is in the public interest of the residents of South Carolina."

Recommendation #2:
Reconvening of the Wind Energy Production Farms Feasibility Study Committee
The Committee recommends that it reconvene in March 2010 to follow up on the recommendations and see if additional changes or instructions are required.

RECOMMENDATIONS SUPPORTING CLEAN POWER PRODUCTION FROM OFFSHORE WIND

Recommendation #3:
South Carolina should establish a policy of strong support for renewable energy development.
The Committee recommends that the State establish a clean energy portfolio standard with a target of 40-80 MW for generation capacity from offshore wind by 2013, and 1000 MW by 2018. The portfolio should also include targets for other renewable energy sources, energy efficiency, and nuclear energy. Strong supportive renewable energy policies can provide the assurance needed for companies to ramp-up investments – especially the large investments that are needed for offshore projects – and decrease risks. Without a clean energy policy that includes specific support for offshore wind, moreover, South Carolina may find itself disadvantaged relative to other states in its ability to attract industry investment, project development, and manufacturing. Currently 29 states have developed renewable portfolio

standards and an additional six states have established nonbinding goals for renewable energy. Of the nine states with active offshore wind initiatives, eight have established a renewable portfolio standard. A South Carolina clean energy portfolio standard, which could be enacted by the SC General Assembly. The Committee recommends that the legislation contain either a carve-out or a renewable energy credit multiplier for offshore wind energy to account for the increased investment costs of these projects compared to other technologies. It will be critical for the in-state deployment of offshore wind to maintain a dedicated "tier" for renewable energy toward which an offshore wind carve-out or credit multiplier can be applied.

Recommendation #4:
South Carolina should establish a leasing framework for offshore coastal ocean activities in state waters.
The Committee recommends the Coastal Clean Energy Regulatory Task Force develop a leasing framework for state offshore waters which could be applied to all potential uses of state waters offshore, including wind energy development. Though existing regulations are in place to permit offshore wind energy projects in state waters, permitting alone may not be sufficient to address all issues that are of interest and concern to the state and to potential investors/energy developers in South Carolina. A leasing framework could address eligibility, scope, aerial coverage, lease duration, exclusivity, performance, and state compensation issues. A leasing system would allow the state to evaluate and develop offshore resources, minimize use conflicts, reduce risks to the state and to the user, and result in more certainty for the state and investors. Existing projects should continue unimpeded under current regulations with provisions to accommodate these under any future leasing plan. The Coastal Clean Energy Regulatory Task Force should take the lead on developing the leasing framework as it is comprised of the full spectrum of state and federal regulatory and resource protection agencies, universities, private industry and utility companies.

Recommendation #5:
South Carolina should establish a permit facilitation office to coordinate the permitting and leasing of offshore wind projects.
The Committee recommends that the SC Department of Health and Environmental Control and the SC Energy Office establish and coordinate a permit facilitation office, to reduce the time and cost of permitting and/or leasing offshore wind energy projects. The Committee recommends using the model of the state aquaculture program, which is contained in the South Carolina Code, Section 46-51-10.

Recommendation #6:
South Carolina should develop a marine spatial plan for its offshore coastal ocean waters.
The Committee recommends that funding be provided from the General Fund to SC Department of Health and Environmental Control to initiate and coordinate a statewide ocean spatial planning effort. Given the wide variety of coastal users, it is important that the state begin a process of ocean resource planning and management to allow predictability in decision making and protection of existing ocean uses. Marine spatial planning, which relies on high-resolution, integrated mapping of ocean resources, is now a widely recognized practice that can

help states identify the most suitable locations for various ocean activities and uses. To engage in marine spatial planning, the state should invest in several core capacities, including seafloor mapping, data and basemap integration, research and extension, and community-based planning. This clearinghouse of ocean information will require strong partnerships among state and federal agencies, local communities, industry and stakeholders. The designated agency should also actively engage in the CEQ Ocean Policy Task Force and solicit input from other relevant state and federal agencies and stakeholders for consideration in the development of a state adopted plan. The State should also help developers identify good locations to install offshore wind farms using marine spatial planning data.

Recommendation #7:
Provide 'revenue certainty' for offshore wind projects.
The Committee recommends that the State establish a program to provide 'revenue certainty' to offshore wind power production sufficient for non recourse financing for a fixed number of years which would balance utilities, rate payer advocates, banks and profitability. The program could be equivalent to a feed-in tariff as seen in other states and countries.

Recommendation #8:
Coordinate offshore wind activities with North Carolina and Georgia.
The Committee recommends that the Governor establish a Memorandum of Understanding (MOU) with North Carolina and Georgia to collaborate on future offshore wind projects. Similar to a November 2009 initiative among governors of Maryland, Virginia, and Delaware, a MOU would promote offshore wind power in the Southeastern region by creating a formal partnership among the states to work together to promote federal policies, transmission strategies, and address other issues. Additionally, with Duke Energy's recent announcement of a 10 MW demonstration offshore wind project in North Carolina's Pamlico Sound and Southern Company's plans for a 10 MW demonstration project in Georgia, the states could combine forces to install demonstration projects in each state to reduce ship rental fees.

Recommendation #9:
Develop an offshore wind anemometer loan and/or rebate program.
The Committee recommends the State establish a no-interest loan program or a rebate program available to utilities or private investors for anemometer projects, in order to obtain accurate offshore wind measurements. Offshore anemometer platforms designed to obtain this information are expensive and require a lengthy permit process.

Recommendation #10:
Expand and increase existing tax credits for renewable energy equipment to include wind.
The Committee recommends that the State amend existing state income tax credits for solar energy and small hydropower projects be expanded to include wind energy. Small-scale wind energy could be utilized now by homeowners and businesses in coastal regions and the Upstate of South Carolina. The renewable energy tax credit amount is fairly limited and should be increased to accommodate large-scale commercial projects such as offshore wind energy. In-

state tax credits leverage existing federal tax credits, help developers secure financing, and provide long-term economic viability of projects.

Recommendation #11:
Establish a Wind Working Group.
The Committee recommends that the SC Energy Office promote the education and awareness of offshore wind activities through the formal establishment of a Wind Working Group through the US Department of Energy Wind Powering America (WPA) program. Engaging in the WPA program will enhance South Carolina's opportunities to win competitive WPA grants. The WPA should also serve the capacity of developing a strategic roadmap for wind energy development in South Carolina by bringing together the key players.

Recommendation #12:
Establish an umbrella marine institute in South Carolina.
The Committee recommends that the State recognize and expand its well-positioned and outstanding marine research programs at the Ft. Johnson Marine Resources Center complex (the location of SC Department of Natural Resources Marine Resources Research Institute, College of Charleston's Grice Marine Biology Program, the Medical University of South Carolina's Marine Biomedicine Program, and the National Oceanic and Atmospheric Administration's Hollings Marine Laboratory and Center for Coastal Environmental Health and Biomolecular Research), Coastal Carolina University's Burroughs and Chapin Center for Marine and Wetland Studies, and the University of South Carolina's School of the Environment and Bell W. Baruch Institute. The coastal and ocean science and outreach work being done all along the coast of South Carolina could be coordinated and promoted as a premier marine resource enterprise for the East Coast, similar to Woods Hole Oceanographic Institution or Scripps Institute of Oceanography. All of the key participants are already located strategically to develop these into a world-class umbrella organization. The US Department of the Interior's Minerals Management Service should be encouraged to consider locating here as well. This South Carolina marine enterprise could facilitate the development of environmental impact studies for future offshore energy parks and other offshore operations. The Committee recommends that the SC Sea Grant Consortium, given its legislative mandate, programmatic focus on marine and coastal resources, and university-based organizational structure, engage its member institutions and federal partners to develop strategic options to establish such an enterprise.

Recommendation #13:
Issue a RFP for a demonstration project and test bed project
The State should negotiate with its state-owned utility, Santee Cooper, to purchase wind energy from an offshore wind demonstration project. As part of the project, Santee Cooper should also develop two test towers for research that would attract manufacturers to the State.

RECOMMENDATIONS TO PROMOTE A WIND POWER INDUSTRY IN SOUTH CAROLINA

Recommendation #14:

Establish a Wind Energy Cluster.
The Committee recommends that the South Carolina Energy Office establish a Wind Energy Cluster within South Carolina to bring together existing wind industry members and develop a strategy to recruit others. The Wind Energy Cluster should work closely with the SC Department of Commerce and other economic development organizations to develop materials to assist in the recruitment of wind supply chain manufacturers. The SC Department of Commerce should give priority to actively recruiting this nascent industry. The new Wind Turbine Drive Train Test Facility at the former Charleston Naval Base should be established as a focal point for economic development of the offshore wind industry within the state.

Recommendation #15:
Wind energy manufacturing incentives.
The Committee recommends that existing in-state incentives for manufacturing be reviewed by the SC Department of Revenue to ensure compatibility to wind component manufacturing. If an alteration is needed in the South Carolina Code to accommodate this industry, the Committee recommends that the SC Department of Revenue prepare draft legislative changes for the SC General Assembly and the legislature should adopt those modifications.

Recommendation #16:
Reinstate the SC Renewable Energy Infrastructure Development Fund to provide funding for wind research and demonstration activities.
The Committee recommends the SC General Assembly reinstate and fund the SC Renewable Energy Infrastructure Development Fund to encourage the development of renewable energy projects in South Carolina, including offshore wind. In 2007 and 2008 the program provided grants up to $200,000 for the research and demonstration of renewable energy technologies. The program was suspended in July 2008 by the SC Supreme Court because of a "bobtailing" ruling.

Recommendation #17:
Fund a State Port Refurbishment Study.
The Committee recommends the State Ports Authority (SPA) conduct a study of the Charleston and Georgetown Ports to identify the refurbishment needs of both ports and develop a strategy to finance their redevelopment to encourage the establishment and manufacturing of offshore wind farms in the Mid-Atlantic and Southeastern United States. The State Ports Authority (SPA) could benefit greatly from the growth of the ports in this new niche market. The report should also examine opportunities to obtain rail clearance to the Port of Charleston to allow for easy transportation of large wind turbine component equipment and encourage the growth of new manufacturing.

Recommendation #18:
Promote offshore wind industry creation through increased visibility
The State should promote offshore wind development through outreach, particularly through the SC Department of Commerce and the SC Energy Office, and be represented at major wind

energy trade conferences and events. Additionally, the Governor should be a visible supporter of offshore wind energy.

Appendix A: Public Comments

October 7, 2009
Nancy Kreml, 111 Southwood Drive, Columbia SC and 165 Old Tram Way Pawley's Island, SC
nancykreml@gmail.com
As an SC resident and a property-owner on the coast, I wanted to speak in favor of wind energy for South Carolina. Wind is clean, renewable, and practical for our state--far superior to other sources of energy. I want to encourage the establishment of wind farms off the coast of South Carolina. Thank you for your consideration of this important resource.

October 7, 2009
Weldon Barker, weldonb@sc.rr.com
Please do everything in your power to aid and promote the realization of a wind power energy program off the coast of South Carolina. We must do all we can to assist our nation in the vital conversion from polluting fossil fuels to clean, inexhaustible, DOMESTIC sources. This will provide thousands of desperately-needed jobs for South Carolinians and improve the quality of life for ALL our citizens!

October 7, 2009
Judy Timmons, judyhtimmons@yahoo.com
My husband and I were on a cruise to the Baltic countries in June and saw offshore wind turbines EVERYWHERE. It caused us to wonder why SC does not have any. There everyone seems pleased to have this renewable source of energy, and we did not hear anyone criticizing their appearance. Actually, they look like sleek modern sculptures, all very attractive, especially when you realize how important they are to the economy and to the ability to move away from dependence on oil from countries whose treasures we should not be supporting.

October 7, 2009
Micki McCormick, najamcc@aol.com
I think this is an innovative idea for our energy needs. I live on the ocean and have often thought if I could only capture all this wind and turn it into energy I could save a fortune. Thank you for pursuing this concept.

October 7, 2009
Paul J Sykes, paulc17@aol.com
South Carolina could prove to be the Saudi Arabia of offshore wind. Recent studies have estimated that the wind industry could bring tens of thousands of jobs and tens of billions of dollars to this state over the next couple of decades. The US Department of Energy has estimated our state has the technical potential to double our current electricity production by tapping into our offshore wind potential, and they are also touting an initiative that would result in 20% of US energy generation coming from wind by 2030. Recognizing that offshore wind holds immense potential for South Carolina in terms of energy production and economic development is the first step towards embracing this renewable resource as a key to a secure energy future. It is time we stop sending our dollars to other states and other countries to purchase their fossil fuels, and start taking advantage of the opportunities we have here in the Palmetto State. Respectfully Submitted, Col (ret) Paul J Sykes

October 7, 2009
Ms. Barrie Bozard, janebarrie1@yahoo.com

I will not able to attend the meeting in Georgetown on October 12th. I feel very strongly for our state to move on to wind power. It is time that South Carolina will wake up and join other states and nations to help our environment and to rid ourselves the toxins that are killing our citizens. Come on, we all are suffering. Sincerely, Barrie Bozard

October 7, 2009
Ronda and Bob Greaves, greavesrc@aol.com
Recent studies have estimated that the wind industry could bring tens of thousands of jobs and tens of billions of dollars to this state over the next couple of decades. The US Department of Energy has estimated our state has the technical potential to double our current electricity production by tapping into our offshore wind potential. Recognizing that offshore wind holds immense potential for South Carolina in terms of energy production and economic development is the first step towards embracing this renewable resource as a key to a secure energy future. It is time we stop sending our dollars to other states and other countries to purchase their fossil fuels, and start taking advantage of the opportunities we have here in the Palmetto State.

October 7, 2009
Joel McKellar, joelmckellar@ls3p.com
While energy efficiency should always be the first source for fostering a sustainable energy system, I strongly support the development of wind energy systems off of the coast of South Carolina.

October 8, 2009
Paula Feldman, feldmanp@mailbox.sc.edu
I have been thrilled to learn that South Carolina has tremendous offshore wind potential. As you know studies have estimated that the wind industry could bring tens of thousands of jobs and tens of billions of dollars to this state over the next couple of decades. The US Department of Energy has estimated our state could double our current electricity production by tapping into offshore wind potential. Recognizing that offshore wind holds immense potential for South Carolina in terms of energy production and economic development is the first step towards embracing this renewable resource as a key to a secure energy future. Let's stop sending our dollars to other states and foreign countries to purchase fossil fuels, when we could take advantage of the opportunities we have right here to become more energy self-sufficient. The City of Columbia, where I live, has invested a tremendous amount in hydrogen technology. Let's try to develop wind technology, too.

October 8, 2009
David Adam Foster, fostera@cofc.edu
Hi! I just wanted to voice my support for an offshore wind industrial cluster in SC. I think this is a GREAT idea. Thanks, D. Adam Foster

October 8, 2009
Burton Callicott, chance74@hotmail.com
I strongly support the effort to utilize offshore wind for our energy needs. Not only is it "clean" energy, it could provide lots of new jobs and save us $$$ in the long run. Burton Callicott.

October 8, 2009
Doug Corkern, dcarchitect2@hargray.com
Adopt an offshore wind policy-we need it to curb our foreign oil purchases.

October 8, 2009
Ani Lees, aniLees1@hotmail.com
I am fully in favor of this form of energy!! I have seen these installations by the dozens out west and they look like a flock of angels, or a group of nuns on the go. I am originally from SC and love this state-- I love its beaches, and would be OK with the installation of these beautifully designed installations.

October 8, 2009
Gail Clark, southcoastscnps@yahoo.com
Wind power seems like a wonderful option to explore, instead of coal. I am looking forward to the opportunity to get our energy from safe, renewable resources.

October 8, 2009
William D. Anderson, Jr., 655 Clearview Drive Charleston, South Carolina 29412-4508
andersonwd@cofc.edu
This is to ask you to give your strongest support to the implementation of offshore wind farms off South Carolina. Offshore wind represents South Carolina's most promising utility-scale renewable energy resource. The US Department of Energy estimates that up to 20,000 jobs and $80 billion in revenue could result from a wind industrial cluster in South Carolina, and preliminary studies suggest that our offshore wind resource could satisfy a significant portion of our energy needs. Please investigate thoroughly the benefits that can be derived from offshore wind farms and act to see that the State soon becomes committed to wind as a significant source for the production of usable energy. Yours very truly, William D. Anderson, Jr.

October 8, 2009
Helen S. Warren, hswarren@bellsouth.net
Please work hard to get offshore wind power harnessed to provide electricity for a sustainable future. Thank you. Best regards, Helen Warren

October 8, 2009
Kelle Welch, kellegrace@msn.com
I think that off shore wind is an excellent energy idea for South Carolina. It has been proven to create energy in many US States, create jobs and be a clean source of fuel. I hope that you will also consider this to be a great solution to our energy needs. Sincerely, Kelle Welch

October 8, 2009
Joseph E. Bresnahan, jrbresnahan1928@att.net
South Carolina has study the use of wind for energy. I am a boater who cruises off shore so I should know what I am talking about. I promise not to run into anything you come up with through the study.

October 9, 2009
David Mikell, dsmikell@yahoo.com
Yes to offshore wind power in South Carolina.

October 10, 2009
Vick Crawley, vickcraw@yahoo.com
This is a tremendous opportunity for SC and for the environment. As a state we need to move forward as quickly as possible on this initiative.

October 12, 2009
Toni Reale, Coastal Program Coordinator, Southern Alliance for Clean Energy, 1259 Old Orchard Rd Charleston, SC 29412, (843) 641-0600, toni@cleanenergy.org
My name is Toni Reale and I'm the coastal program coordinator for the Southern Alliance for Clean Energy and I've prepared a few comments I would like to share with you all. My organization, Southern Alliance for Clean Energy, works to preserve, restore and protect our environment through the use of innovative technology, grassroots and decision-maker education, and dedicated policy advocacy. As both a citizen of Charleston County and a member of an organization who works to ensure that the Southeast becomes a leader on climate energy issues, I thank you for the work that this committee has done thus far, in helping South Carolina realize its renewable energy potential. Offshore wind farms have been proposed and are currently in detailed planning stages in Massachusetts and Delaware. In North and South Carolina and Georgia offshore wind farms are in various stages of planning. We are pleased that South Carolina is currently conducting a research study with Coastal Carolina University and the South Carolina Energy Office that uses weather buoys to measure the wind off our state's coast. We are glad to see this because this is a significant step towards the beginning of offshore wind development in this area. Once developed, offshore wind power will supply affordable, inexhaustible energy to our region's economy. It will also provide jobs and other sources of income, as has been the case elsewhere in the world where offshore wind energy has been developed. The assembly, staging, construction and maintenance of offshore wind farms will create a range of jobs for South Carolinians. Germany offers an example of offshore wind, how offshore wind can create a booming economy where 700 new jobs have already been created in the past three years with the introduction of offshore wind to the city of Furmerhaven, and three to five hundred more are expected. Offshore wind energy offers a hedge against the impact of rising fuel costs and can help stabilize and reduce electricity prices by displacing the need for more expensive power plants. It is anticipated that there will be a reduction in energy costs as new technology is developed and as the offshore wind industry advances in this county. GE, as we know, produces land based wind turbines in Greenville, SC, and they are currently conducting a research project on new generation of offshore wind turbines that will reduce the cost of energy delivered. The proposed projects in the Southeast and along the US coast provide the market to support new technology development that can lead to further job creation in this region. The Charleston area, where I'm from, with our active port facilities, established manufacturing and steel industry can serve as a future hub as the offshore industry emerges along the US coast. Research has found that most birds fly around offshore wind turbines rather than into them and change their migratory patterns accordingly. Offshore wind turbines are also designed with bird safety in mind with slower moving blades and a tower that is inhospitable for birds to land on. Also wind energy developments overall impact on birds is extremely low compared to other human related causes of bird deaths including buildings, communication towers, traffic and house cats. Lastly, I would like to point out the impressive potential for offshore wind energy that our region is fortunate to have. The strong consistent winds that blow along the shallow vast outer continental shelf that span the Carolinas, Georgia and Florida represent a potential 486,000 GWh of clean sustainable energy for our region. Thank you.

October 12, 2009
David Wylie, Georgetown County School District, dwylie@gh.gcsd.k12.sc.us
Good Evening. This is kind of informal. I'm from Georgetown County School District. My push is really from an education perspective. I see in students as well as adults a huge potential for education in regards to wind energy. I have parents phoning me up asking how they can be more involved in the wind project and so on. I would like to suggest that we formalize an education from high school all the way up as far as wind energy goes because no matter which way you look at it, it's part of the equation of the future. Having talked to several people tonight, I hear that there are potential grounds out there

to do that. This is happening in our backyard so to speak, so I'm really hear to secure my students' future in regards to the green jobs. You hear it all the time from the White House down, but I think we need to formalize it more, because those are the people who are going to be repairing the turbines or whatever. There needs to be more attention drawn and formalized to potential funding for students and more collaboration and I really appreciate the collaboration with Santee Cooper today, and I think we need to carry that on, but it really needs to be formalized otherwise these potential engineers of the future are going to be left a bit behind and we want to be leaders in that just like Santee Cooper is. I can't help but resist a side comment, because as a researcher on a previous slide mentioned, as far as the migration of birds goes, there have been a huge number of studies in Europe, and it really wasn't a significant factor as far as migration habits goes on birds and birds impacts in the turbines and so on. So there's a lot of research out there as far as visibility, sound and also migration habits of birds out there, that these huge turbines off Holland and so on are not really detrimental to the environments of the birds. I just wanted to make that comment. Thank you.

October 12, 2009
David Stoney, Kitchen Table Climate Study Group, dstoney@tds.net
Thank you very much. My name is David Stoney. I'm from McClellanville, SC, and I'm the director of an all volunteer grassroots group that is concerned about climate change and global warming. The name of that group is the "Kitchen Table Climate Study Group". If you would like to learn more about us, we have a website: Google "KTCSG" to pull us up. We are trying to educate and inform our friends and neighbors about the peril that South Carolina's lowcountry is in due to global warming and sea level rise. So we are delighted to see the emphasis on wind power. We are delighted that Horry County and Georgetown County has an opportunity for green jobs and a boost in their economy. Marc Tye, we are delighted to see Santee Cooper take such an active interest in this. I wanted to urge the feasibility study panel to work with all due speed. The climate crisis is accelerating. Changes at the poles are accelerating due mainly to increases in ocean temperatures, and of course the oceans get their increased heat from the increased global warming due to greenhouse gas productions. And the greenhouse gases that enter the atmosphere today will still be there, especially the CO2, in the next 100 years. What goes into the air today will have a warming effect for 100 years. And if we don't start a program for our country that will rapidly reduce greenhouse gas emissions, we will lose the South Carolina lowcountry, and without the South Carolina lowcountry we're not going to have a state and we are not going to have an economy. So it is critical that we develop alternative sources of power and that we find ways to reduce greenhouse gas emissions very substantially by 2020. So I urge the committee to work as fast as you can to see if this offshore capacity for wind indeed is feasible. And if it is, go for it. One comment about the cost comparison Marc presented: it is a little misleading to try to out cost when you don't take into account the cost of taking no action. The cost of coal will be much higher than indicated in that chart if we lose the lowcountry due to greenhouse gas emissions. You need to start taking into account the best guesses about what it will cost us if we do nothing. So remember when you look at these costs that we need to factor in the cost of doing nothing. If we lose the South Carolina lowcountry, we're going to lose everything. I don't know how you put a dollar value on that, but it is much higher than a few bucks per kWh. So I urge you to work hard, glad to see you hear. If you want some information about the Kitchen Table Climate Study Group, I have some little handouts that I brought with me. Thank you very much.

October 12, 2009
Nancy Cave, North Coast Office Director, SC Coastal Conservation League, (843) 545-0403, nancyc@scccl.org

Good evening, I am Nancy Cave, the North Coast Office Director of the Coastal Conservation League. Our North Coastal Office is here in Georgetown. I want to thank the Feasibility Study Committee for inviting us all to comment to you. I think it is very commendable that you are out talking with the public. Offshore wind represents South Carolina's largest clean energy resource, and the Coastal Conservation League supports taking the necessary steps to make wind a utility energy source in this state. In addition to providing a significant energy source, the wind industry can give South Carolina an enormous economic boost creating new sources of revenue and new jobs. The US Department of Energy estimates that the wind industry could provide the state with in the range of 80 billion dollars in revenue and 20,000 jobs. The state needs to take advantage of this opportunity. We have to do it now before others take it away from us. But we must have the necessary energy policy in place to bring offshore wind investors and developers to the state. We need to participate if not lead the national and international discussion on offshore wind to do this. And leadership must come from you, the elected officials. The Coastal Conservation League encourages this study committee to make clear, substantive recommendations to the General Assembly in the 2010 session. Recommendations that will put South Carolina to capitalize on wind energy now. I would add that we are having an energy efficiency conference on October 22nd in Florence and Senator Campbell is speaking and I would welcome you all to attend.

October 12, 2009
Bob Grove, Georgetown, rngrove323@comcast.net
Good evening my name is Bob Grove and I live in Georgetown, more specifically in Debordieu Colony. This is not a presentation for or against, I just want to present a fact and answer a question that came up repeatedly during a presentation a few months ago by one of your project staff. "Will the turbines be visible from the shore?" was the question. A little bit of plain geometry answers that question if you stand with your eye at the surface of the earth and look out, the curvature drops off and using the Pythagoras theorem if the height of the turbines or the blades is a 100 feet up it has to be 12.2 miles out to be invisible. I saw on your chart here you are talking about anywhere from 50 meters to 100 meters, which is 300 feet, so if you up on 200 feet you have to be 17 miles out. If anyone wanted to know more about that I brought some papers here that show my calculations. Thank you.

October 12, 2009
Philip Branton, Folly Beach
Hi my name is Philip Branton. I drove up from Folly Beach. Where do I begin? Number one, this is political. Do you see any black people in this room? That's problem number one. Number two is education which was pointed out earlier. Number three, Santee Cooper, this is about three decades to late. I don't know how long GE has been producing turbines in Greenville, but the very first one should have gone up off the coast of South Carolina. We had these magic carpet people coming in here from the Middle East buying our turbines the least we could show them was the sales model. I'm not being too nice. We have Sandia National Labs, we have Idaho National Labs, we have Hanford Facility and we know what's been developed. And 200 meters up? We are talking about a mile, mile and a half. We have vast marsh farmland and I don't hear one turbine complaint from the farmlands out west. The City of Myrtle Beach they should be energy self-sufficient. Alaska gets a rebate on the oil they sell to the 48 state. It seems like the City of Folly Beach with the marshland around that city that they control, could have 10, 15, 20 turbines at least. That ocean out there ought to be growing ocean hair, along just like the rows of corn that the shrimpers go up and down. It is not rocket science. Now of course, I am no Santee Cooper engineer. But you know when I see all of these high tension power lines and I see the easements that are available and I see all of these Santee Cooper power workers, and I ask them, hmm, what type of royalty are you getting off those easements in addition to the power running along those

easements? This is long overdue. Long overdue! I appreciate your time coming down here Mr. Verdin. Some of the meetings I have been at, there is not one elected official. That is unsatisfactory. I appreciate it. Mr. Hamilton, I appreciate your time. I drove an hour, just like Jim Valdono and there are no black people here. None! That is unsatisfactory, in my book. (Question from the crowd: "Did you invite any?") Well the two that I know that would have been here tonight, are actually over at Maple's Inlet serving us right now. (Comment from the crowd: "Well I read it in the paper.") I did to, today. I made that comment in the Post and Courier. Thanks for telling us – it sure would have been nice to make appointments for babysitters. We have a job to do people. And this is political. And I appreciate everyone coming out here, because I am fed up.

October 12, 2009
John Geiger, jgeiger@sc.rr.com
I live in Georgetown so therefore have a vested interest in the "windmills" that might be built off our coast. I am very, very much pro this happening. The first reason is that (1) wind does not quit, (2)does not cost anything for it to blow, (3)we have an unused steel mill that could be converted into a "windmill factory" thus creating new jobs in Georgetown, (4) once they are built(way in the future) our power bill could be reduced. (5) We have a port that could be used for shipping the product to and from the construction site and a railroad to bring the equipment to Georgetown and (6) it is clean, green energy. The low country and the grand strand need to push the Governor and the legislator to fund this project. Other states are getting ahead of us and we will again lose out if we drag our feet. The farmers in the West have long known that wind power works. They have been using it in a small scale to power water pumps on their property. Thank you very much. If you wish to use this letter in any way, please feel free. John Geiger

October 12, 2009
Ann Wilcocks, dead@sc.rr.com
I will be unable to attend the meeting today in Georgetown organized by the Wind Energy Production Farms Feasibility Study Committee to discuss the possibility of a wind farm off our coast but want to voice my support. I think it is a wonderful idea and we really need to do all we can to explore and use alternative energy sources. -Ann Wilcocks

October 12, 2009
Christina, dyepot@verizon.net
Along the Grand Strand or any part of SC!!! - Christina (who plans on moving back to Horry County ASAP), Handpainted Fibers & Yarn, www.dyepot.com

October 12, 2009
Dr. Virginia G. Brown, drbrown@gcvetclinic.com
I think that wind turbines are an excellent additional energy resource and should be considered strongly. The turbines need to be off the coast far enough not to detract from the beauty of the coast but we fortunately have a large coastal shelf available. Dr Virginia G Brown, Goose Creek Veterinary Clinic, LLC

October 12, 2009
Kent Hodges, Pavilack Mortgage and Finance, Lighthouse Capital Group, LLC, 843-839-1046, 843-839-5809 Fax, kenthodges@msn.com
I was reading the article regarding the wind farm that is possibly being built off the coast of SC and wanted to inform you that our firm has closed a wind farm in Milford, UT as well as funding a wind turbine patent which will take the place of the standard prop type version of the turbine. The vertical

spine turbine has been proven to be safer for the environment as well as safer for birds and most wind farms are going to this type of turbine for those reasons. My question is can we help facilitate the funding for the wind farm or provide you with the turbines for the wind farm once you have completed your feasibility study? We have extensive experience in this field and I can provide you proof of what we have been involved in so that you can be comfortable with our firm. Please let me know as soon as you can. This is as you know the future of our energy production. - Kent Hodges

October 12, 2009
Paul Hucks, Horry County Schools Energy Management, 2205 Hwy 501 West, PO Box 260005, Conway, SC 29526, 843-488-6967, Cell 843-241-4667, PHucks001@horrycountyschools.net
I think this is an excellent project. Those opposed to a renewable energy source should be educated to know the difference in renewable and non renewable energy sources. Fossil fuels will be depleted soon enough at the rate they are currently being used. Our children's children will not be able to sustain energy sources or afford them like our generation has with out harnessing wind, solar or some other renewable form of energy. We started hearing and learning about wind and solar sources when I began energy management work in 1984. After 25 years in the energy management field I say "Full steam ahead on this excellent project." - Paul Hucks

October 12, 2009
Peter Zalka, pcz9@yahoo.com
I strongly support off shore wind farms in SC. Our coast from Georgetown to Charleston is uniquely situated to support this clean energy technology. SC's coastal communities such as Georgetown and Charleston have the industrial base and transportation infrastructure to facilitate this effort. Interestingly several SC companies are already important players in wind turbine production. SC has companies that make wind turbines, a coastline that is conducive to wind farm placement, transportation infrastructure and many authoritative reports that indicate SC will gain economically from pursuing wind technology. Yes let's move forward in an expeditious manner so SC can become a national leader in wind technology and wind energy production.

October 21, 2009
Ann Shahid, Important Bird Areas Coordinator, Climate and Energy Outreach Coordinator, Audubon South Carolina, 336 Sanctuary Rd., Harleyville, SC 29448, 843-462-2150, ashahid@audubon.org
Audubon South Carolina wholeheartedly supports the feasibility study of wind farms off the SC Coast. We believe this to be one of the best ways to replace the use of fossil fuels. We would like to hear from other states about bird mortality and the optimum way to minimize deaths. We know that there will be some casualties, but unchecked global warming will in the long run cause many more casualties. If you have any questions, please contact me.

October 30, 2009
Waccamaw High School Students submitted by Richard Bankert, Science Teacher, Waccamaw High School, 2412 Kings River Rd., Pawleys Island, SC 29585, (843) 237-9899, RBANKERT@wh.gcsd.k12.sc.us

K.S. I believe that this is a very good idea. It creates new jobs and will help the environment. It is expensive to replace if it gets destroyed which is a bad thing because we live in a Hurricane area. It is also heavy and there are not very many cranes to lift the windmill. So physically it is a tough job to maintain these windmills. I think it is a good idea, but maybe we should wait until it is more affordable for our country. I know that if some people can't afford to buy extra items for

their family they are not going to be happy paying for these windmills.
J.M. My opinion on using wind farms to generate electricity is that we should use them. Although it will cost $1.12 billion, it could save a lot more than that in the long run. It will produce a lot of needed jobs. It will give 3042 people local jobs and 458 local long-term jobs. Another good thing about these wind farms is that they will reduce electric utility natural gas consumption by 50%. To keep hurricanes from destroying wind farms they make the blades shorter, and the foundation stronger.
A.D. – Grade 12 - Wind farms will greatly benefit our community. Economically, later benefits of the farms will greatly outweigh the initial costs. They will provide jobs, bring in revenue, and with a cleaner environment we will be able to save money cleaning up pollution. With decreased use of oil and natural gas, these farms will also allow for a cleaner environment and preservation of natural resources. Therefore, the wind farms are a good idea for our community.
B .W. - I would like to express my opinion on wind farms. The expense of this could be $1.12 billion. The time frame to build this could be 20 years from now. It will give 3042 people local jobs, and 458 local long-term jobs. It also reduces electric utility natural gas consumption by 50%. In order to make it hurricane proof you would have to make the blades shorter. I know that if some people can't afford to buy extra items for their family they are not going to be happy paying for these windmills. I think it is a good idea, but maybe we should wait until it is more affordable for our country.
To who may be concerned, I think that having offshore wind turbine(s) is an excellent idea. This idea has great potential for those in South Carolina. It has the ability to give "birth" to a new generation of workers by providing about 1600 jobs, and it will boost the economy. If it only takes about one to two years to build but it lasts about twenty years then that right there is a good deal if you ask me. If we do end up building these wind turbine(s) we have to make them hurricane proof and for the state of South Carolina that is a big deal because we get so many hurricanes each year. I've learned that with special fans and a particular foundation we can make them hurricane proof, so we have the technology all we have to do now is to weather or not to build them. Sincerely J. R., senior at Waccamaw High School
D.P., 12th grade student, I believe that windmills would be a good idea. Building windmills would approximately leave about 15,517 new jobs available. They would reduce the coal in take by approximately 18% and would reduce the electric energy by 50%. It would really help the environment but at the same time it could harm us because it costs so much money to build or even have a windmill farm. But we have to be careful and make sure that one of the turbines does not get damaged because it would cost millions of dollars to repair it. South Carolina will also benefit with 7.5 billion dollars from the operation and the construction of the windmills. So in a way we could benefit and in other ways it could harm our state.

J.G., Waccamaw High School, Grade 12 - I believe that wind farms are a good idea and they will make a huge impact on our lives in the future. Our total economic benefit in the next twenty years after the construction would be 1.2 billion. There would be 3,042 new local jobs during the construction. Wind farms would reduce electric utility coal consumption by 18%.
M.S., Environmental Science - South Carolina has and idea to construct a windmill. It will benefit us and it will hurt us; in my opinion. The windmill construction can provide jobs for people and it can also save money. However, the cost of the construction is a big disadvantage on the economy. I believe that we could save money by waiting a couple years to build one. The windmill will benefit us later when our economy is fixed and back on track.
Wind Farms, A. D., 12th grade, Waccamaw High School - Wind farms are a very effective form of energy. However, the cost and maintenance of a wind turbine may not be worth the initial cost of building one. South Carolina has some ideal places to set up a wind farm, either off shore or inland. The main concern is the hurricane, but there are blade designees to help fix this. The blades will not be fixed so during storms the blades can be folded down, but still collect energy. I believe the state should do more research on the matter before making the state pay for it. In think it would be worth the try of building a few to see if we even get enough wind to power the state.
J.J., 12th Grade - The wind turbine energy is a great idea. The wind turbine energy project is good for the social. The building of the wind turbine will add 3,000 more jobs in the community. One of the main problems that I have with the wind turbine is the cost and repair. If a major hurricane damage a wind turbine multiple times. The cost of repair a wind turbine will cost million of dollars. My opinion on the wind turbine being build is a yes and no response. The wind turbine help get more jobs and it good for the environmental. The wind turbine saves energy dollars for South Carolina.
D.A., Environmental Sciences, 13 October 2009, Carpe Ventem - Based on the research that I've done, I think that the building of wind farms in Georgetown County would be beneficial in the long run. According to my research, if twenty percent of the state's energy is produced by wind farms, the amount of natural gas and coal used to produce energy would decrease. A decrease in the use of natural gases and coal is good because they are nonrenewable resources that can't be replaced. Another reason these wind farms would be value to our future is because they would create more jobs in this area. We all know that jobs are becoming a scarcity in our society, so this would be a major step forward. Based on the twenty percent scenario, a wind farm could create up to 15,517 new jobs during the constructional phase and up to 3,222 local long term jobs. So all in all, these wind farms could benefit the Georgetown County by reducing the use of natural gas and coal and creating new jobs that could benefit many people in this county and state. So Carpe Ventem.
E .B. -12th Grade - I believe that the wind turbines in our country can benefit us greatly within the next five to ten year. If we look at this industries long term goal of making this country

energy efficient, wind power, and hydroelectric power which will allow us to make better financial changes within our environments and communities. I no for a fact that the projects of installing the wind turbines are costly projects being somewhere close to $1.73 million for the constructing of the turbine not including the cost of the placement of them to the coast near the oceans and sea where the turbines can receive different miles of wind so they can measure the winds speed to see what is the most likely place to set the turbines up to keep regular speeds to produce enough energy for our country. Also the production of the turbines will create new energy efficient jobs for our fellow country man who needs them.

J. J .G. - I think this would be a good idea. It would bring more jobs to the area and keep people that want jobs busy. If we were to get windmills it would be kind of bad in a way because we stay in an area where there are lots of hurricanes during the season. Keeping up with these windmills would be a hassle and if it breaks it would be lots of money to get it fix. However we would be the ones who have to pay for it. There are people that could barely take care of their family to be giving money away to get the windmills fix. I think we should wait until the country gets enough money to build one and fix it if it breaks.

L .S., WIND FARM - The reason we should have wind farm because of many reasons like this.

- Because it is created when multiple wind turbines are placed in the same location for the purpose of generating large amounts of electric power.
- Due to the rising energy prices there are a lot of wind farms in many countries.
- And because it creates new jobs, also good environment.
- Wind Farm services will give u the weather intelligence you need to make smarter decisions.

I .H. - Wind farms would greatly benefit our community. Economically, later benefits of the farms will greatly outweigh the initial costs. The farms will help provide jobs for people, bring in revenue. With decreased use of oil and natural gas, these farms will also allow for a cleaner environment and preservation of natural resources. Therefore, the wind farms are a good idea for our community.

Appendix B: Meeting Minutes

Wind Energy Production Farms Feasibility Study Committee Meeting #1
Minutes
April 20, 2009, 1:00 – 4:00 PM
209 Gressette Office Building
Columbia, SC 29201

I. Introductions

John Clark, Director of SC Energy Office
Hamilton Davis, Coastal Conservation League
John Boyd, Haynesworth, Sinkler, Boyd, P.A.
Roger Schonewald, GE Energy in Greenville, SC
Robert Leitner, Director of SC Institute for Energy Studies, Clemson University
Nelson Hardwick, District 106, South Carolina House of Representatives
Paul Campbell, South Carolina Senate, Berkeley County
Earl Hunter, Commissioner of SCDHEC
Mac Toole, SC House of Representatives, Lexington County
Erika Myers, SC Energy Office
Amy Lawrence, SC Energy Office
Catherine Vanden Houten, SC Energy Office

II. Legislative Intent of the Committee

John Clark:

Committee should look at how suitable SC is for wind energy production farms on land and offshore.

Grant Awarded to SCEO for $500,000 to help SC:

1. Study how coastal energy could be transmitted to users from offshore onto land and into the grid
2. Study wind, wave, and tidal energy that would be used for a pilot offshore wind project in state waters (within three miles of shore)
3. Establish a coastal clean energy taskforce to study the regulatory barriers for offshore energy generation.

III. Review and Discussion of Draft Outline for the Report

Erika Myers discussed her role as the staff representative of the committee and her responsibility to bring together the committee report. An outline of the report was distributed and the committee was asked to provide comments or suggestions.

IV. Presentations:

Wind Industry Overview – Mr. Roger Schonewald, GE

A few thoughts relative to the wind industry: the wind industry has grown substantially, and GE is largest supplier of wind turbines in the US. There is substantial wind in the central part of the US and parts of California. There is not as much wind in SC until you get to the shore. To get to 20% wind energy by 2030 (1% currently) it will take a committed effort. This would mean using wind energy in a meaningful way and jobs. Wind turbines are more expensive offshore than onshore, and it will take more wind and greater capacity factor to make it economically attractive.

Largest wind turbines (wingspan of over 100 m) are larger than wingspan of a 747 at 65 m; it takes a special effort to get wind turbines in place. There is a tall pole, and quite a bit of weight on top of the pole, like mounting an M1 tank on top of a pole and making sure it is structurally sound. It works by capturing the wind energy as the blades rotate which turn the rotor to produce electricity. GE is in Greenville with about 3,000 employees. There are many opportunities to create more jobs with the growing wind business. Offshore there is need for transportation of the equipment and need for specialized manufacturers. It requires infrastructure, equipment and expertise.

(Inaudible question) – Mr. Schonewald answers: wind turbines will end up being larger offshore to be the most economically efficient. In US wind turbines are generally 1.5 MW, but are more powerful in Europe.

(Inaudible question) – Europe has been pushed into offshore wind turbines more than the US because of limited land.

(Multiple inaudible questions and comments) –Wind turbines have been placed offshore to see how they will perform and to better understand their potential.

Overview of Wind Energy Studies in South Carolina – Ms. Elizabeth Kress and Mr. Eric Boessneck, Santee Cooper

Elizabeth Kress—Work that has been done so far includes a wind mapping study to produce wind maps that everybody uses shows there is not utility-scale land-based wind in SC. SE Regional Offshore Wind Symposium with GA and NC went very well and demonstrated interest to federal government. We got hard data to correlate with wind maps, at the height of the wind turbine. We then developed Sodar for offshore use, and the Wind for Schools program. We have done an extensive study of offshore wind potential. We are farther along than most states. Physical oceanography shows that SC has a shallow coast going very far out. Environmental impacts appear to be acceptable, though bird migration, whale breeding grounds, and turtles may be affected and need to be studied. Navigation fairways, aviation areas, sand borrow areas, wrecks and obstacles out in the ocean, reefs, special fish management zones, dredge dump sites, fish habitat areas, shellfish harvest areas and habitats of certain species are places you can't put turbines. There are some feasible zones for wind turbines. The master's thesis of Jennifer Banks at Clemson University showed how the regulatory process would need to be coordinated.

Further work needed: We need to study how to integrate power into the grid. In order to design foundation for turbines, you need to understand environmental factors such as waves, currents and tides—this data will be

useful for other forms of renewable offshore energy. Transmission studies are being done by Clemson. Buoy study of the Palmetto Winds Research Project is to understand how buoys are laid out. Key issues for wind power are policy uncertainty, citing, transmission and operational impacts. We still need to get more information about permit application for anemometer, port refurbishment, what will it take to support offshore wind, public outreach and education, workforce development, economic development, and everything related to the environmental impact study. Accounting for nonmonetary value is also difficult until carbon credit value is determined.

Eric Boessneck—Offshore winds in SC are Class 5 meaning they are sufficient for wind turbines. Fifty meter towers have been deployed at various sites along the coast to obtain data and analyze it. Georgetown has great access to coastal winds 5.7 or 5.8 m/s, but that is not strong enough to support large-scale wind turbine development. Winds are not high enough along the coast for large-scale wind turbines. 8 to 8.5 m/s are necessary for large-scale wind turbines. Offshore winds are much stronger than winds even half a mile inland and are at least at speeds of 8 m/s. Buoys are being installed within the next few weeks at different distances perpendicular to the coast to get a recommendation of where to put offshore platforms. These will take readings for a full year. Sodar technology is useful but has not been validated offshore—it emits a chirp in the atmosphere which bounces off air particles and reads wind speed and direction. Lidar uses laser and is more accurate. There is not much of a resource on the coast. The real resource is offshore.

Refining South Carolina Coastal Ocean Wind Resource Potential: Direct measurements and model groundtruthing – Dr. Paul Gayes, Burroughs and Chapin Center for Marine and Wetland Studies, Coastal Carolina University

The Grand Strand area has shallow waters and high demand for electricity, making it a good location for offshore wind turbines. Just to the North of the Winyah Bay entrance is where CCU is trying to stay because there is a great deal of information on substrate and the seafloor. The main issue is to determine exactly how offshore you need to go to find the best location for a wind turbine. In order to get the most accurate measurements, there is a need to measure wind speeds at hub height. The key data set for industry to make their decision is information at hub height. Expect to have a good idea of what distance out to sea is best after gathering six months of data.

(10 Minute Recess)

Wind Studies using Sodar Technology in South Carolina – Dr. Thomas French, Savannah River National Laboratory

Wind is non-dispatchable and weather-dependent. The utilities that use wind have to predict the weather. The SRNL project is to accelerate the acceptance of Sodar as bankable and to accept Sodar numbers instead of needing a wind tower and anemometer. Ultimately want to do wind farm design, project financing, and be able to forecast the wind with remote stations. Velocity of wind speed cubed directly correlates to power. Ground cover and topography affect power. Wind speed at the tip of the blade at the top is different than wind speed at the tip of the blade at the bottom. Power generation begins at 4 m/s. Above 200 ft. is FAA space which increases the cost of towers. Sodar is a vertical beam going up that gets reflected and gets all sorts of data about wind; it has a solar panel and a satellite phone. Sodar is good for up to 200 m and it can slice the wind column. Sodar is going to be tested against anemometers to make sure it is accurate. Distribution of wind speed must be measured at wind farm sites, and Sodar is appealing because it is much easier to move around than towers.

Offshore Wind Regulatory Task Force – Ms. Catherine Vanden Houten, SC Energy Office

Regulatory Task Force is intended to overcome barriers, and to make sure our goals are grounded in reality and the actual needs of the state. Goals of the grant received are to develop a 80MW offshore wind pilot project, and initial research of wave and tidal energy applications. The initial meeting determined that the task force would be comprised of the regulatory working group, the scientific and technical advisory group and possibly a public outreach working group (Members of the task group are presented). The SCEO would like to address controversy and objections from the public. The first meeting of the task force will be in May. The final report is tentatively in 2011 and the SCEO is in the early stages of this effort.

V. Selection of Committee Chair

John Boyd nominated Senator Paul Campbell to be the committee Chair. Nelson Hardwick seconded and made a motion to close nominations. All in favor.

VI. Schedule Future Meetings

The schedule and timeline for the committee are as follows:
July 13, 2009 - focus on economic development opportunities.
September 21, 2009 – focus on environmental impacts
October 12, 2009 – Public comment period in Georgetown
December 7, 2009 – Synopsis of hearings and focus on final report
January 1, 2009 – deadline to submit final report to the SC General Assembly

VII. Other Discussion Items

We need to make sure we don't negatively impact tourism in the Grand Strand.
(Inaudible questions).

Will distribute and post presentations and minutes of the meeting online and in July a committee member requested the next meeting include discussions about wind farms projects in other parts of the country.

VIII. Adjourn

Minutes Approved Unanimously by the Committee on Monday, July 13th

Wind Energy Production Farms Feasibility Study Committee Meeting #2
Final Minutes
July 13, 2009
1:00 – 4:00 PM
209 Gressette Office Building
Columbia, SC 29201

I. Introductions

Hamilton Davis, Coastal Conservation League
John Boyd, Haynesworth, Sinkler, Boyd, P.A.
Roger Schonewald, GE Energy in Greenville, SC
Rob Leitner, Director of SC Institute for Energy Studies, Clemson University
Nelson Hardwick, District 106, South Carolina House of Representatives
Paul Campbell, South Carolina Senate, Berkeley County
Earl Hunter, Commissioner of SCDHEC
Mac Toole, SC House of Representatives, Lexington County
Erika Myers, SC Energy Office

II. Review and Discussion of Draft Report

Myers requested the committee review the draft report and submit comments to her after the meeting.

Question from Mac Toole: We're going to have 3 more meetings and then we will put together a proposal?
Answer from Erika Myers: Yes, January 1st, 2010 is the deadline to prepare the report to submit to the S.C. General Assembly, and at our last meeting in December we will be looking at the final draft based on the findings of this committee. The first draft is very rough and will be updated with information from today in the next few weeks.

Question from Roger Schonewald: Is this Chapter 1? Did we get an outline of what the whole report will entail?
Answer from Erika Myers: Yes

III. Presentations:

Wind Powering America – Mr. Larry Flowers and Mr. Sandy Butterfield, National Renewable Energy Laboratory (NREL)

Flowers gave a PowerPoint presentation that focused on the status of onshore wind power and reviewed the 20% report DOE issued last year. Flowers showed pictures of an array of different wind turbine designs. Over the last ten years, more than 25 states have installed a significant amount of wind turbines. Nine states have over 100 MW installed. Wind works well in many places and one can expect to have 30 states with significant wind power in the next few years. The USA is the world leader for wind energy as we had over 8,000 MW installed in 2008, a $16 billion dollar investment in one year.

Question from Senator Campbell: How do construction costs compare with coal and nuclear?

Answer from Mr. Flowers: New wind is 6-8 cents/kWh which is comparable to coal and $90-120/MWh. Wind is very well positioned from an economic standpoint.

Natural gas has half of the pollutants and carbon of coal, so natural gas usage increased the most significantly during this decade, but wind power production has increased rapidly over the last two years.

Question from Roger Schonewald: Were the costs mentioned previously for onshore wind only?
Answer: Yes, those numbers were only for onshore. Costs are about 50-100% more for offshore wind.

Question from Mac Toole: Is the cost you're talking about now strictly generation cost and not transmission?
Answer: Yes, but transmission is only 10% of total costs.

Question (unidentified): Was 42% of new generation capacity additions really wind power in 2008 in the USA?
Answer: Yes. We put in over 8,000 MW of wind power in the U.S. in 2008.

Flowers highlighted drivers for growth in wind power including a dramatic increase in manufacturing for wind turbines in the past few years. Flowers also highlighted the economic impacts of installing 1,000 MW of onshore wind in South Carolina including $1,000,000 to local economies and 460 long-term jobs. He explained onshore and offshore levelized costs. For 20% wind energy by 2030, 46 states would potentially have substantial wind development and there would be many positive results. Flowers showed the mix of energy generation in 2030 based on the Energy Information Administration and the 20% wind scenario.

Question from Senator Campbell: Does the 20% wind scenario assume 100% loading onto wind, or 30 or 40%?
Answer: No, we look at the capacity factor and account for it.

If the USA were to install enough wind to meeting 20% of its energy needs, would translate to about $1.4 trillion and 3 million+ jobs in operations. In the southeast, there would be $74 billion for local economies and 590,000 operational jobs to support that development. In South Carolina there would be approximately 3,126 MW installed offshore and 327 MW onshore meaning $7.5 billion infused into South Carolina and 3,000 operations jobs.

Question from Senator Campbell: On the economic model, you're showing payment to landowners and local property tax. Would that apply offshore?
Answer: The model is for onshore wind, and there are different numbers for offshore wind.

When you look at the nation, over 500,000 jobs would be supported by the industry in 2030 with the 20% wind scenario. The scenario also reduces water consumption by 4 trillion gallons by 2030 with a 17% reduction in electric sector water consumption. Total savings would be about $205 billion plus water savings. Our progress toward 20% wind in 2030 is ahead of the curve.

Sandy Butterfield—Mr. Butterfield gave a PowerPoint presentation that focused on offshore issues and applications. He began by elaborating on the graphic of the New England coast and explained that the red zones are category 6 winds and that the blue zones are even better for wind turbines. The red zones off South Carolina's coast are not quite as close to shore.

Question from Senator Campbell: How far off the coast have you seen wind farms done? Ten miles, twenty miles, thirty miles?
Answer: It depends on the water depth. That is the cost factor. Underwater cables are actually not that expensive.

Butterfield talked about the Horns Rev site off the coast of Denmark, which has many turbines that are running on a capacity factor of greater than 50%. Officials are counting on offshore to be the dominant wind source in Europe. Forty gigawatts of offshore wind power are expected by 2015 across the globe. Approximately 30 offshore wind projects have been announced in North America. Butterfield summarized offshore wind technology and the future of offshore wind installations, which may include turbines at depths of 90 feet off the coast of South Carolina. Helicopters or boats are used to service offshore turbines. Monopile foundations are the most common, but gravity foundations can be used in shallow enough water. Butterfield outlined different turbine manufacturers, turbine foundations and criteria for commercial projects. No offshore wind turbines have been installed yet in the USA, but there are many projects underway. This is all proof-of-concept stage technology. Butterfield outlined challenges for offshore wind technology including weight of turbines and quality and functionality of foundations. There needs to be some research before current projects are commercially viable.

Question from Senator Campbell: Roger Schonewald, are you working on anything like that?
Answer: GE continues to look at the market, and it will be a business decision.

Question from Senator Campbell: What depths do you mean when you talk about shallow water?
Answer: Monopiles up to 20 meters.

Question from Senator Campbell: On the construction cost per megawatt, how would you gauge per megawatt wind offshore versus nuclear or coal onshore? *Answer:* Somewhere between 50 and 100 % more.

Question from Earl Hunter: What are maintenance issues for offshore versus onshore? What is the viability of these systems long-term?
Answer: Onshore machines are fairly reliable. Issues encountered have not been design flaws. People are looking at how to do remote diagnostics for offshore. This is all in the formative stage. I don't have a good number for actual maintenance costs; it is much more variable.

New Jersey Case Study: Offshore Wind Energy Development – Ms. Rhonda Jackson, Fishermen's Energy
Ms. Jackson's PowerPoint presentation started with a brief background of Fishermen's Energy: a community-based offshore wind developer that allows the fishing industry to invest and participate in offshore wind industry off the waters of New Jersey. The fishing industry has historically opposed offshore wind. Ms. Jackson then explained the mission of the organization. Fishermen work in the ocean and are familiar with the challenges presented by working there. Ms. Jackson explained why offshore wind and the fishermen's energy paradigm. She elaborated on the experience and knowledge of the organization. Ms. Jackson listed the companies, investors, founders and management, and the development team of Fishermen's Energy. She then explained the NJ Governor's Initiative Energy Master Plan Goals: 1,000 MW by 2012 and 3,000 MW by 2020. Ms. Jackson gave a brief overview of the $12 million Anemometer Rebate Program.

Question from Senator Campbell: Is Fishermen's doing the whole 1,000 MW or 350 MW?
Answer: 350 MW

Ms. Jackson mentioned the Offshore Wind Renewable Credit Program, which is designed to provide revenue certainty of offshore wind projects. She then talked a little about the planned location of the anemometer tower, turbine array and an inshore project, and went over key dates and milestones for those projects. Incredible positive public support has been garnered for the projects of Fishermen's Energy. Ms. Jackson showed a photo-shopped version of what the eight or nine turbines will look like from shore. Fishermen's Energy is forecasting 100 long-term operations jobs for the Met Town Wind Farm. Ms. Jackson concluded her presentation by talking about turbine size and manufacturing opportunities.

Question from Roger Schonewald: What makes this project economically attractive?
Answer: The state involvement.

Question from Roger Schonewald: So basically the state buys the electricity from you and sells it at wholesale whether that's higher or lower than the actual cost?
Answer: Yes. Exactly.

Britain's Offshore Wind Energy Industry and Meeting Renewable Energy Requirements – Jan Matthiesen, British Wind Energy Association
Presentation Pre-Recorded – distributed to the committee and posted online

(10 Minute Recess)

South Carolina Opportunities for Wind – Mr. Ed McCallum, McCallum Sweeney Consulting

Mr. McCallum's PowerPoint presentation included an introduction to McCallum Sweeney Consulting, an overview of the wind industry, South Carolina's place for economic development, and challenges/opportunities involved. He began by describing MCS's history and services, values, clients and project experience. In terms of the wind industry, a short time ago, Germany was number one in wind energy, and now the USA is number one with the greatest installed wind energy capacity in the world. There has been 20-30% growth every year. Wind energy makes economic sense now. Mr. McCallum showed pictures of the basic components of wind turbines. They are all very large, making it challenging to transport them. In terms of manufacturing, gearboxes are now the bottleneck in the major component supply chain. There will be at least 22,000 jobs created in manufacturing in the 20% wind by 2030 scenario for the USA. The transportation infrastructure is critical to transport large parts that are getting bigger, and an OEM and supplier scenario exists with a lot of companies in the space for awhile. Is South Carolina a major player in wind? Yes and no. There is not much wind onshore, but there is opportunity for wind energy offshore. Production tax credits greatly affect the installation of wind turbines. Freight and labor is the needle mover. Transportation accounts for about $1,000,000 per unit. Training is also important. Most labor needed is unskilled or semi-skilled. The gas turbine business presence in South Carolina is probably why we have an offshore opportunity. Access to the Port of Charleston is imperative. The economy slowing down has been a godsend because it will allow South Carolina to catch up in the wind business.

Comment from Senator Campbell: We need to be looking at both installation and job creation in South Carolina.

Comment: We appreciate the presentation, and in the long-term we are competing with Georgia and North Carolina and others, and it is great to have a company like yours helping us out.
Response: Thank you.

Comment from Roger Schonewald: Thank you for your comments Ed. GE in Greenville performs manufacturing of gas turbines and wind turbines. I can go back to GE and see what needs GE foresees for the State of South Carolina to support local growth of the wind industry. The transportation infrastructure is very critical for blades.

Local Perspsectives:
Charleston – Mr. James Meadors, City of Charleston Green Committee

Mr. Meadors began by thanking the committee. His presentation is part of a PowerPoint put together for the mayor of Charleston. The case for SC to become a wind power industrial hub is compelling and urgent. The need combined with the opportunities we have at this moment creates a critical mass for success in the areas of jobs, stewardship

and economic revitalization. Important factors in developing an offshore wind farm include wind power capacity, shallow waters and proximity to the port, and we have an existing rail & interstate system to transport components. Wind power becomes practical at Class 4 wind power density – we have Class 5 & 6 indicated by violet and red in the key below. South Carolina could generate 210% of its energy needs from offshore wind. In terms of jobs, according to the US Department of Energy, manufacturing wind turbines and their components in South Carolina could result in 10,000 to 20,000 new manufacturing jobs. We have an existing manufacturing base. There is an existing pro-forma for a community college program for training technicians. Key industry players such as GE, Fluor, Nucor Steel, and others are already established in SC. South Carolina has existing large-scale shipbuilding facilities and a low-cost manufacturing environment. In terms of stewardship, wind power is clean, renewable and does not create the disposal problems associated with nuclear power. Dependence on foreign energy sources makes the USA more vulnerable. An estimated $1.5 billion per day leaves the USA from oil imports. Nearly 78% of the nation's electrical demand is consumed by 28 coastal states. In addition to the energy it generates, the potential reduction in greenhouse gases from the reduced transportation costs is significant. A multi-year Danish study on the impact of offshore wind farms on the environment shows minimal impact and many benefits. In terms of economic revitalization, wind power is the fastest growing renewable energy market in the world. The trend toward plug-in-electric vehicles will require increased demand for electricity. Economic impact on manufacturing, construction, operations and maintenance, and rural economic development will help our state. The technology has been proven. An offshore wind industrial cluster could potentially capture locally up to 50% of the costs associated with building a wind farm. Taking action now will prevent the need for companies like GE, Fluor and others to relocate to areas more invested in the technology. Vestas, the world leader in turbine manufacturing, established their industrial hub to service land-based wind farm development in Denver due to its rail infrastructure, access to Midwest markets, and manufacturing base. Meadors encouraged the state to take aggressive action, especially now that the climate change debate is no longer an issue. Mayor Riley understands the challenges that come with this mission and is committed to meeting it head on.

Onshore Wind Energy Along the Grand Strand:
North Myrtle Beach – Mr. Monroe Baldwin, City of North Myrtle Beach
Mr. Baldwin began by introducing himself and talking a little about the Myrtle Beach Economic Development Council, whose primary objective is to seek diversification and expansion to our coastal region, provide economic stability and an increased quality of life. Mr. Baldwin introduced Doug Chastain and Scott Wolfry, an intern at CCU, both of who have been putting up anemometers in N. Myrtle Beach.

Mr. Baldwin informed the committee about N. Myrtle Beach's efforts to study the wind energy potential on rooftops along the ocean front. The Grand Strand has hundreds of ocean front towers, many 200 feet tall. Harnessing the wind brings two levels of economic opportunity: Micro – benefits to *individual* building owners, and Macro – benefits to the *city*, region and state. Micro level of opportunity: Simply provide free power to offset the house account of a condo building. Effects include reducing the

expense to the condo investor, shoring up the value of the asset, and protecting the property tax valuations for the county and city. Additionally, vacationers get excited about wind turbines. Macro level of opportunity: Provide a viable market for the vertical axis turbine industry and a key component to a future smart grid system. How do we maximize the economic impact for the state of South Carolina? Build a wind industry commons: Build a collective area for the benefit of the industry to supply research and development and innovation in engineering. Also, provide structure for the industry to supply the product for local installation and export. Wind Energy Incubator Program: The North Myrtle Beach Chamber of Commerce in partnership with the City of North Myrtle Beach stands ready to facilitate this program. Bring vertical axis turbine companies to innovate for an oceanfront application. Bring upstart businesses to learn installation and maintenance. There is an opportunity for new areas in architecture, electrical engineering, and structural engineering. What's missing is that there is no local level industry to install and maintain turbines. Where are we now? We are conducting tests to determine if there is enough wind on rooftops. We have equipment and grant money to get answers but have none yet. We are establishing a wind index (Apache pier) that allows shorter survey periods and easy comparative analysis between buildings, and offers an academic frame for a business perspective. Concepts for the future: We are constantly asking, "Is there enough wind to feasibly install the wind turbines?" But what if the wind can be manipulated to our advantage? Any increase in wind speed brings exponential returns:

Power in the area swept by the wind turbine rotor: $P = 0.5 \times \rho \times A \times V^3$
P = power in watts (746 watts = 1 hp) (1,000 watts = 1 kilowatt)
ρ = air density (about 1.225 kg/m^3 at sea level, less higher up)
A = rotor swept area, exposed to the wind (m^2)
V = wind speed in meters/sec (20 mph = 9 m/s) (mph/2.24 = m/s)

Mr. Monroe showed a picture of a building that formed a wind funnel, an example of unintended consequences. Part of the new industry commons is a new future in architecture and structural engineering along the ocean front, and it is exportable! The City of North Myrtle Beach, in conjunction with its partners, fully endorses and stands ready to support this Onshore Wind Energy project. Furthermore, North Myrtle Beach seeks additional support and funding to become a "Demonstration City for the Advancement of Wind Energy Production." North Myrtle Beach Chamber of Commerce is on record in the support of seeking alternative energy solutions, working cooperatively with our local, state, and federal governments, and supporting the research being conducted by Coastal Carolina University in the development of wind and tidal energy sources. Contact information for the North Myrtle Beach Chamber of Commerce can be found on Mr. Baldwin's PowerPoint.

Question from Senator Campbell: Offshore, what kind of impact would wind turbines have on commercial people on the beach?
Answer: South Carolina is different than other states. SC will rally around an economic opportunity like this.

Question from Senator Campbell: What is the generation capacity of the smaller units? How many would it take to power a building?
Answer: Those are probably about 5 kW for each turbine. An array of turbines could not completely power one of these buildings, but could put a dent in the power needed.

V. Other Discussion Items

- Approval of the minutes – approved.
- The presentation that was skipped will be e-mailed out to committee members and can be reviewed outside of the meeting.

VI. Next Meeting

September 21st, 2009, 1pm-4pm in 209 Gressette Building, Columbia.

VIII. Adjourn (4:10pm)

Wind Energy Production Farms Feasibility Study Committee Meeting #3
Minutes
September 21, 2009
1:00 – 4:00 PM
209 Gressette Office Building
Columbia, SC 29201

I. Introductions

Committee Members in Attendance:

Senator Paul Campbell: Chair
Senator Daniel Verdin
Representative Nelson Hardwick
Representative Mac Toole
Hamilton Davis: Coastal Conservation League
John Boyd: Haynsworth, Sinkler, and Boyd Law Firm
Roger Schonewald: GE Energy
Robert Leitner: SC Institute of Energy Studies
Earl Hunter: Commissioner, SCDHEC

II. Review and Discussion of Draft Report

Toole and Schonewald suggested that the report include case studies from other states in a table format of what has been done to date. Additionally, committee members wanted to highlight the quantity of new wind being installed around the country.

Toole asked if the recommendations would be made into an executive summary. He was curious if the recommendations would be finalized at the meeting, but Campbell responded that there would be a final meeting in December to finalize the recommendations.

Davis suggested that the report also include more information on the potential for industrial manufacturing economic development. Campbell agreed and expounded on the US Department of Energy grant that the Clemson University Restoration Institute (CURI) had applied for that would be critical to getting the industry started and that CURI would provide a presentation at the December meeting.

III. Presentations:

Offshore-Wind Project in South Carolina: The Potential Natural Resource Impacts – Bob Perry, South Carolina Department of Natural Resources

Mr. Perry of the SC Department of Natural Resources spoke on behalf of the Coastal Clean Energy Regulatory Task Force. The objective of his presentation was to further introduce a list of potential natural resource impacts that may be associated with a wind energy production farm located off the northern upper coast of South Carolina. The main point he wanted to get across was that the exact location will be the biggest question. Variations in location will greatly vary the environmental impact of an offshore wind farm. Potential environmental impacts include an affected action in the marine, near-shore and associated upland environments. There will be any number of potential

environmental impacts covered under Federal or State environmental laws or regulations. The impacts will be analyzed under the stepwise process outlined in the National Environmental Policy Act (NEPA). Under a good scenario, such a process should take two to three years. The following areas must be analyzed: within the marine environment (from site location to the high water mark), areas above the surface, the surface, the water column, and the bottom; the near-shore environment (from the high water mark to inland connection destination(s)); and the upland environment (from the nearshore to inland connection destination(s)). The greatest impact will be on marine life and above the surface for avian species. This will affect both breeders and migratory birds such as the scaup, scoters, and pelicans. Perry spent much of his early career flying aerial surveys of coastal migratory birds. He said that there were times that they would see over 100,000 scaup and scoters at the same time, and that considerable marine geo-spatial planning will be required to determine the best location to locate desirable wind while avoiding natural resource impacts.

He also described the potential impacts of transmission and cabling for endangered loggerhead turtles that nest on SC beaches. He stressed that North Island is an inviolate wildlife sanctuary by deed restriction as is Hobcaw, the Belle Baruch Foundation property. North Island is a wilderness area of about 4,000 acres only accessible by boat.

Mr. Perry indicated that there were probably no "show stoppers" but that is still uncertain at this time. Many unwanted impacts could probably be avoided by a change of location. Questions were asked and Laurel Barnhill, the DNR avian specialist was brought up to help answer questions.

Questions included whether the migratory birds were less of a problem farther out to sea. They answered that typically this was so. They also talked about the birds being able to modify their patterns after a while—a coping or avoidance mechanism. They also talked about the bats that have been problematic with onshore wind farms. This was cited as an example where one really needs to look at the location before constructing a wind farm. Bats would not be a problem offshore.

The NEPA Process for Offshore Wind Farms – Doug Heatwole, Ecology and Environment, Inc.

Doug began his presentation with some background information: within 3 miles of shore, State has authority. From 3 to 200 miles offshore, Minerals Management Service (MMS) has authority (conveyed by Energy Policy Act of 2005). MMS issues renewable energy leases, easements, and rights-of-way under Outer Continental Shelf Lands Act. MMS has the authority to issue leases offshore as of EPACT 2005. FERC is in charge of wave and current energy.

Doug spoke in great depth on the impending NEPA process that permitting a wind farm entails. NEPA, the National Environmental Policy Act was passed in 1969 and requires federal agencies to consider the environmental consequences of their actions. There are 2 types of NEPA investigations:

1) Environmental Assessments, when it is uncertain whether the proposed action would result in significant impacts.
2) Environmental Impact Statements, for proposed actions that may have significant impacts.

According to MMS, an EIS would more than likely be required for any offshore wind farm. This requires public input/involvement. Stakeholders include coastal states, agencies, fishermen, recreational boaters, commercial shipping, waterfront landowners, marine/coastal advocacy groups, and utilities/power generators. The leasing process can take about 2-2 ½ years. There are different time levels of leases; there is the limited lease is used for resource assessment and technology testing and lasts for 5 years and the commercial lease, which is generally 25 years. Either of these can either be competitive or noncompetitive. Most projects would require 2 stages of NEPA: the lease sale process (2-2.5 years) and the site assessment plan (SAP)/construction and operation plan (COP), which requires 1-2 years. Therefore, the regulatory process may require 4 to 4.5 years from initial concept to granting of a license.

Plan information required under the MMS regulatory framework includes water quality, biological resources, threatened and endangered species, sensitive biological resources or habitats, archaeological resources, socioeconomic information, coastal and marine uses. MMS adopted a policy of adaptive management. Uncertainty of impacts requires "learn as you go." We need well-designed monitoring programs. Phased development facilitates adaptive management.

NEPA requires addressing cumulative impacts/effects from past, present, and reasonably foreseeable future actions. While one wind farm may not have a significant impact, multiple wind farms may result in a cumulative significant impact. Furthermore, the spatial area for assessing cumulative impacts can be quite large depending on the resources affected. For example, some marine mammals, such as the right whale, migrate between Massachusetts and Florida, meaning that wind farms anywhere along this distance could contribute to cumulative impacts on this species.

Federal Aspects of Marine Spatial Planning and Territorial Sea Planning: How state policy can line up with federal policy – Steve Kopf, Pacific Energy Ventures

Mr. Steve Kopf began with a brief description of Pacific Energy Ventures, LLC and its employees. Industry imperatives include balancing new and existing ocean uses, establishing consistent and appropriate regulatory process, understanding project effects – environmental and socioeconomic, coordinating industry needs and prioritizing research and development, identifying resource gaps – workforce and maritime infrastructure, and developing market support. The cost for offshore wind in Delaware is 18 cents/kWh (They have an RPS, which provides confidence to the investment community).
Other methods for encouraging offshore wind besides an RPS include:

- Carve outs where a certain percentage of an RPS must come from wind
- Investment tax credits at the state level
- Quantifying aggregate market costs

The development phase is very expensive. Investors need clarity and a roadmap showing where state and federal processes overlay.

Territorial Sea Plans are a must. The State needs to get out in front. States should include a clawback provision for environmental studies.

Committee members were interested in knowing whether other states' initiatives were driven by the private sector. The answer was that it depends. Apparently Cape Winds shows an example of when the private sector gets out in front of the government and the difficulty that that implies.

Toole wanted a whole renewable energy plan. He talked about small hydro plants in his district that are interested in net metering.

Recommendations from Regulatory Task Force for Coastal Clean Energy – Catherine Vanden Houten, SC Energy Office, and Blair Williams, Office of Costal Resource Management, SC Department of Health and Environmental Control

Ms. Catherine Vanden Houten of the South Carolina Energy Office made a presentation of recommendations of the Regulatory Task Force for Coastal Clean Energy. She began by explaining that the Regulatory Task Force was established as a result of a 2008 grant from the U.S. Department of Energy entitled: the South Carolina Roadmap to Gigawatt-Scale Coastal Clean Energy Generation: Transmission, Regulation & Demonstration. The goal of the grant is to overcome existing barriers for coastal clean energy development for wind, wave and tidal energy projects in South Carolina. Included in the grant are the offshore wind transmission study; wind, wave & current study; and the Regulatory Task Force for Coastal Clean Energy.

The mission of the Regulatory Task Force is to create a regulatory environment conducive to wind, wave and tidal energy development in state waters. The Task Force is comprised of the full spectrum of state and federal regulatory and resource protection agencies, universities and utility companies. The Task Force was established in April and has had regular meetings since May. While the work of the Task Force will continue until 2011, there was consensus among the members to present some preliminary recommendations to the Wind Farm Feasibility Study Committee at this meeting.

Catherine explained that the Regulatory Task Force was making three main recommendations to the Committee:

1. The first recommendation is that South Carolina needs to establish a policy of support for the renewable energy. There are various ways to achieve that goal including executive and legislative approaches. In terms of renewable energy policy, eight states have offshore wind initiatives (six of them are in states with renewable portfolio standards), 24 states have a renewable portfolio standard, and five states have nonbinding goals for renewable energy. She pointed out that without state-level support for renewable energy development, South Carolina may miss out on the opportunities to attract renewable energy investors to this state.

In order to provide context and background for the subsequent recommendations, Catherine then introduced Blair Williams of Office of Ocean and Coastal Resource Management with SC Department of Health and Environmental Control (and member of the Regulatory Task Force). Blair made a brief presentation on a regulatory roadmap for offshore wind projects. He explained the work that the Task Force had done to identify lead permitting authorities, identify timeframes associated with regulatory permitting, and identify regulatory gaps. Blair spoke about projects in state waters and what resource agencies would be involved in permitting such a project. He explained that through this exercise, the Regulatory Task Force had clarified timeframes. He concluded his remarks by pointing out that a previous Memoranda of Agreement may need to be strengthened and updated (e.g. MOA PSC & SC Coastal Council, 1978). He also pointed out that Marine Spatial Planning (MSP) is a possible management or planning gap. Geospatial information about ocean resources, uses and conditions is needed for comprehensive planning. He pointed out that he SC Ocean Planning Work Group is looking at needs for MSP in SC waters. He concluded, however, that no major regulatory gaps were identified in this process.

Catherine Vanden Houten then summarized the final two recommendation of the Regulatory Task Force to the committee. In light of the findings that Blair Williams outlined, she explained that no regulatory gaps had been identified by the Task Force that would prevent the permitting of an offshore wind farm. However, she explained, two significant issues remain: that permitting may not address the entirety of issue and that the permitting process is complicated and cumbersome. Therefore, the Regulatory Task Force recommends that a leasing framework be developed. She explained that while the permitting structure is in place, permits are short-term, do not protect user investment, do not provide exclusivity, can be withdrawn, and do not allow compensation to the state. The result is uncertainty for both the state and investors. The recommendation is then that South Carolina should develop a leasing framework to create a more comprehensive process, because leases provide more certainty for the state and investors.

The third recommendation of the Task Force is that a “one-stop-shop” be developed, which would make the process more efficient by coordinating the permitting/leasing process. A model for a one-stop-shop already exists in SC for aquaculture. The Task Force is proposing that some sort of coordinating function could be housed in a non-regulatory agency, responsible for assisting investors through the leasing/permitting process and coordinating and streamlining the various steps in the process.

Catherine went on to summarize what other states and the federal government have done so far regarding offshore wind. She provided highlights from similar efforts and studies in North Carolina, Michigan, Texas, Virginia. She explained that each of these states grappling with these issues have come to similar conclusions that the Regulatory Task Force has.

Catherine concluded by reiterating the three recommendations of the Regulatory Task Force was making to the Committee: (1) South Carolina should develop a state policy supporting renewable energy, (2) a comprehensive leasing framework should be

developed for offshore wind, and (3) a one-stop shop needs to be established for permitting and leasing wind energy projects.

IV. Other Discussion Items

Approval of July 13, 2009 minutes: Hardwick motioned that the committee should approve the minutes and Toole seconded the motion. All in favor. None opposed.

V. Next Meetings

Public Hearing – October 12, 2009 at the Baruch Institute in Georgetown, 6pm – 8 pm
Final Committee Meeting – December 7, 2009 in 209 Gressette Office Building in Columbia, SC, 1pm – 4 pm

VII. Adjourn

Wind Energy Production Farms Feasibility Study Committee Meeting Public Hearing Minutes
October 12, 2009
6:00 – 8:00pm
Clemson Facility at the Baruch Institute
Georgetown, SC

Committee Members in attendance:

Senator Paul Campbell: Chair
Senator Daniel Verdin
Representative Nelson Hardwick
Hamilton Davis: Coastal Conservation League
John Boyd: Haynsworth, Sinkler, and Boyd Law Firm
Roger Schonewald: GE

Presenter

Marc Tye, Vice President of Renewable Energy and Energy Efficiency, Santee Cooper

Introduction

Sen. Campbell introduces self, board of panelists. Panelists explain their roles in the committee, all support the responsible development of offshore wind, the creation of jobs, and would like to shape state legislation such that economic gains can be achieved and turbines installed.

Marc Tye presents Santee Cooper's wind activities to date, including an introduction to S/C, renewable energy goals, cost comparison of renewables to conventional, and the need to create a cost-effective energy portfolio. After the presentation, two audience members seem to have urgent questions, but the panelists have no questions and he returns to his seat.

Public Comments

Toni Reale – My name is Toni Reale and I'm the coastal program coordinator for the Southern Alliance for Clean Energy and I've prepared a few comments I would like to share with you all. My organization, Southern Alliance for Clean Energy, works to preserve, restore and protect our environment through the use of innovative technology, grassroots and decision-maker education, and dedicated policy advocacy. As both a citizen of Charleston County and a member of an organization who works to ensure that the Southeast becomes a leader on climate energy issues, I thank you for the work that this committee has done thus far, in helping South Carolina realize its renewable energy potential. Offshore wind farms have been proposed and are currently in detailed planning stages in Massachusetts and Delaware. In North and South Carolina and Georgia offshore wind farms are in various stages of planning. We are pleased that South Carolina is currently conducting a research study with Coastal Carolina University and the South Carolina Energy Office that uses weather buoys to measure the wind off our state's coast. We are glad to see this because this is a significant step towards the beginning of offshore wind development in this area. Once developed, offshore wind power will supply affordable, inexhaustible energy to our region's economy. It will also provide jobs and other sources of income, as has been the case elsewhere in the world where offshore wind energy has been developed. The assembly, staging, construction and maintenance of offshore wind farms will create a range of jobs

for South Carolinians. Germany offers an example of offshore wind, how offshore wind can create a booming economy where 700 new jobs have already been created in the past three years with the introduction of offshore wind to the city of Furmerhaven, and three to five hundred more are expected. Offshore wind energy offers a hedge against the impact of rising fuel costs and can help stabilize and reduce electricity prices by displacing the need for more expensive power plants. It is anticipated that there will be a reduction in energy costs as new technology is developed and as the offshore wind industry advances in this county. GE, as we know, produces land based wind turbines in Greenville, SC, and they are currently conducting a research project on new generation of offshore wind turbines that will reduce the cost of energy delivered. The proposed projects in the Southeast and along the U.S. coast provide the market to support new technology development that can lead to further job creation in this region. The Charleston area, where I'm from, with our active port facilities, established manufacturing and steel industry can serve as a future hub as the offshore industry emerges along the U.S. coast. Research has found that most birds fly around offshore wind turbines rather than into them and change their migratory patterns accordingly. Offshore wind turbines are also designed with bird safety in mind with slower moving blades and a tower that is inhospitable for birds to land on. Also wind energy developments overall impact on birds is extremely low compared to other human related causes of bird deaths including buildings, communication towers, traffic and house cats. Lastly, I would like to point out the impressive potential for offshore wind energy that our region is fortunate to have. The strong consistent winds that blow along the shallow vast outer continental shelf that span the Carolinas, Georgia and Florida represent a potential 486,000 GWh of clean sustainable energy for our region. Thank you.

David Wylie – Good Evening. This is kind of informal. I'm from Georgetown County School District. My push is really from an education perspective. I see in students as well as adults a huge potential for education in regards to wind energy. I have parents phoning me up asking how they can be more involved in the wind project and so on. I would like to suggest that we formalize an education from high school all the way up as far as wind energy goes because no matter which way you look at it, it's part of the equation of the future. Having talked to several people tonight, I hear that there are potential grounds out there to do that. This is happening in our backyard so to speak, so I'm really hear to secure my students' future in regards to the green jobs. You hear it all the time from the White House down, but I think we need to formalize it more, because those are the people who are going to be repairing the turbines or whatever. There needs to be more attention drawn and formalized to potential funding for students and more collaboration and I really appreciate the collaboration with Santee Cooper today, and I think we need to carry that on, but it really needs to be formalized otherwise these potential engineers of the future are going to be left a bit behind and we want to be leaders in that just like Santee Cooper is. I can't help but resist a side comment, because as a researcher on a previous slide mentioned, as far as the migration of birds goes, there have been a huge number of studies in Europe, and it really wasn't a significant factor as far as migration habits goes on birds and birds impacts in the turbines and so on. So there's a lot of research out there as far as visibility, sound and also migration habits of birds out there, that these huge turbines off Holland and so on are not really detrimental to the environments of the birds. I just wanted to make that comment. Thank you.

David Stoney – Thank you very much. My name is David Stoney. I'm from McClellanville, SC, and I'm the director of an all volunteer grassroots group that is

concerned about climate change and global warming. The name of that group is the "Kitchen Table Climate Study Group". If you would like to learn more about us, we have a website: Google "KTCSG" to pull us up. We are trying to educate and inform our friends and neighbors about the peril that South Carolina's lowcountry is in due to global warming and sea level rise. So we are delighted to see the emphasis on wind power. We are delighted that Horry County and Georgetown County has an opportunity for green jobs and a boost in their economy. Marc Tye, we are delighted to see Santee Cooper take such an active interest in this. I wanted to urge the feasibility study panel to work with all due speed. The climate crisis is accelerating. Changes at the poles are accelerating due mainly to increases in ocean temperatures, and of course the oceans get their increased heat from the increased global warming due to greenhouse gas productions. And the greenhouse gases that enter the atmosphere today will still be there, especially the CO2, in the next 100 years. What goes into the air today will have a warming effect for 100 years. And if we don't start a program for our country that will rapidly reduce greenhouse gas emissions, we will lose the South Carolina lowcountry, and without the South Carolina lowcountry we're not going to have a state and we are not going to have an economy. So it is critical that we develop alternative sources of power and that we find ways to reduce greenhouse gas emissions very substantially by 2020. So I urge the committee to work as fast as you can to see if this offshore capacity for wind indeed is feasible. And if it is, go for it. One comment about the cost comparison Marc presented: it is a little misleading to try to out cost when you don't take into account the cost of taking no action. The cost of coal will be much higher than indicated in that chart if we lose the lowcountry due to greenhouse gas emissions. You need to start taking into account the best guesses about what it will cost us if we do nothing. So remember when you look at these costs that we need to factor in the cost of doing nothing. If we lose the South Carolina lowcountry, we're going to lose everything. I don't know how you put a dollar value on that, but it is much higher than a few bucks per kWh. So I urge you to work hard, glad to see you hear. If you want some information about the Kitchen Table Climate Study Group, I have some little handouts that I brought with me. Thank you very much.

Nancy Cave – Good evening, I am Nancy Cave, the North Coast Office Director of the Coastal Conservation League. Our North Coastal Office is here in Georgetown. I want to thank the Feasibility Study Committee for inviting us all to comment to you. I think it is very commendable that you are out talking with the public. Offshore wind represents South Carolina's largest clean energy resource, and the Coastal Conservation League supports taking the necessary steps to make wind a utility energy source in this state. In addition to providing a significant energy source, the wind industry can give South Carolina an enormous economic boost creating new sources of revenue and new jobs. The U.S. Department of Energy estimates that the wind industry could provide the state with in the range of 80 billion dollars in revenue and 20,000 jobs. The state needs to take advantage of this opportunity. We have to do it now before others take it away from us. But we must have the necessary energy policy in place to bring offshore wind investors and developers to the state. We need to participate if not lead the national and international discussion on offshore wind to do this. And leadership must come from you, the elected officials. The Coastal Conservation League encourages this study committee to make clear, substantive recommendations to the General Assembly in the 2010 session. Recommendations that will put South Carolina to capitalize on wind energy now. I would add that we are having an energy efficiency conference on October

22nd in Florence and Senator Campbell is speaking and I would welcome you all to attend.

Bob Grove – Good evening my name is Bob Grove and I live in Georgetown, more specifically in Debido Colony. This is not a presentation for or against, I just want to present a fact and answer a question that came up repeatedly during a presentation a few months ago by one of your project staff. "Will the turbines be visible from the shore?" was the question. A little bit of plain geometry answers that question if you stand with your eye at the surface of the earth and look out, the curvature drops off and using the pathagorium theorem if the height of the turbines or the blades is a 100 feet up it has to be 12.2 miles out to be invisible. I saw on your chart here you are talking about anywhere from 50 meters to 100 meters, which is 300 feet, so if you up on 200 feet you have to be 17 miles out. If anyone wanted to know more about that I brought some papers here that show my calculations. Thank you.

Philip Branton – Hi my name is Philip Branton. I drove up from Folly Beach. Where do I begin? Number one, this is political. Do you see any black people in this room? That's problem number one. Number two is education which was pointed out earlier. Number three, Santee Cooper, this is about three decades to late. I don't know how long GE has been producing turbines in Greenville, but the very first one should have gone up off the coast of South Carolina. We had these magic carpet people coming in here from the Middle East buying our turbines the least we could show them was the sales model. I'm not being too nice. We have Sandia National Labs, we have Idaho National Labs, we have Hanford Facility and we know what's been developed. And 200 meters up? We are talking about a mile, mile and a half. We have vast marsh farmland and I don't hear one turbine complaint from the farmlands out west. The City of Myrtle Beach they should be energy self-sufficient. Alaska gets a rebate on the oil they sell to the 48 state. It seems like the City of Folly Beach with the marshland around that city that they control, could have 10, 15, 20 turbines at least. That ocean out there ought to be growing ocean hair, along just like the rows of corn that the shrimpers go up and down. It is not rocket science. Now of course, I am no Santee Cooper engineer. But you know when I see all of these high tension power lines and I see the easements that are available and I see all of these Santee Cooper power workers, and I ask them, hmm, what type of royalty are you getting off those easements in addition to the power running along those easements? This is long overdue. Long overdue! I appreciate your time coming down here Mr. Verdin. Some of the meetings I have been at, there is not one elected official. That is unsatisfactory. I appreciate it. Mr. Hamilton, I appreciate your time. I drove an hour, just like Jim Valdono and there is no black people here. None! That is unsatisfactory, in my book. (Question from the crowd: "Did you invite any?") Well the two that I know that would have been here tonight, are actually over at Maple's Inlet serving us right now. (Comment from the crowd: "Well I read it in the paper.") I did to, today. I made that comment in the Post and Courier. Thanks for telling us – it sure would have been nice to make appointments for babysitters. We have a job to do people. And this is political. And I appreciate everyone coming out here, because I am fed up.

The floor is opened to public questions.

- Roger Schonewald answers a man's questions regarding technical aspects of wind turbines. Confirms that they will most likely be in the 3.5MW to 5MW range, that turbines are designed for case specific wind characteristics, emits electricity at 60Hz,

and should be spaced 3-5x blade diameter lengths. Questioner wants audience to realize these turbines could be 500' tall, will have to go through a lot of trouble to develop, and don't throw out coal or nuclear yet.

- Toni Reale of SACE asks Marc Tye why nuclear was excluded from cost comparison and how much it costs. Tye replies that this was an independent study that he was not a part of, he does not know those costs. P. Campbell states that the cost for nuclear is similar to coal.

- P. Campbell answers a man's question that MMS will handle development in federal property and a task force is preparing regulations for state waters. Confirms that development must conform to NEPA guidelines.

- Commenter notes that most bird studies have been performed in EU and email exchanges say there is a possibility that migrating song birds would be affected by offshore turbines. Asks that the bird issue not be dismissed but should be studied. P. Campbell comments that b/c of NEPA, any federal action requires an EIS, and all bird, marine, wildlife issues would be addressed.

- Commenter asks panel/crowd for confirmation that S/C's cost comparison was accurate, and if an independent study could confirm it. Tye notes that the LaCapra study was independent and paid for by the Electric Co-ops. Campbell confirms that from his experience the numbers seem accurate. Hamilton Davis comments that the range of costs for coal may be low b/c no new facility has been built in years and fuel costs have increased 60% in past 5 years. Notes that the costs for coal do not account for increasing fuel costs or potential carbon taxes and states that the fuel for wind turbines is free.

- Campbell states that solar power is not ready for utility scale development in SC. Good for hot water heaters and residential use, but wind and biomass are utility ready.

- J. Sutton, Pawley's Island, states that he owns a wind farm in MI and his company focuses on private funding for onshore wind projects. Has concluded that onshore is economical in SC and that a 1MW turbine, 100m tall located at the Winyah generating facility would produce electricity at $66.67/MW-hr. States that he does not want onshore wind power to be overlooked.

- David Wylie asks if there are any subtleties involved with the transmission and it is explained that transmission must be underground and the technology is commonly used already.

- Rep from PPG Industries wants to know what industry can do to leverage job creation and market expansion in state. He is told that is a committee goal and to contact state rep.

- Private fiberglass manufacturer looking to get more involved told to meet with Elizabeth Colbert Busch of CURI. The manufacturer also is asking for an industry consortium to help solicit and develop turbine manufacture in South Carolina.

- Schonewald explains decision process for selecting the 3-blade design.

- Sen. Campbell states that South Carolina needs to pursue the offshore wind manufacturing industry, and let the central US states have the onshore sector. Our port access makes a good fit for manufacturing of wind turbines.

- Rep. Hardwick explains committee and sub-committee process required before final committee recommendations, and notes that people can offer opinion at any time and contact their state reps to voice their opinion. Report should be finalized by end of year, hoping for legislative action by June 2010.

- Mary Conley of The Nature Conservancy asks if state regulators have looked into marine spatial planning. Campbell replies that the Reg. Task Force is looking into this, and someone comments that policy guidance for comprehensive marine spatial planning will begin to be distributed in the next 90 days. Campbell responds that he cannot answer Conley's question as to whether the state has requested a wind task force from MMS, H. Davis indicates that several initiatives are underway with that goal.

- Extended discussion concerning whether the committee has considered wave, current and tidal energy. Steve with PEV states that South Carolina has a very limited resource for any of these. Paul Gayes notes that currents, waves, etc are being documented by the Palmetto Wind Research Project.

- Eric Smith of PPG asks what barriers or restrictions remain to developing offshore wind. Campbell notes that the cost of the power generated is a significant limitation to development, but that he is not aware of any other major impediments.

- The meeting ends with an offer from Sen. Campbell for the public to stay and talk further with the committee members individually, and thanks everyone for their attendance and input. Sen. Campbell also suggests that the public can access all the Wind Farms Feasibility Study Committee work and lots of additional information, including all presentations made to the committee by going to the South Carolina Energy Office website.

Organizations in attendance:

- *Coastal Conservation League: Hamilton Davis, Nancy Cave*
- *The Nature Conservancy: Mary Conley*
- *Southern Alliance for Clean Energy: Toni Reale*

Businesses in attendance

- *Pacific Energy Ventures: Steve (?)*
- *Natural Energy Consulting: JC Sutton, two others*
- *PPG Industries - Chester, SC: Eric Smith*
- *ABS Consulting - Luke Blessinger*
- *GE Energy - Fred Gates*
- *SCE&G - Jack Robinson*

Total of 60 attendees

Wind Energy Production Farms Feasibility Study Committee Meeting #4 Minutes
December 11, 2009
1:00 – 4:00 PM
209 Gressette Office Building
Columbia, SC 29201

I. Introductions

John Boyd, Haynsworth Sinkler Boyd, Columbia
Hamilton Davis, Coastal Conservation League, Charleston
Roger Schonewald, GE Energy, Greenville
Rob Leitner, SC Institute for Energy Studies
Earl Hunter, Commissioner of SC DHEC
Mac Toole, Representative from Lexington County
Brad Hutto, Senator of District 40
Paul Campbell, Senator of District 44, Chair
Erika Myers, Staff, Renewable Energy
Gene Hogan, Research Director, Senate Agriculture and Natural Resources

II. Presentations

Preliminary Findings of the Offshore Wind Transmission Study—Dr. Adly Girgis and Dr. Elham Makram, Clemson University Electric Power Research Association

Dr. Girgis provided basic definitions of terms used in the presentation and then explained the research objectives of the Offshore Wind Transmission Study. The study was funded as part of the US Department of Energy Gigawatt-Scale Coastal Clean Energy grant through the SC Energy Office to determine whether or not South Carolina's existing transmission grid could support additional energy from offshore wind resources. The Clemson University Electric Power Research Association (CUEPRA) was selected to prepare the report due to their experience with South Carolina transmission studies. The study was divided into three stages: Stage I analyzed the impact of an 80 MW offshore wind farm by 2014, Stage II: 1,080MW by 2020, and Stage III: 3,080MW in federal water by 2030.

For the first phase of the project, 80 MW would be injected into the coastal network at 115 KV buses. Six different 115 KV locations are available, and that would lead to two wind farms, one in North Myrtle Beach and one in Winyah Bay. For the second phase, 1,080 MW would be injected by 2020. There would be two wind farms, similar to phase I. When the wind farms' energy got injected into the transmission system from offshore, it would be coming to Duke Power, Santee Cooper, Progress Energy, SCE&G and it would be divided to those utilities by the ratio of their total loads. It will be coming into Zone 342 and Zone 1375. Modeling these wind generators, CUEPRA chose the 3.6 MW wind turbine by GE, because of available information, but that could be applied to any other wind turbine that could be selected in the future. For each farm, each offshore turbine will be connected to the generator and a transformer, as each will generate power at 4.16 KV and will be transformed to 34.5 KV offshore, which is the normal primary distribution voltage level, and then transformed to the 115 KV bus onshore as AC generation.

CUEPRA uses simulation software packages for the purpose of accuracy and comparison: PSSE and Power World Software. For Phase I CUEPRA used data from the 2013 summer load and the 2013/14 winter load. For Phase II CUEPRA used data from the 2018 summer load because 2020 load was unavailable. CUEPRA will compare the result based on voltage violation (desired limits are 100% of normal ± 6%) and the loading condition of all the branches (not to exceed 100%).

In conclusion, there will be no problem with 80 MW, and with 1,000 MW added to the 80 MW (and reducing generation in the Santee Cooper system at the Rainey plant) the transmission system can absorb the extra capacity. However, if a second new nuclear facility comes online there may be a problem. CUEPRA expects receiving additional information from in-state utilities to update the transmission data, and will soon complete the transmission study for phase III. CUEPRA will complete a final report with recommendations for redesigning or upgrading the transmission system to handle new offshore wind capacity in 2010. Additional funding will be required to research voltage stability, transient stability, and contingency and short circuit analysis.

U.S. Department of Energy Wind Drivetrain Testing Facility Award & Comparison of other State Initiatives—Nicholas Rigas, Clemson University Restoration Institute
Dr. Rigas opened his presentation with a discussion about independent drivers for renewable energy including the economy, the environment and national security. All these factors have merged together recently to drive new thinking about an integrated energy policy and new innovation to stimulate the economy. The drivers behind the 'Green Economy' are the goals to diversify the energy supply, reduce imports, be environmentally responsible, be sustainable, have energy security, and encourage economic development through innovation/research, manufacturing, operations, installation, and maintenance.

As of February 2009, 28 states have adopted a Renewable Portfolio Standard and five states have a renewable energy goal. Unlike counterparts in Europe or Asia, renewable energy development is being driven by states in the USA rather than the federal government. DOE's 2008 plan for 20% wind power by 2030 requires 290 GW of new wind to reach the goal including 50 GW of offshore wind power along the east coast with more than a $175 billion investment. The plan identified SC potential at 1 to 5 GW offshore, which is consistent with the work we heard about transmission infrastructure. The plan will require technology and infrastructure improvements but will provide greenhouse gas reductions, water savings and economic development. Under this same scenario, SC would have 10,000 to 20,000 new manufacturing jobs. Despite not having any commercial wind turbines in SC, we do have a presence in the market through GE, Timken, Ilgin and others who have set up operations in SC. Along the East Coast, SC stands out because of its involvement in the wind industry. Most of the new and expanded facilities are in the Midwest (i.e. Iowa). The big markets are Illinois and Minnesota. Why is Iowa getting the manufacturing sites? Iowa has been very aggressive in its policies to attract manufacturers. Colorado has been aggressive also. Strengths we have in SC include outstanding port facilities and rail, large scale ship rebuilding

facilities, low cost manufacturing, a company friendly environment, excellent research institutions, raw material providers (steel), entrepreneur spirit and key industry players.

Offshore wind resources are important because they lie near demand centers. Given that most of the population of the U.S. lives along the coast, the transmission infrastructures are strong and demand is high. In the U.S. 78% of electrical demand is consumed along the coast and 26 of the states have offshore wind resources to meet the 20% scenario. South Carolina has a good wind resource. The issue with the market is that the Midwestern states are trying to develop their land based wind resources and get them to the market of the east coast. They are looking at massive transmission lines, which would have electricity traveling to the east with money going back to the Midwest. A lot of projects are being proposed up and down the east coast and in the Great Lakes. If we can establish the manufacturing to service these markets we can also service European and Asian markets. The state programs including Massachusetts, Rhode Island, New York, New Jersey, North Carolina, Michigan, Wisconsin, Ohio, Delaware and Toronto have been fairly aggressive to attract offshore wind manufacturing. The NC project in Pamlico Sound will install 3 turbines (about 10 MW). The technology related to the wind industry continues to evolve as wind turbines get larger. As the markets emerge, there is a need for innovation and the transfer of innovation to the market, job training, and the opportunity to incubate new enterprises.

The Drivetrain Test Facility is innovation-driven and industry focused project with many partners. Clemson University Restoration Institute was the recipient of a $45 million grant from DOE and the total project will be $98 million dollars funded by local participation and in-kind contributions. One of the strengths of the proposal was equipment logistics. The technology for offshore wind turbines is massive and getting more complex, so it was important to be able to move this equipment in for testing. Our hope is that the Drivetrain Test Facility would be a catalyst to spur an offshore wind turbines manufacturing and services cluster. Complementary activities include tower fabrication, cable laying, turbine assembly, logistics, foundation fabrication, construction, blade manufacturing and component manufacturing. Component manufacturing is important because many of the main turbine manufacturers outsource many of the components and there are many components that go into producing the turbines.

In summary, for South Carolina to be successful, Rigas suggested that South Carolina must compete globally, be innovative, build on its existing infrastructure, develop its work force and have sustainable public policies.

Campbell asked Rigas about what happens with offshore wind turbines in the event of a hurricane. Rigas said that current technology can withstand Category 3 storms. They can be designed to withstand higher wind speeds. It is something we'll have to look at, but the technology is there.

Campbell asked about the Clean Energy Standard with specific renewable goals: a demonstration project by 2013 with a gigawatt by 2018. Rigas said this is an opportunity for South Carolina to be innovative. There is no need to copy other states. A clean

energy standard would be very strong. New Jersey's Renewable Portfolio Standard (RPS) was intended to spur market development. If the project is in state waters, the project may be achievable faster. There is a lot of risk in being the first, but there is also a lot of prestige. The goal of having a project by 2013 would set South Carolina out as one of the first, but North Carolina will probably be the very first unless things change. Rigas additionally suggested developing a test tower in the waters to allow companies to test new turbines. Hutto asked who would apply for the permit for the building of the wind farm. Rigas said it would be the owner/operator of the development and that the group would also be responsible for the transmission lines from the wind farm to the substation. That transmission would all be under water. It would be best to bring the transmission lines into existing substations. Would authority need to be given for eminent domain? That is an issue. A private company would have to pay landowners. Campbell mentioned that the aesthetics of wind turbines don't seem too unpleasant to the people on the coast.

The minutes from the September 21, 2009 general meeting and October 12, 2009 and were approved by Committee members.

III. Review of the Final Draft Report and Selection of Final Committee Recommendations

Staff person, Erika Myers, reviewed the draft report with committee members and provided backup information as requested by Campbell. The committee discussed potential corrections and amendments to the draft recommendations:

Recommendation #1: South Carolina should develop a policy of strong support for renewable energy development through the establishment of a renewable portfolio standard. Legislation should contain either a carve-out or a renewable energy credit multiplier for offshore wind energy.

- Instead of a Renewable Portfolio Standard, Campbell suggested making it a Clean Energy Standard with specific carve-outs for renewable energy, nuclear energy, and energy efficiency.
- Campbell noted on the materials provided that according to EIA 2007 data: 51% of energy generated is nuclear—clean energy, 40% coal, 1% hydro and 6% gas and 1,000 MW of offshore wind by 2018 would be 1% of energy use in S.C. and that the state should start out with a 80 MW pilot project for offshore wind
- Liz Kress, Santee Cooper—We need to address the regulatory side of things, 2013 may not be realistic goal, so Campbell asked the group to find a suitable challenge by 2013 but still realistic. Campbell requested the committee keep the goal of 1,000 MW by 2018.
- The committee decided to set a specific target for wind rather than a percentage of total energy production in the state and to not develop targets for other renewable energy requirements. Campbell asked if the target should be set for capacity or production, but given variability in wind generation, John Clark, the Director of the SC Energy Office, suggested that it be a capacity goal.
- Toole suggested that the committee strongly recommend support for renewable energy as opposed to clean energy, and do it in an environmentally-friendly way.

Toole suggested the idea of supporting a roadmap as opposed to outlining specific recommendations. Toole also suggested including recommendations for onshore wind energy applications based on the presentation the committee had received from Monroe Baldwin with the City of North Myrtle Beach which wanted to install vertical axis wind turbines on beachfront hotels and condos.

Recommendation #2: The Coastal Clean Energy Regulatory Task Force should establish a leasing framework for offshore coastal ocean activities in state waters. A leasing system would allow the state to evaluate and develop offshore resources, minimize use conflicts, reduce risks to the state and to the user, and result in more certainty for the state and investors.

- The committee approved the recommendation with no changes.

Recommendation #3: South Carolina should establish a permit facilitation office through the SC Energy Office to coordinate the permitting and leasing of offshore wind projects.

- Hunter asked that DHEC be included in this recommendation along with the SC Energy Office.
- The committee approved the recommendation with the DHEC addition.

Recommendation #4: South Carolina should develop a marine spatial plan for its offshore coastal ocean waters through the SC Department of Health and Environmental Control, Office of Coastal Resource Management (OCRM) to allow predictability in decision making and protection of existing ocean uses. Additionally DHEC should actively engage in the CEQ Ocean Policy Task Force and solicit input from other relevant state and federal agencies and stakeholders.

- The committee approved the recommendation with a minor change to remove the specific appropriation to OCRM

Recommendation #5: Provide 'revenue certainty' for offshore wind power production sufficient for non recourse financing for a fixed number of years which would balance utilities, rate payer advocates, banks and profitability. The program could be equivalent to a feed-in tariff as seen in other states and countries.

- The committee discussed what a feed-in tariff was that would allow developers/utilities to be guaranteed revenue certainty to reduce risk, especially for this new technology. The feed-in tariff may be designed to come from the State.
- The committee approved the recommendation with no changes.

Recommendation #6: The Governor should establish a Memorandum of Understanding (MOU) with North Carolina and Georgia to collaborate on future offshore wind projects and promote federal policies, transmission strategies, and joint demonstration projects.

- The committee approved the recommendation with no changes.

Recommendation #7: Develop an offshore wind anemometer loan and/or rebate program available to utilities or private investors to obtain accurate offshore wind measurements.

- The committee approved the recommendation with no changes.

Recommendation #8: The SC Department of Revenue should review existing in-state incentives for manufacturing to ensure compatibility for wind component manufacturing and prepare draft legislation for the SC General Assembly if modifications are required.

- The committee approved the recommendation with no changes.

Recommendation #9: Expand and increase existing renewable energy tax credits to include wind installations and increase the amount of credit to accommodate large-scale commercial projects such as offshore wind energy.

- The committee approved the recommendation with no changes.

Recommendation #10: The State should establish a Wind Working Group to promote the education and awareness of offshore wind activities and prepare a strategic roadmap for wind energy. Additionally, the State should develop a Wind Energy Cluster to coordinate with existing and new wind industry members in the state and work closely with the SC Department of Commerce and other economic development organizations to develop materials to assist in the recruitment of wind supply chain manufacturers.

- The committee recommended that the SC Energy Office be responsible for creating and staffing these organizations.
- The committee approved the recommendation with the addition of the SC Energy Office.

Recommendation #11: Reinstate the SC Renewable Energy Infrastructure Development Fund to provide funding for wind research and demonstration activities.

- The committee approved the recommendation with no changes.

Recommendation #12: The State Ports Authority should fund a Refurbishment Study of the Charleston and Georgetown Ports to identify the refurbishment needs of both ports and develop a strategy to finance their redevelopment to encourage the establishment and manufacturing of offshore wind farms in the Mid-Atlantic and Southeastern United States.

- The committee approved the recommendation with no changes.

Recommendation #13: The SC Sea Grant Consortium should engage its member institutions and federal partners to develop strategic options to establish an umbrella marine institute in South Carolina.

- The committee approved the recommendation with no changes.

Additional recommendations:
According to Davis, the committee should add a statement that offshore wind is in the interest of the public and that the State issue an RFP for the demonstration. Would it be possible that someone would be interested in the test platform but not the production? They should be separate recommendations. There may be federal grant money available and we should go after it. We need to think about how to promote the project across the nation.

According to Schonewald, the committee should also add a statement that the State be involved in major wind events and that the State's efforts be properly published.

Campbell asked the committee to send all the changes to Myers by Wednesday, December 15 and finalize the report by the end of the year.

V. Other Discussion Items
None

VI. Adjourn (3:00pm)

Appendix C: Presentations

Wind Energy Production Farms Feasibility Committee
209 Gressette Office Building
Columbia, SC
April 20, 2009
1:00 PM – 4:00 PM

I. Introductions

II. Legislative Intent of the Committee

III. Review and Discussion of Draft Outline for the Report

IV. Presentations:

Wind Industry Overview – Mr. Roger Schonewald, GE

Overview of Wind Energy Studies in South Carolina – Ms. Elizabeth Kress and Mr. Eric Boessneck, Santee Cooper

Refining South Carolina Coastal Ocean Wind Resource Potential: Direct measurements and model groundtruthing – Dr. Paul Gayes, Burroughs and Chapin Center for Marine and Wetland Studies, Coastal Carolina University

Wind Studies using Sodar Technology in South Carolina – Dr. Thomas French, Savannah River National Laboratory

Offshore Wind Regulatory Task Force – Ms. Catherine Vanden Houten, SC Energy Office

V. Selection of Committee Chair

VI. Schedule Future Meetings

VII. Other Discussion Items

VIII. Adjourn

GE
Energy

Wind Energy Highlights

South Carolina Wind Energy Production Farms Feasibility Study Committee

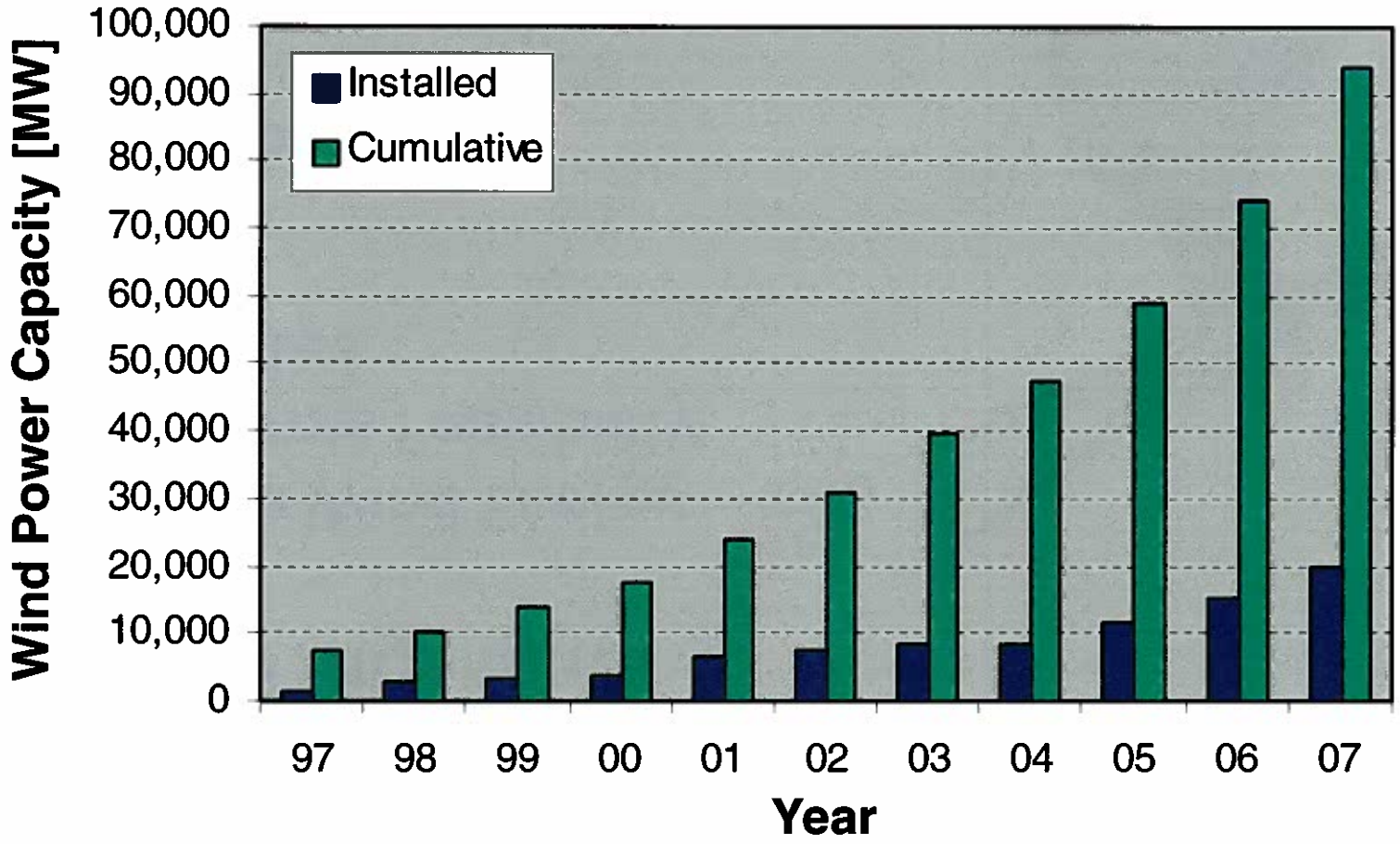
20 April 2009

Roger Schonewald
Mgr, Technology External Programs

imagination at work

Wind Power Capacity Worldwide

- 30% avg. growth over last 10 yrs
- Source: Global Wind Energy Council (www.gwec.net)



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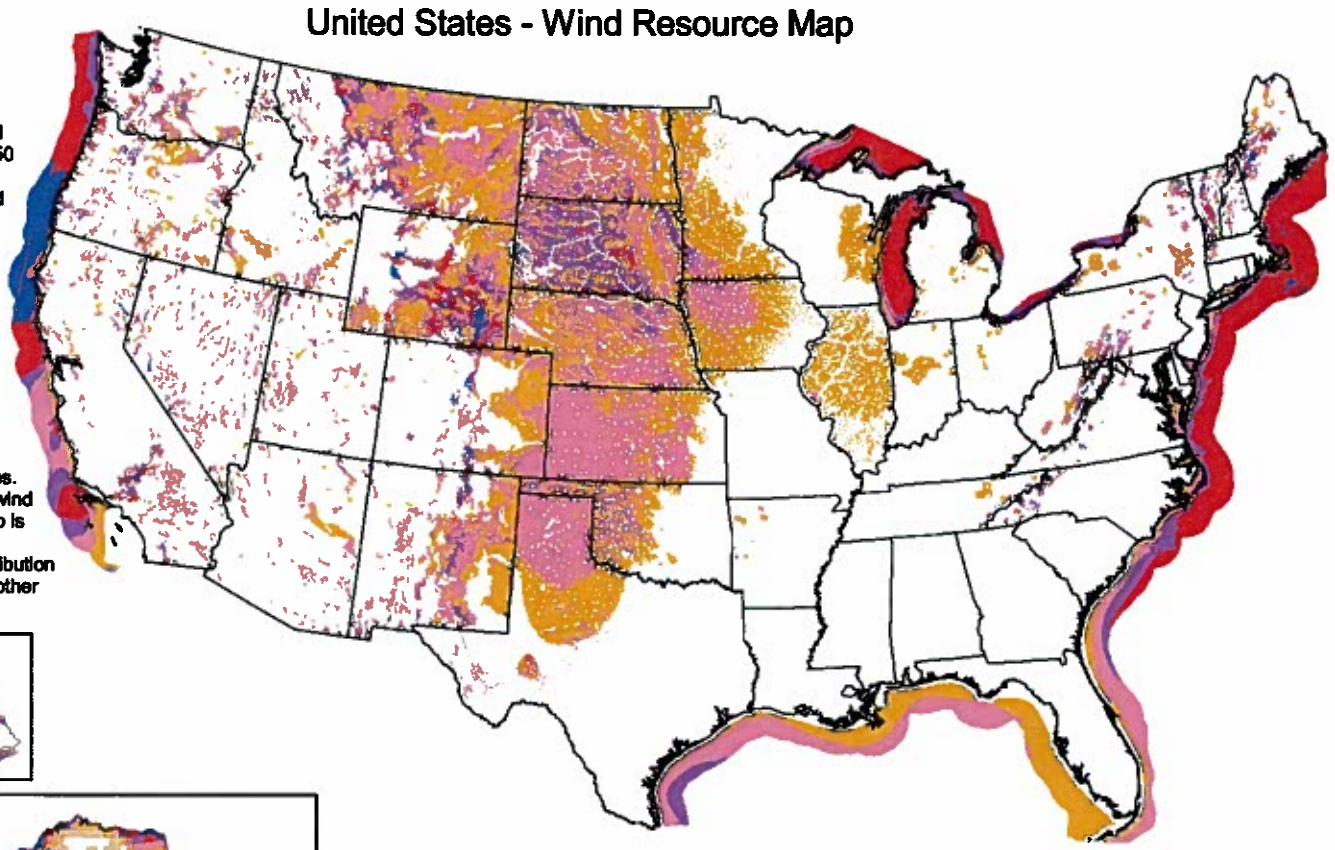
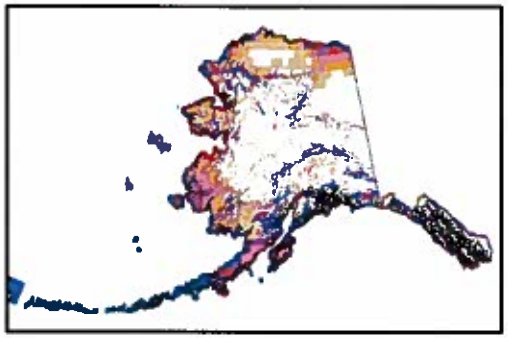
Wind Resource in U.S.



This map shows the annual average wind power estimates at 50 meters above the surface of the United States. It is a combination of high resolution and low resolution datasets produced by NREL and other organizations. The data was screened to eliminate areas unlikely to be developed onshore due to land use or environmental issues. In many states, the wind resource on this map is visually enhanced to better show the distribution on ridge crests and other features.



Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed [a] at 50 m m/s	Wind Speed [a] at 50 m mph
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

[a] Wind speeds are based on a Weibull k value of 2.0

U.S. Department of Energy
National Renewable Energy Laboratory

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US 20% by 2030

- Next decade: manufacturing growth rates of 20-25% necessary to reach annual installations of ~ 20 GW in the U.S.
- Maintaining this rate through 2030 results in 20% Wind generation
- Annual WTG installations starting at ~2000 to ~7,000+ by 2017
- 10%-20% ↑ in capacity factor and 10% ↓ in capital costs by 2030
- Availability of raw material, investment, and qualified labor is achievable

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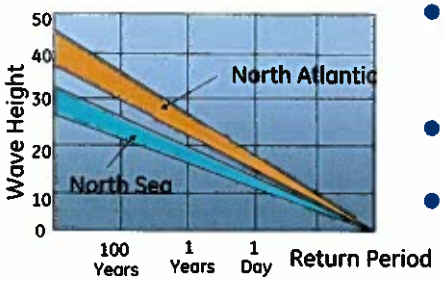
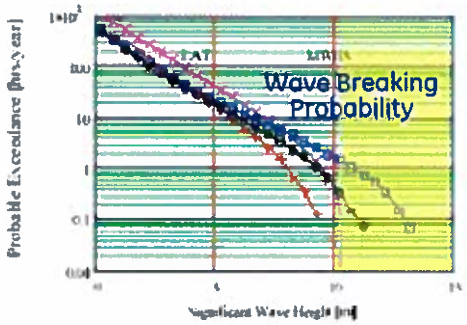
Offshore Wind Market Drivers / Constraints

Market Drivers:

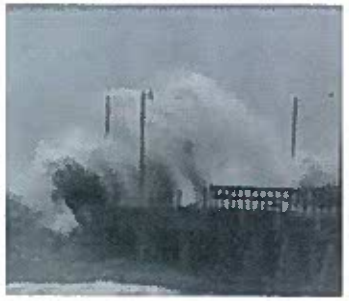


Wave Heights Larger than European Experience

- High interest - Green, Renewable Energy close to major Load Centers
- PR and Gov'mt support critical
- Great wind conditions
  - capacity factors to 0.5
  - Low turbulence & wind shear
- Favorable Sites: US East Coast, Irish Sea, North Sea, Baltic …
  - Water depths to 30 m, 10-20 km offshore



Fuse site data & physics-based models



Storm Conditions

Constraints:

- Risks/Costs: Technology; Construction; Operational; Maintenance
- Accessibility: Difficult service environment
- Exposure: hurricane; waves; sea bed stability
- Economics - Cost of Energy

GE Wind At Arklow

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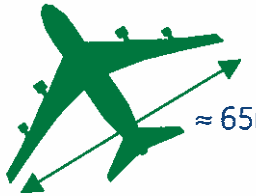
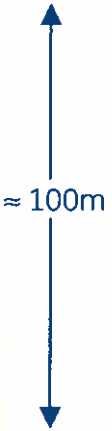
Wind Turbine Giant Example

- GE 3.6-MW, 104-meter (341 ft) rotor

Boeing 747-400





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Wind Turbine Example - GE 1.5sle

Rotor
39 tons
253 ft diameter

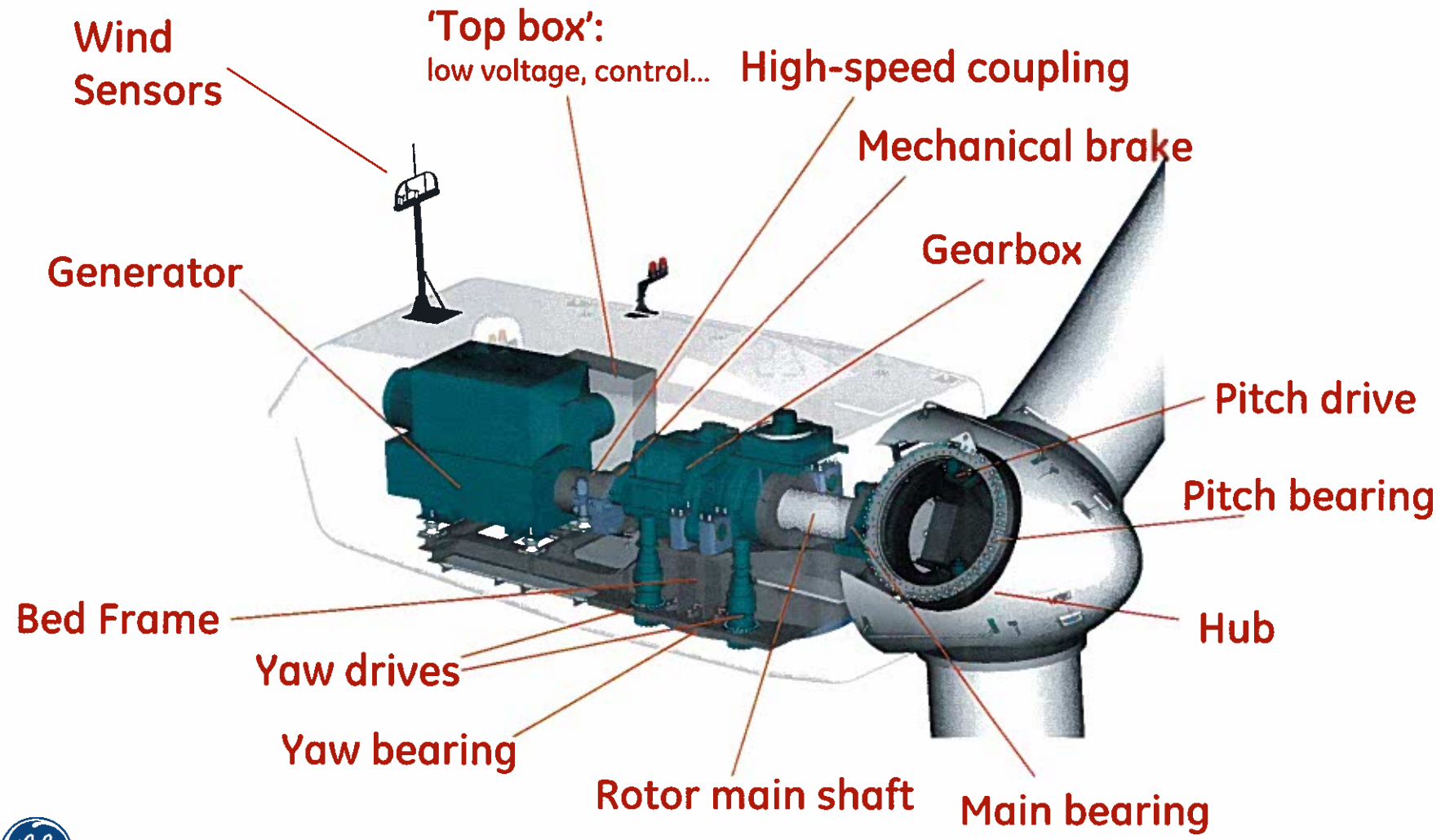
Nacelle
57 tons

Tower
130+ tons
200 to 325 ft hub height

Car (for scale)

imagination at work

Nacelle Components GE 1.5 Turbine Series



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GE in Greenville

- **Gas turbines**
  - Heavy duty (40–500MW)
  - Combined cycle

- **Wind turbines**
  - Land based (1.5MW, 2.5MW)

Two main product lines …

3000+ employees … Split between Engineering & GSCM

Engineering

- Wind systems
- Blades, Nacelles & Towers COE
- Drive Systems COE
- Controls & Power Electronics
- Materials & Processes
- Wind Advanced Technology Ops
- Aerodynamics
- Test & Validation
- Six Sigma Quality
- Safety

Supply Chain

- Fulfillment Mgr
- Sourcing Quality Ldr
- Global Commodity Leaders:
  - Castings
  - Forgings
  - Composites
  - Gearbox
  - Bearings
  - Electrical
  - Fabrications
  - Parts & Svcs

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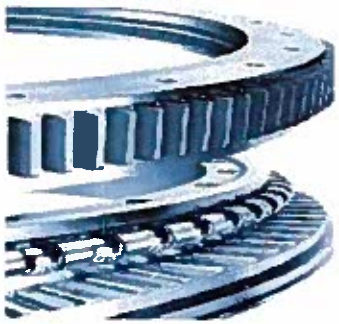
Sourced in the US

Already produced in the US:

Blades, Tower, Gearbox, Controls, Casting, Forging, Main Bearings, P&Y Bearings, B&C parts . . .



Start in 2010:

Pitch & Yaw bearings

Greer, SC

Since 2004:

Hub & MH assy

Pensacola, FL

In discussion:

Pitch & Yaw Drives

NC

Current Needs:

Wire harnesses, Ring rolling, Foundry

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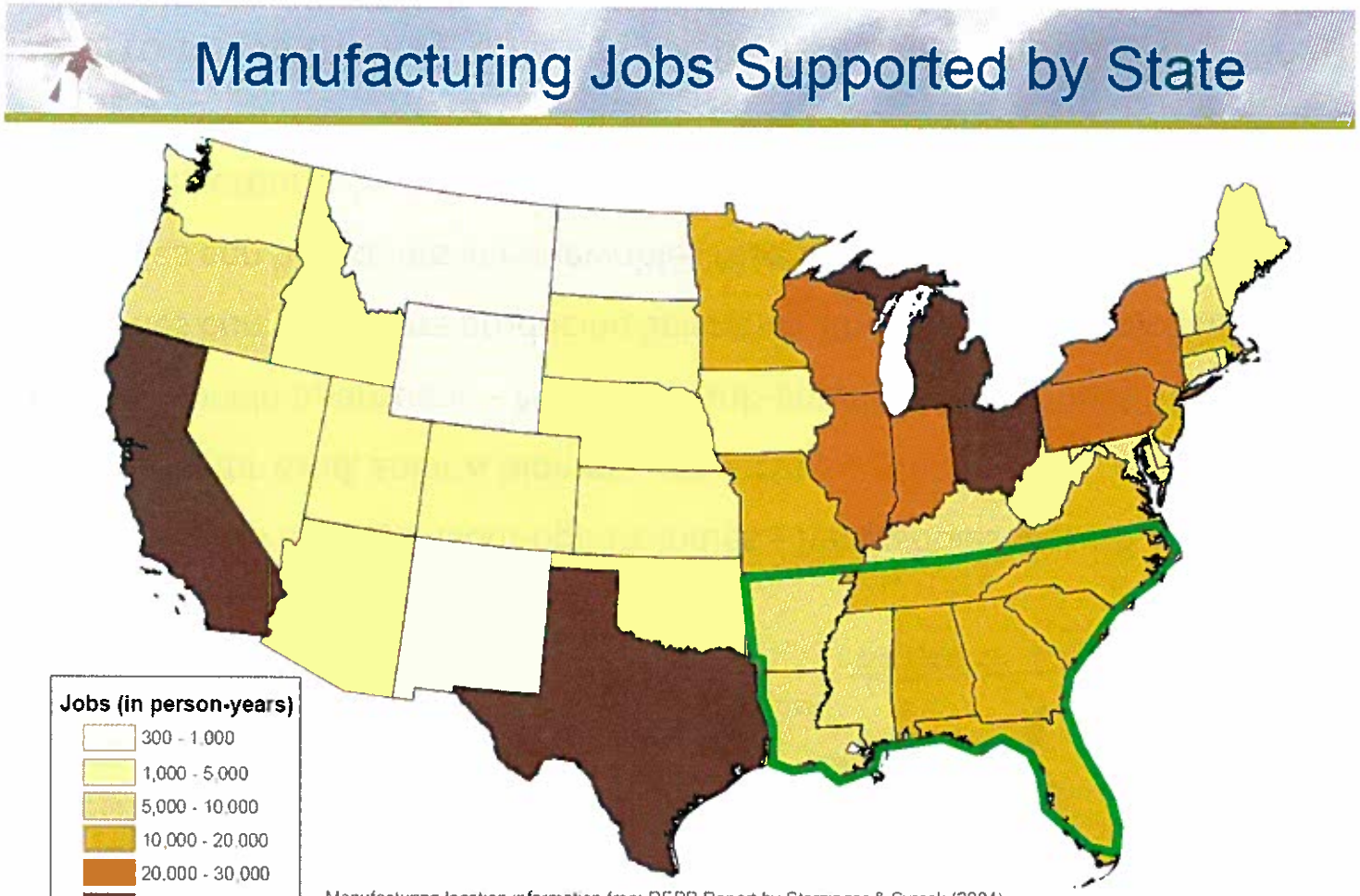
Opportunity to attract others. . .

20% wind ... green collar jobs by state



Manufacturing location information from REPP Report by Sterzinger & Svrcek (2004)

Major component assumptions: 50% of blades are manufactured in U.S. in 2007 increasing to 80% by 2030, 26% of towers are from the U.S. in 2007 increasing to 50% by 2030 and 20% of turbines are made in the U.S. increasing to 42% by 2030.

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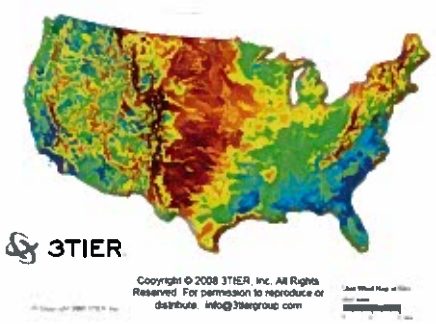
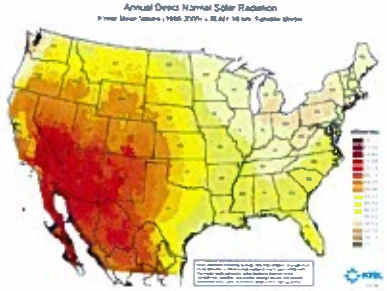
Recent hearing before Subcommittee on Energy & Environment of the House Energy & Commerce Committee entitled "Renewable Energy: Complementary Policies for Climate Legislation"

"Designing a federal standard that is acceptable to the Southeast has clearly emerged as the major challenge to passage of a bill"

Wind



Solar



Response:

- Solar PV & biomass are significant opportunities – Renewables growth . . . Jobs
- Lower cost mfg for wind, solar & biomass products . . . Jobs
- GE GVL & Pensacola operations – Numerous sub-suppliers throughout the region . . . Jobs
- SE Universities can be leaders producing Scientists, Engineers & Technicians . . . Jobs
- SE Universities can be leaders in Renewables research . . . Technology
- Offshore wind getting a look . . . SC preparing for the possibilities [1]

Policy certainty is the key enabler for Renewables supplier base expansion

[1] https://www.santeecooper.com/portal/page/portal/SanteeCooper/Press/windEvent_poster.pdf

Offshore Project Resource Challenges

- **Transportation**
  - Cables
  - Towers
  - Foundations
  - Nacelles
- **Heavy Duty Equipment Availability**
  - Specialized Equipment Required:
    - Heavy-lift jack-up barges & cranes
    - Large pile-driving hammers & eqpt
    - Marine cable-laying equipment
- **Specialized Manufacturers & Suppliers Required:**
  - Heavy steel rolling/welding
  - Submarine cable production
  - Foundries for cast hubs & frames

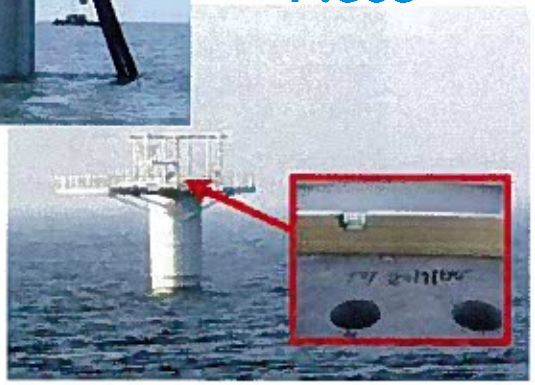
Sea Cable Installation

Offshore Wind Turbine Installation

Pile Transport

Pile Placement

Transition Piece



Nacelle Loading

Nacelle Lift

Tower and Nacelle

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South Carolina Offshore Wind

Overview of Studies

Liz Kress and Eric Boessneck

Topics

I. Work that has been done so far.
II. Planned work, near term.
III. Further work that is needed.
IV. Wind data review – Eric Boessneck

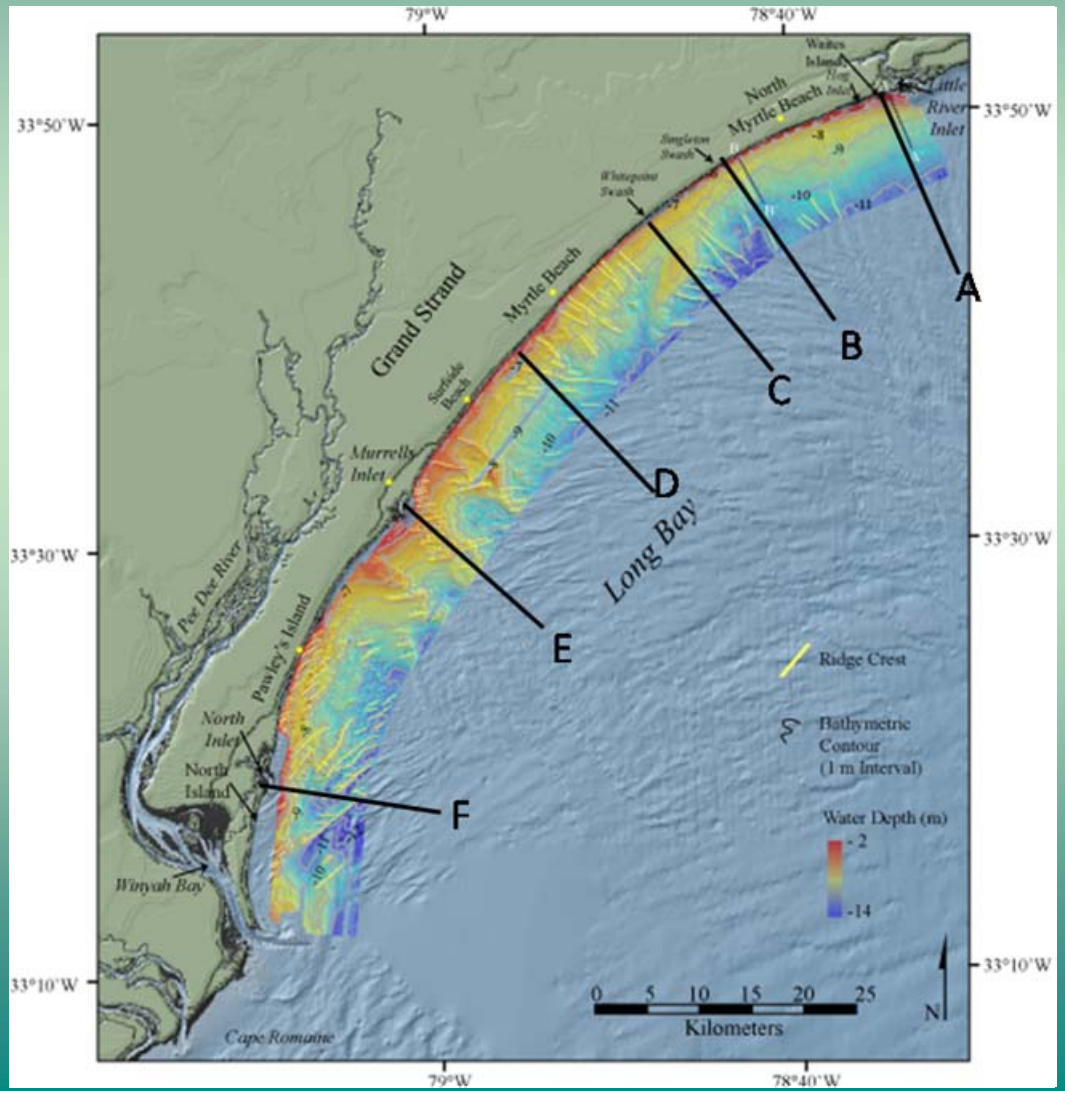
Wind Study Overview

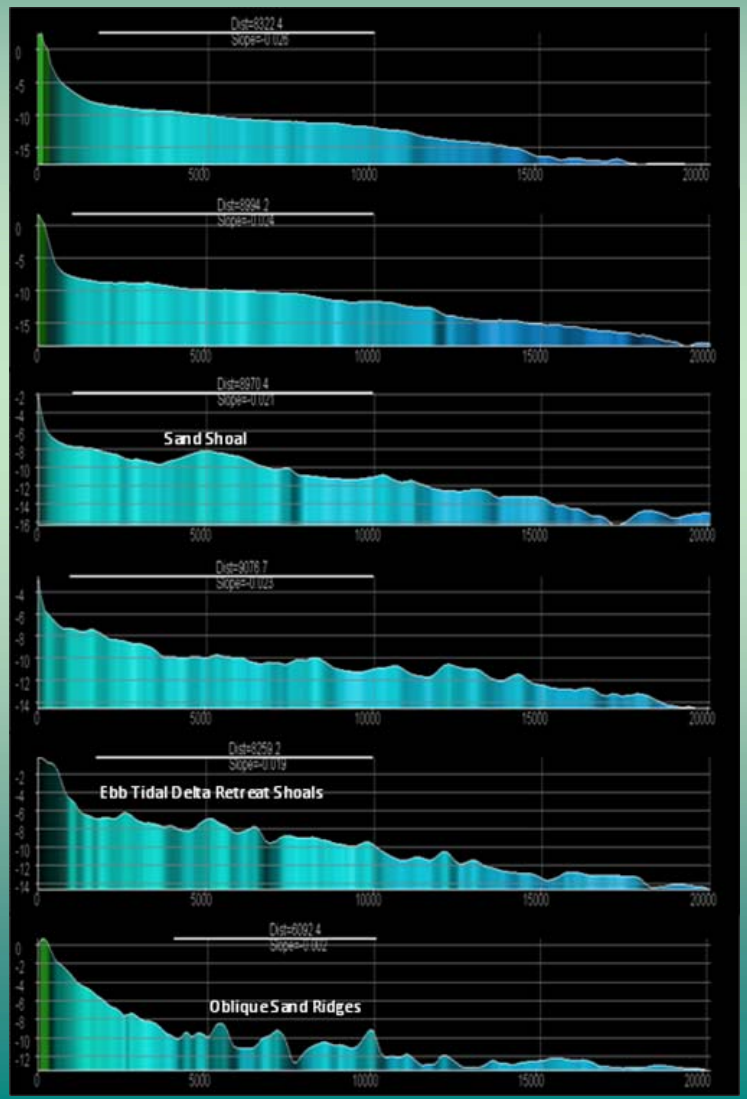
- Wind Mapping
- Southeast Regional Off-shore Wind Symposium
- Five Anemometer Stations
- SODAR development for offshore use
- Coastal Wind for Schools Program

  3 schools, Coastal Carolina Univ and SCCHR
- Extensive Study of Offshore Wind Potential
  - **In partnership with SC Energy Office, CCU, Sav River Nat Labs, Clemson (CURI and SCIES), Eco-Energy**
  - **Grants to develop the data, plans and rules needed**
  - **As far advanced as any other state in our study (just no name on a project)**

Physical Oceanography

- Depth Contours

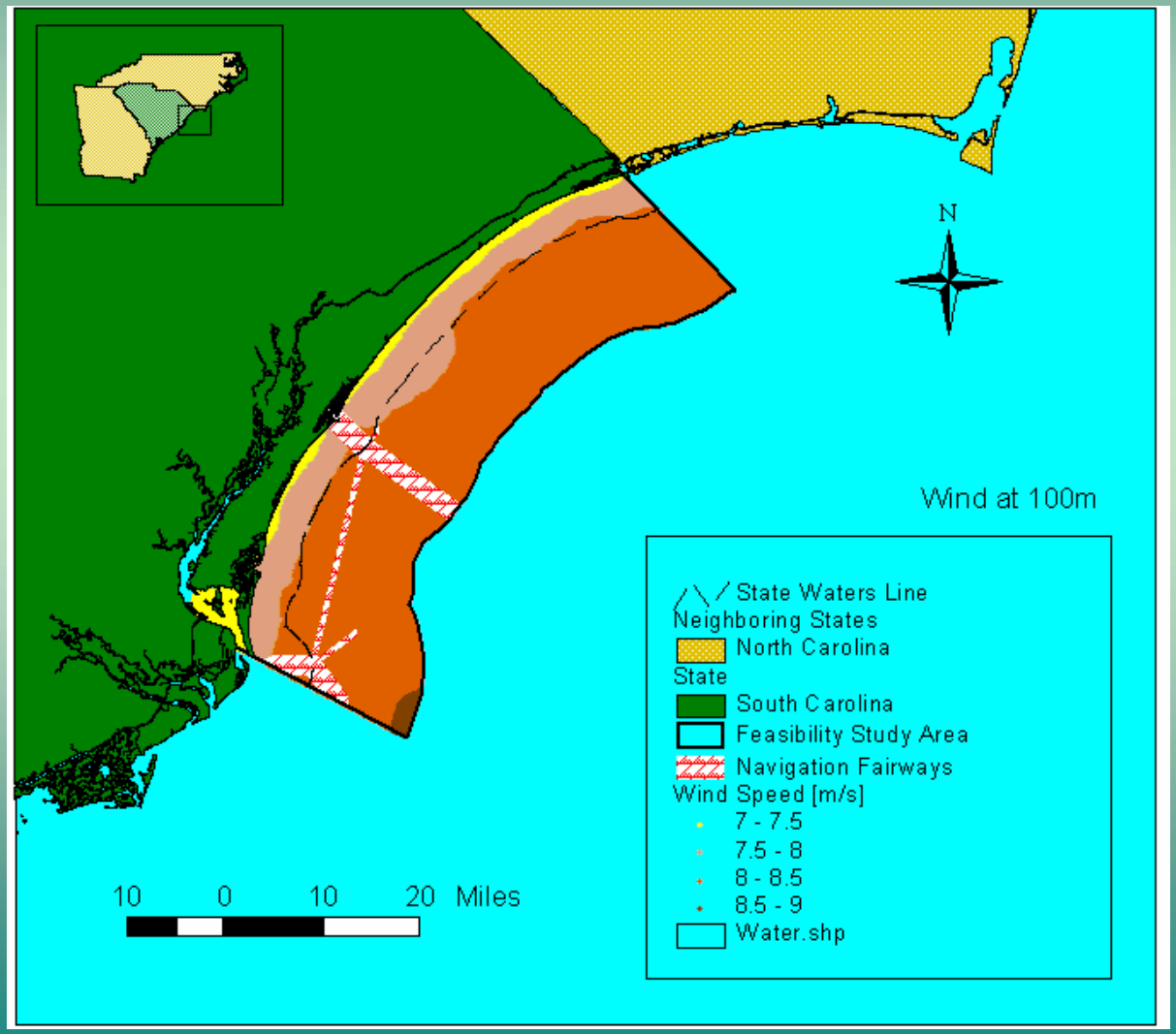




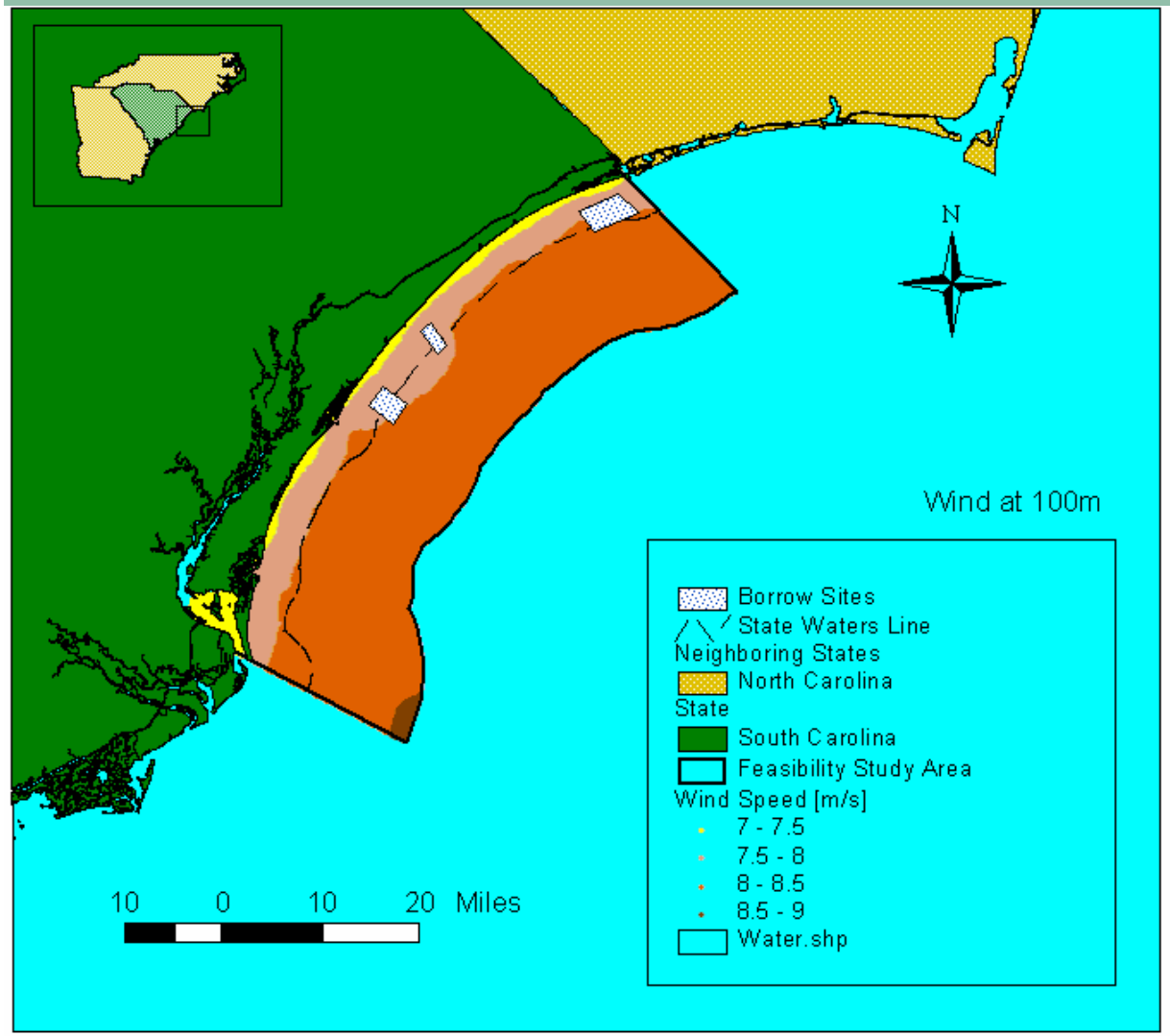
Environmental Impact Conclusions

- Environmental impacts appear to be acceptable
- Careful site selection is critical
- Bird migratory and breeding areas may impact locations
- Whales, dolphins and manatee will be impacted during construction phase
- Turtles could be impacted, especially in coastal areas (cabling)
- Site specific studies should be performed

Site Selection - Exclusion Zones
- Navigation Fairways



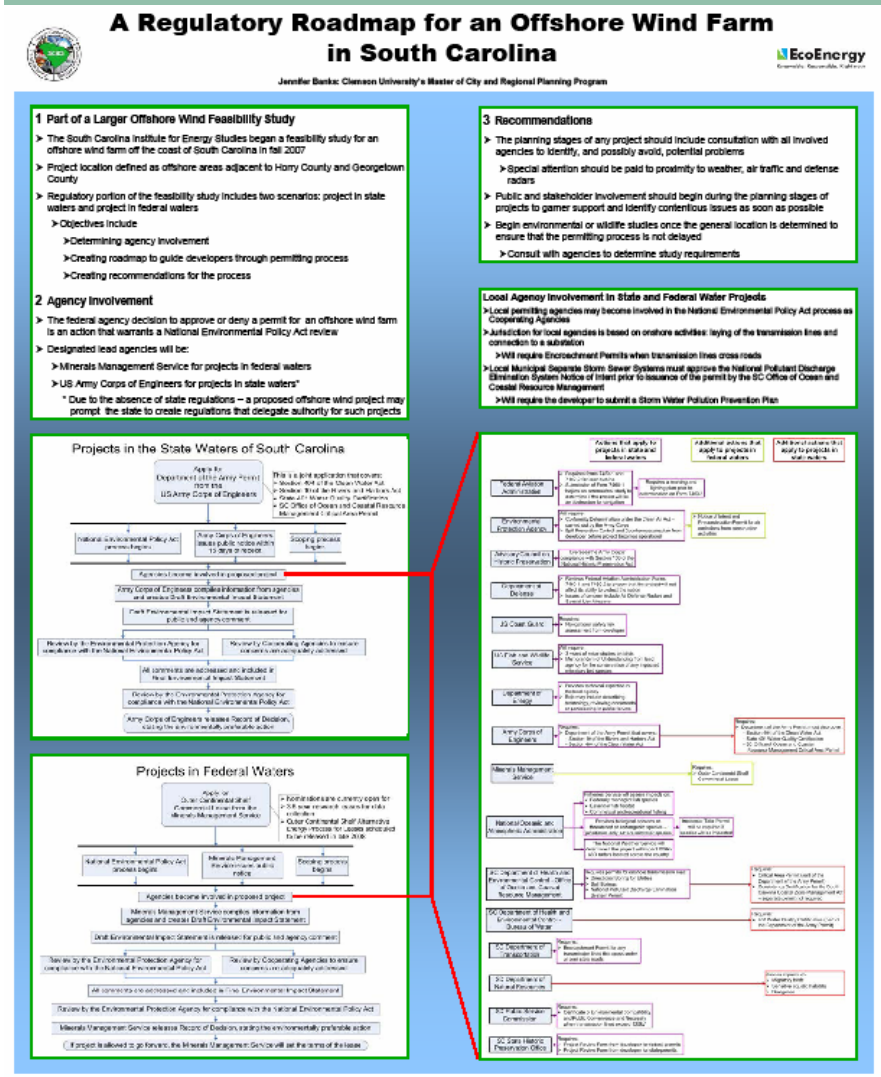
Site Selection - Exclusion Zones
- Remaining Feasible Areas



Exclusion Zones Studied

- Navigation
- Aviation
- Surveillance Radars
- Wrecks and Obstacles
- Reefs
- Special Fish Mgmt Zones
- Dredge Dump Sites
- Sand Borrow Areas
- Fish Habitat Areas
- Shellfish Harvest Areas
- Red Drum Habitats

South Carolina Offshore Wind Permitting Study



Focus topic from Clemson's Offshore Wind Feasibility

Jennifer Banks, MS Thesis – now working for AWEA

Topics

I. Work that has been done so far.

II. Planned work, near term.

III. Further work that is needed.

IV. Wind data review – Eric Boessneck

SC Roadmap to Gigawatt-Scale Coastal Clean Energy Generation: Transmission, Regulation, Demonstration

3-part Mission:

1. Study Transmission Infrastructure and Develop Options for Integrating Offshore Wind
2. Study Wind, Wave and Current Energy for Wind Turbine Foundation Design and for Other Potential Marine Energy Development
3. Regulatory Coordination Task Force to Develop Permitting Process

Partners:

SCEO CURI CCU
Santee Cooper NCSU

Transmission Study

- Clemson Univ's South Carolina Institute for Energy Studies (SCIES)- lead
- Clemson Univ Electric Power Research Association will assist
  - Has access to transmission information
  - Has support and coordination in place with other state utilities (Scana, Duke, Progress)
- Addressing best way to integrate up to 3GW of offshore wind
  - Intermittency
  - Transmission access from offshore
  - etc.

Buoy Study

- Palmetto Winds Research Project
- Study Wind, Wave and Current Energy for Wind Turbine Foundation Design and for Other Potential Marine Energy Development.
- 6 instrumentation buoys and 2 shore-based observation stations deployed along lines out from Winyah Bay and Little River.
- DOE Grant provides partial funding, and Santee Cooper provided additional funding to extend study to one year in duration.
- After 6 months of data, will look for a site for an anemometer station.

Regulatory Task Force

- SC Energy Office will coordinate a team of the necessary state agencies to develop offshore wind regulations for the state.

- Catherine Vanden-Houten is here to introduce her approach to this.

Topics

I. Work that has been done so far.

II. Planned work, near term.

III. Further work that is needed.

IV. Wind data review – Eric Boessneck

Key Issues for Wind Power

- Policy Uncertainty
- Siting and Permitting: avian, noise, visual, federal land
- Transmission: FERC rules, access, new lines
- Operational impacts: intermittency, ancillary services, allocation of costs
- Accounting for non-monetary value: green power, no fuel price risk, reduced emissions

Future Study Needs

I. Permit Application for Offshore Anemometer

II. Port Refurbishment Study
- Georgetown – niche facility for construction support and O&M support
- Charleston – possible manufacturing site for wind turbine components (old Navy base?)

III. Public Outreach and Education for Offshore Wind Development

IV. Workforce Development in SC

V. Economic Development in SC- recruiting new industry?

VI. Environmental Impact Study

Topics

I. Work that has been done so far.

II. Planned work, near term.

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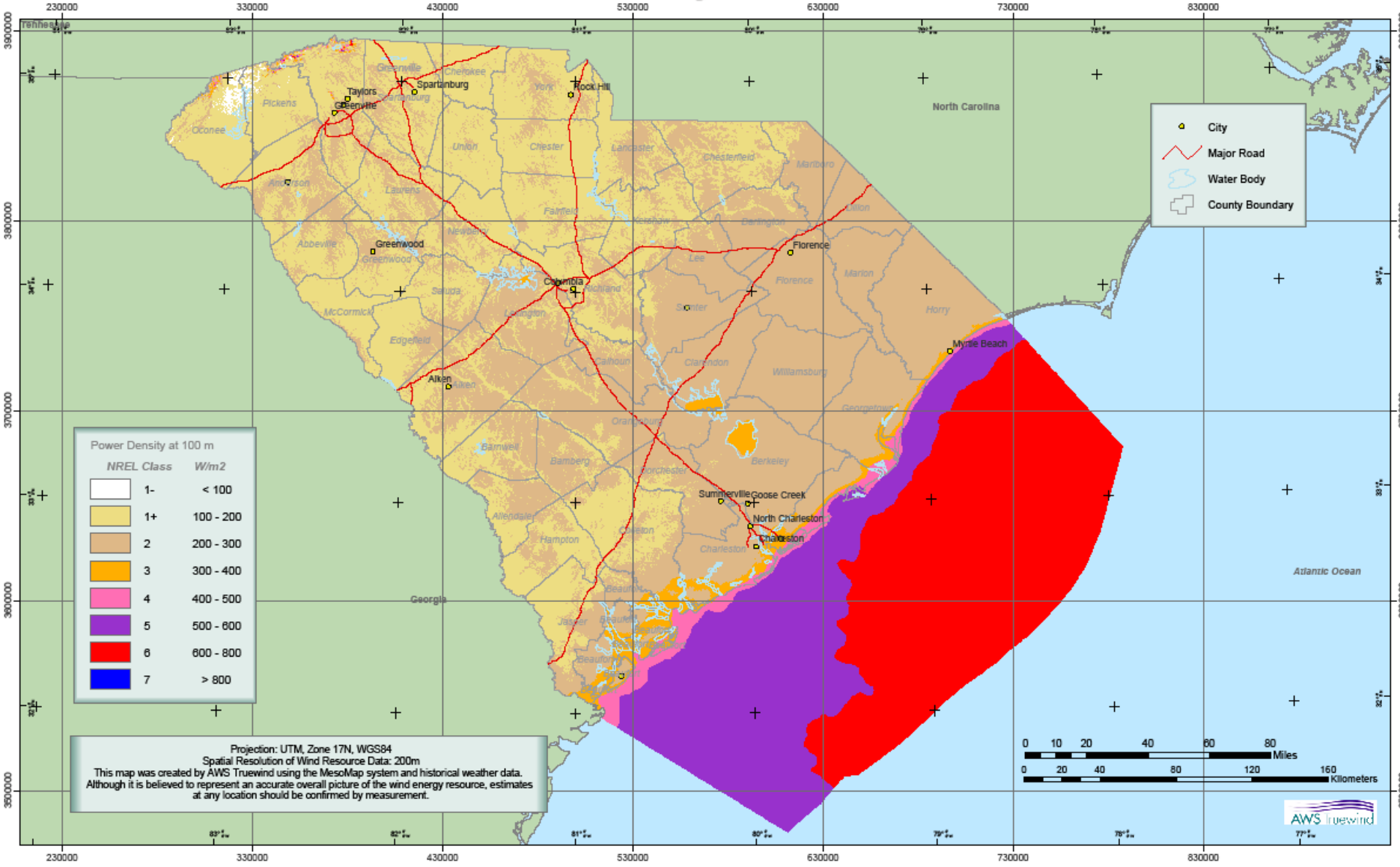
IV. Wind data review – Eric Boessneck

Mean Annual Wind Power Density of South Carolina at 100 Meters



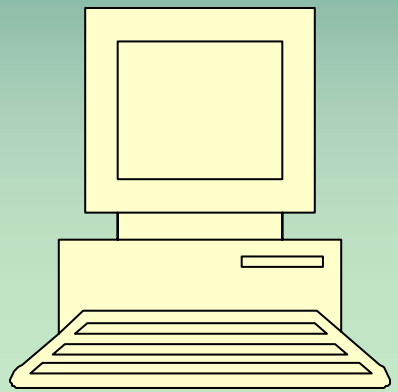
Review of Existing Data

Data managed and made available by NOAA

Station ID	Station Type	Station Manager	Location	Distance Offshore km (mi)	Anemometer Height m (ft)	Water Depth m (ft)
FPSN7	Light Tower	National Data Buoy Center (tower is decommissioned)	SE of Southport, NC	61 (38)	44.2 (145)	14[2] (46)
SNSN7	Water Level	Caro-COOPS	Sunset Beach, NC	Pier-based	9 (30)	1 (3.3)
41024	Buoy	Caro-COOPS	SE of Sunset Beach	2.5, (1.6)	3 (10)	11 (36)
41027	Buoy	Caro-COOPS	SE of Sunset Beach	71.3 (44.3)	3 (10)	28 (92)
NIWS1	Weather	National Estuarine Research Reserve System	North Inlet-Winyah Bay Reserve, SC	Pier-based	10.7 (35)	--
MROS1	Water Level	NOAA's National Ocean Service	Springmaid Pier, SC	Pier-based	9 (30)	1 (3.3)

One Year Wind Study – 3 Sites

NRG 50M Mobile
Anemometer Station



Clemson
University

Data Logger

Real-time Data Acquisition

Santee Cooper

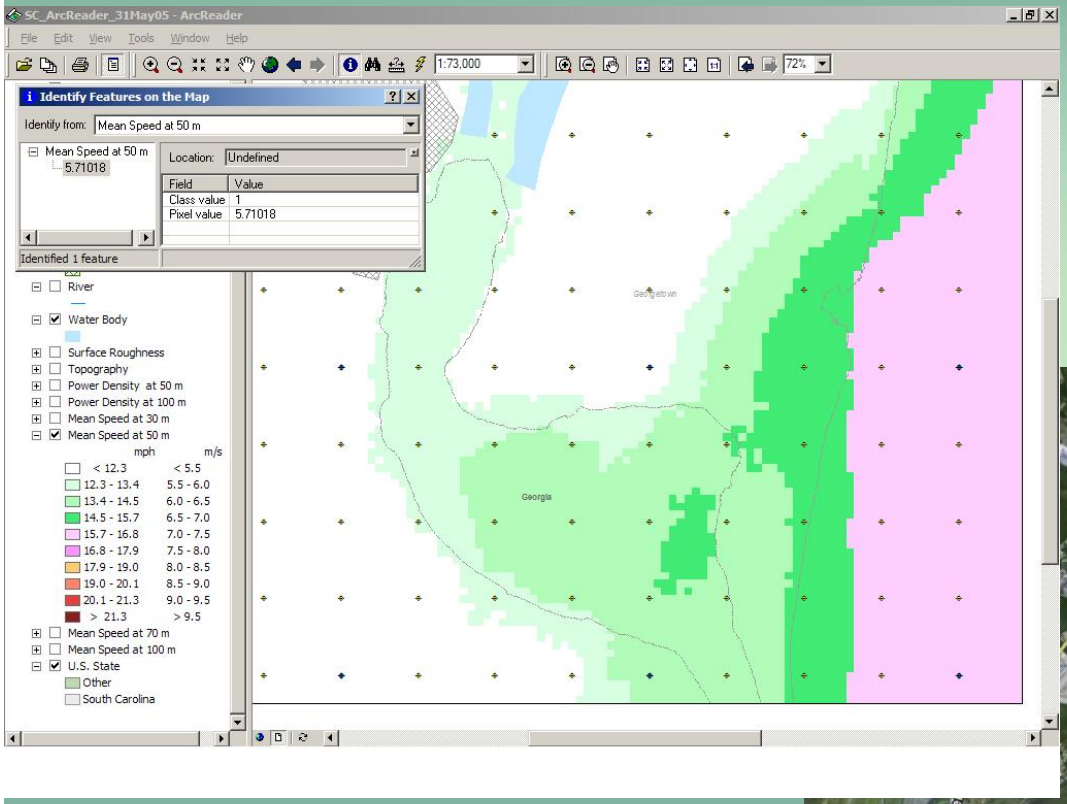
Public

Host Institution

Station at Coastal Carolina University Waties Island: June 2007

Station at Baruch Foundation, Georgetown: August 2008

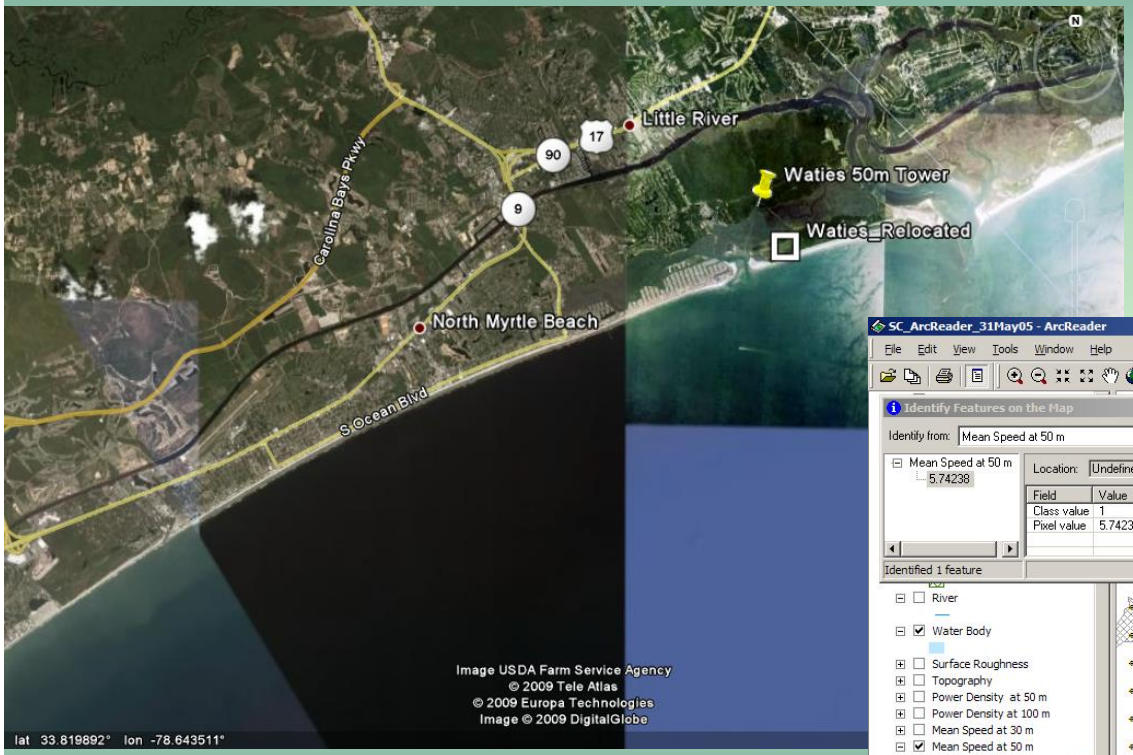
50m Tall Tower Data: Correlation

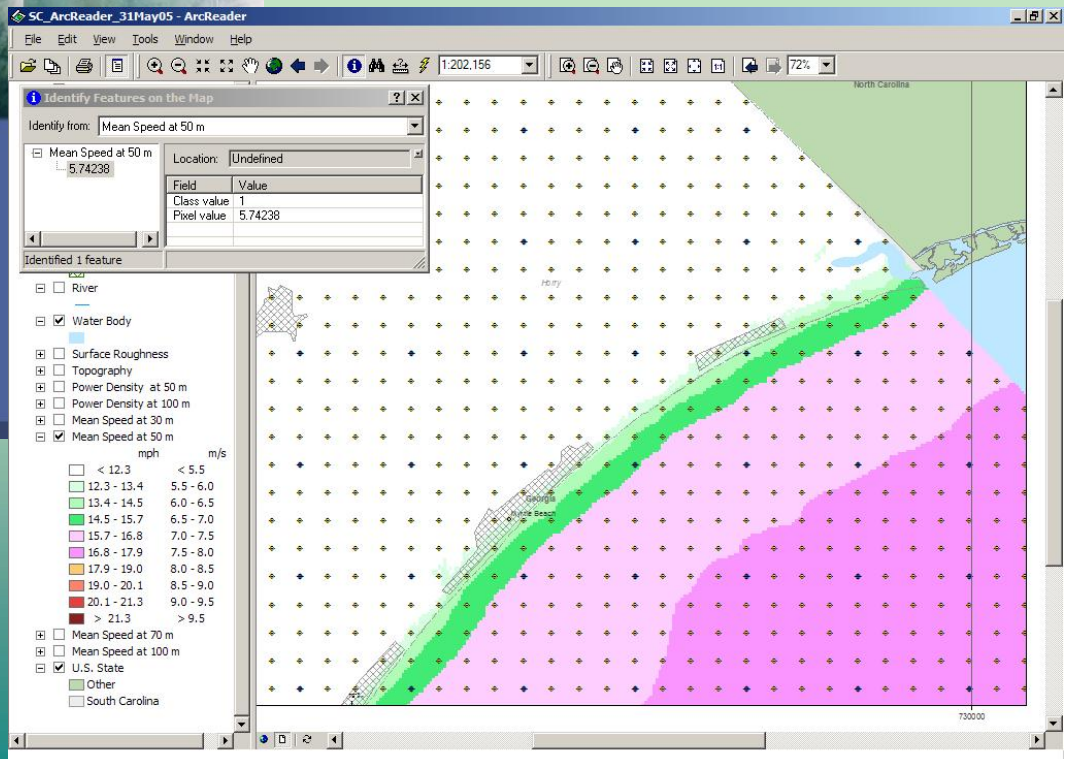


Baruch Data: 5.7 m/s

AWS Prediction: ~5.8 m/s

50m Tall Tower Data: Correlation



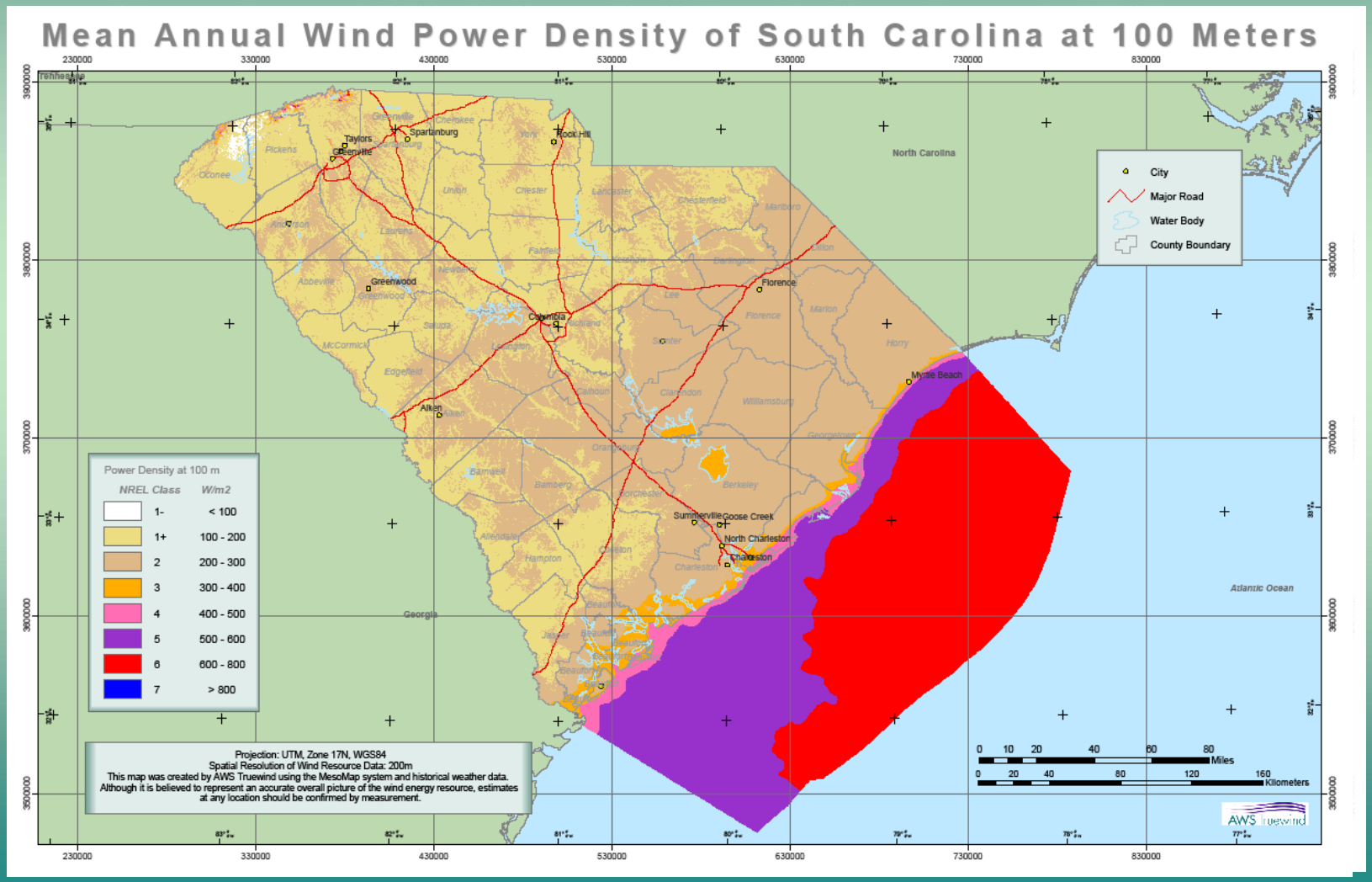


Waties Data: 4.8 m/s

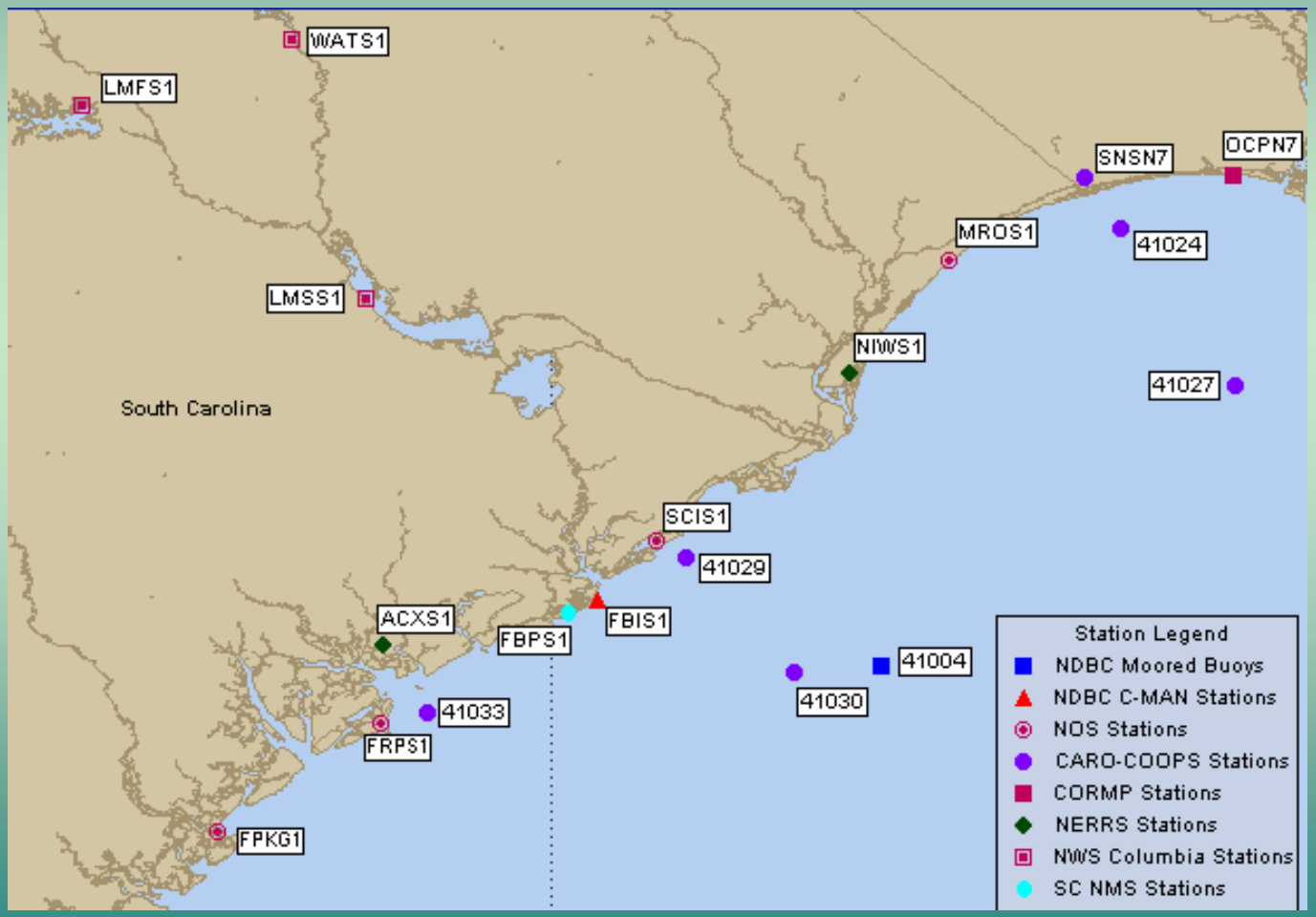
Clemson Model: 5.7-5.9 m/s

AWS Prediction: ~5.75 m/s

50m Tall Tower Data: Implications



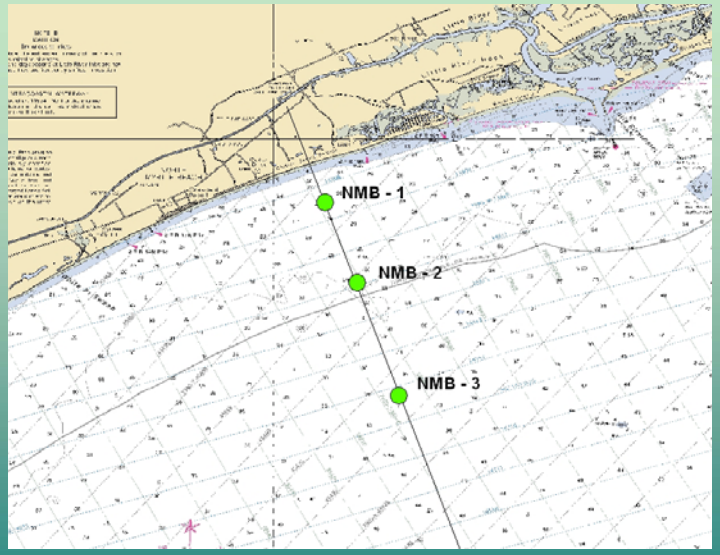
Next Step: Verification



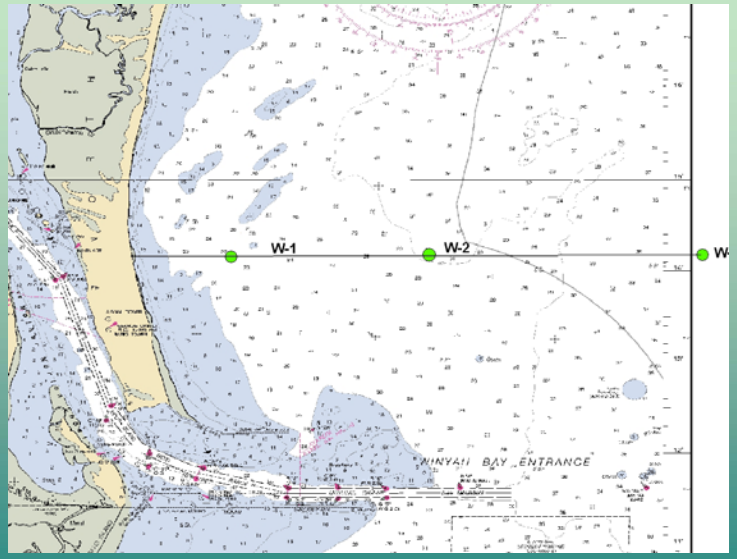
Interactive Map from NOAA's National Data Buoy Center www.ndbc.noaa.gov/

Palmetto Winds Research Project

- DOE Grant provides partial funding, Santee Cooper provided funding to extend study to one year
- 6 instrumentation buoys, 2 shore-based observation stations
- Will study wind, wave, and current energy for foundation design and marine energy potential



North Myrtle Beach



Winyah

Anemometer Tower

60m monopole on pilings

150m lattice tower on gravity foundation

Fig.3: Arkona Becken Südost platform.

SODAR Technology

TRITON SONIC WIND PROFILER

- Collects data without being attended, just like a met mast.
- Data is ready to use, reported just like the anemometry data from a met mast.
- Works under all conditions—made of rugged plastic with polyester lining, has drainage scuppers and other all-weather features
- Patented hex array provides optimal beams that virtually eliminate side lobes.
- Triton is bundled with SkyServe Satellite Wind Data Service to deliver data to any computer from any location in North America.
- Precision-manufactured as a self-contained unit.
- Compact—six feet tall with 6 x 6 footprint.

Triton Profiler Features

- Polyethylene shell
- Non-woven polyester lining*
- Aluminum substructure, stainless steel hardware
- Hexagonal transducer array,* tri-lobed enclosure*
- Vertical recessed array, acoustically transparent plastic protective screen*
- Aluminum sound mirror, large drainage scupper
- Hinged, tool-free latchable front door, array plate, and electronics enclosure
- ARM and Blackfin processors
- SD memory card socket
- Rear door
- Operator panel
- Power consumption: less than 10 watts average
- Orientation sensors
- GPS receiver
- Atmospheric sensors
- Operating range: –40° to 150°F
- Internal nesting locations for up to four 100 AH batteries and two standard five-gallon LPG bottles
- Dimensions: 6' x 6' x 6'
- Weight: under 1000 lbs.
- Integrated 4' x 6' base

Options

- Solar charging packages
- Mirror heater system—computer-controlled 6500 BTU/Hr LPG heater
- Globalstar satellite modem
- Custom enclosed trailer

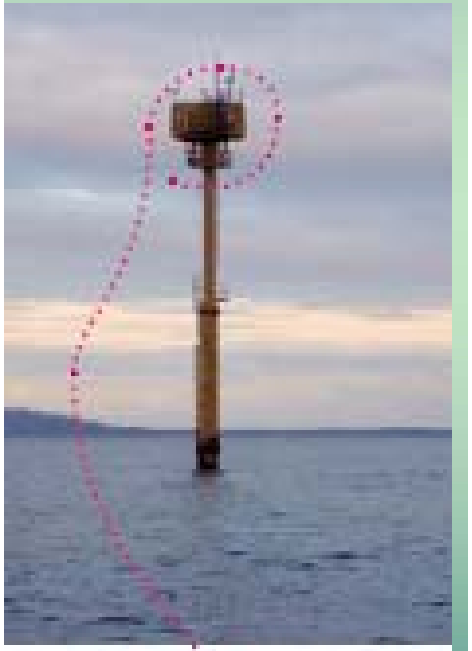
*Patents pending.

TRITON SONIC WIND PROFILER

SECONDWIND
Measurement. Management. And more.

Second Wind Inc. 366 Summer Street, Somerville, MA 02144 USA
Tel. 617-776-8520 • Fax 617-776-0391 • www.secondwind.com

LIDAR Technology



NaiKun deployment offshore in Canada

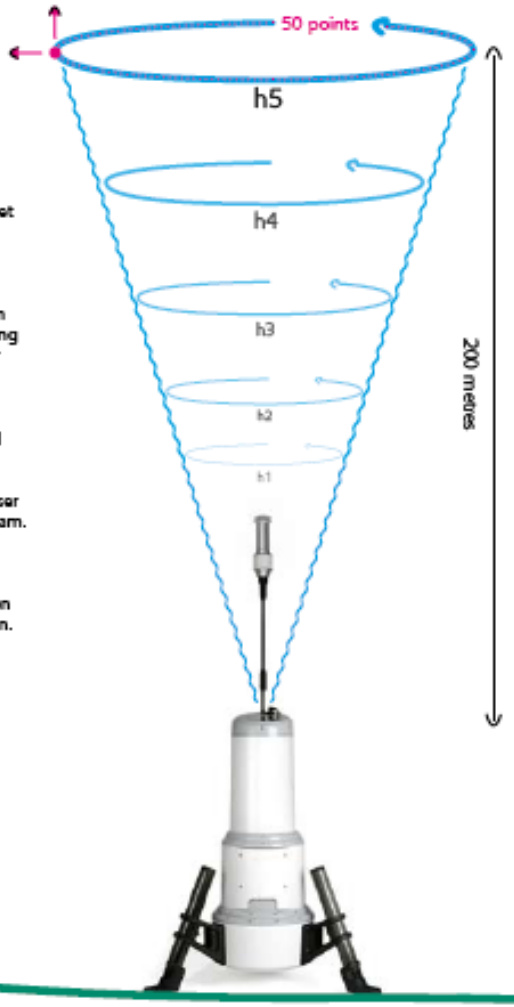
ZephIR® laser anemometer

An eye-safe infrared beam illuminates natural aerosols in the atmosphere (such as dust, pollen and droplets) and a small fraction of the light is backscattered into a receiver. Motion of the target particles along the beam direction leads to a change in the light's frequency through Doppler shift which is then accurately measured.

A conical scan pattern is used to move the beam and intercept the wind at different angles, building up a series of measurements around a disc of air from which the wind speed vector is obtained.

ZephIR obtains each measurement in just 20 milliseconds, and three seconds of data are used to derive the horizontal and vertical wind speed components and wind direction. This can be repeated up to a height of 200 metres, at five user defined heights by focussing the transmitted beam.

At each height a total of 50 points of data are gathered which enhance the quality of measurement, providing additional information on turbulence essential for sites with complex terrain.



technical specification

DIMENSIONS	Optics Pod	345 mm dia. x 660 mm
	Electronics Pod	450 mm dia. x 390 mm
	Battery Pod	550 mm dia. x 290 mm
WEIGHT	Optics Pod	28 kg
	Electronics Pod	24 kg
	Battery Pod	20 kg
	Batteries	44 kg
	Tripod	14 kg
	Met Probe	4 kg
	TOTAL	134 kg
POWER	28v @ 100W continuous 0°C to +25°C	
OPERATING TEMP.	-25°C to +40°C	
CERTIFICATION	Class 1 Laser Product eye safe to IEC/EN 60825 - 1 (2001) Safety requirements to EN61010 - 1 : 2001	
RANGE	Minimum height	10 metres
	Maximum height	200 metres
WIND SPEED	Minimum	2 m/s
	Maximum	70 m/s
LASER WAVELENGTH	1575 nm	
DATA STORAGE	12 months wind data or 24 months with upgrade	
DATA OUTPUT	1 or 3 second average wind data comprising:	

Horizontal wind speed
Vertical wind speed
Direction of wind speed
Turbulence parameter
Gusts
Height reading
Shear
Orientation
Battery status
Status flags
Reference to raw data
Time of day & date
GPS location
Pod temperatures
Temperature
Humidity
Barometric pressure

FOCUS HEIGHTS	5 user programmable heights 50 or 150 data points per height at 50 Hz
REMOTE OPERATIONS	Remote download Remote system integrity check Remote system configuration changes

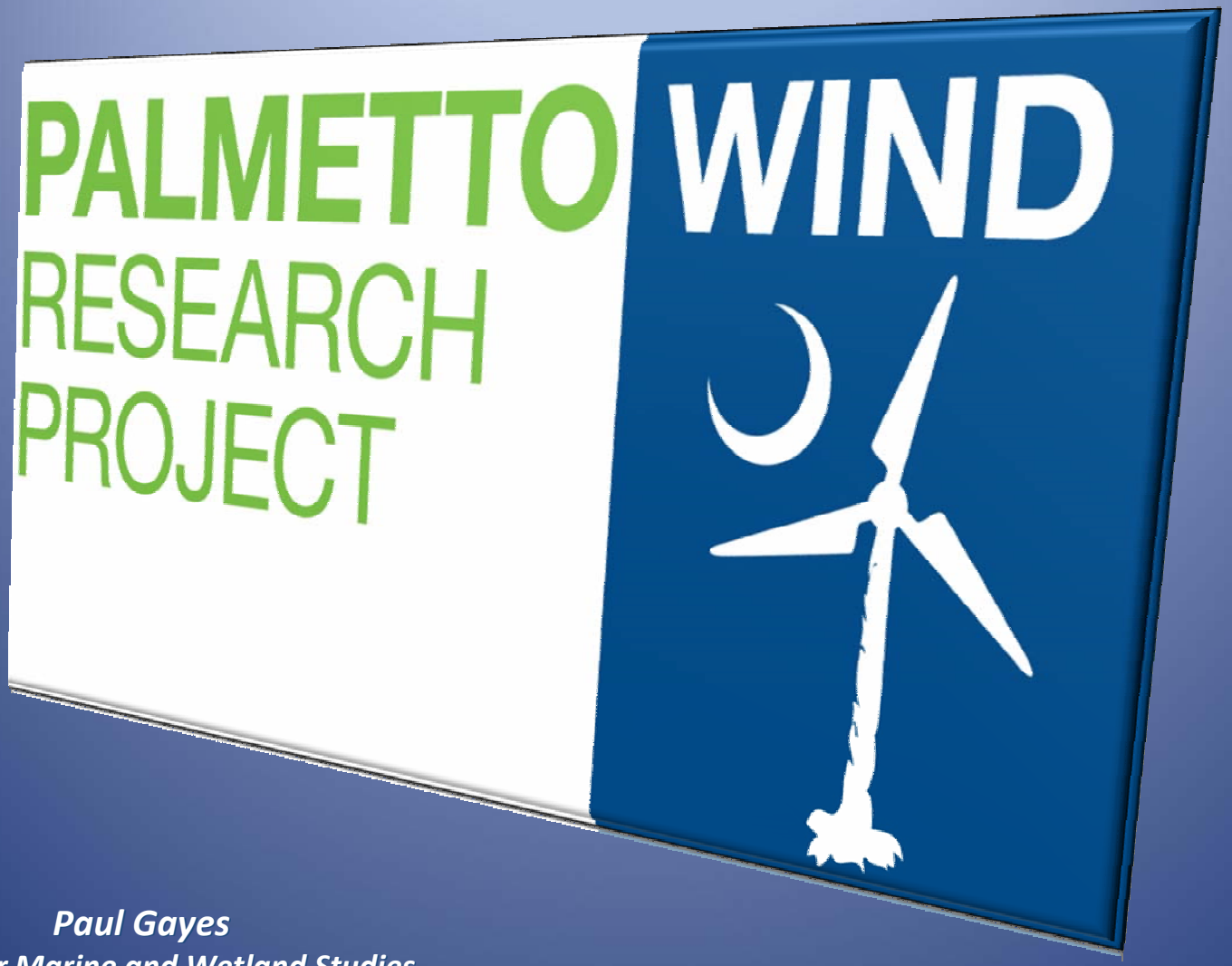
South Carolina Offshore Wind

Current Status of Investigation

Liz Kress

Principal Engineer – Renewable Energy

PALMETTO WIND RESEARCH PROJECT

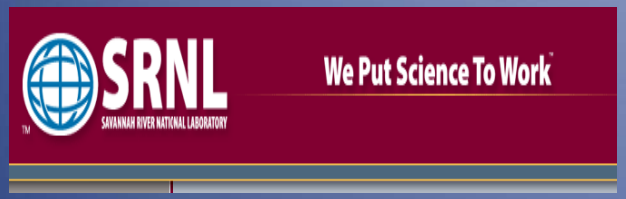


Paul Gayes
Center for Marine and Wetland Studies
Coastal Carolina University

Len Pietrafesa
Dept. of Marine, Earth and Atmospheric Science
North Carolina State University

Build on Progression of Cooperative Working Group

Stepping Offshore to Verify Potential Resource



PALMETTO RESEARCH PROJECT

WIND

Santee Cooper

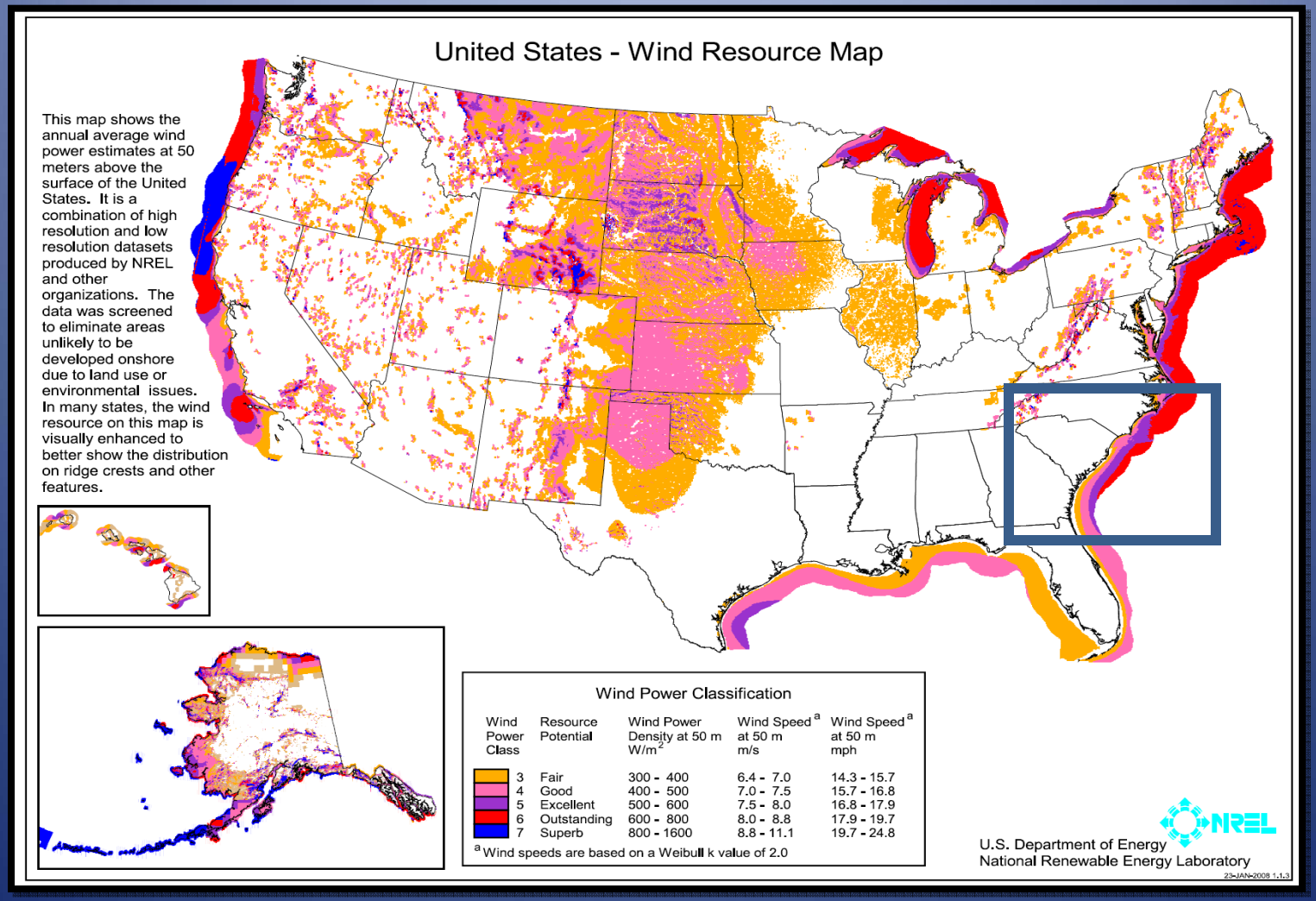
Studies Leading to a Request for Proposals from Wind Project Developers

+

SC Energy Office (US DOE)

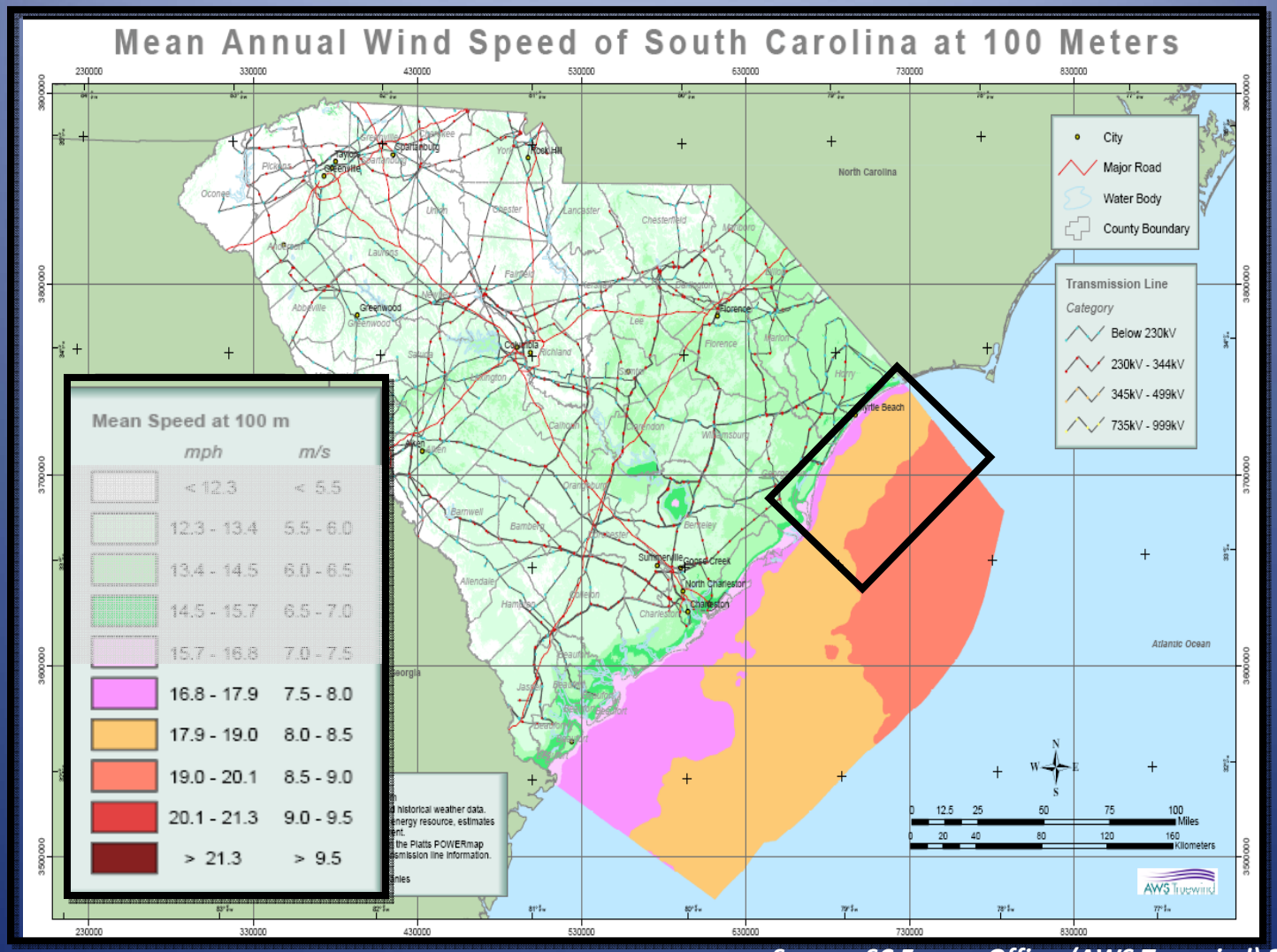
SE II: South Carolina Roadmap to Gigawatt-Scale Coastal Clean Energy Generation: Transmission, Regulation & Demonstration

Main Wind Resource Potential For U.S. - Offshore

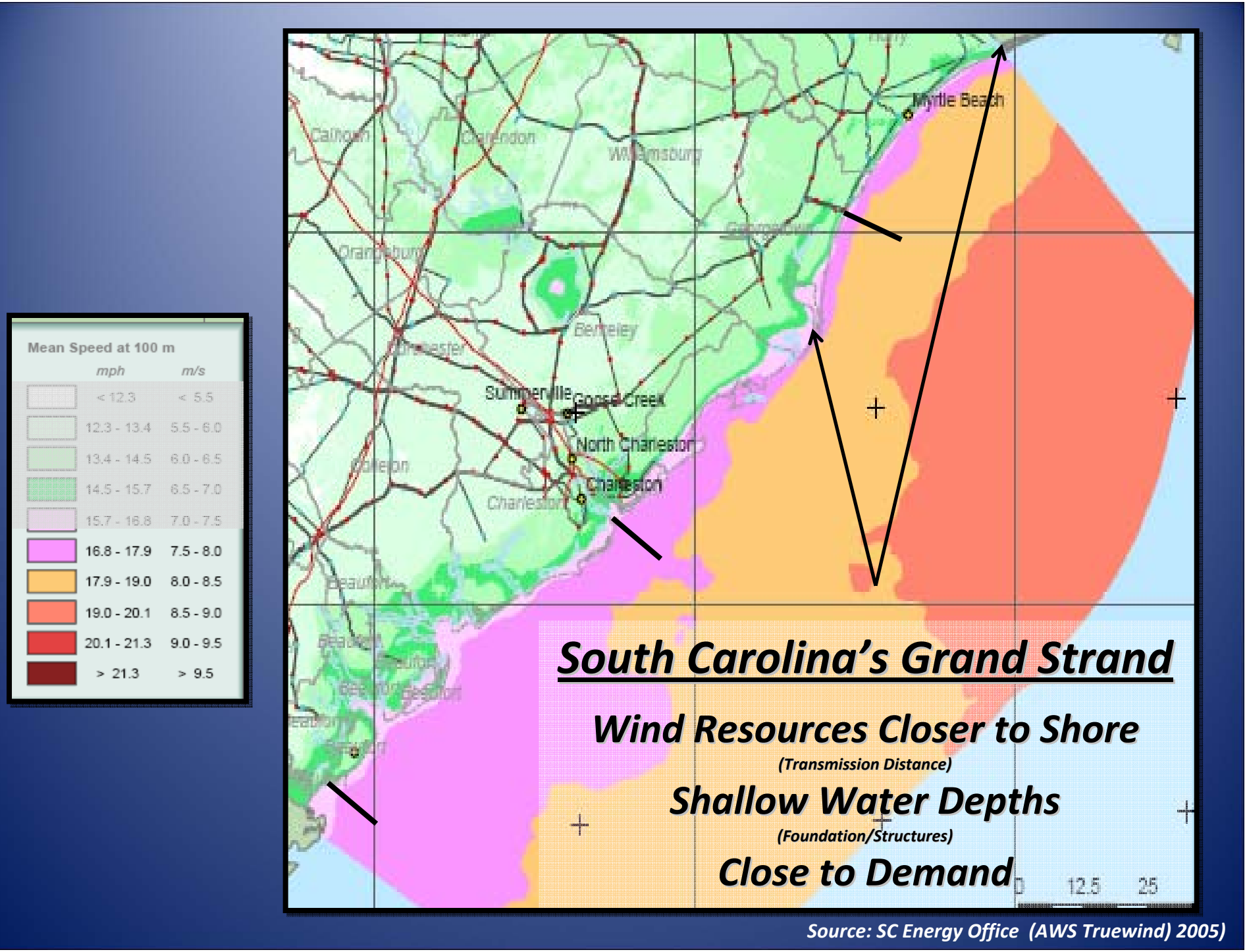


Source: US DOE National Renewable Energy Laboratory

SC Energy Office Commissions Initial Meso-Scale Regional Wind Model Characterization For SC (AWS Truewind)



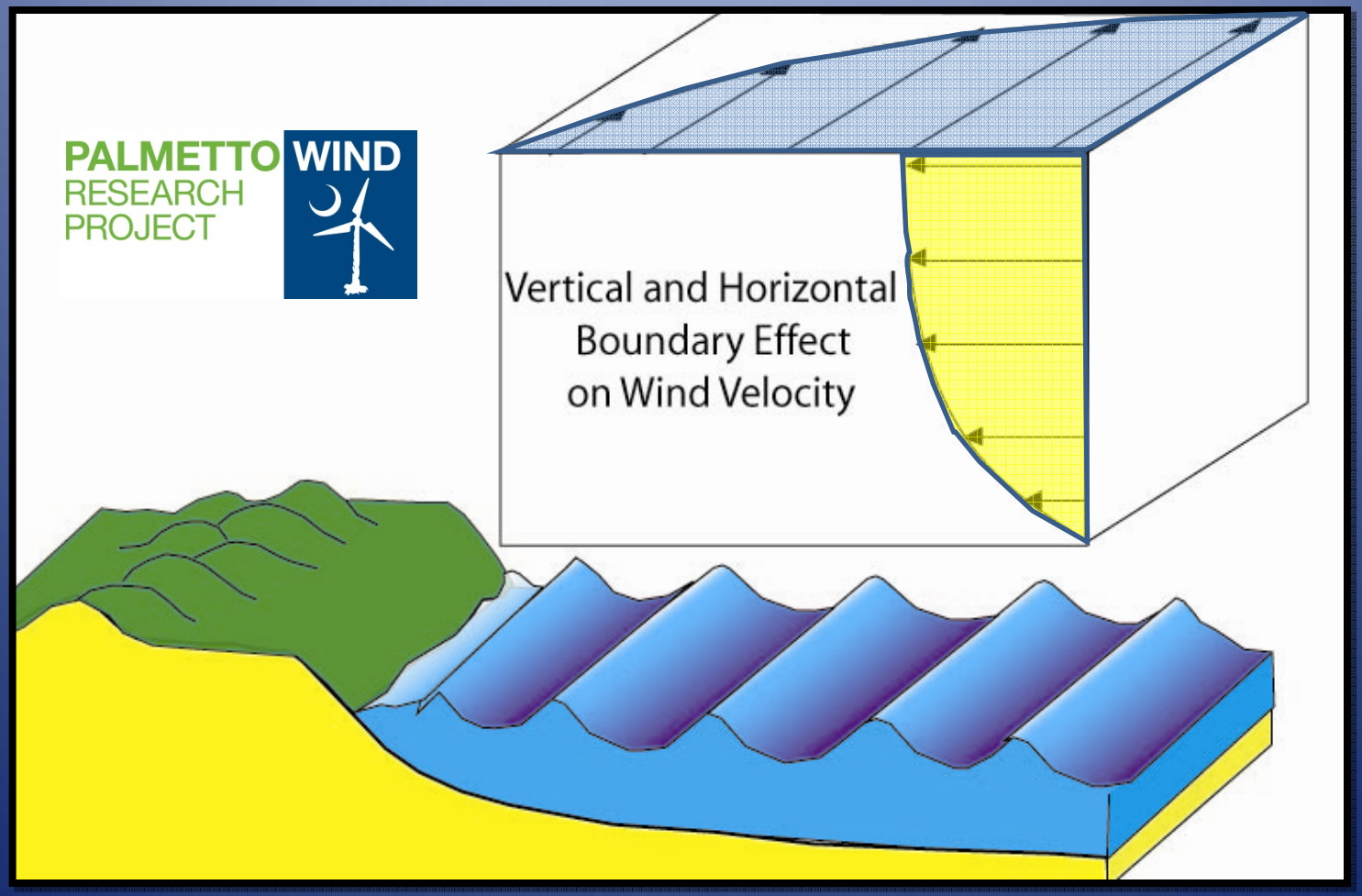
Source: SC Energy Office (AWS Truewind) 2005)



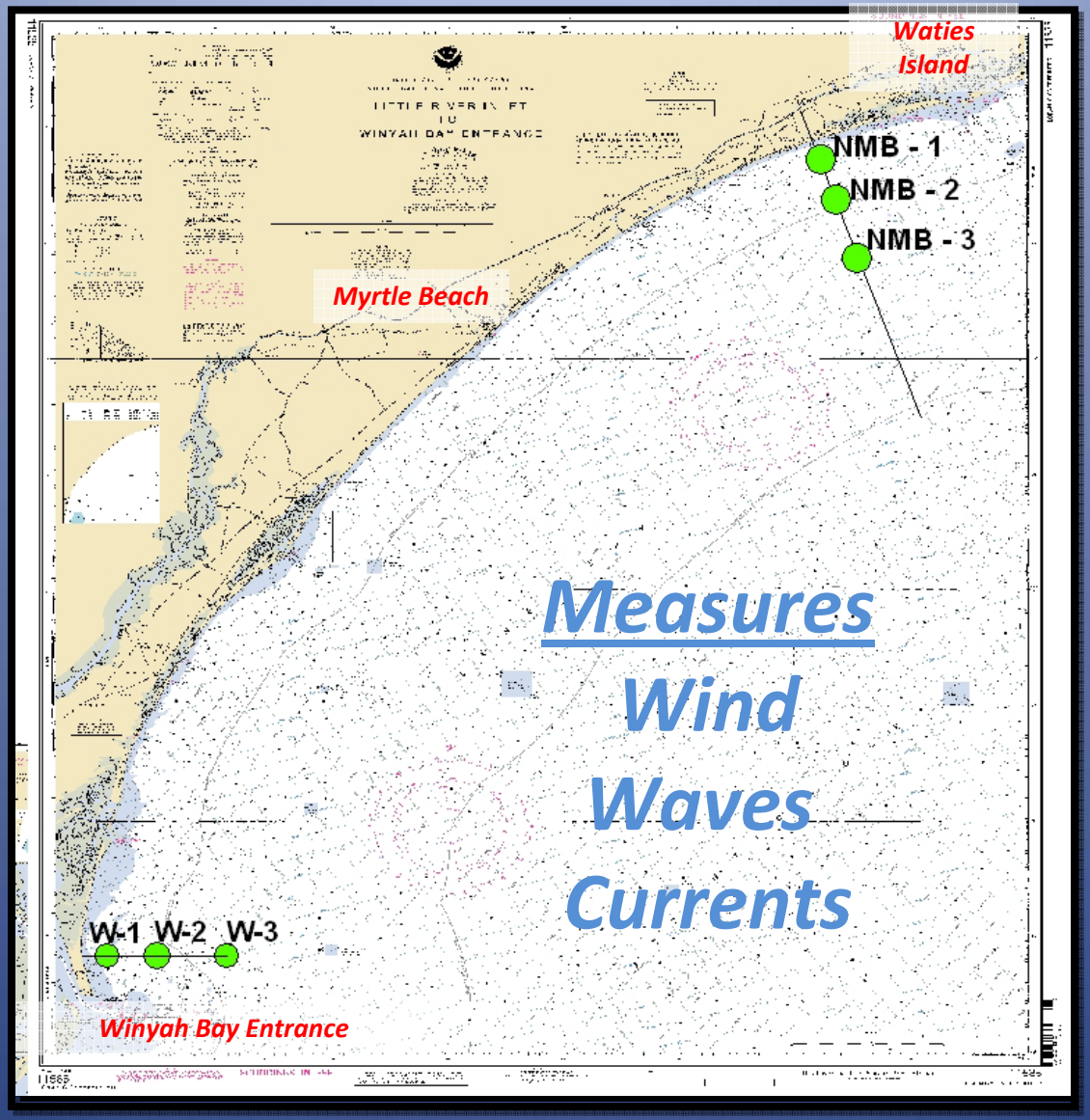
Source: SC Energy Office (AWS Truewind) 2005)

Phase I. Cross Shore Instrument Array
Atmospheric/Oceanographic Buoys

Phase II. Vertical Instrument Array
Offshore Instrument Platform



Cross-Shore Verification

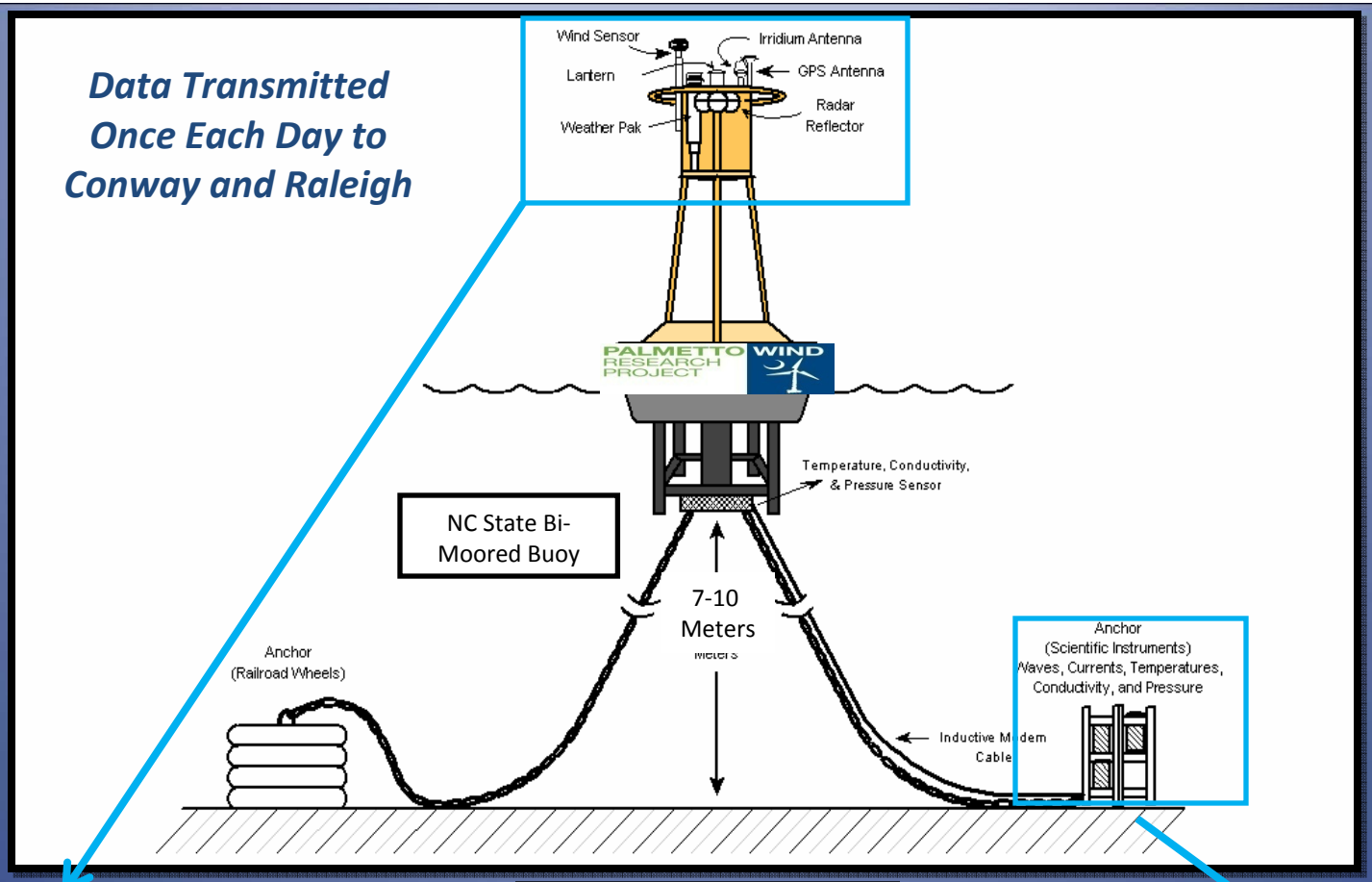


Two Shore-Normal Instrumentation Transects

Instruments @ Beach , 1.5, 3 and 6 Miles

PALMETTO WIND RESEARCH PROJECT

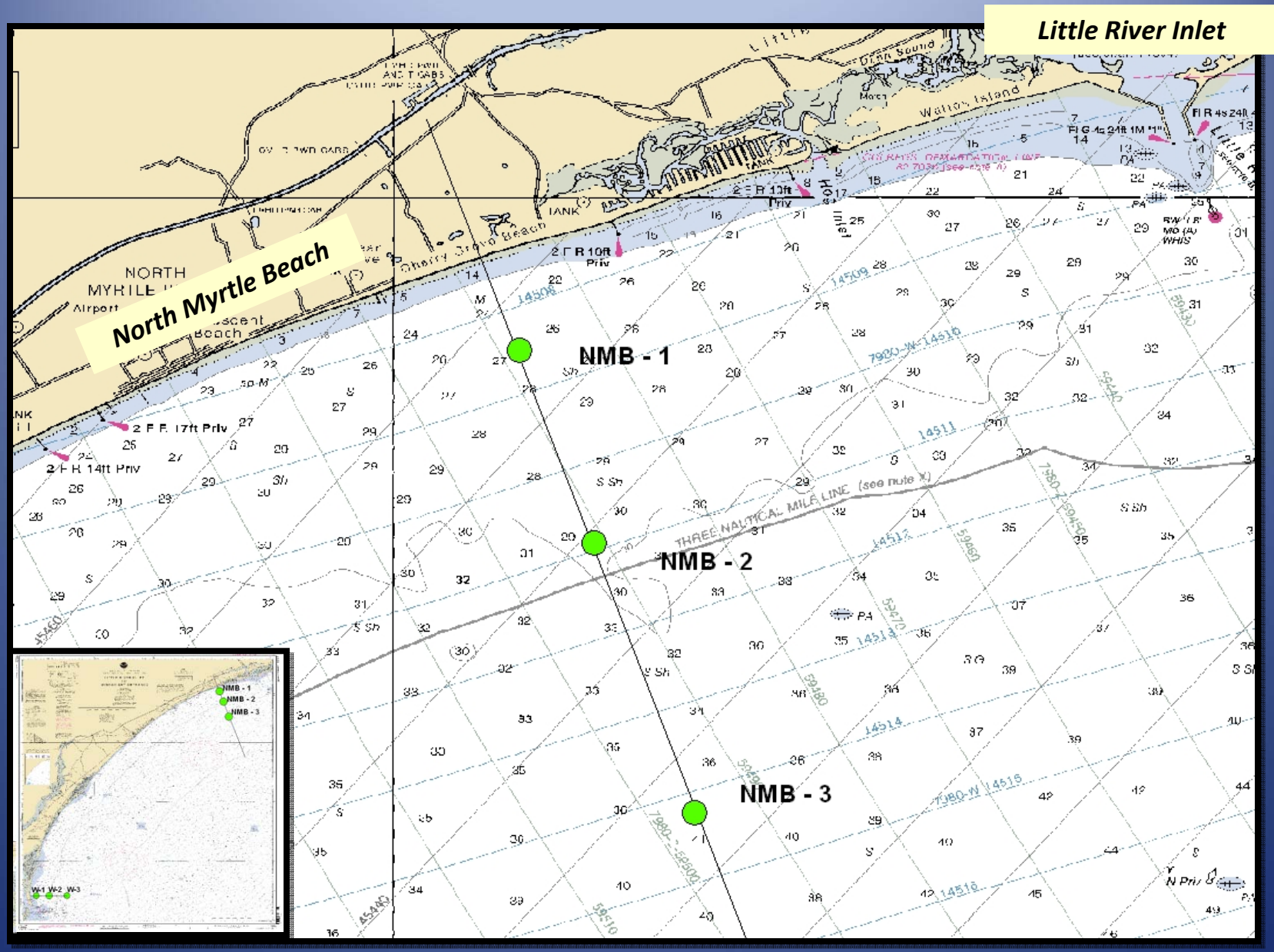
Data Transmitted Once Each Day to Conway and Raleigh



Instrumentation Provided By NC State University

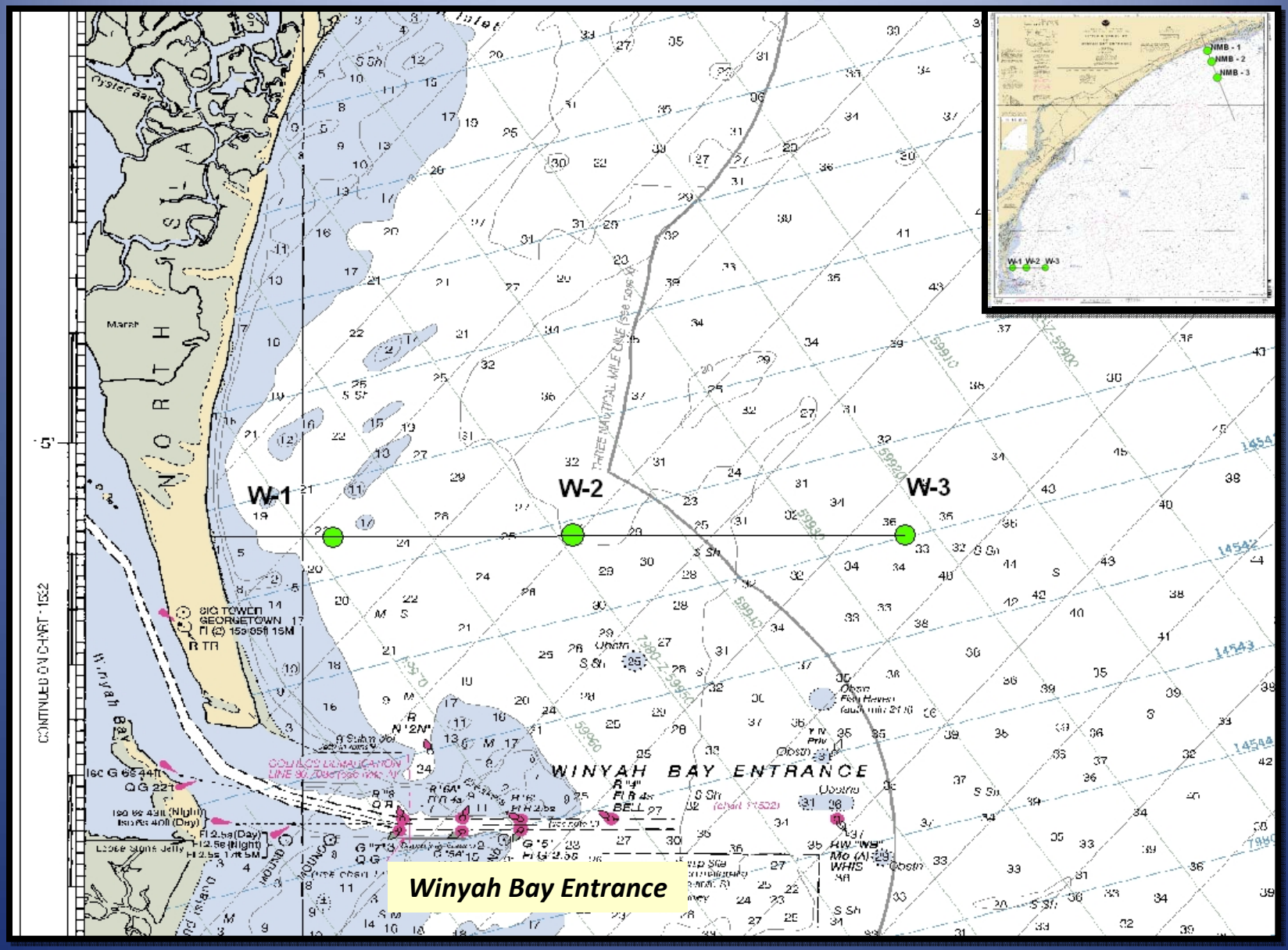
Graphics Courtesy of L. Piestrafesa

PALMETTO RESEARCH PROJECT WIND



Northern Grand Strand Transect

PALMETTO WIND RESEARCH PROJECT



Southern Grand Strand Transect

PALMETTO WIND RESEARCH PROJECT

Data Transmitted Once Each Day

QA/QC Checked

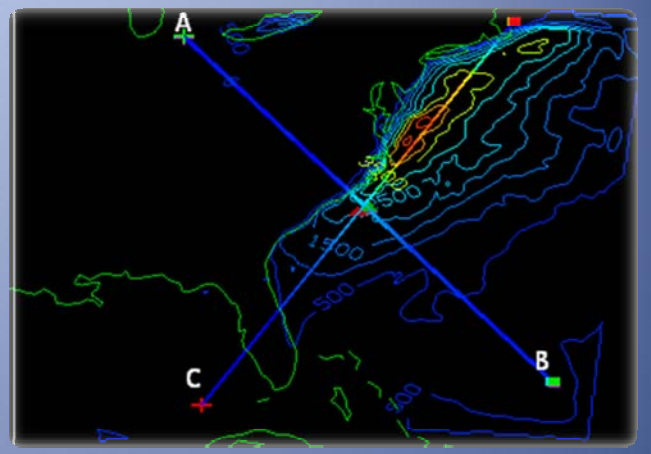
Show What Conditions Have Been

Analyze Wind, Wave, Current Energy Potential at Sites

Assimilated into NCSU/NCAR Atmosphere/Ocean Interactively Coupled Model

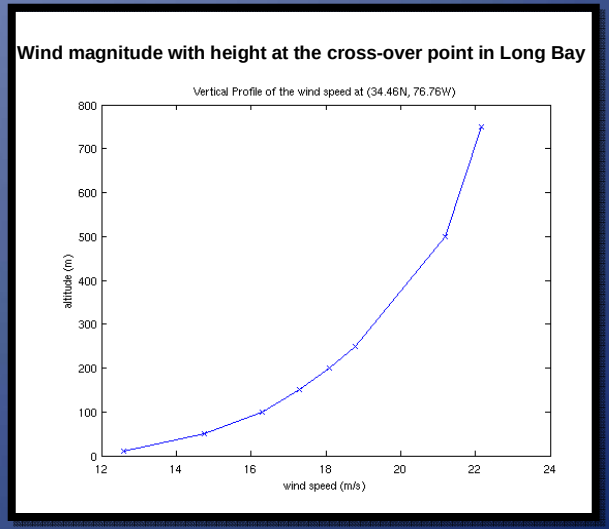
Refine Spatial and Temporal Character of Resource-Select Site for Vertical Verification

Predictive/Forecast Bi-products

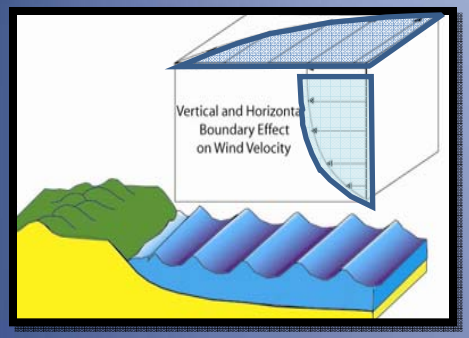


Model Output for Wind Conditions at 50, 100 and 150m . Non-Storm Day 2/22/07
(From Bao, Pietrafesa and Peng in Prep)

Projected Vertical Wind Profile at Selected location
(From Bao, Pietrafesa and Peng in Prep)



PALMETTO RESEARCH PROJECT WIND



Key Dataset

Physical Measurements at Hub Elevation
Requires Offshore Tower

BUOY ARRAYS

Verify Near Surface Coastal Boundary

Refine Spatial Distribution of Class 5+ resources

With compiled exclusionary zones select site for verification of resource at operational height

Navy R-2 Tower –Georgia
http://www.ndbc.noaa.gov/station_page.php?station=spag1

SANTEE COOPER OFFSHORE PLATFORM

Construct Offshore Platform - Direct Measurements
Verifying Magnitude and Character at Hub Elevation

PALMETTO WIND RESEARCH PROJECT

PALMETTO WIND RESEARCH PROJECT

TIMETABLE

Deploy Buoy-Based Cross Shore Instrument Array Daily Data Transmission-Assimilated into Interactively Coupled Model	*April/May 2009*
Compile Resource Verification / Boundary Characterization	
Tentatively Project Spatial Distribution , Use previously Compiled Exclusionary Information - Site and Construct Offshore Tower	*Oct./Nov. 2009*
Complete One-Year Monitoring at Operational Elevation	*Oct./Nov. 2010*

With Partnering Agencies and Organizations Continue to work parallel on other issues such as Environmental , Regulatory, Engineering, Financial etc.

SRNL
SAVANNAH RIVER NATIONAL LABORATORY
TM

Wind Studies Using Sodar Technology

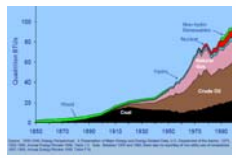
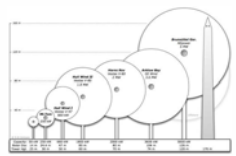
Where is all the wind?

Tom French

Manager BioEnergy Programs

April 20, 2009



Wind Energy Production Farms Feasibility Committee

Columbia, SC

Partners

- **CMMC LLC**
- **Deyton's Shipyard Inc.**
- **SecondWind**
- **U. S. Coast Guard**

“Thinking differently”

Fuel	Availability	Energy	Future
Coal	Dispatchable (capacity resource)	Btu/kg	
Nuclear	Dispatchable (capacity resource)	Btu/kg	
Wind	Non-dispatchable Weather dependent	Btu/(m/s) Depending on temp and pressure	Storage = capacity resource, dispatchable

Objective

- **Accelerate acceptance of *Sodar* data as "bankable" for use in obtaining financing of wind farm projects**
  - **Currently accepted technology is expensive to perform offshore due to construction costs.**
  - **Hub height measurements using accepted technology requires FAA permit due to the height of the towers.**

Wind Monitoring

Why?

- Prospecting
- Wind farm design
- Project Financing
- Operation
  - Forecasting
  - Maintenance

What?

- Wind speed
- Wind direction
- Turbulence
- Temperature
- Barometeric pressure

Wind Power

$$Power = 0.5 * \rho * A * U^3$$

$\rho = air\ density$

$A = area\ of\ rotor$

$U = wind\ speed$

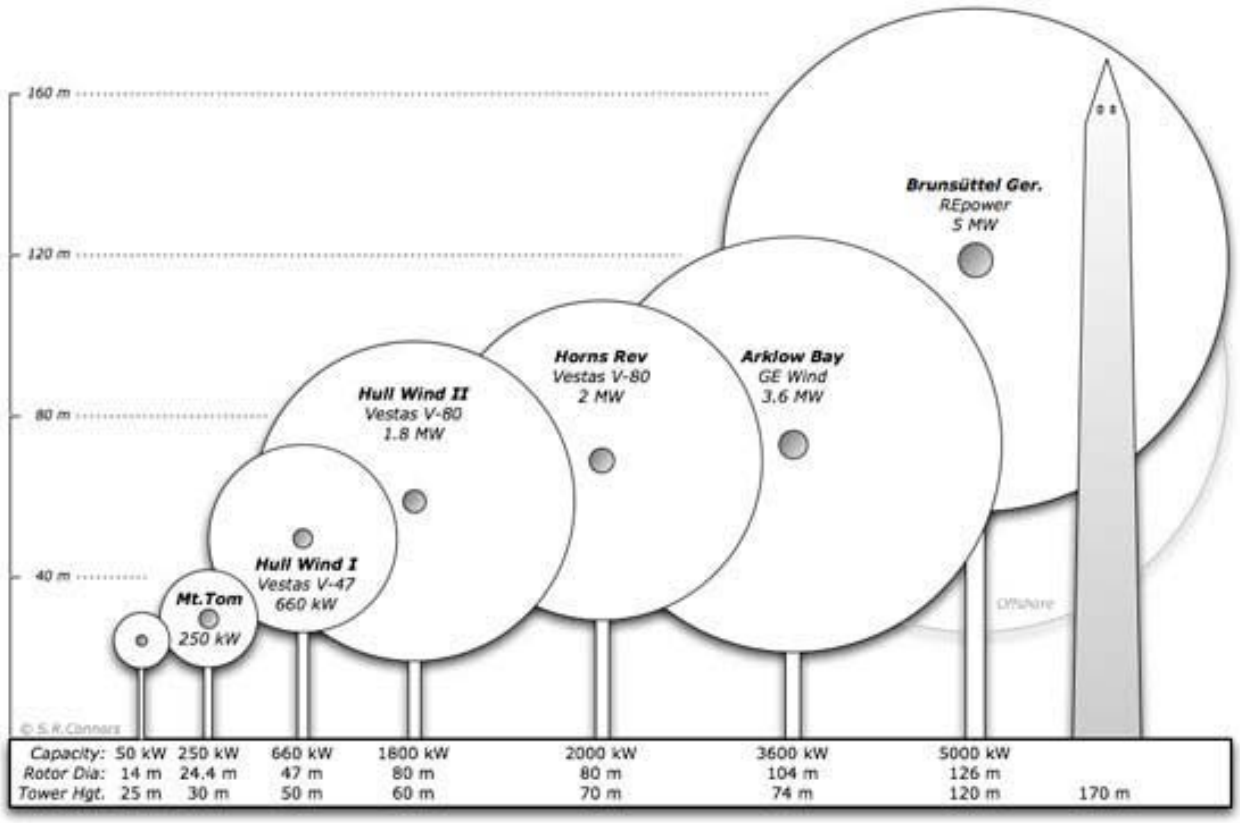
$4^3 = 64$

$6^3 = 216$

$8^3 = 512$

$10^3 = 1000$

Not Your Dad's Windmill



Wind Shear

- Surface roughness
- Wind speed increases with height
- Increase varies depending on site conditions
  - Groundcover
  - Topography
- Typical wind turbine has a hub height of 40m – 80m
- Measure wind speed at difference heights

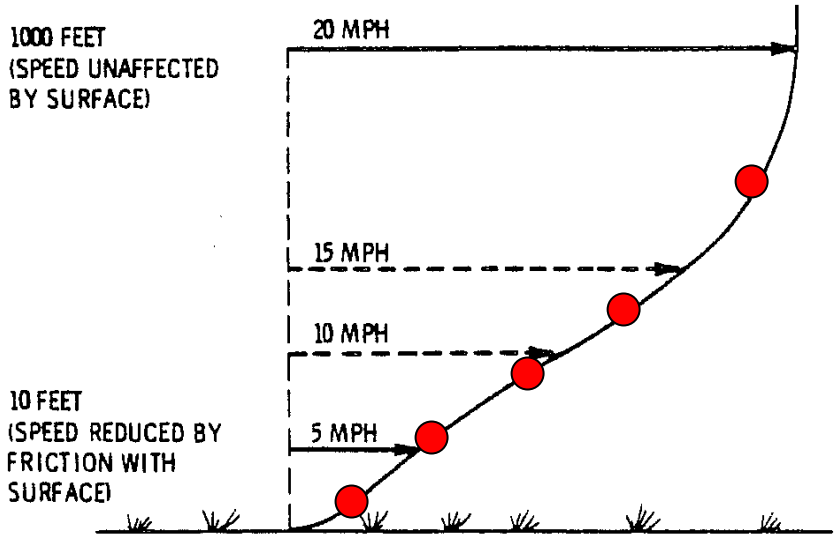
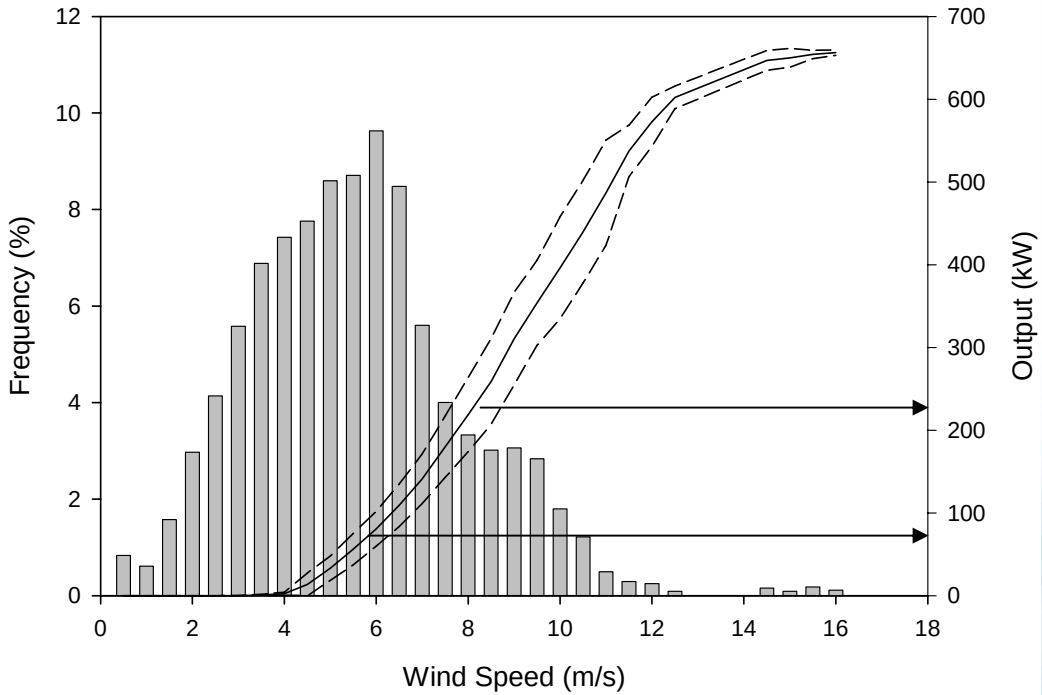


FIGURE 2. Effect of Surface Friction on Low-Level Wind

$$\frac{U(z_2)}{U(z_1)} = \frac{\ln(z_2/z_0)}{\ln(z_1/z_0)}$$

Power Curve

- **Wind speed histogram**
- **660 kW wind turbine**
  - **Power generation begins at 4 m/s**
  - **33% increase in wind speed, 6 – 8, results in a 300% increase in power output**



Measuring Wind Speed

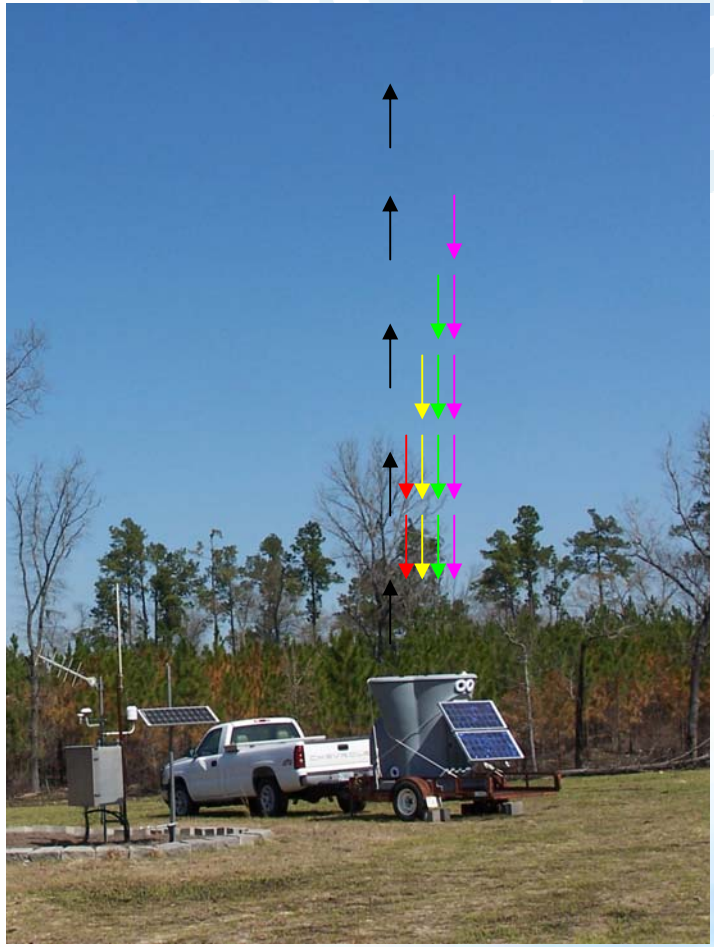
- **Anemometer, wind vane**
  - **Requires tower**
    - **>200ft needs FAA permit**
  - **Multiple heights**
    - **Wind shear**
  - **Multiple sensors**
    - **Shadowing**
    - **Require maintenance**
  - **Cup**
    - **Rotation speed correlated to wind speed**
  - **Data recorder**

Measuring Wind Speed

- **Sodar**
  - **Sound detection and ranging**
  - **“Chirp” of sound emitted from a phased array of transceivers**
  - **Reflected sound collected by transceivers array**
    - **Different air densities at different heights**
  - **Data analyzed to determine wind speed and direction (horizontal and vertical) at 11 different heights, up to 200m**

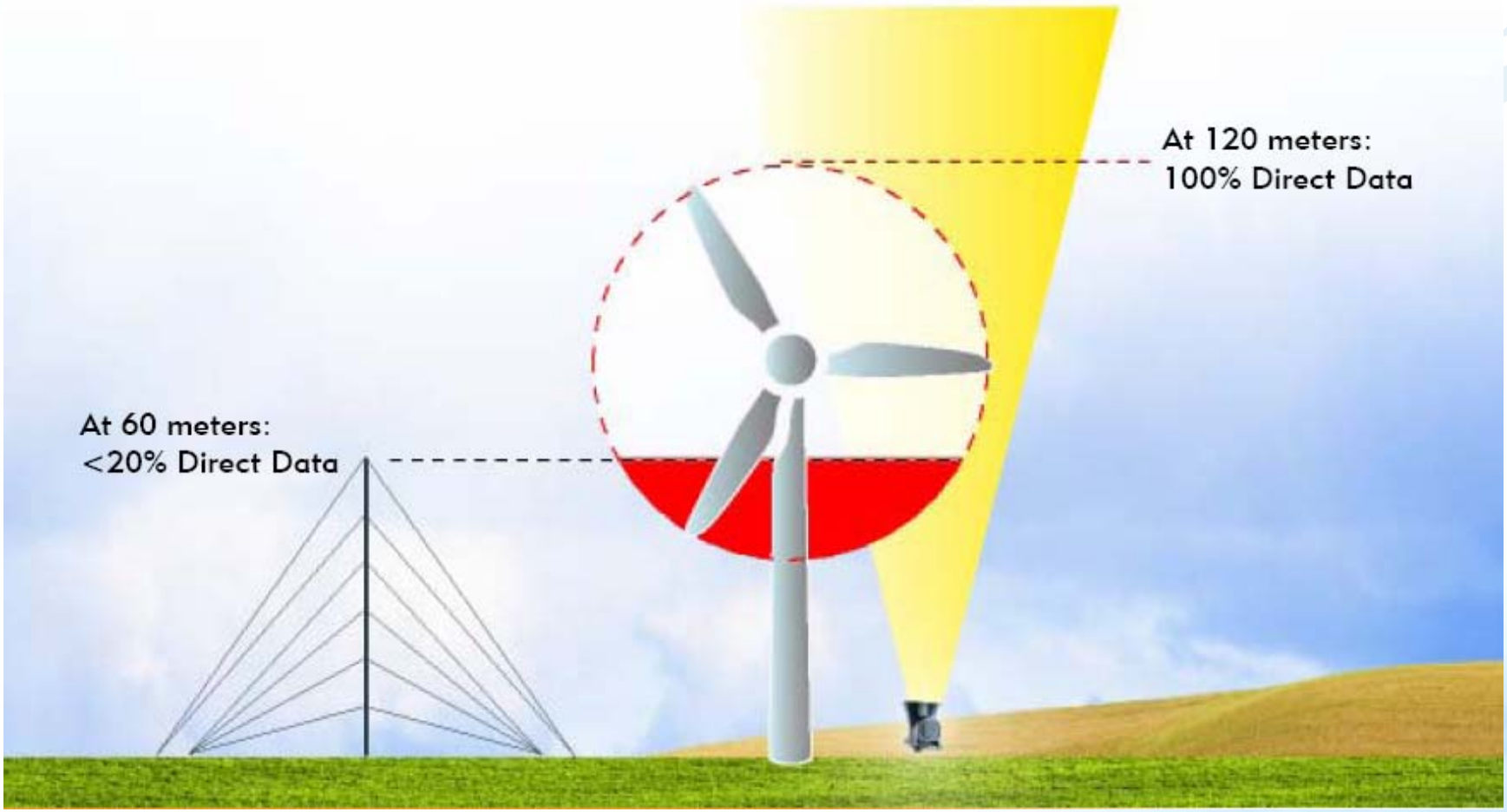
Sodar

- **Triton by SecondWind**
  - **Low power consumption**
  - **Operates in adverse weather conditions**
  - **Robust online data analysis package**
  - **Small (6’x6’x4’) and portable**
  - **Rugged**
  - **Designed for wind power assessments**



SRNL

Swept Area Coverage



Triton Data - Skyserve

SECONDWIND

Home > Site Data

Standard Data | Extended Data | Operational Data | Analysis | Configuration

Site: Triton 149
Time: 3/31/2009 17:30:00 UTC

Latitude: 33.33333
Longitude: -81.59157
Elevation: 318.16ft

Humidity: 53%

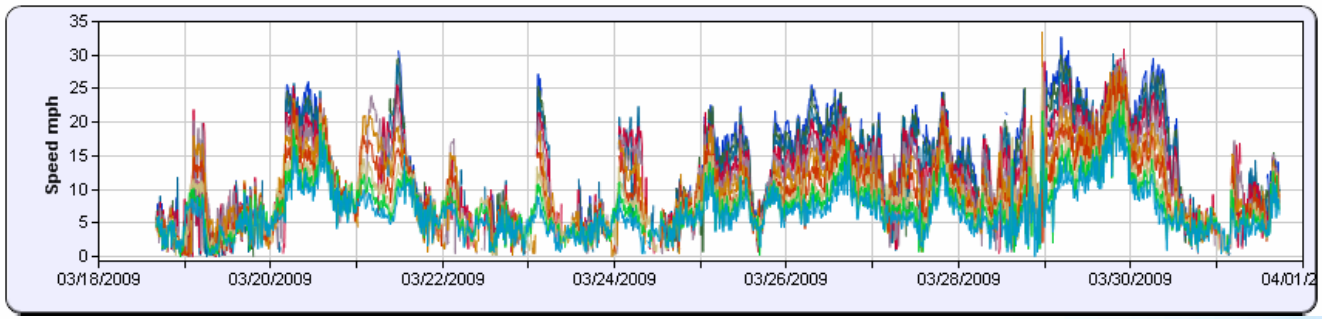
Q > 85%

Height	Wind Speed	Wind Direction	Avg. Wind Speed
656ft	9.9 mph	179°[SSE]	16.5mph
590ft	9.8 mph	178°[SSE]	14.9mph
524ft	9.7 mph	177°[SSE]	13.2mph
459ft	8 mph	178°[SSE]	12.2mph
393ft	8.2 mph	167°[SSE]	11.3mph
328ft	9.6 mph	173°[SSE]	10.4mph
262ft	9.2 mph	168°[SSE]	9.4mph
196ft	7.1 mph	171°[SSE]	8.2mph
164ft	6.9 mph	180°[S]	7.4mph
131ft	6.1 mph	178°[SSE]	6.5mph

Start: 3/18/2009 00:00
End: 4/1/2009 00:00
Time selections are in UTC, mm/dd/yyyy
Other: Custom Update

Export

< Prev | Next >



Sodar Testing

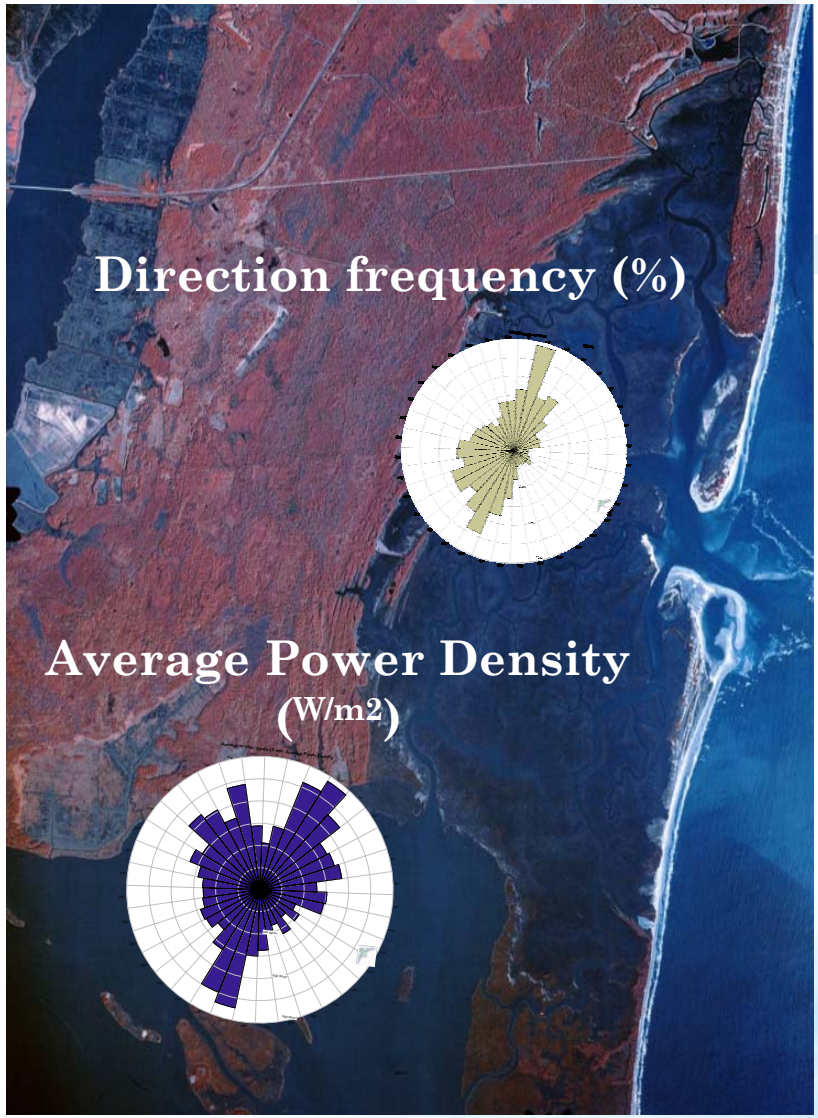
- **Coastal**
- **Offshore**
- **Validate with Met tower**

Sodar Testing

- **Locations**

Met Tower

- **Preliminary Data**

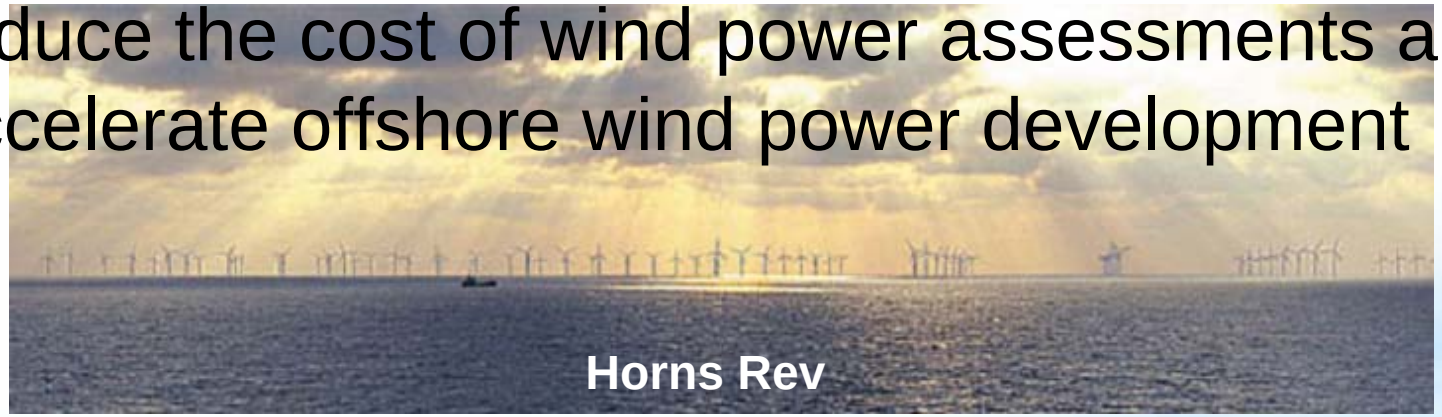


Where Are We?

- **Sodar purchased and received**
- **Operational check performed at SRNL**
- **Mount on trailer for transport to coast**
- **Begin testing at Goat Island, 5/14/09**
- **Begin testing on USCG platform, 5/14/10**

Summary

- Wind power varies with the cube of wind speed
- ***Distribution*** of wind speed must be measured at a potential wind farm site
- Offshore met towers are expensive and are not typically built to the height of the wind turbine
- Acceptance of Sodar data as “bankable” will reduce the cost of wind power assessments and accelerate offshore wind power development



Horns Rev

Regulatory Task Force
for
Coastal Clean Energy

Catherine Vanden Houten

Monday, April 20, 2009

South Carolina Energy Office

Mission:

To increase energy efficiency and diversity,
enhance environmental quality
and save energy dollars for South Carolina.

DOE Wind Grant

- 2008
- U.S. Department of Energy
- South Carolina Roadmap to Gigawatt-Scale Coastal Clean Energy Generation: Transmission, Regulation and Demonstration

DOE Wind Grant

- Goal: to overcome existing barriers for coastal clean energy development for wind, wave and tidal energy projects in South Carolina.

DOE Wind Grant

- Partners:
  - S.C. Energy Office –primary award recipient
  - S.C. Institute for Energy Studies, Clemson University
  - EcoEnergy, LLC
  - Coastal Carolina University
  - North Carolina State University
  - Savannah River National Lab
  - Santee Cooper

DOE Wind Grant

- **Objective:** to develop an 80 MW offshore wind pilot project in state waters and initial research of wave and tidal energy applications

DOE Wind Grant

- Task 1: offshore wind transmission study
- Task 2: wind, wave & current study
- Task 3: Regulatory Task Force for Coastal Clean Energy

Regulatory Task Force

- Mission: to create a regulatory environment conducive to wind, wave and tidal energy development in state waters

Regulatory Task Force – structure

- Regulatory Task Force
  - Regulatory Working Group
  - Scientific/Technical Advisory Group
  - Public Outreach Working Group (TBD)

Regulatory Working Group

- U.S. Fish & Wildlife Service
- Minerals Management Service
- National Marine Fisheries Service, NOAA
- U.S. Army Corps of Engineers
- Bureau of Water, S.C. DHEC
- Office of Coastal Resource Management, S.C. DHEC
- S.C. Department of Natural Resources
- S.C. Department of Archives & History

Scientific/Technical Advisory Group

- Coastal Carolina University
- EcoEnergy, LLC
- North Carolina State University
- Research Planning, Inc.
- Santee Cooper
- Savannah River Ecology Lab
- S.C. Coastal Conservation League
- S.C. Institute for Energy Studies, Clemson University
- S.C. Sea Grant Consortium
- University of South Carolina, Marine Science Program
- University of South Carolina, School of the Environment

Regulatory Task Force – timeframes

- March - April 2009
  - establish Regulatory Task Force
- May 2009
  - begin regular meeting schedule
- October 2009
  - visit offshore wind platforms, wave & tidal buoys, proposed transmission line areas
- October 2010
  - recommend regulations & legislation
- October 2011
  - produce final report

South Carolina Energy Office

www.energy.sc.gov

Catherine Vanden Houten 803.737.9852
cvandenhouten@energy.sc.gov

Wind Energy Production Farms Feasibility Committee
209 Gressette Office Building
Columbia, SC
Monday, July 13, 2009
1:00 PM – 4:00 PM

I. Introductions

II. Review and Discussion of Draft Report

III. Presentations:

Wind Powering America – Larry Flowers and Sandy Butterfield, National Renewable Energy Laboratory (NREL)

New Jersey Case Study: Offshore Wind Energy Development – Rhonda Jackson, Fishermen's Energy

Britain's Offshore Wind Energy Industry and Meeting Renewable Energy Requirements – Jan Matthiesen, British Wind Energy Association

South Carolina Opportunities for Wind – Ed McCallum, McCallum Sweeney Consulting

Local Perspectives:
Charleston – James Meadors, City of Charleston Green Committee
Onshore Wind Energy Along the Grand Strand: North Myrtle Beach – Monroe Baldwin, City of North Myrtle Beach

IV. Other Discussion Items

V. Next Meeting

VI. Adjourn

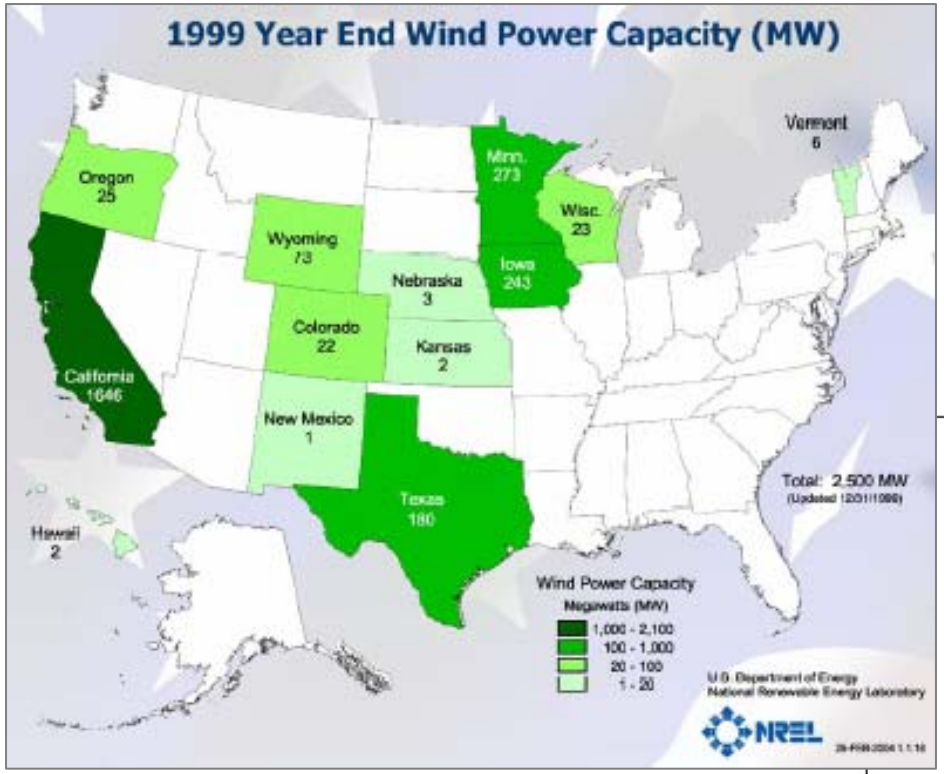
Wind Energy Update

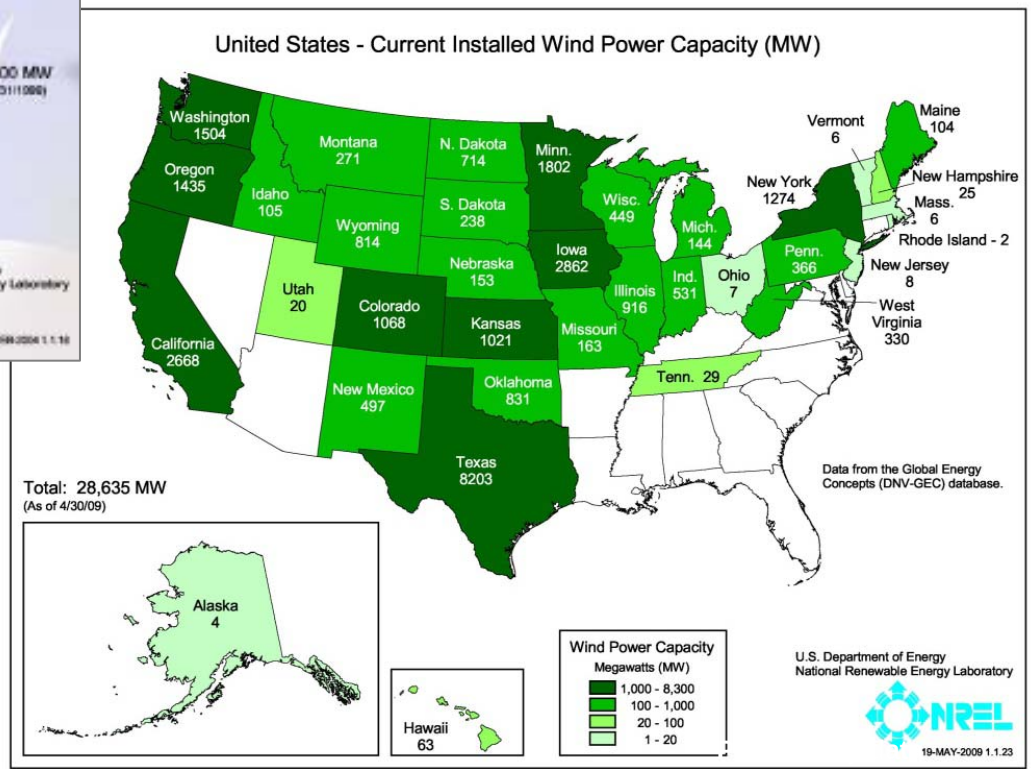
Larry Flowers

National Renewable Energy Laboratory

South Carolina - July 13, 2009

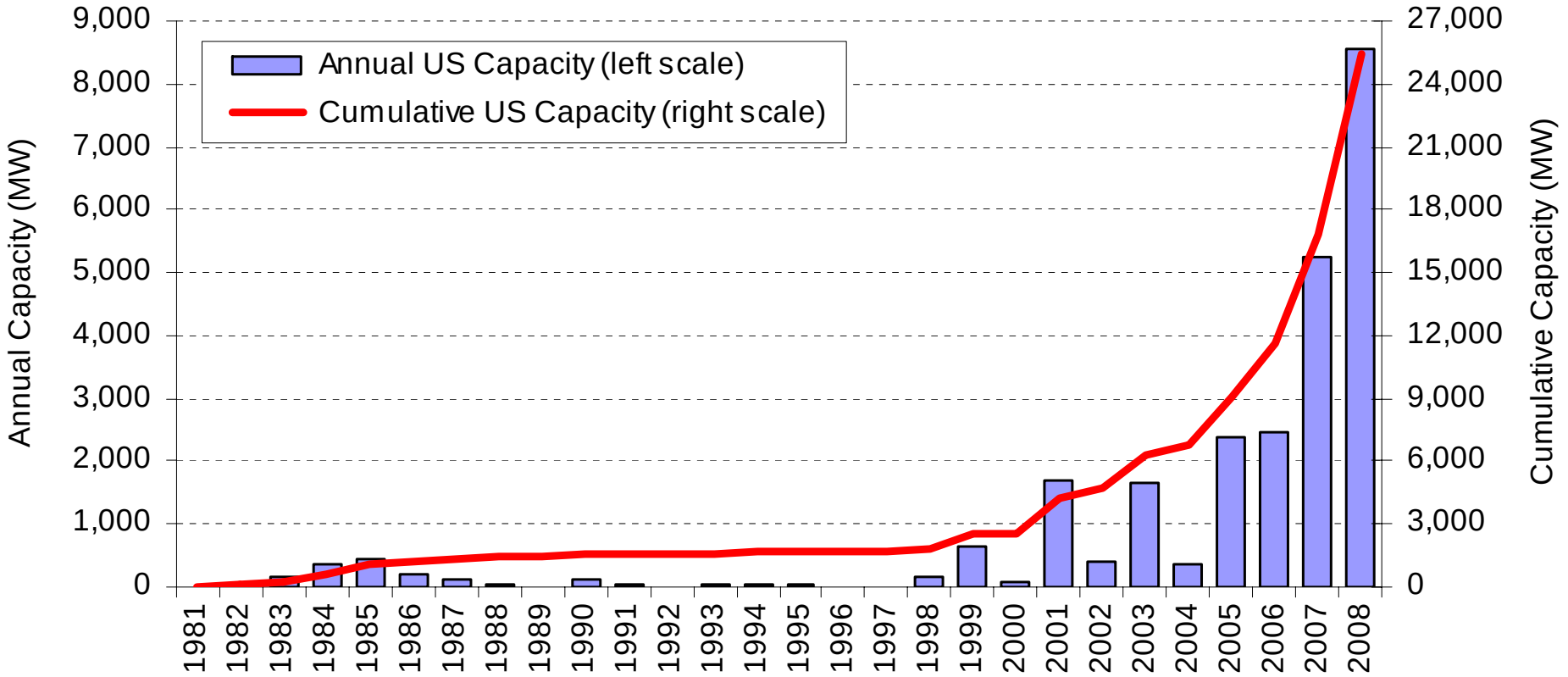
Installed Wind Capacities ('99 – '09)





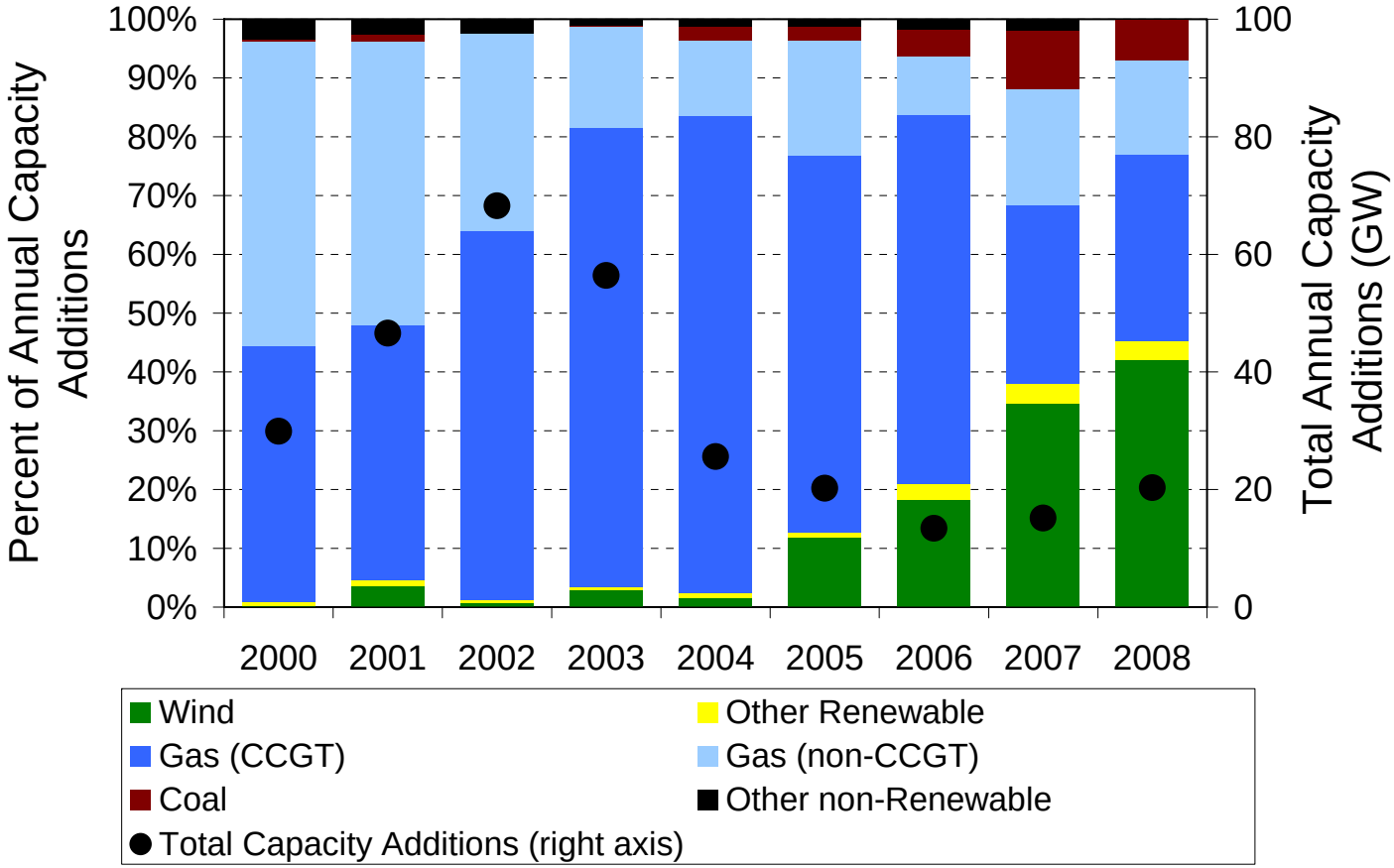
Four Years of Strong Growth:

2008: 8,558 MW Added; $16 billion Investment



2008 Wind Market Report; LBL

Wind Is a Major Source of New Generation Capacity Additions



2008: 42%
2007: 35%
2006: 18%
2005: 12%
2000-04: <5%

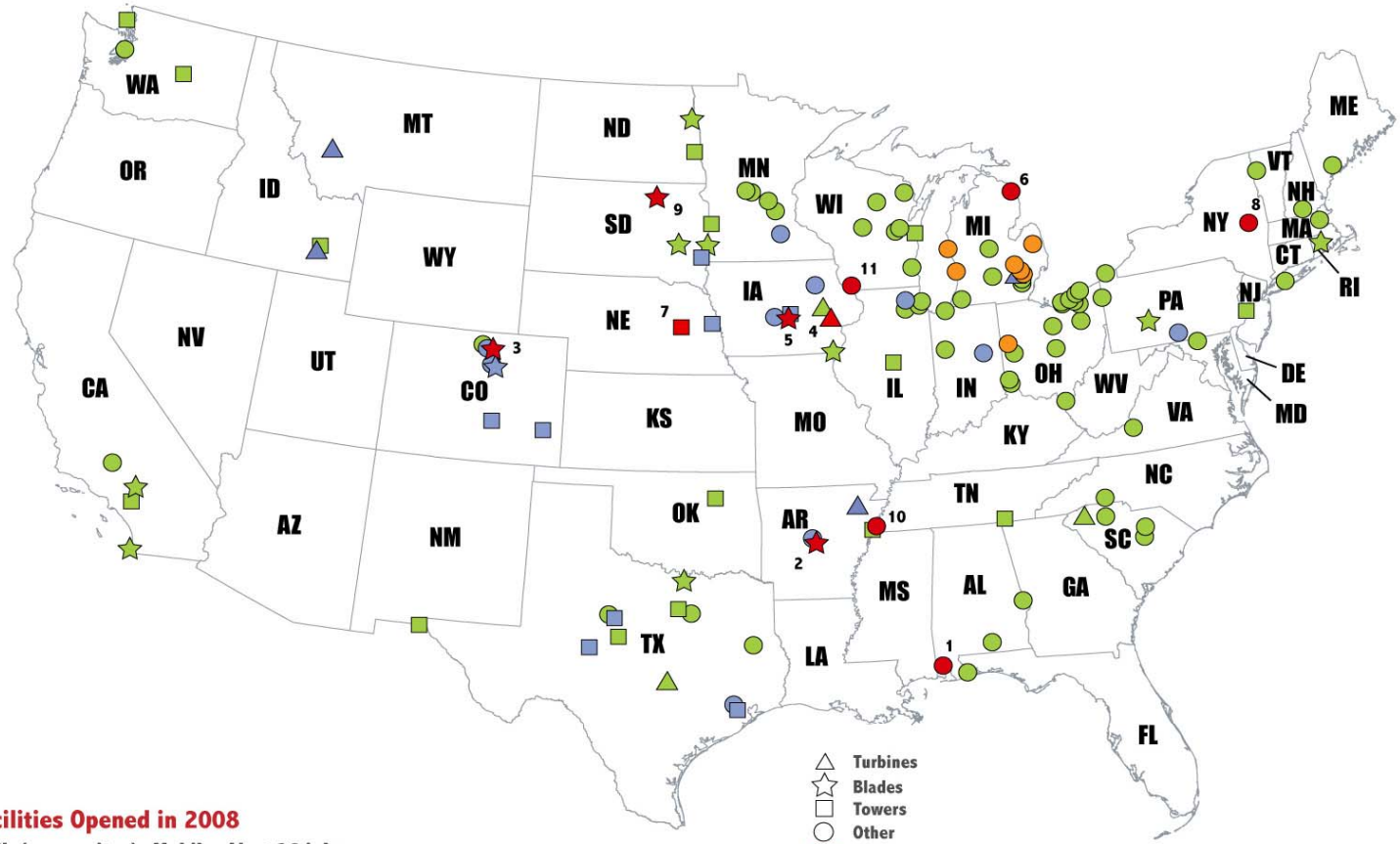
Source: EIA, Ventyx, AWEA, IREC, Berkeley Lab

2008 Wind Market Report; LBL

Drivers for Wind Power

- Declining Wind Costs
- Fuel Price Uncertainty
- Federal and State Policies
- Economic Development
- Public Support
- Green Power
- Energy Security
- Carbon Risk

Soaring Demand Spurs Expansion of U.S. Wind Turbine Manufacturing



New Facilities Opened in 2008

1. Evonik (composites), Mobile, AL, +26 jobs
2. LM Glasfiber (blades), Little Rock, AR, +1,000 jobs within 5 years
3. Vestas (blades), Windsor, CO, +650 jobs
4. Acciona (turbines), West Branch, IA, +110 jobs
5. TPI Composites (blades), Newton, IA, +140 jobs
6. ATI Casting Services (casting and foundry), Alpena, MI, +20 jobs
7. Katana Summit (towers), Columbus, NE
8. GE (parts fulfillment center), Schenectady, NY
9. Molded Fiberglass (blades), Aberdeen, SD, +up to 750 jobs
10. GE (parts operation center), Memphis, TN
11. Wausaukee Composites (housings), Cuba City, WI, +61 jobs

Figure includes wind turbine and component manufacturing facilities, as well as other supply chain facilities, but excludes corporate headquarters and service-oriented facilities. The facilities shown here are not intended to be exhaustive. Those facilities designated as "Turbines" may include turbine assembly and/or turbine component manufacturing, in some cases also including towers and blades.

This map was created by The National Renewable Energy Laboratory for the U.S. Department of Energy. May 18, 2009

South Carolina – Economic Impacts

from 1000 MW of new wind development

Wind energy's economic "ripple effect"

Direct Impacts

Payments to Landowners:
- $2.7 million/year

Local Property Tax Revenue:
- $8.7 million/year

Construction Phase:
- 1629 new jobs
- $188.5 M to local economies

Operational Phase:
- 250 new long-term jobs
- $21.2 M/yr to local economies

Indirect & Induced Impacts

Construction Phase:
- 1413 new jobs
- $122.5 M to local economies

Operational Phase:
- 208 local jobs
- $19.1 M/yr to local economies

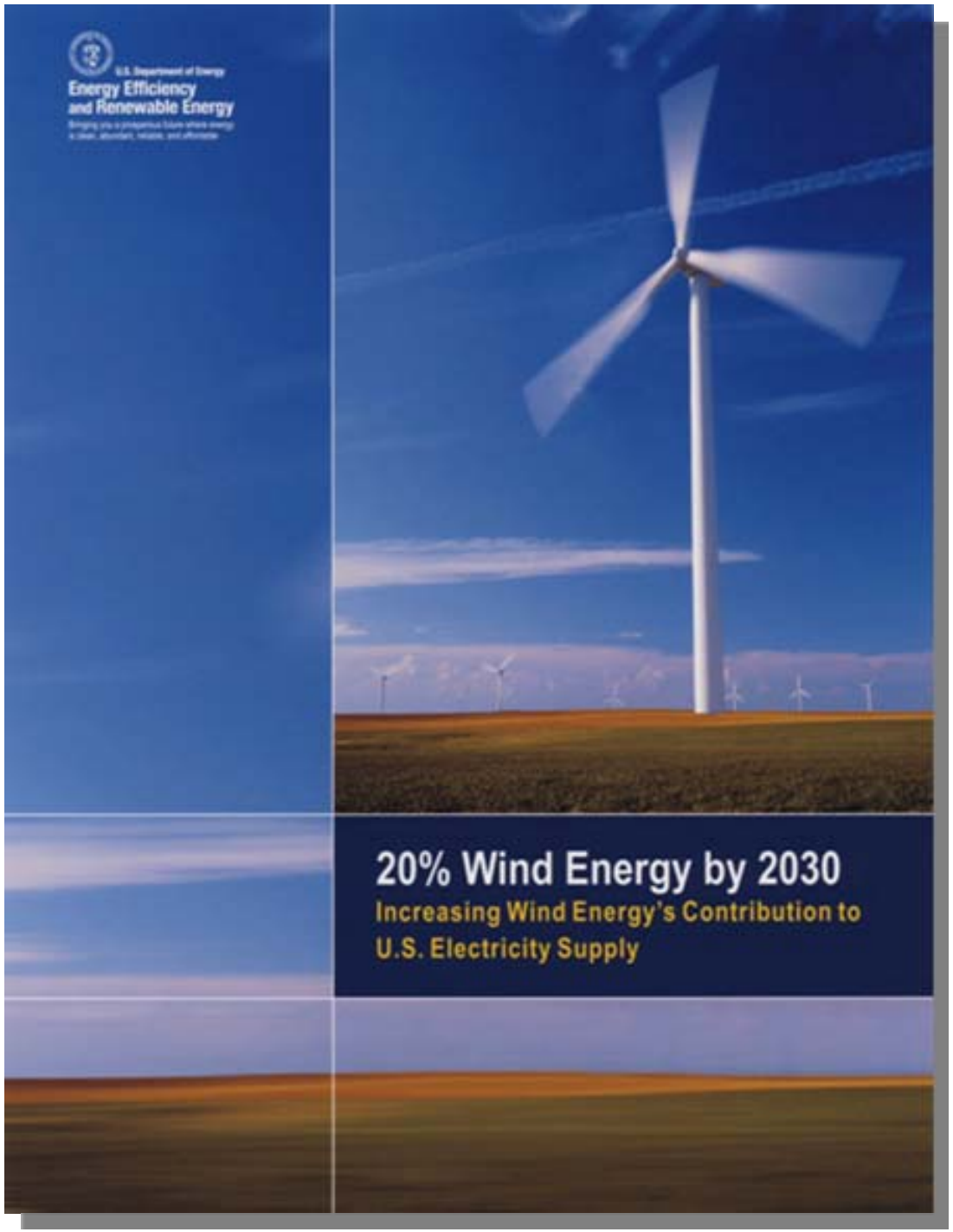
Totals (construction + 20yrs)

Total economic benefit = $1.12 billion

New local jobs during construction = 3042

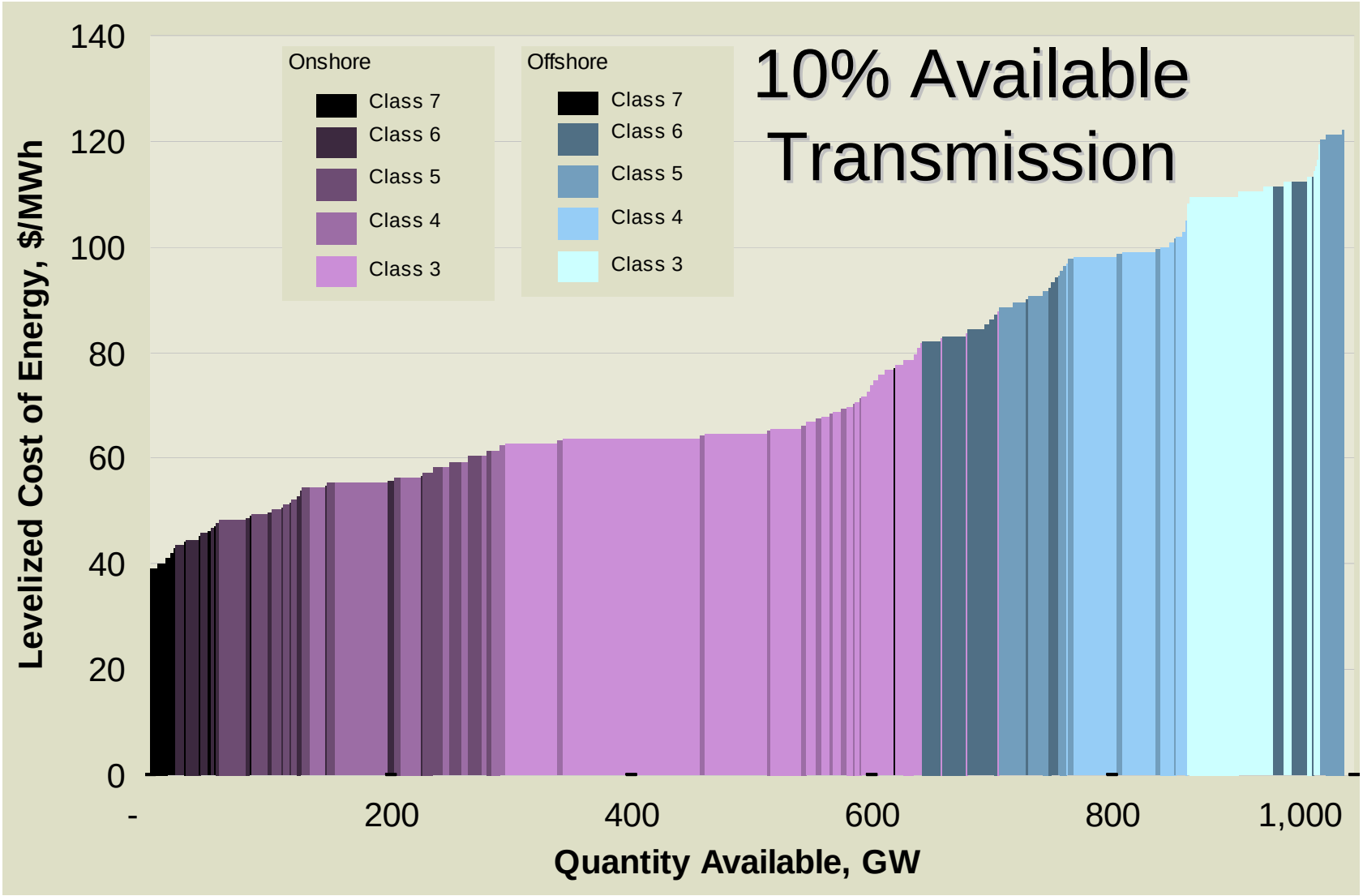
New local long-term jobs = 458

Construction Phase = 1-2 years
Operational Phase = 20+ years



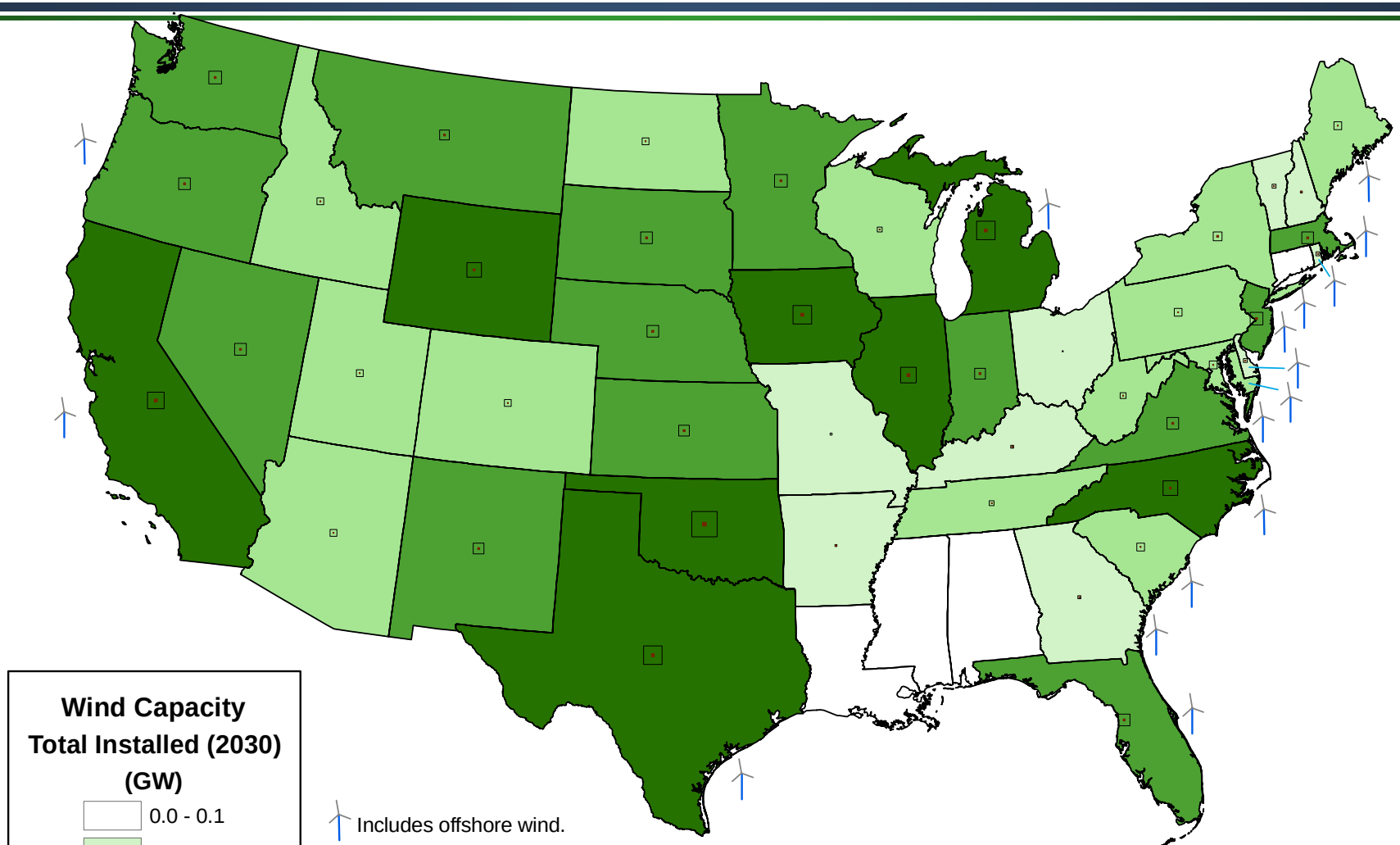
"The future ain't what it used to be."

- Yogi Berra



2010 Costs w/ PTC, $1,600/MW-mile, w/o Integration costs

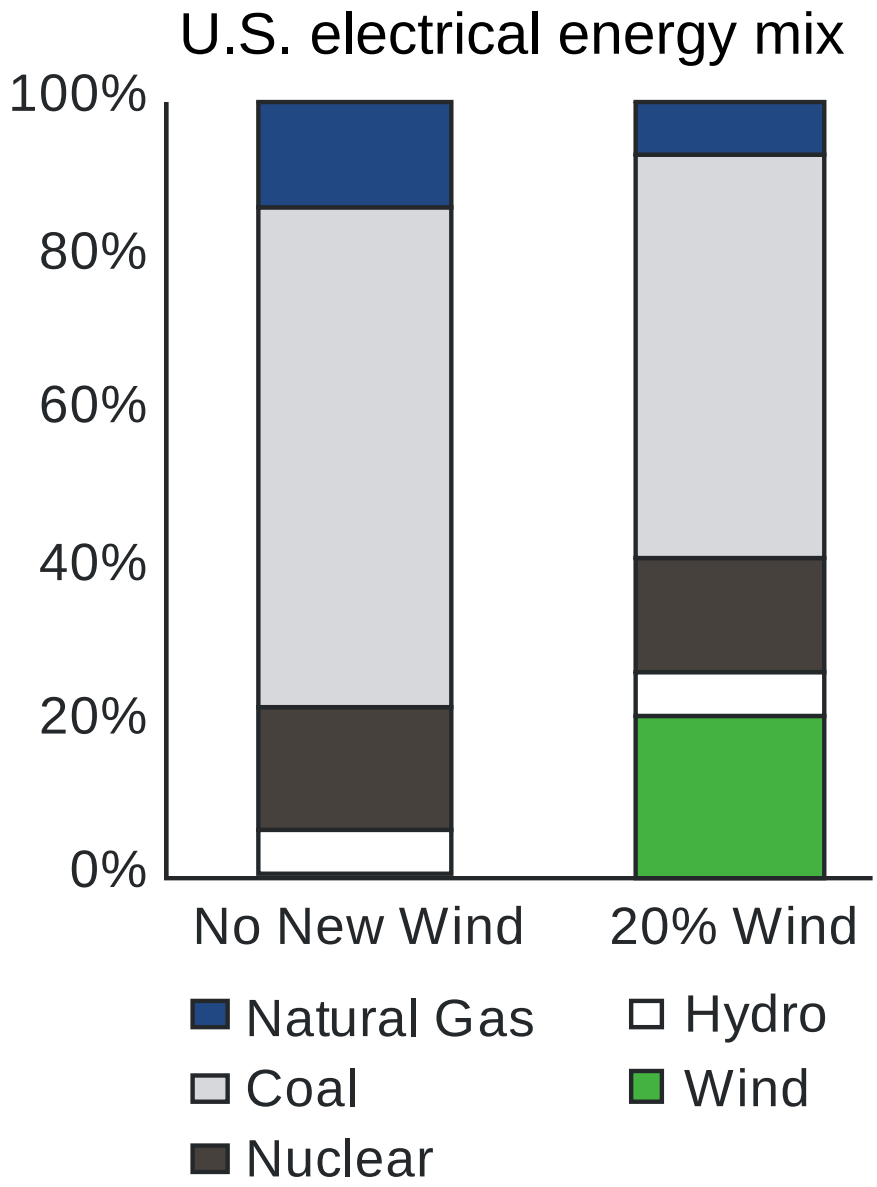
46 States Would Have Substantial Wind Development by 2030



The black open square in the center of a state represents the land area needed for a single wind farm to produce the projected installed capacity in that state. The brown square represents the actual land area that would be dedicated to the wind turbines (2% of the black open square).

20% Wind Scenario Impact on Generation Mix in 2030

- Reduces electric utility natural gas consumption by 50%
- Reduces total natural gas consumption by 11%
- Natural gas consumer benefits: $86-214 billion*
- Reduces electric utility coal consumption by 18%
- Avoids construction of 80 GW of new coal power plants



Source *: Hand et al., 2008

National (U.S.) – Economic Impacts

Cumulative impacts from 2007-2030

From the 20% Scenario- 300 GW new Onshore and Offshore development

Wind energy's economic "ripple effect"

Direct Impacts

Payments to Landowners:
- $782 M

Local Property Tax Revenue:
- $1,877 M

Construction Phase:
- 1.75 M FTE jobs
- $ 293 B to the US economy

Operations:
- 1.16 M FTE jobs
- $122 B to the US economy

Indirect & Induced Impacts

Construction Phase:
- 4.46 M FTE jobs
- $651 B to the US economy

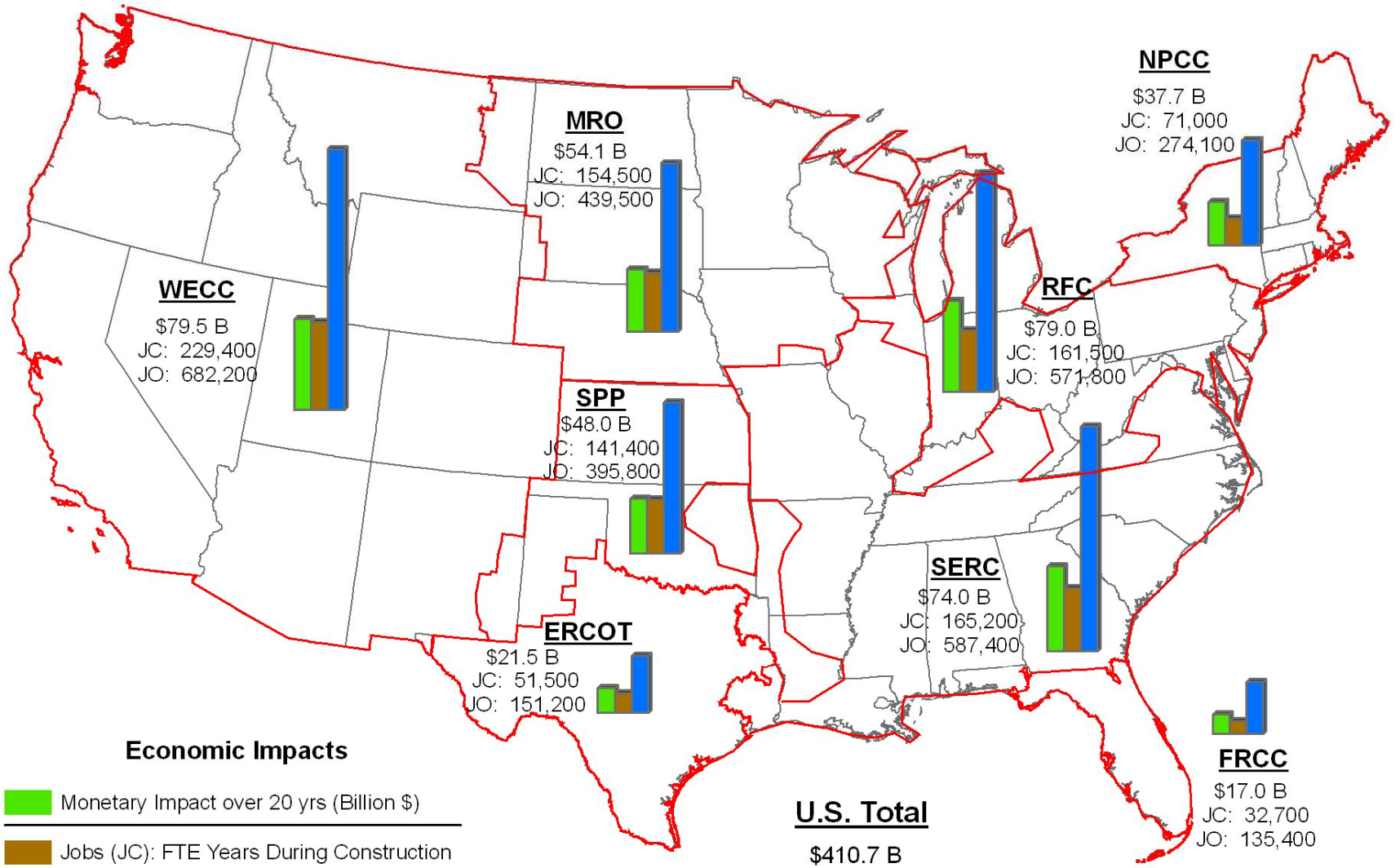
Operations:
- 2.15 M FTE jobs
- $293 B to the US economy

Totals (construction + 20yrs)

- **Total economic benefit** = $1,359 billion
- **New jobs during construction** = 6.2 M FTE jobs
- **New operations jobs** =3.3 M FTE jobs

All monetary values are in 2006 dollars.
Construction Phase = 1-2 years

20% Wind Electricity by 2030 - Economic Impacts by NERC Region



Economic Impacts

Monetary Impact over 20 yrs (Billion $)

Jobs (JC): FTE Years During Construction

Jobs (JO): FTE Years over 20 yrs Operation

Wind Vision case = 304 GW of wind capacity.
All job values rounded to the nearest 100.

U.S. Total

$410.7 B
JC: 1,007,200
JO: 3,237,400

U.S. Department of Energy
National Renewable Energy Laboratory

NREL

Wind_Vision_06-19-2007 - DRAFT

South Carolina – Economic Impacts

From the 20% Scenario

327 MW of new Onshore and 3,126 MW new Offshore development

Wind energy's economic "ripple effect"

Direct Impacts

Payments to Landowners:
- $872 thousand/yr

Local Property Tax Revenue:
- $2.8 M/yr

Construction Phase:
- 8,309 new jobs
- $962 M to local economies

Operational Phase:
- 1,995 new long-term jobs
- $184 M/yr to local economies

Indirect & Induced Impacts

Construction Phase:
- 7,208 new jobs
- $625 M to local economies

Operational Phase:
- 1,227 local jobs
- $112 M/yr to local economies

Totals (construction + 20yrs)

Total economic benefit = $7.5 billion

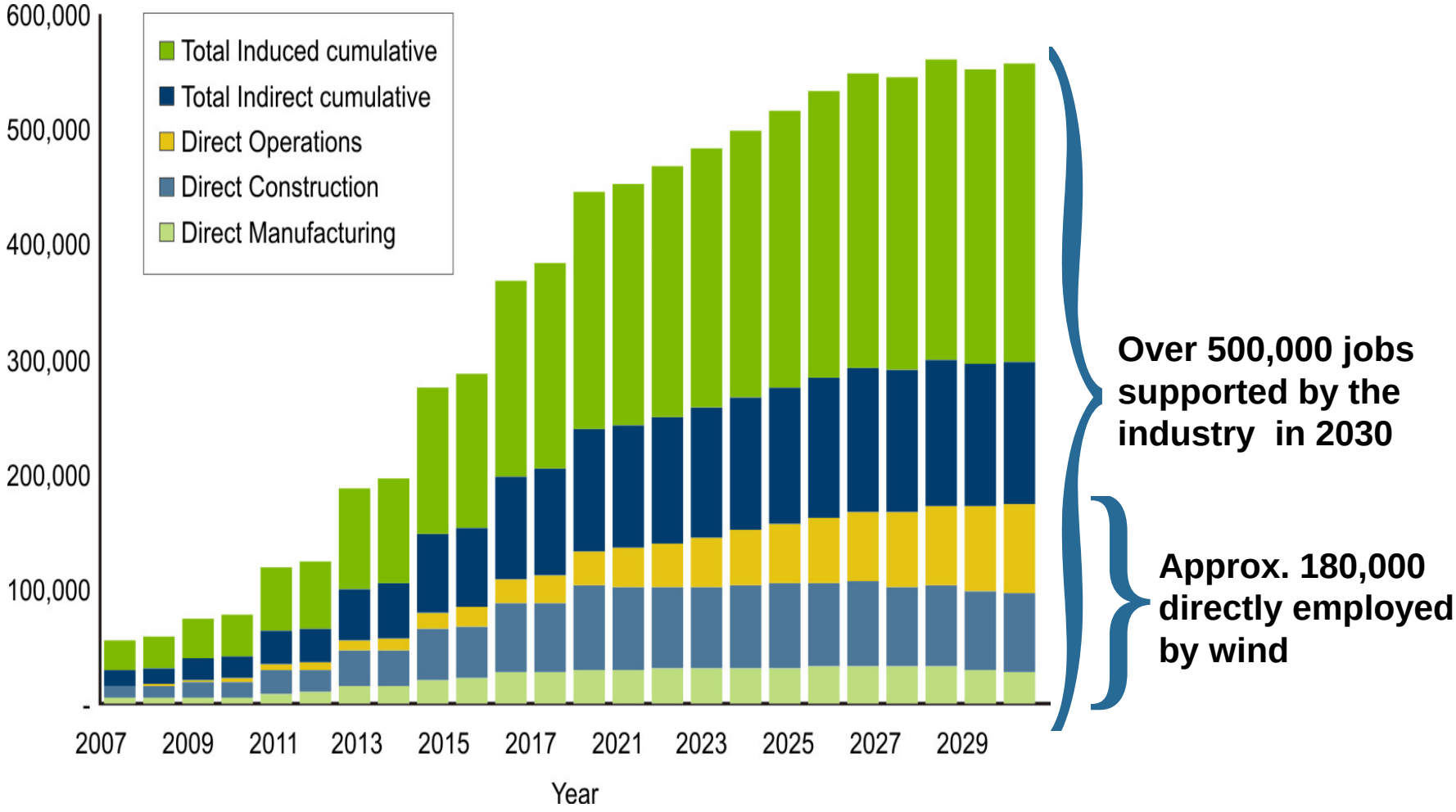
New local jobs during construction = 15,517

New local long-term jobs = 3,222

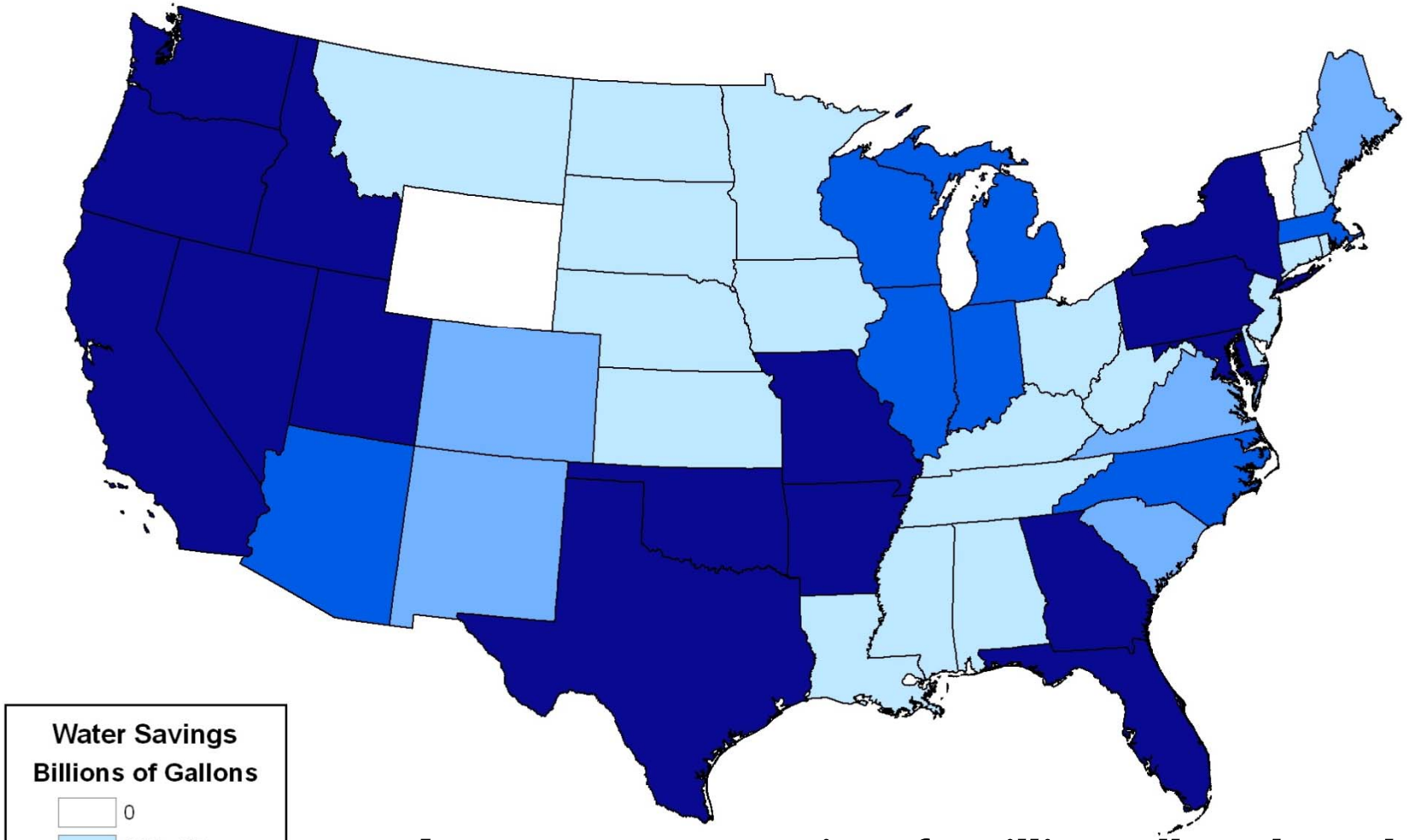
Construction Phase = 1-2 years
Operational Phase = 20+ years

Jobs Supported by the 20% Scenario

Over 500,000 jobs would be supported between 2007 and 2030



Cumulative Water Savings from 20% Scenario

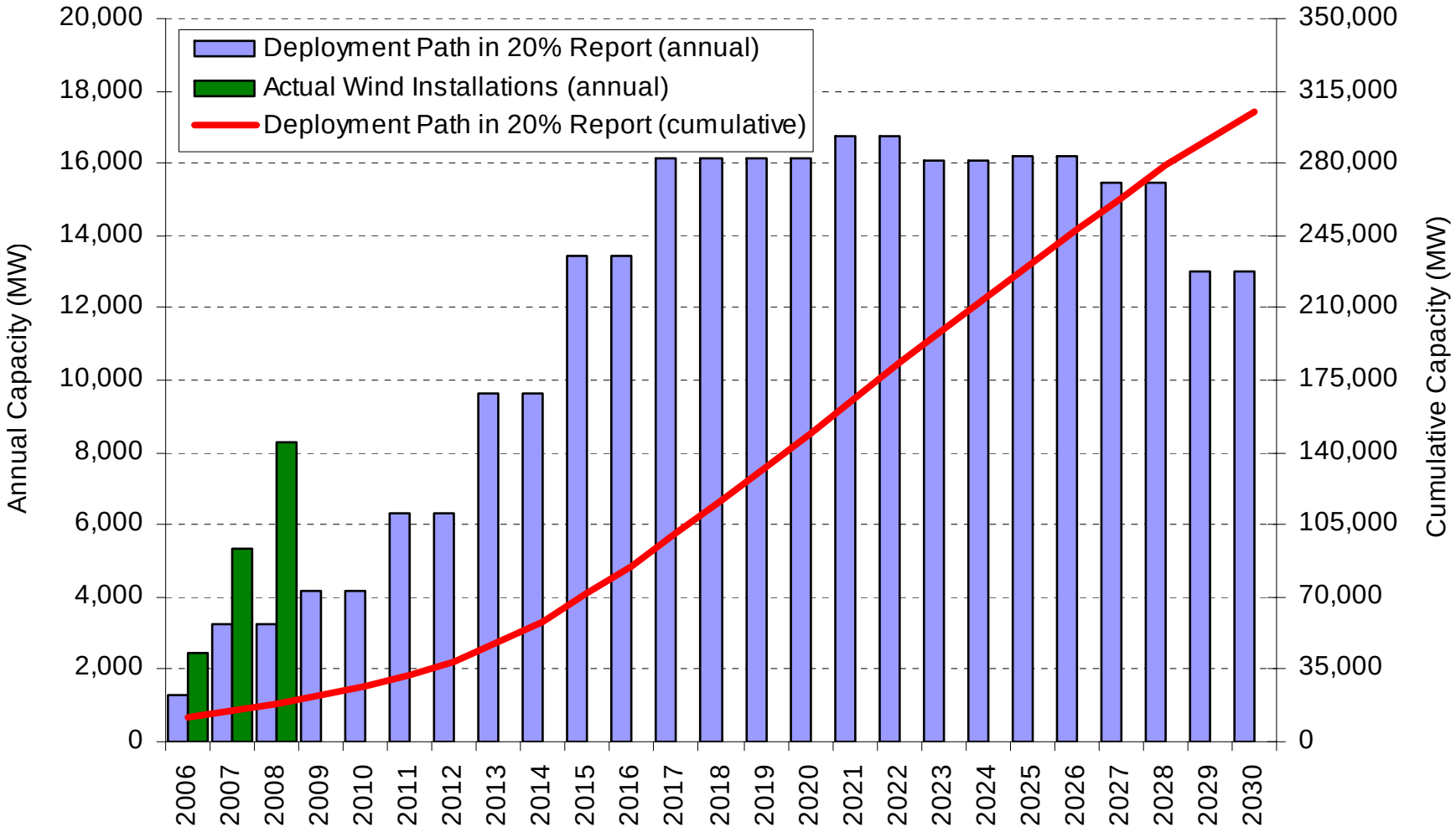


Reduces water consumption of 4 trillion gallons through 2030 (represents a reduction in electric sector water consumption by 17% in 2030)

Results: Costs & Benefits

Incremental direct cost to society	**$43 billion**
Reductions in emissions of greenhouse gasses and other atmospheric pollutants	825 M tons (2030) **$98 billion**
Reductions in water consumption	8% total electric 17% in 2030
Jobs created and other economic benefits	140,000 direct $450 billion total
Reductions in natural gas use and price pressure	11% **$150 billion**
Net Benefits: $205B + Water savings	

Progress Toward 20% Wind



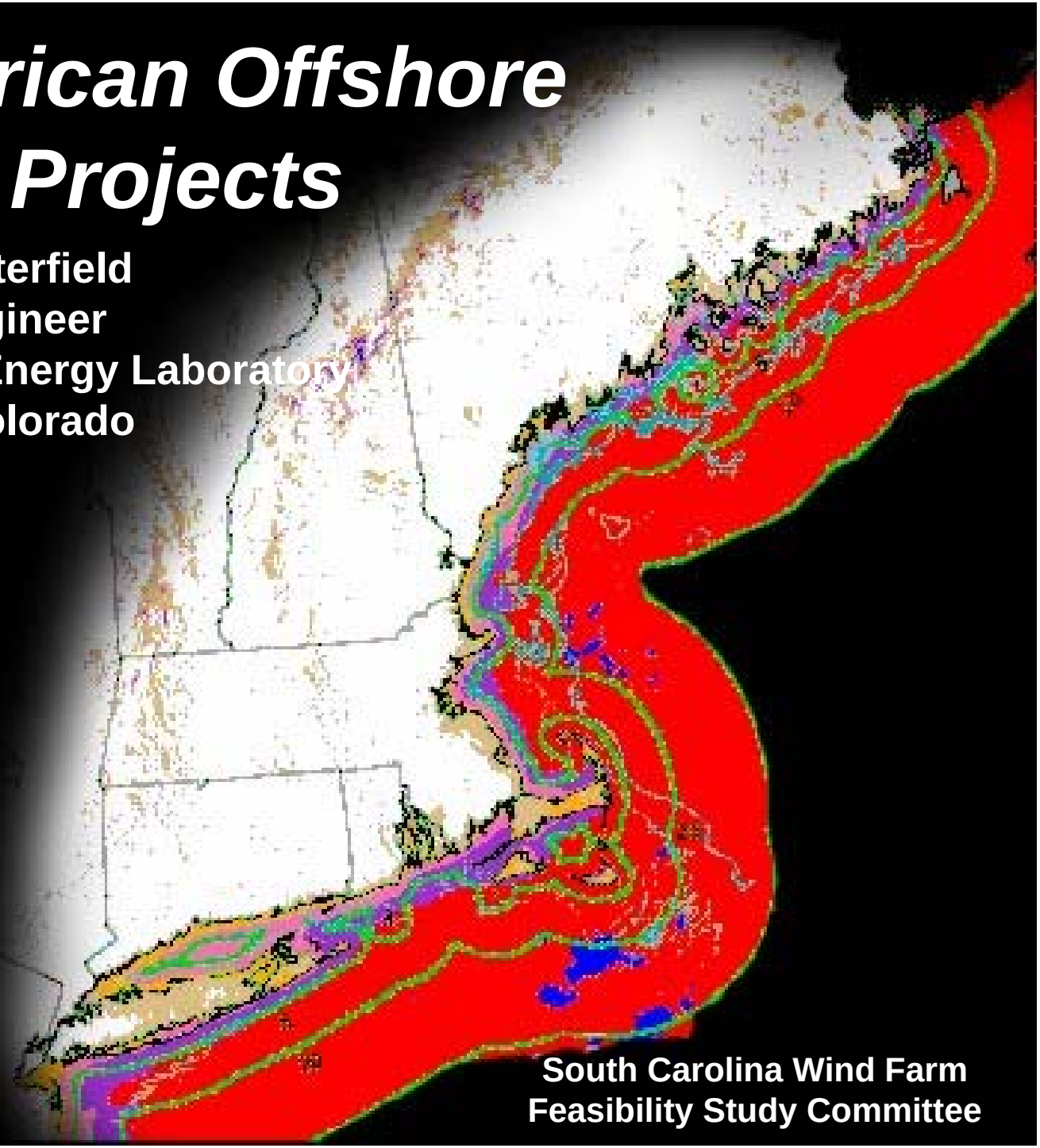
2008 Wind Market Report; LBL

Carpe Ventem

www.windpoweringamerica.gov

North American Offshore Wind Projects

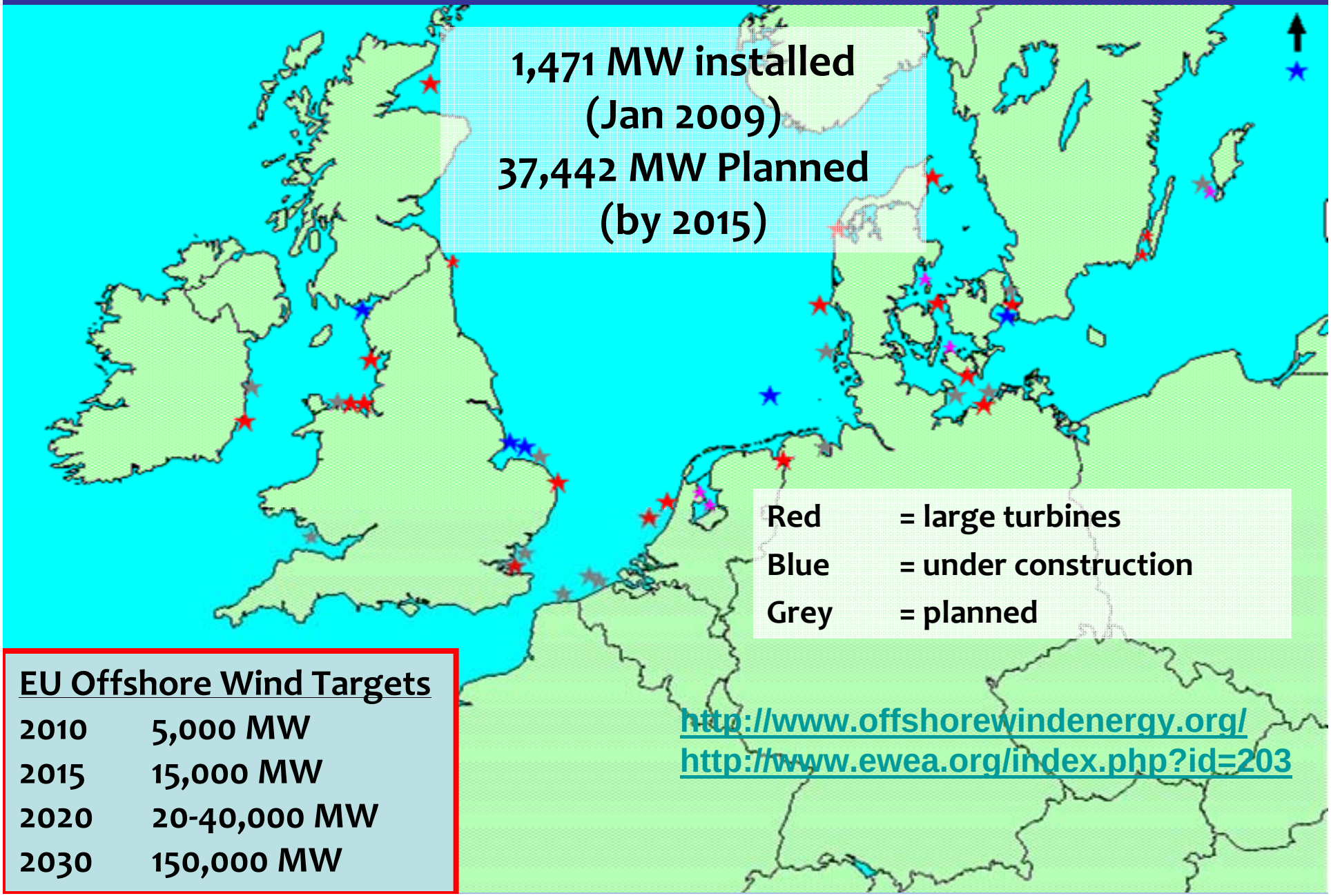
Sandy Butterfield
Chief Engineer
National Renewable Energy Laboratory
Golden, Colorado



South Carolina Wind Farm
Feasibility Study Committee

Offshore Wind Projects

European Activity Offshore Wind

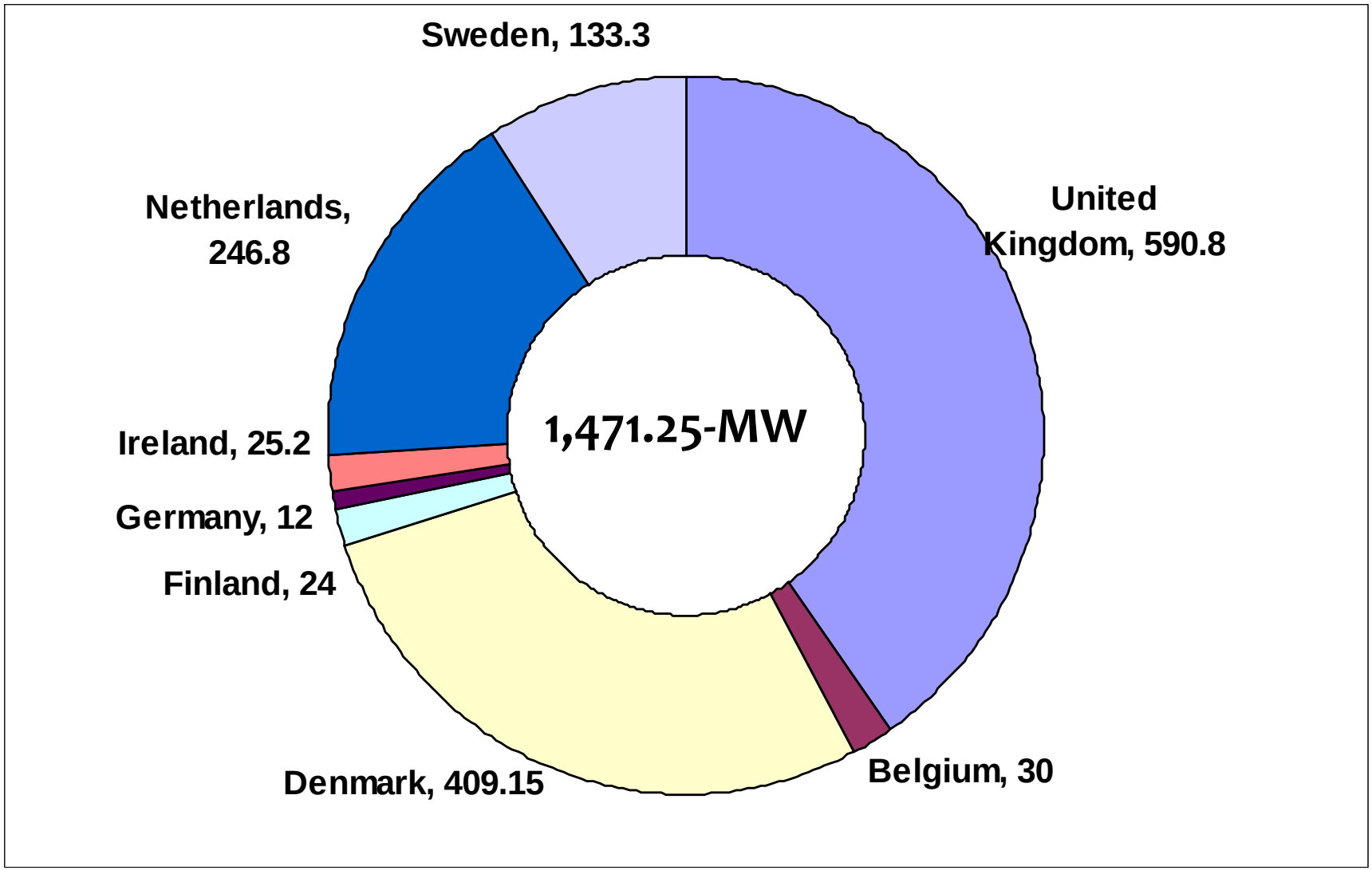


EU Offshore Wind Targets

2010	5,000 MW
2015	15,000 MW
2020	20-40,000 MW
2030	150,000 MW

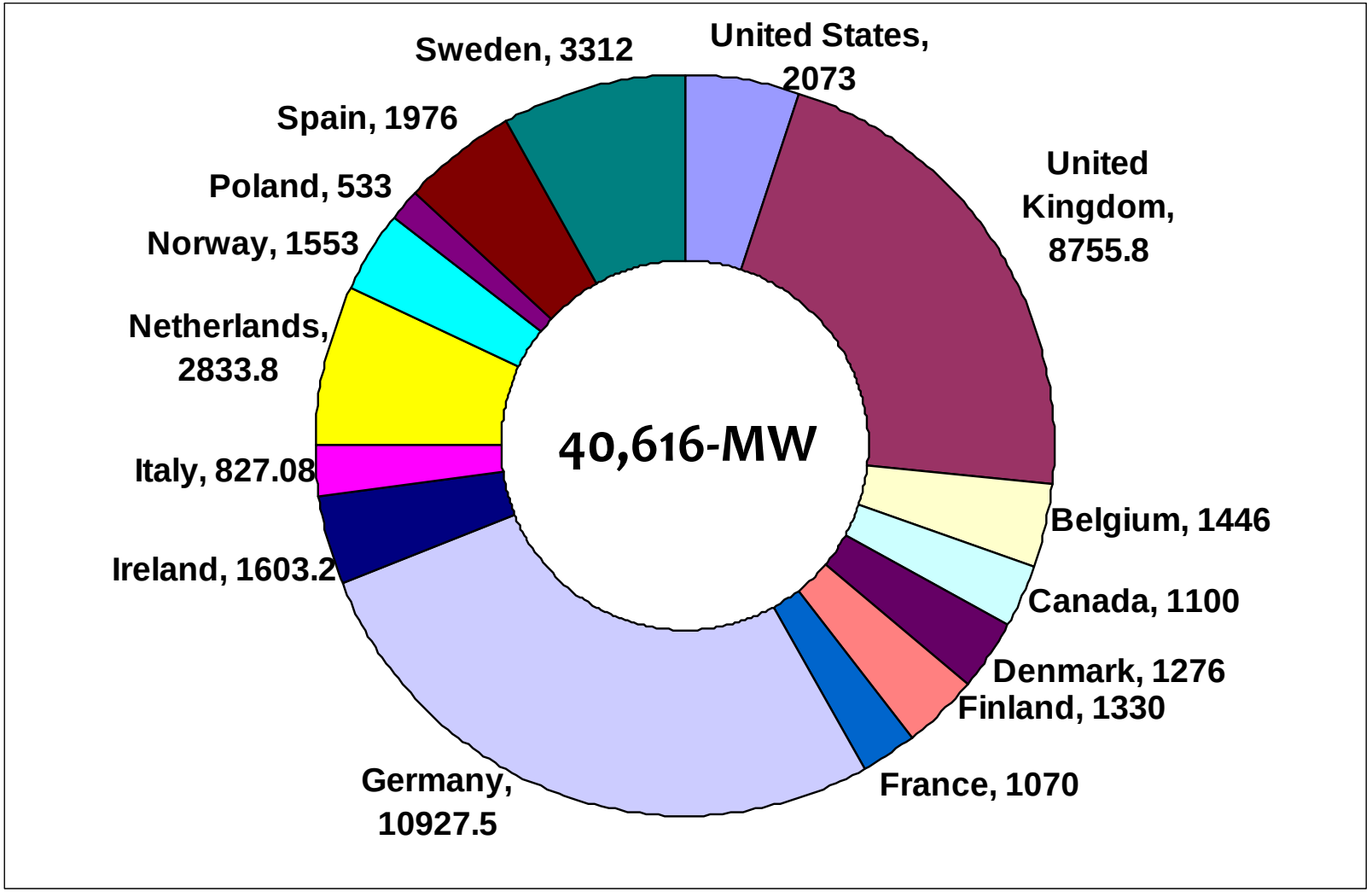
http://www.offshorewindenergy.org/
http://www.ewea.org/index.php?id=203

Current Installed Offshore Capacity
(Country, MW Installed at the end of 2008)



http://www.ewea.org/index.php?id=203

Projects Planned by 2015
Europe and North America

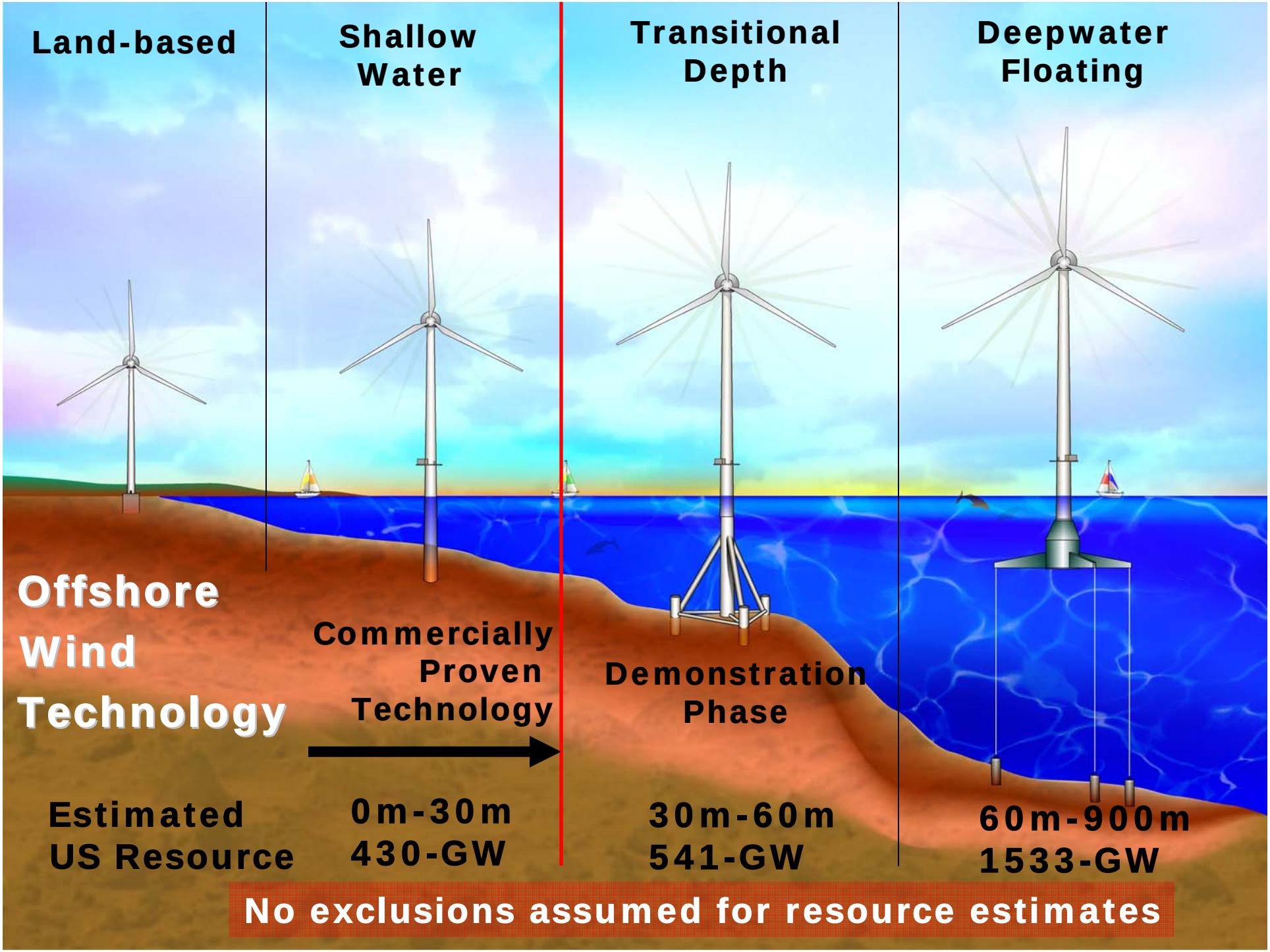


http://www.ewea.org/index.php?id=203

Presentation Scope

- *"Approximately 30 offshore wind projects have been announced in North America".*

- *"This presentation will provide brief overviews of the projects announced to date in various regions".*


Land-based
Shallow Water
Transitional Depth
Deepwater Floating
Offshore Wind Technology
Commercially Proven Technology
Demonstration Phase
Estimated US Resource
0m-30m 430-GW
30m-60m 541-GW
60m-900m 1533-GW
No exclusions assumed for resource estimates

Commercial Offshore Wind Technology


Vestas 2.0 MW Turbine
Horns Rev, DK


Talisman Energy:
Repower 5-MW
Beatrice Fields,
Scotland


GE 3.6 MW Turbine
Arklow Banks


Seimens 2.3 MW Turbines
Middlegrunden, DK

- Initial development and demonstration stage; 22 projects, 1,471 MW installed
- Fixed bottom shallow water 0-30m depth
- 2 – 5 MW upwind rotor configurations
- 70+ meter tower height on monopoles and gravity bases
- Mature technology for submarine power cable
- Existing oil and gas experience is essential
- Reliability problems and turbine shortages have discouraged early boom in development.
- Cost are not well established in the US.

Monopile Foundations

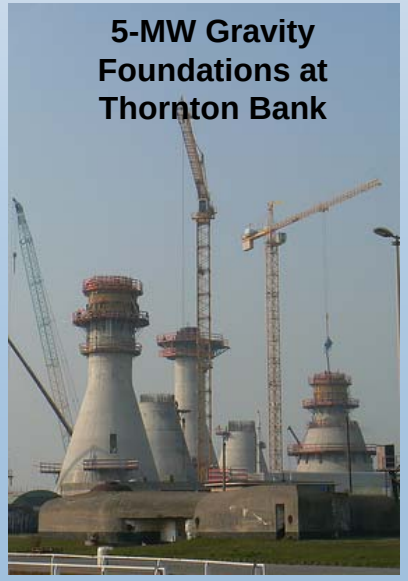
Pile Hammer
Credit: DONG Energy

- Most common type
- Driven or drilled 25-30m embedment
- Stiff soils only (e.g. sand)
- 4.5 - 5 m diameter steel tube typical
- Wall thickness 30 - 60 mm
- Minimal Footprint
- Water depth experience to 28-m

Transition Pieces
Credit: DONG Energy

Credit: GE Energy

Gravity Base Foundations



5-MW Gravity Foundations at Thornton Bank

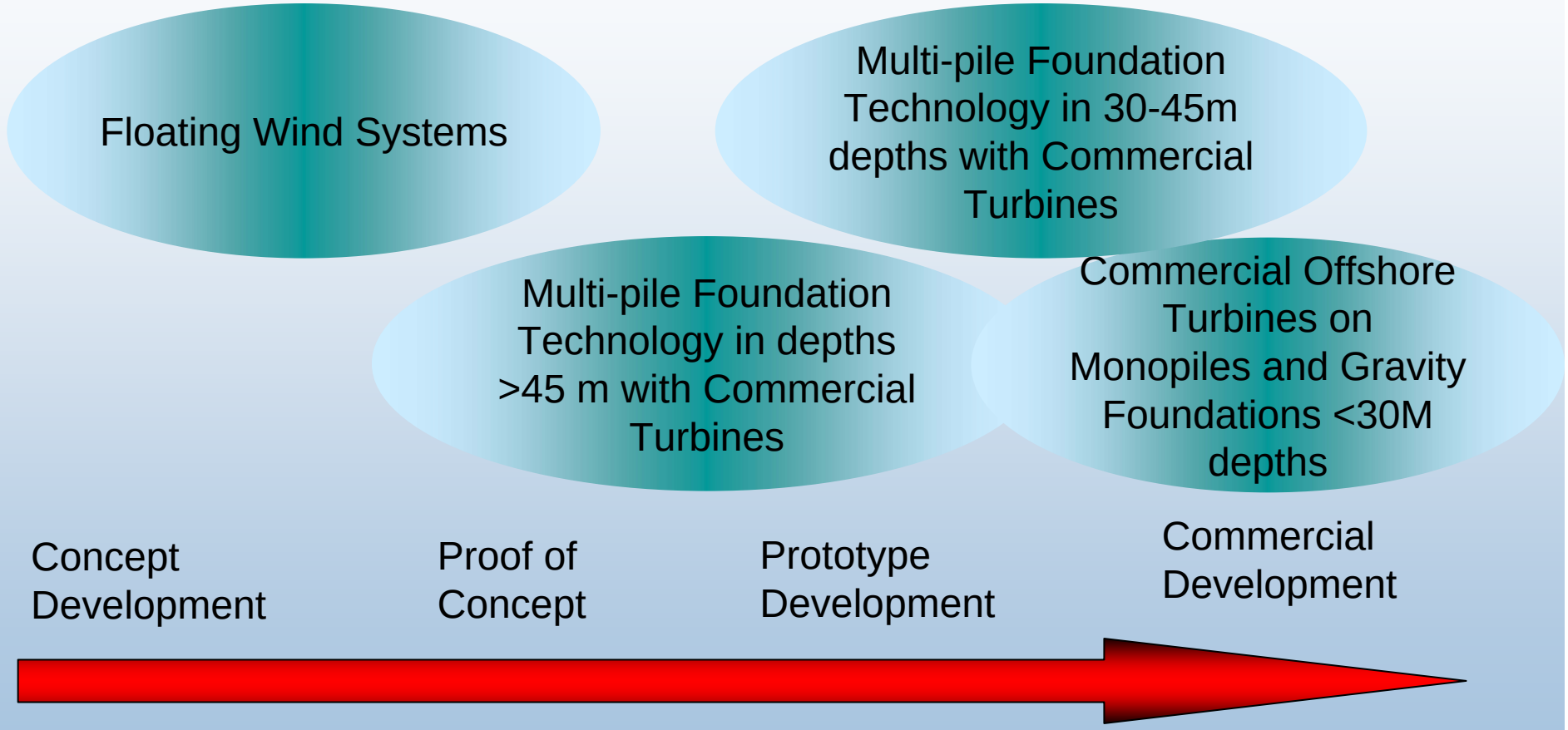
- Steel or concrete
- Relies on weight of structure to resist overturning
- Ballast added after placement
- Seabed preparation essential
- Examples: Siemens turbines at Nysted and Samsø.
- New project underway at Thornton Bank in Belgium.
- Depth experience to 30-m

5-MW Gravity Foundations at Thornton Bank

Commercial Offshore Wind Turbines

Turbine Manufacturer	Turbine model & rated power	Date of availability	Offshore Operating Experience
Siemens	SWT-2.0 - 2.0 MW	2000	Commercial
Vestas	V80 - 2 MW	2000	Commercial
General Electric	GE – 3.6-MW	2003	Commercially inactive
Siemens	SWT-2.3 - 2.3 MW	2003	Commercial
Vestas	V90 - 3 MW	2004	Commercial
Siemens	SWT-3.6 - 3.6 MW	2005	Commercial
RePower Systems (Suzilon)	5M - 5 MW	2005	45-M Demonstration Offshore Commercial
Multibrid (Areva)	M5000 - 5 MW	2005	Onshore 2005 Borkum West Pilot

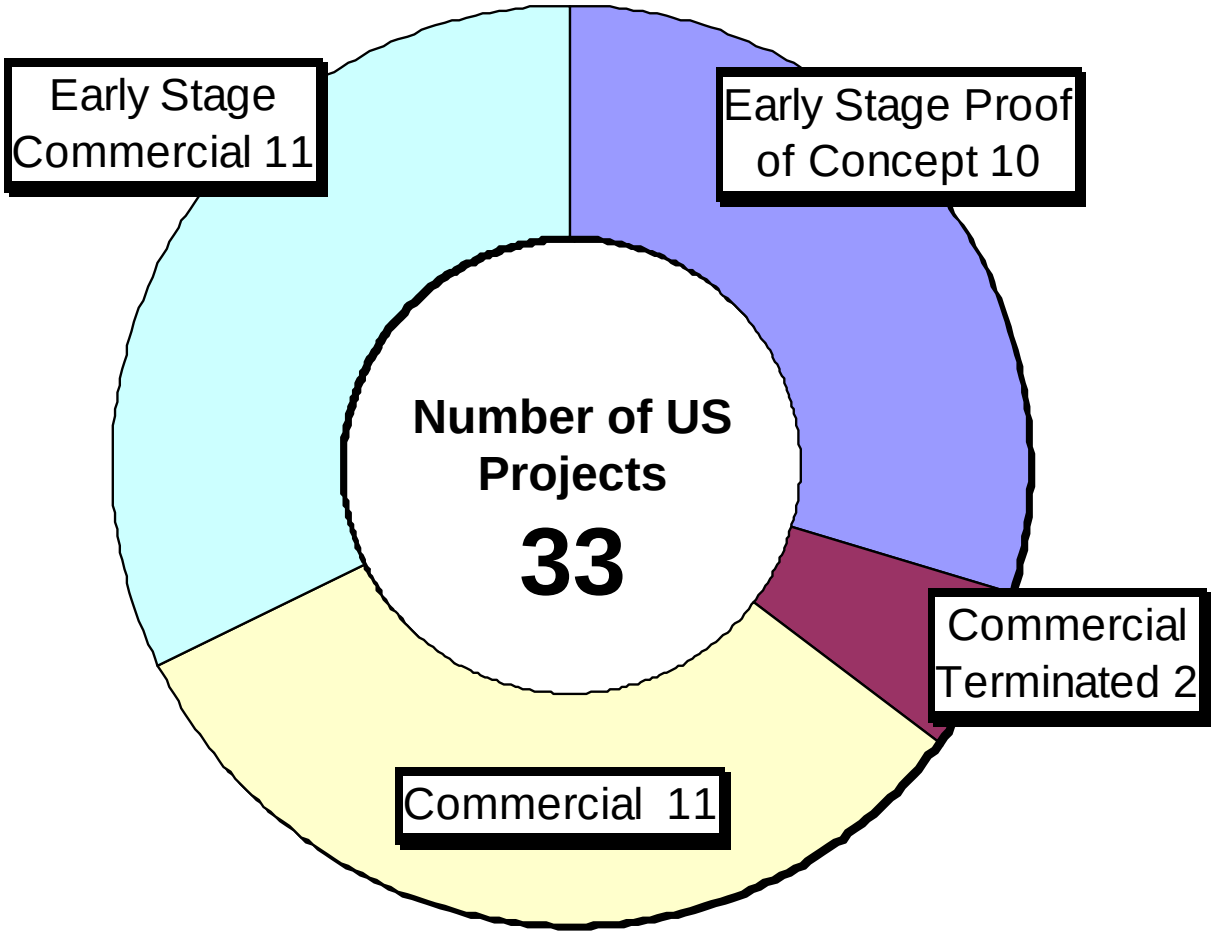
Progress Toward Commercial Viability and Technical Maturity



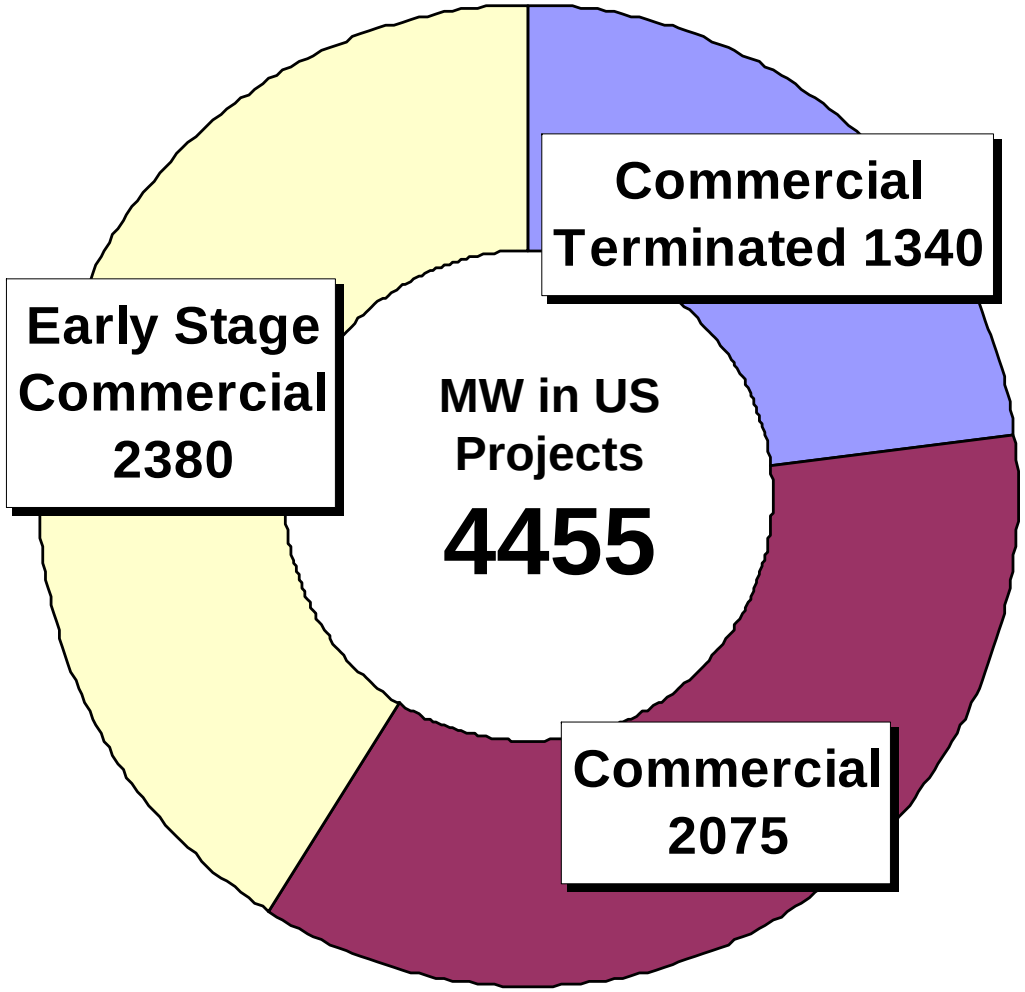
Criteria for Commercial Projects

- ✓ Commercially available wind turbines.
- ✓ System technology has been proven in other commercial offshore wind applications.
- ✓ Potential to generate sustained electricity to the grid.
- ✓ Can be completed before 2015.
- ✓ Technology is recognized by the current regulatory process, offshore wind standards, and certification bodies.
- ✓ Specific site and capacity is defined.
- ✓ Metocean, micrositing, environmental, and other risk impact feasibility studies have been performed.

U.S Projects by Development Status



US Projects by Rated Power Capacity (MW)



US Offshore Wind Commercial Projects

US Offshore Wind Initiatives		
Project	**State**	**MW**
Capewind	MA	468
Hull Municipal	MA	15
Buzzards Bay	MA	300
Rhode Island (OER)	RI	400
Winergy	NY	12
New Jersey (BPU)	NJ	350
Delmarva	DE	350
Southern Company	GA	10
W.E.S.T.	TX	150
Cuyahoga County	OH	20
Total MW		2075

No Offshore Wind Projects Installed In North America Yet

Description of Individual Commercial Projects

Project	Developer	Jurisdiction	State	MW
Capewind	Cape Wind Associates	MMS	MA	468
Hull Municipal	Town of Hull MA	MA State	MA	15
Buzzards Bay	Patriot Wind	MA State	MA	300
RIWinds	Deepwater Wind	RI State	RI	20
RIWinds	Deepwater Wind	MMS	RI	380
Winergy Plum Island	Deepwater Wind	NY State	NY	12
New Jersey (BPU)	Deepwater Wind	MMS	NJ	350
Delmarva	Bluewater Wind	MMS	DE	350
Savanna GA	Southern Company	MMS	GA	10
Galveston Offshore Wind	W.E.S.T.	TX State	TX	150
Cuyahoga County	Cuyahoga CO. Task Force	OH State	OH	20
Total				2075

Canadian Offshore Wind Projects

Project	Developer	Status	Province	Size (MW)
Nai Kun	Nai Kun Wind	Commercial Track	British Columbia	396
Trillium Power Wind	Trillium Power Wind Corp.	Commercial Track	Ontario	710
Lake Ontario (3 Sites Under Consideration)	Toronto Hydro	Preliminary Planning/ Commercial Track	Ontario	200
Amherst Island Offshore Wind Farm	Gilead Power	Preliminary Planning	Ontario	NA
Prince Edward County Offshore Wind Farm	Gilead Power	Preliminary Planning	Ontario	NA
Salmon Point Offshore Wind Farm	Gilead Power	Preliminary Planning	Ontario	NA
Southpoint Wind Power Leamington	Leamington	Preliminary Planning	Ontario	30

Multi-pile Foundations

Moving into Deeper Water

Wind Industry Experience is Limited

Jackets (welded truss towers) are the Oil and Gas Standard

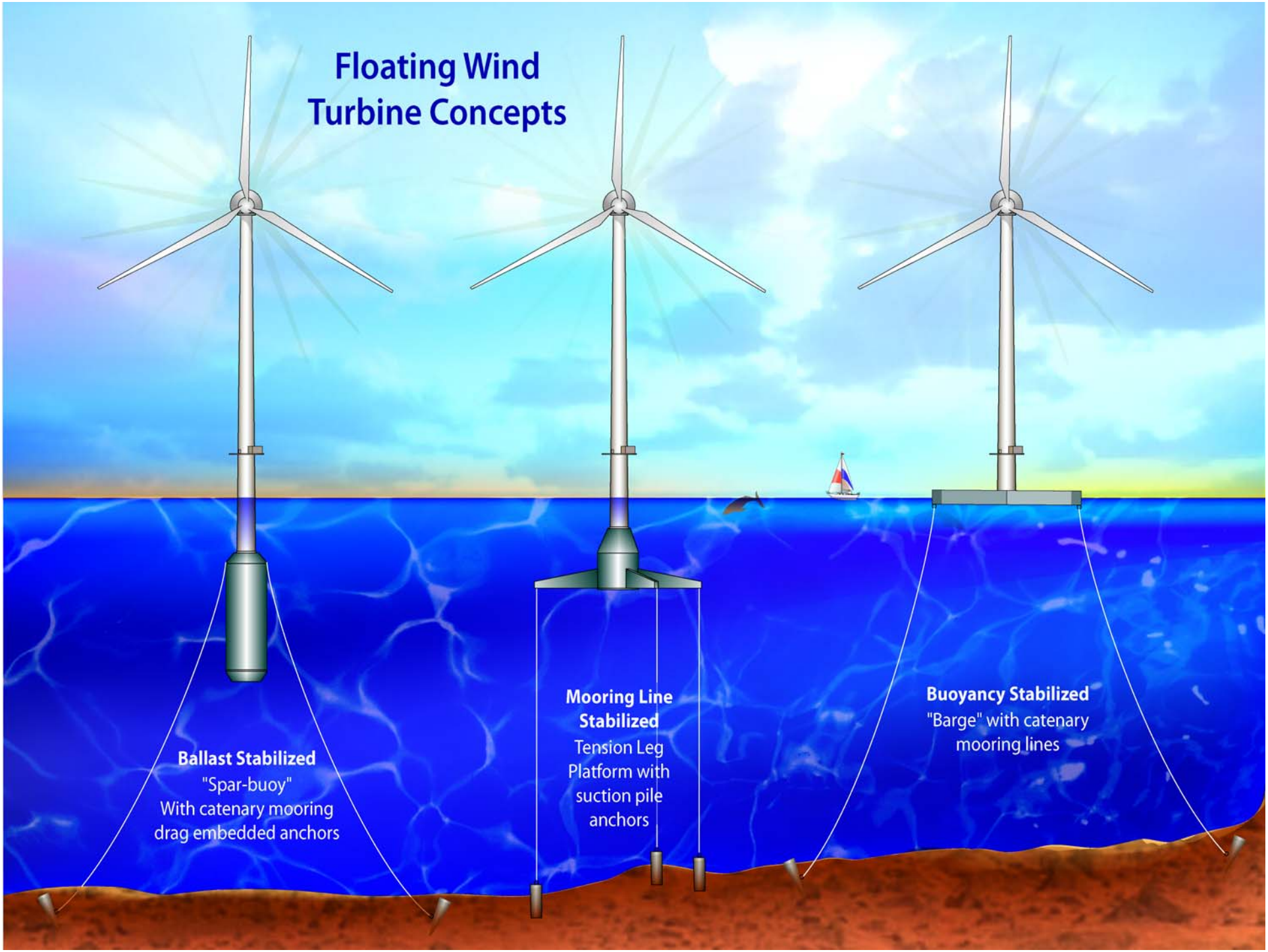
Bard Engineering Tripod Variation

Multibrid M5000 Prototype on Tripod

Repower 5MW Demonstration at Beatrice Four-pile jacket

Offshore Wind Turbines Under Development

Turbine Manufacturer	Turbine model & rated power	Date of availability	Technology Status
RePower Systems (Suzilon)	6M – 6MW	2009	Prototype Assembled
Bard Engineering	VM - 5 MW	2009	Onshore prototype 2008
Nordex	N90 - 2.5 MW	2006	Offshore Demo 2003
Clipper Windpower	Liberty 2.5 MW	-	Commercial Onshore
Clipper Windpower	Britannia 7.5 MW	-	Prototype Design Underway


Floating Wind
Turbine Concepts
Ballast Stabilized
"Spar-buoy"
With catenary mooring
drag embedded anchors
Mooring Line
Stabilized
Tension Leg
Platform with
suction pile
anchors
Buoyancy Stabilized
"Barge" with catenary
mooring lines

Innovative Offshore Wind Systems Under Development

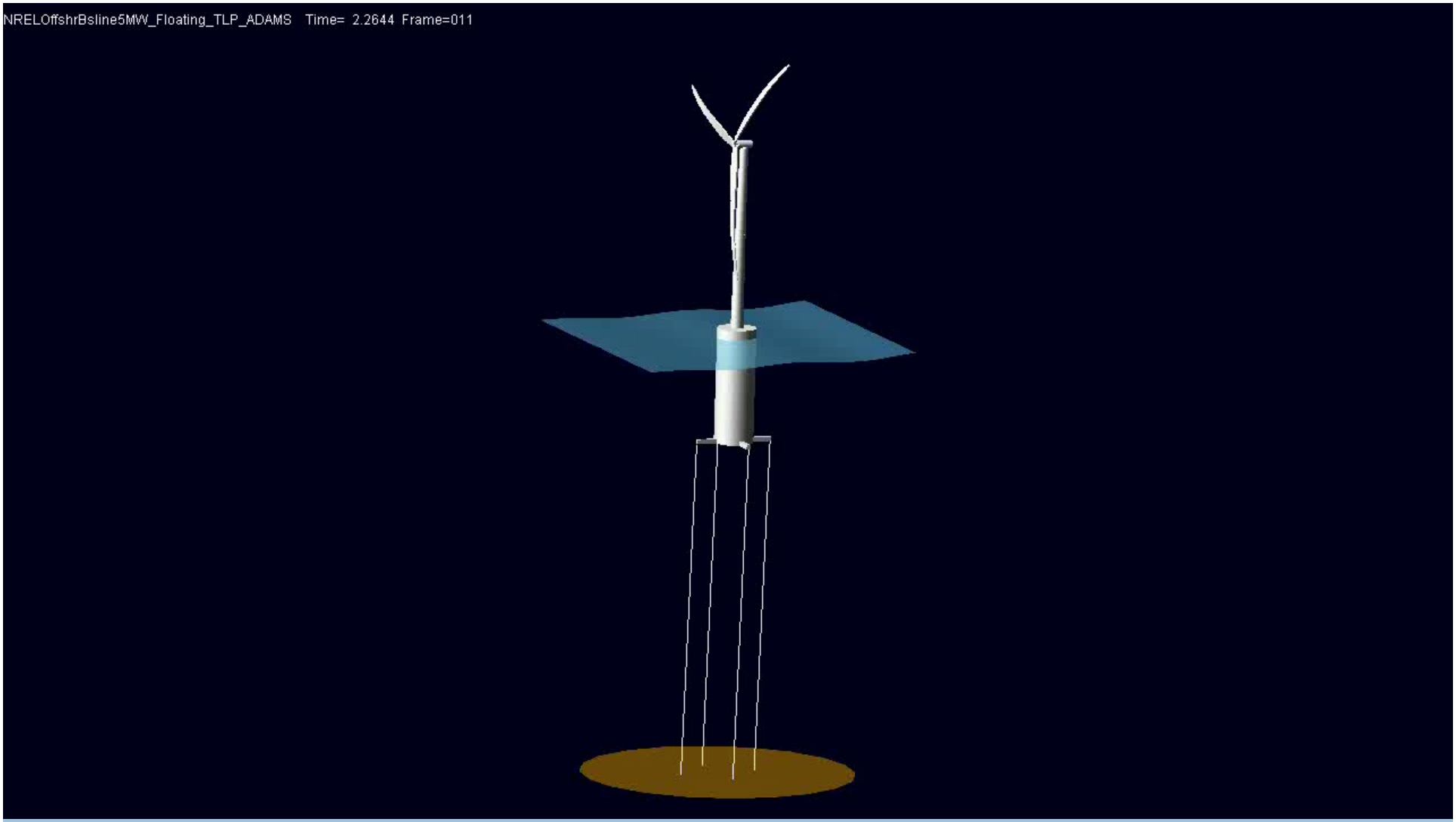
Developer	System Model and rating	Type	Technology Status
Statoil/Norske Hydro	HyWind – 2.3 MW POC	System	Proof of Concept Underway
Blue H Group	80-kw 2.5-MW / 5-MW planned	System	Proof of Concept Underway
Principal Power	2-MW	Platform / System	Concept development
Statoil/Norske Hydro	SWAY	System	Concept development
Offshore Windpower Systems of Texas	Triton	Platform	Proof of concept
Grey's Harbor	-	Wind/Wave Hybrid	Concept development
Ecopower	Vertical axis 300-kW	System	Concept development

Fundamental Technology Challenges for Commercial Floating Offshore Wind Turbines

- ✓ Develop new design tools to minimized loads.
- ✓ Understand deepwater external conditions and develop new design basis to account for open ocean conditions.
- ✓ Redesign turbine/platform systems to withstand new deflections and load regimes.
- ✓ Optimize lower weight systems for floating design space.
- ✓ Update offshore regulations, certification, and standards to account for floating systems.

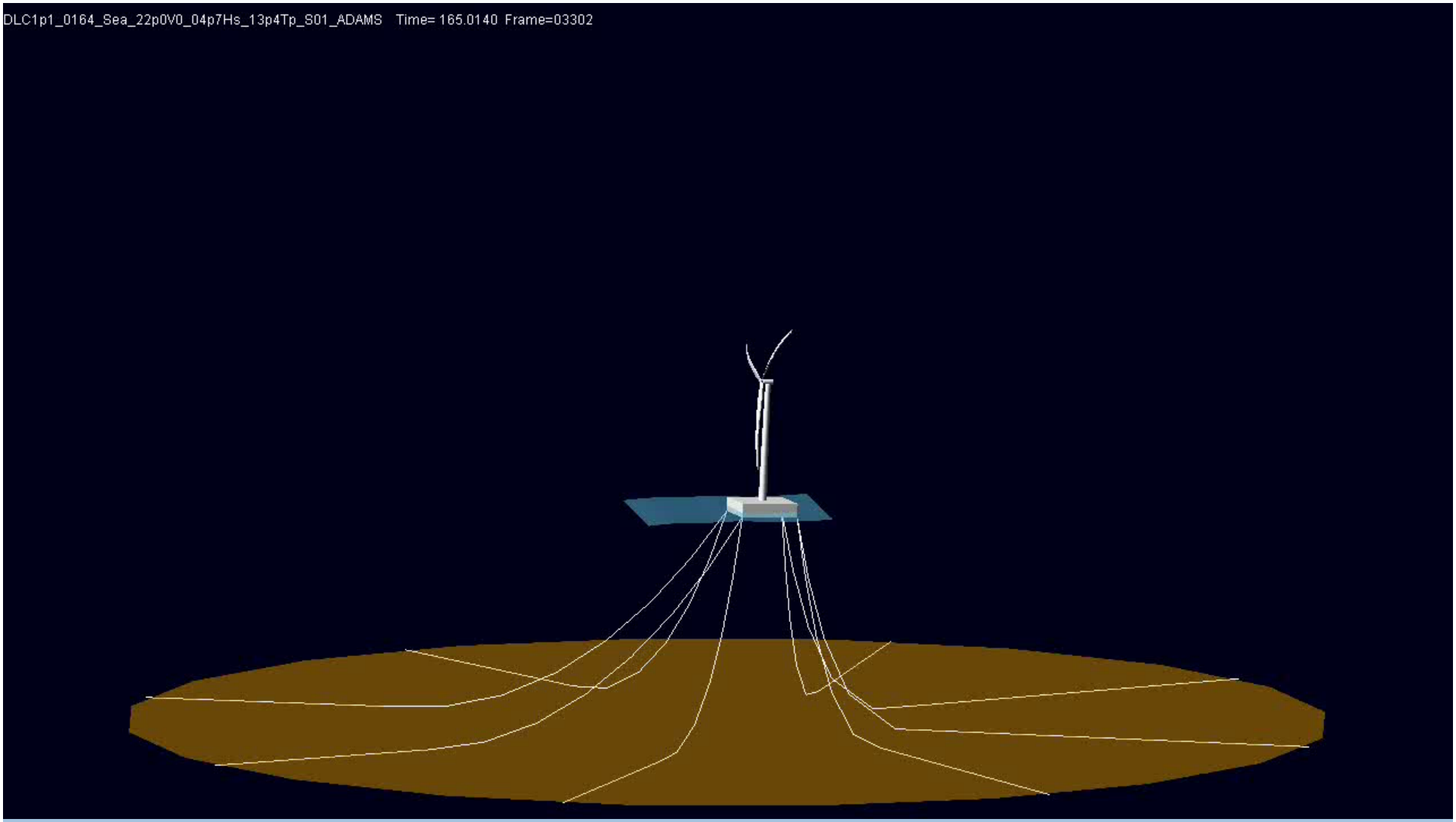
NREL simulation of MIT tension leg platform

slack lines under extreme loading



NREL simulation of barge type platform

high loads and extreme deflections under extreme loading



Floating Wind Turbine Pioneers

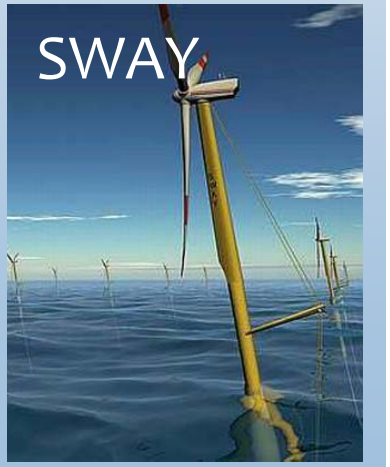
- HyWind is Under development by StatoilHydro – Norway
- Needs 100-m+ depth to operate.
- Announced a $78MM proof of concept demonstration project near Norway.
- Partnering with Siemens using their 2.3MW turbine.
- Costs estimated about where solar is today.
- Expectations to compete with conventional wind energy long term.

- BlueH is the first company to claim "in-the-water" floating wind turbine status.
- Deployed tension leg platform near Italy in late 2007.
- 80-kW Proof of concept is underway.
- Recently Awarded a Grant from UK pursue 5MW demonstration.

- WindFloat
- Platform Technology from Principal Power
- Planning proof of concept demonstration project.

- Ecopower
- Darrius Vertical Axis
- Phase 1 is 45-MW demonstration project in China – shallow water

- SWAY technology is under development by StatoilHydro – Norway
- Needs 100-m+ depth to operate.



Offshore Projects Summary

- Over 1400-MW deployed in Europe but none yet in the USA.
- Offshore wind resources are abundant in the USA and Canada.
- 33 projects have been announced in USA. 11 are on a commercial track for near-term energy supply.
- Over 2000-MW of offshore projects are in the permitting pipeline in USA and approximately 1100-MW are underway in Canada.
- Atlantic states with transmission constrained load centers are leading development.
- Most projects await completion of regulatory process.
- All commercial projects and technology are in shallow water (>30-m)
- Floating systems are beginning to emerge and several concepts are advancing to a proof of concept stage.
- No significant environmental impacts so far.

Questions?

Sandy Butterfield
Chief Engineer
Walt Musial
Principle Engineer
National Renewable Energy Laboratory
Sandy.Butterfield@NREL.Gov
Walter.Musial@nrel.gov

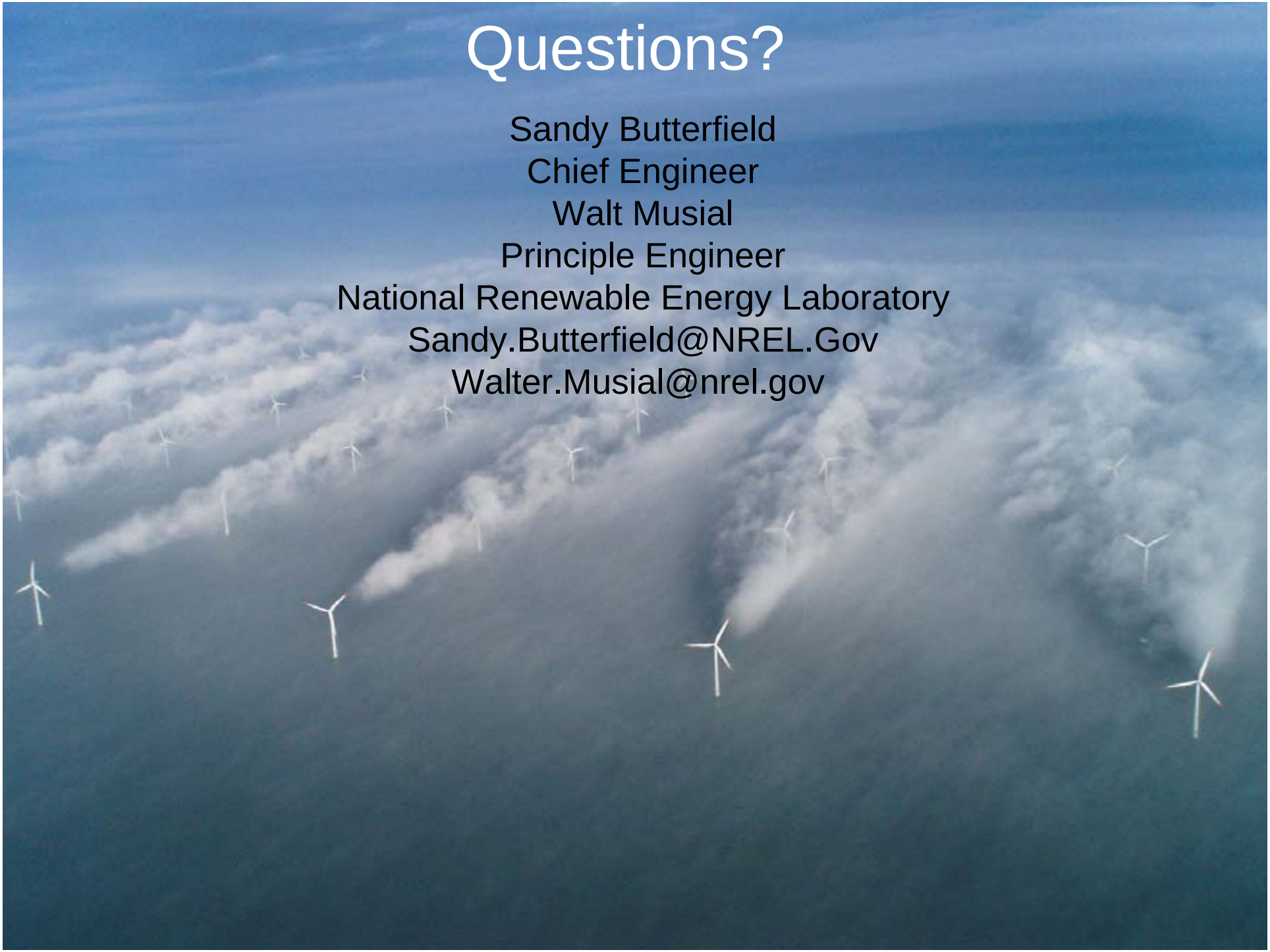


Photo credit: http://www.owen.eru.rl.ac.uk/images/seaside.jpg

Fishermen's Energy

Off-Shore Wind Project off Atlantic City

South Carolina Energy Committee

July 13, 2009

Fishermen's Energy

- A community-based offshore wind developer
- Formed by principals of the New Jersey fishing companies to enable the fishing industry to participate in and invest in offshore wind energy
- Presenting a constructive program for alternative uses of waters off NJ that these companies have fished for decades

Fishermen's Mission

- ***Develop*** offshore energy facilities for the benefit of fishermen owners and participating investors
- ***Maximize*** the potential of offshore wind energy production for the benefit of the public and owners
- ***Market*** renewable electric energy to strategic electric customers
- ***Mitigate*** the cumulative impact of the development of offshore energy on fishermen by maximizing their ability to participate as owners
- ***Manage*** sustainably our renewable offshore marine fishery and energy resources

Why Offshore Wind?

….because it is where we work.

Why Offshore Wind?

Key is where we're starting -- coastal Mid-Atlantic:

- Limited onshore wind in harvestable sites
- Strength, consistency, reduced wind shear of offshore vs. onshore winds
- Shallow water, sandy sea bottom suitable for technically mature monopile foundations
- Proximity of offshore wind to key load centers
- Ecological considerations
- Potential for low human, avian, and marine impacts – if deployed properly

Fishermen's Energy Paradigm

- Smart facility siting with a view towards minimizing impacts to fishermen while maximizing offshore energy production, serviceability, and maritime safety
- Enabling members of the local commercial fishing industry to invest directly in offshore wind development
- Creating profit for local businesses capable of serving as vendors both land-based and water-based
- Contributing to fisheries science and collaboration with local academic institutions and associations
- Providing direct mitigation payments to fishermen in specific circumstances where impacts are localized, specific and cannot be adequately addressed by other options

Why Fishermen's?

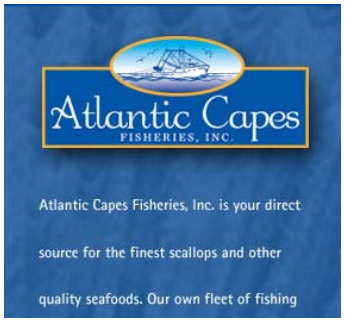
….the right team

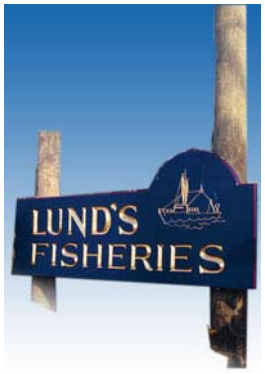
- Professional team:
  - Strong core management team
  - World-class technical & engineering team

  - …backed by decades of maritime knowledge and skills:
  - Comprehensive knowledge of sea-bottom
  - Experience handling heavy machinery in high winds and in rough seas
  - Control of key upland assembly docks, boats, and key water access
  - Dedicated, experienced, conscientious employees who make their living at sea already!

Principals of Fishermen's Energy

www.atlanticcapes.com





www.lundsfish.com

www.essf.com

Sea Products, Inc.

www.vikingvillage.net

Cold Spring Fish & Supply Co.

www.thelobsterhouse.com

www.seawatch.com

Atlantic Shellfish

Dock Street Seafood

Truex Enterprises

Foxy Investments

Fishermen's Energy – The People

- **Founders and Management**
  - Daniel Cohen, President
  - Aviv Goldsmith, Chief Operating Officer
  - Andrew Gould, VP/Finance
  - Paul Gallagher, VP/General Counsel
  - Rhonda Jackson, Director – Communications
  - Mike Madia – Director – Development
  - Steve O'Malley – Engineering Coordinator

- **Initial Fisherman Investors**
  - Jeff Reichle - Lund's Fisheries, Inc.
  - Keith Laudeman – Cold Spring Fish & Supply Company
  - Rick Hoff – Dock Street Seafood
  - Daniel Cohen – Atlantic Capes Fisheries, Inc.
  - Barney & Martin Truex, James Meyers – Truex Enterprises, Inc. / Seawatch International
  - John & Kirk Larson – Viking Village
  - John Kelleher – Foxy Investments
  - Warren Alexander - Independence Fishing
  - Barry Cohen – Sea Products, Inc.

...People who earn their living from harvesting the sea

World-class Development Team

Team Member	Responsibility
AMEC	Project Engineer – EPC, Environmental Lead
AWS Truewind	Wind Resource and Modelling
Thomas Hoffman / Richard Hluchan -Ballard Spahr Andrews & Ingersoll, LLP	New Jersey, Project, and Finance Counsel
Beth Emery - Tuggey Rosenthal Pauerstein Sandoloski Agather, LLP	Special Finance Counsel
Carolyn Kaplan - Nixon Peabody, LLP	Federal Permitting and Transmission
Randy Snowling - Deloitte & Touche	Accounting, IRS Tax, PTC
AOS	Construction Advisor
Rutgers University	Marine & Shellfish Impacts
Curry & Kerlinger, LLC	Avian Impacts
The Brattle Group / Energy Investors Advisors	Financial Forecasting and Modelling

NJ Governor's Initiative

Energy Master Plan Goals:

- **1000 MW by 2012 – about 300 turbines**
- **3000 MW by 2020 – about 900 turbines**
- 3 Developers approved for met towers to be installed in 2009 (2010 extension)
- Expect each to build about 350 MW to meet first goal with construction in 2013

New Jersey Initiative:

Met Tower Rebate Program

- $12 Million rebate program, up to $4M each ‘rebate’ to be paid to three projects, for 3 met towers built in 2009 (2010 extension)
  - State provided commitment letter sufficient for financing
  - Met towers construction must be installed and operational in 2009 (2010 extension) – ecological data is public
  - Wind data is private unless project is abandoned or shared with a confidentiality agreement
  - Developer receives ‘rebate’ in check after met tower operational

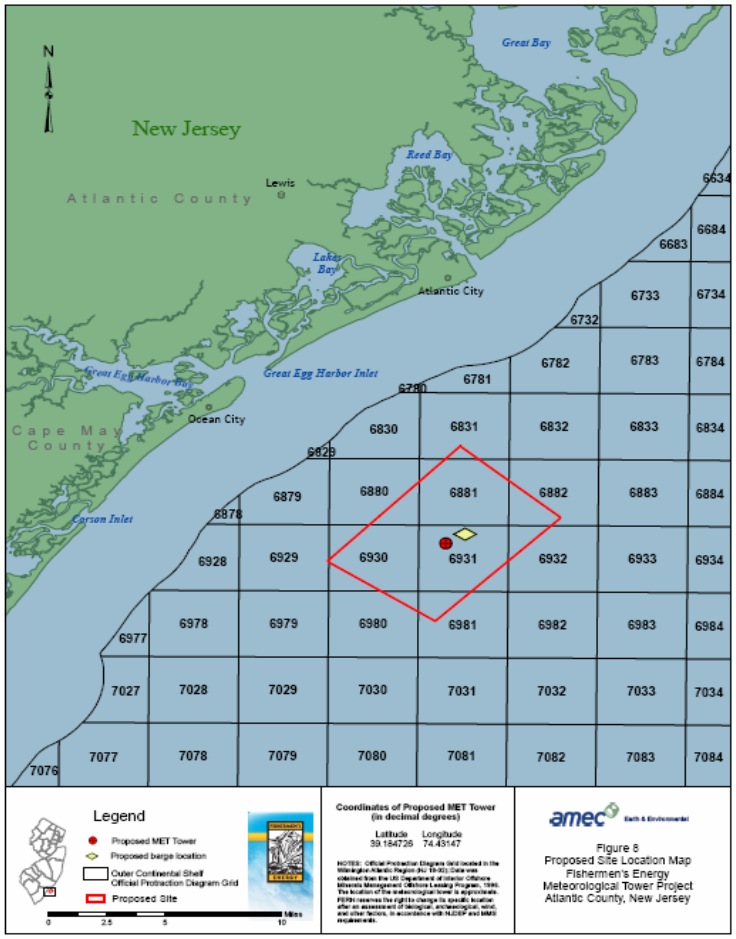
New Jersey Initiative:

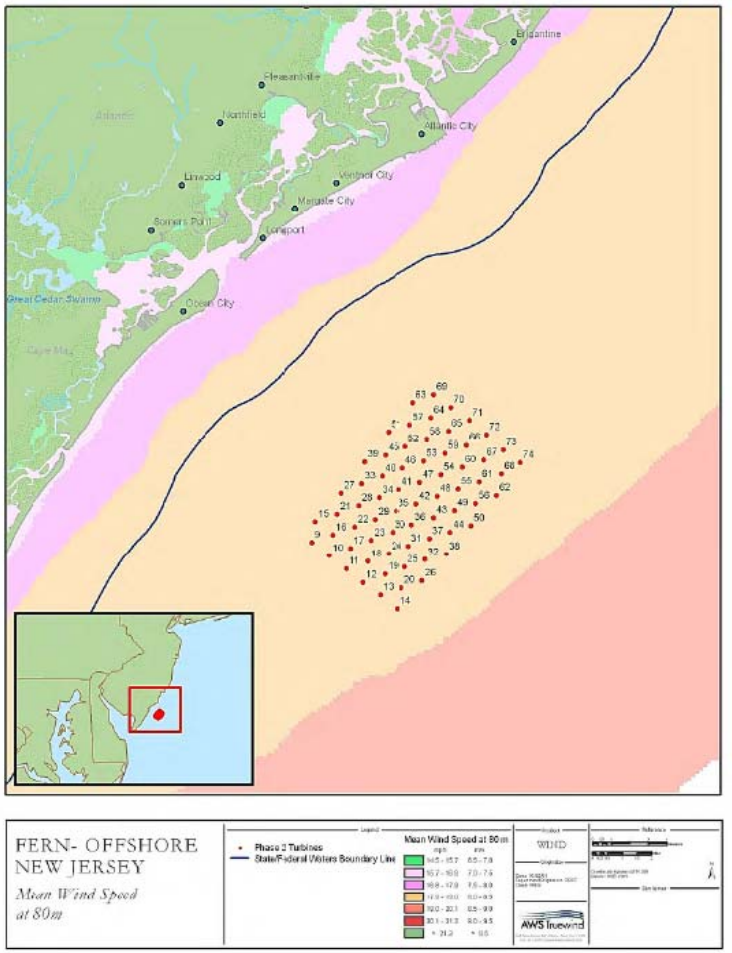
Offshore Wind Renewable Credit Program

- OREC program to provide 'revenue certainty' to offshore wind projects sufficient for non recourse financing
  - Fixed OREC price for a fixed number of years -- balancing utilities, rate payer advocates, banks and profitability
  - Stakeholder meetings began in December 2008
  - Draft rule being reviewed by Developers and other interested parties in July 2009
  - Rule to be proposed by BPU in August 2009
  - Public hearings Fall 2009
  - Formal adoption by BPU in early 2010

New Jersey Project

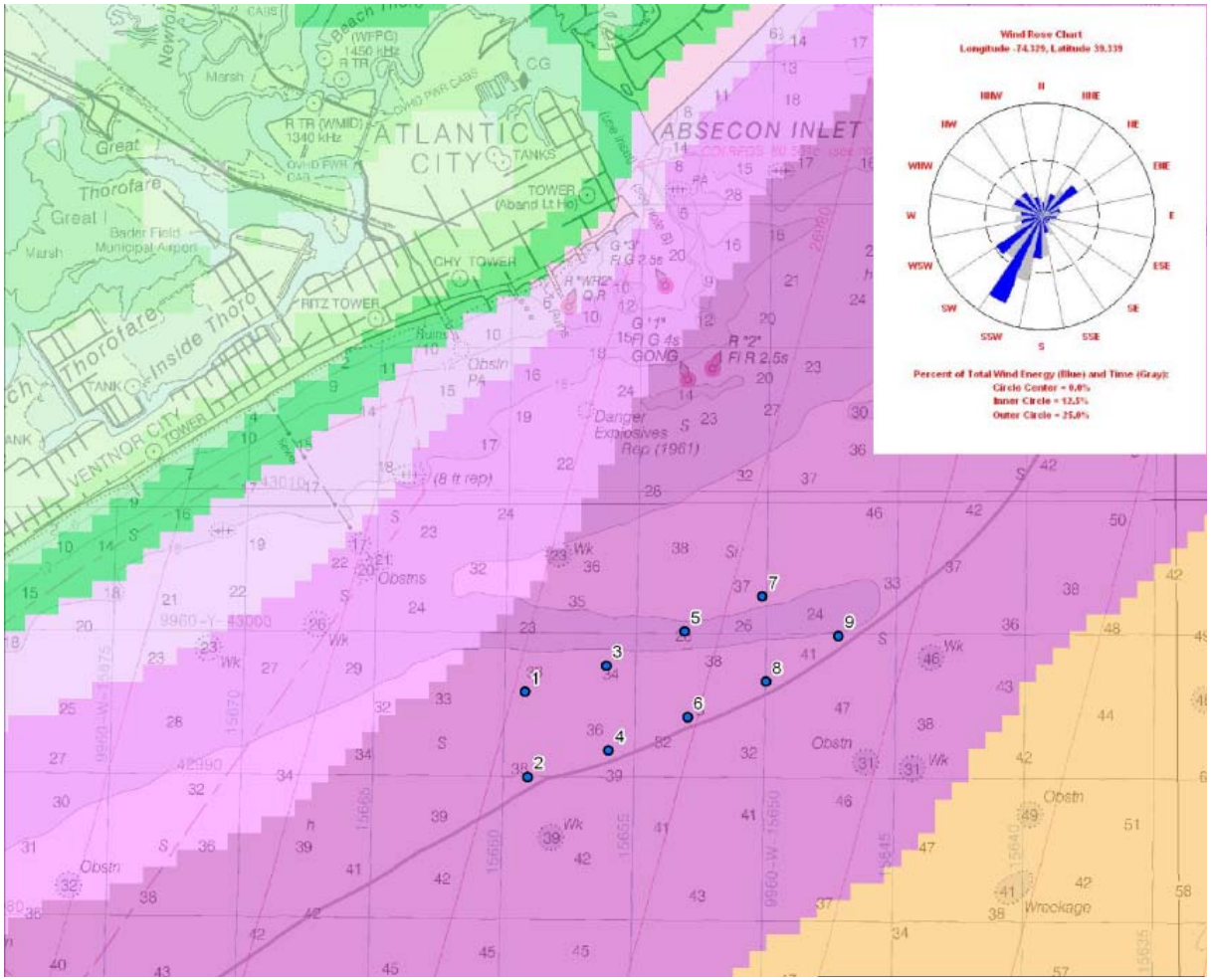
Planned Location of Met Tower and Turbine Array





New Jersey Project

Planned Location of Inshore Turbine Array



Key Dates & Milestones

- March 2008 Fishermen's proposed 2 projects – a 20MW wind farm in NJ state waters and a 330MW+ utility scale wind farm in federal waters
- October 2008 NJ Energy Master Plan Goals increased
- December 2008 Fishermen's received $4M Rebate for Met tower
- June 23, 2009 Fishermen's received one of the first Exploratory Leases
- MMS Rules active June 29, 2009 – 18 months took 4 years
- MMS timeline to permits in federal waters is 2 years or more
- Timeline of all 350MW utility scale projects in NJ, DE and RI is now 2013 construction start date
- Currently working on Met Tower Design and permitting
- Public opinion and public policy have clearly shifted from 2006 studies
- Turbine manufacturer is now committed to Fishermen's 20MW project

Public Support

- 2003 to 2008 Mixed Signals prior to any specific proposals
  - 2006 Lieberman Opinion Poll
  - Polling based on 80 Turbines at 3 / 6 / 12 / 20 miles
  - 2008 Commerce – Global Insight Liebermann Opinion Poll
- Specific Proposal of Fishermen's has garnered positive support
  - State and local politicians
  - Positive local and regional press articles -- no negative articles
  - Positive opinion polls supporting development – University of Delaware and recent Stockton College (Hughes Center) and Monmouth University polling
- 2009 Fishermen's has commissioned Stockton College to duplicate 2006 Lieberman Opinion Poll from boardwalks and beaches Atlantic City and area with visualizations

Atlantic City Wind Farm

2006 Lieberman Study

Atlantic City Wind Farm

2009 Fishermen's

Opportunities

Economic Development Opportunities:

- Construction – Met Tower, Wind Farm
  - Forecast: 10 – 12 jobs - Met Tower construction
  - Forecast: 500 jobs during construction
  - Forecast: 100 jobs for continuous operations of wind farm
- Ports & Vessels
- Manufacturing opportunities
- Administrative, Financial, etc ???

Fishermen's Energy looks forward to working with the Stakeholders in South Carolina as we develop this new resource for America's future.

Rhonda Jackson
Director, Communications and Outreach

609-374-1387
rhonda.jackson@fishermensenergy.com

BWEA

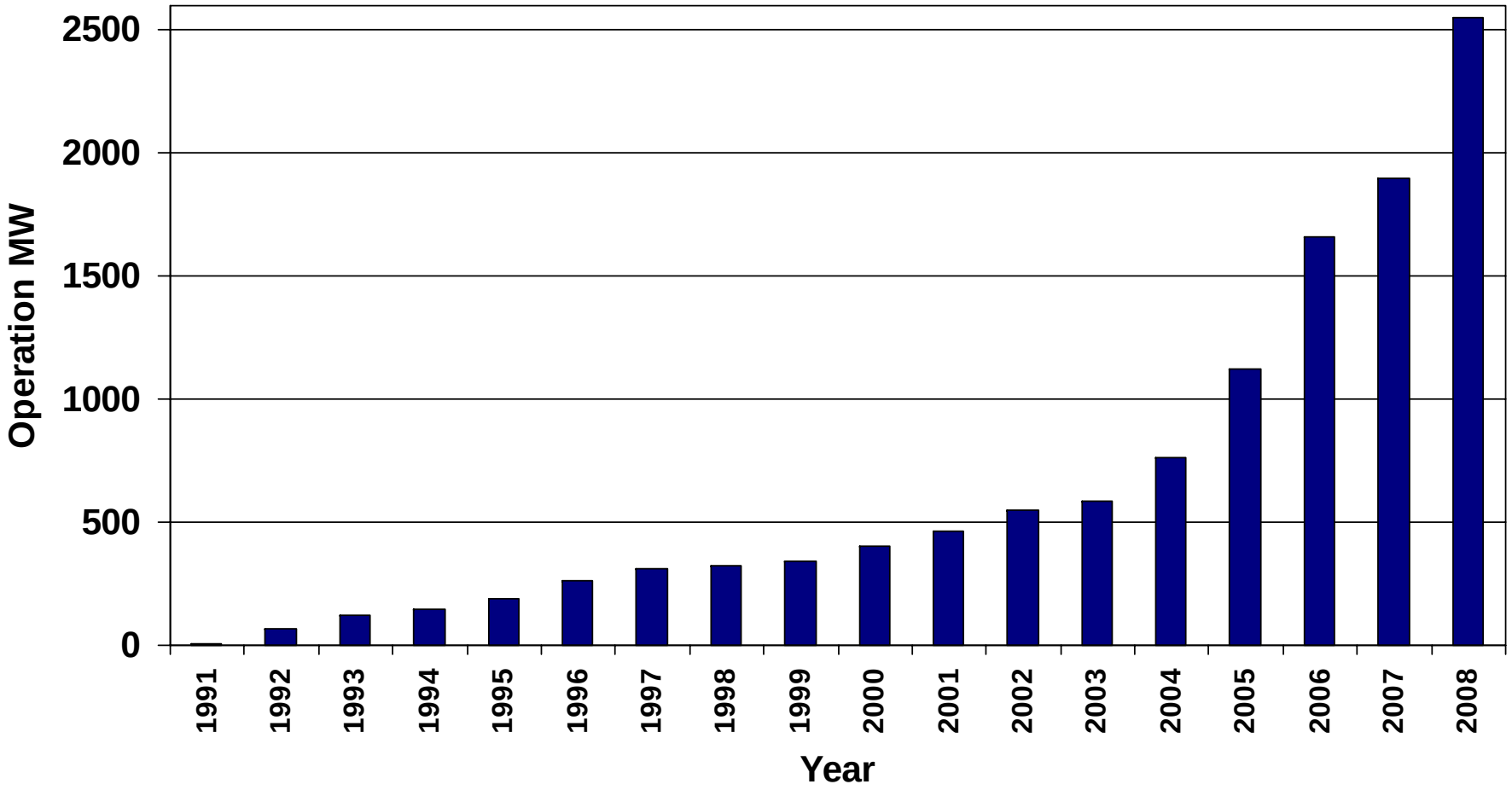
BWEA
Representing the wind, wave and tidal sectors

Powering Ahead

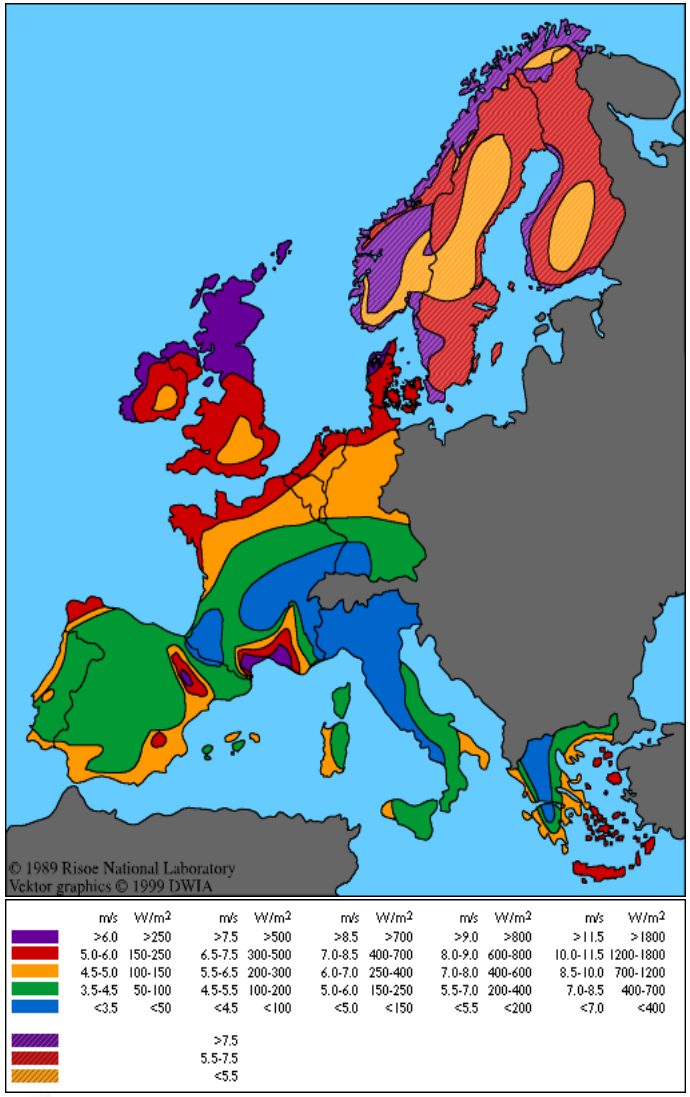
About BWEA

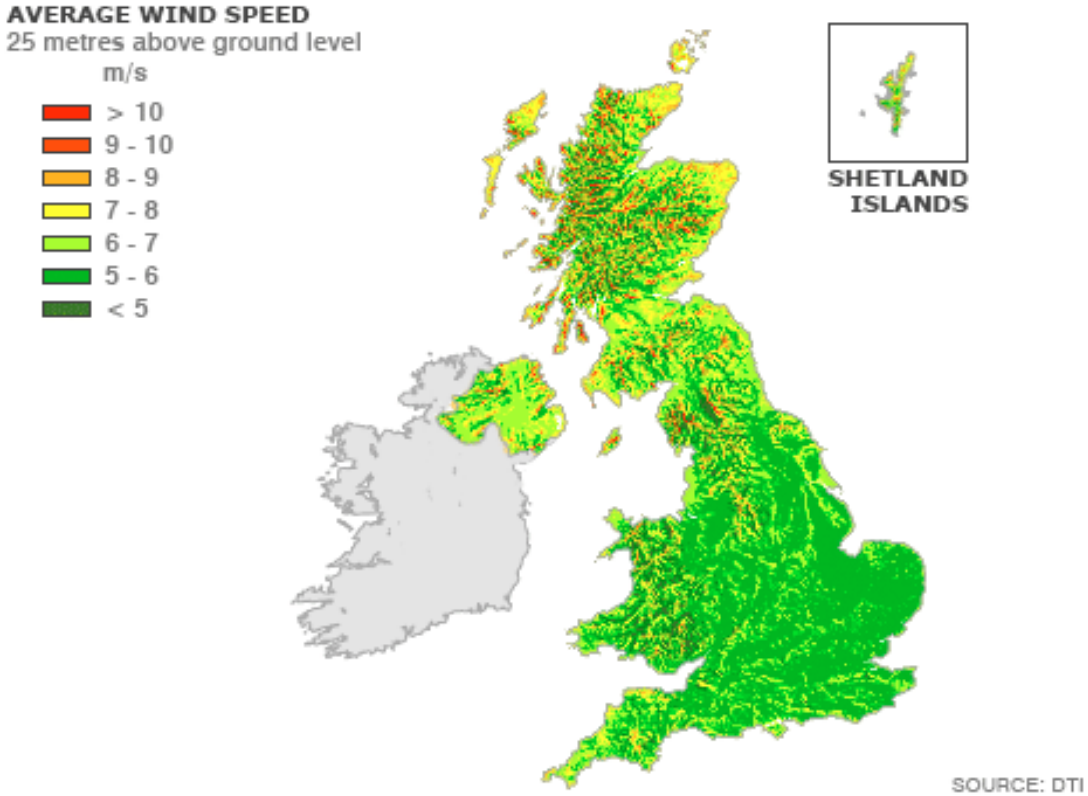
- BWEA represents the wind, wave & tidal sectors in the UK
- Over 500 corporate members, large & small from all sectors
- 25 members of staff based in Victoria, London

Market Growth (Onshore)



Wind Resource





Market Drivers

- Economic Driver
- Environmental Driver
- Social Driver

About the sector

- 217 windfarms
- 2,537 turbines
- 3,647 MW operational (3081 MW onshore / 566 MW offshore)

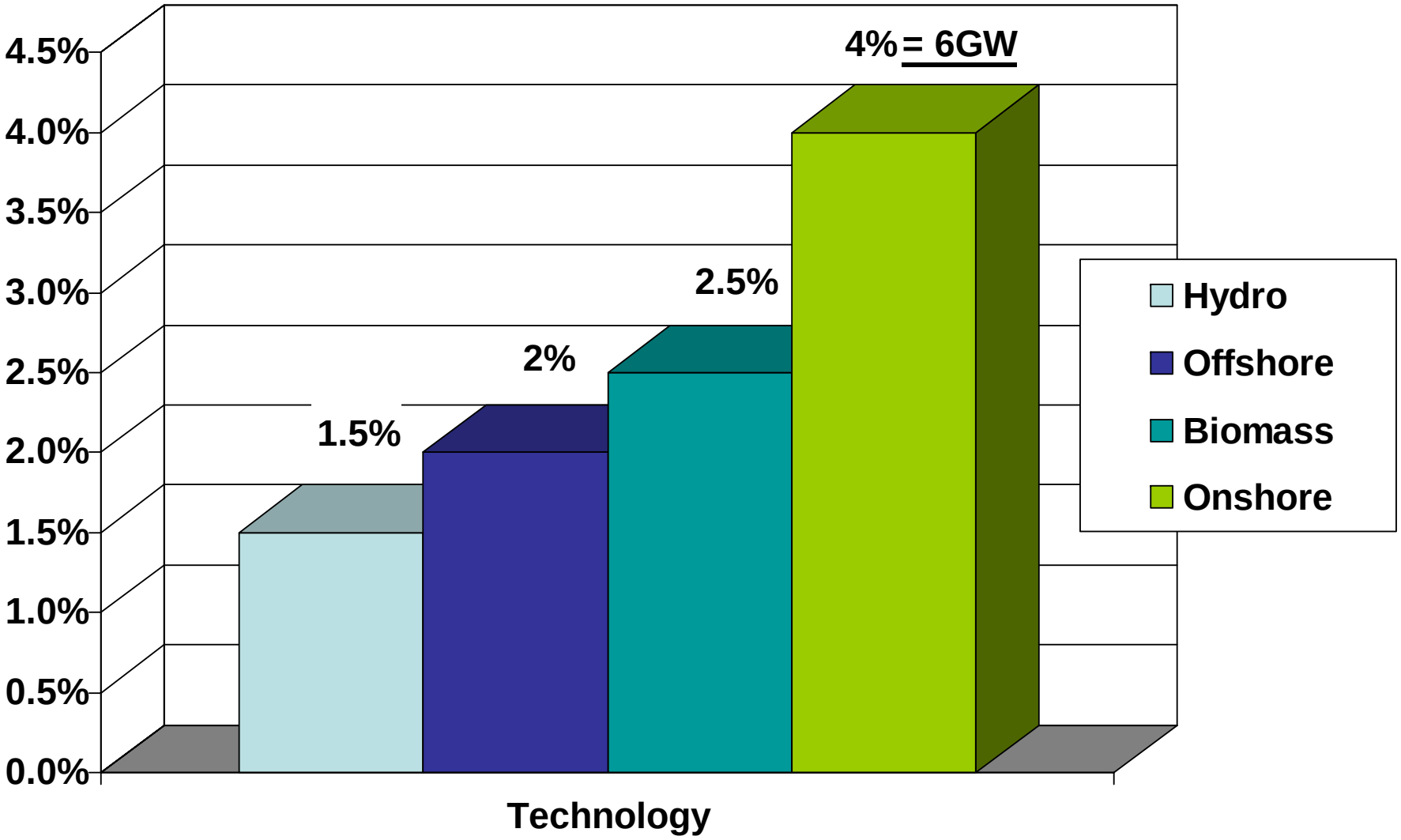
- *2688 MW under construction*
- *6443 MW consented*
- *9771 MW in planning system*

- 2,039,211 homes
- 4,121,245 CO2 emission reductions

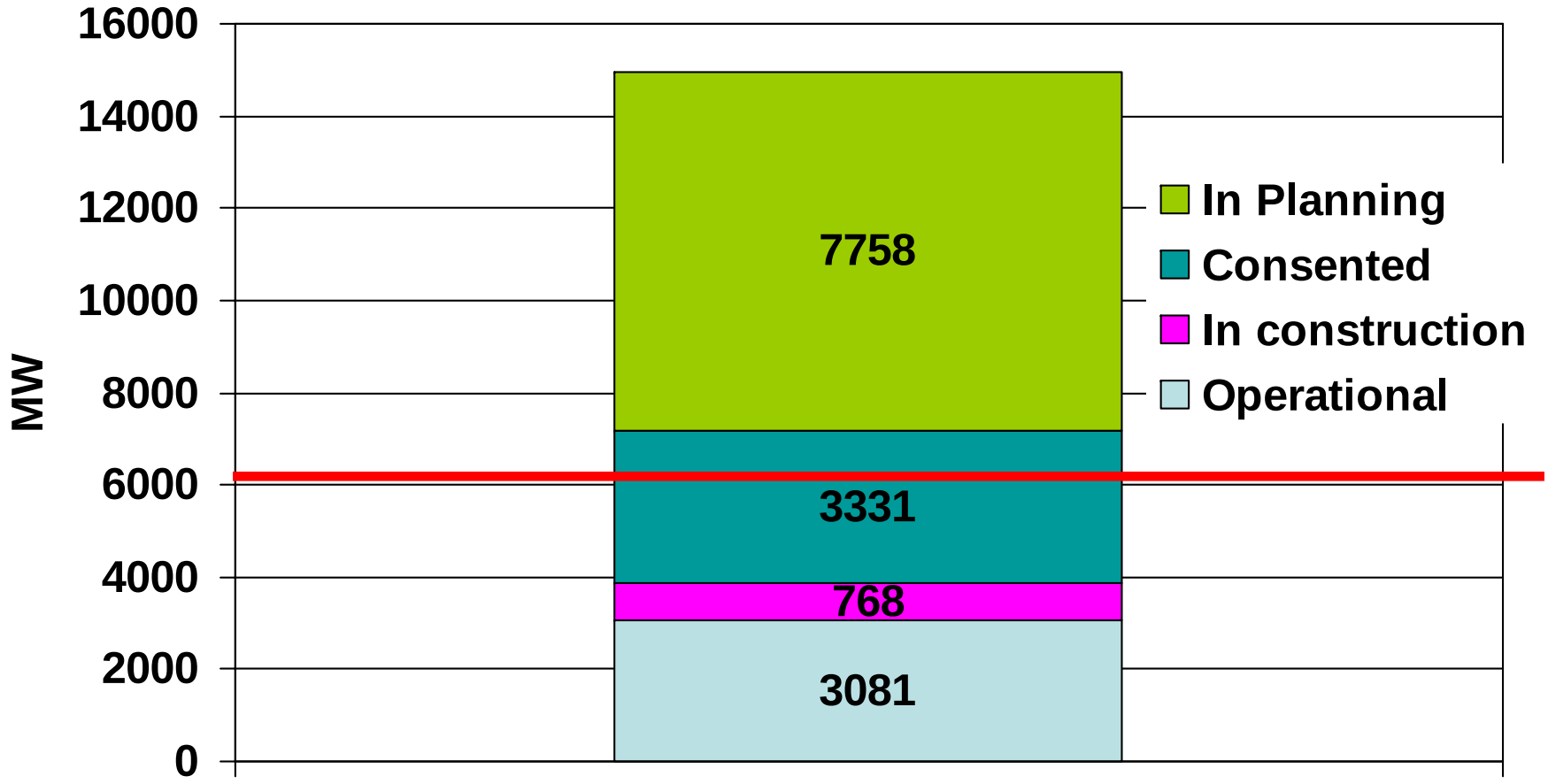
Aims for the Future

- 2010 – 10% of electricity from renewables
- 2020 - 15% all energy from renewables
  - Requires 35% of electricity by 2020

Technologies to deliver 10%



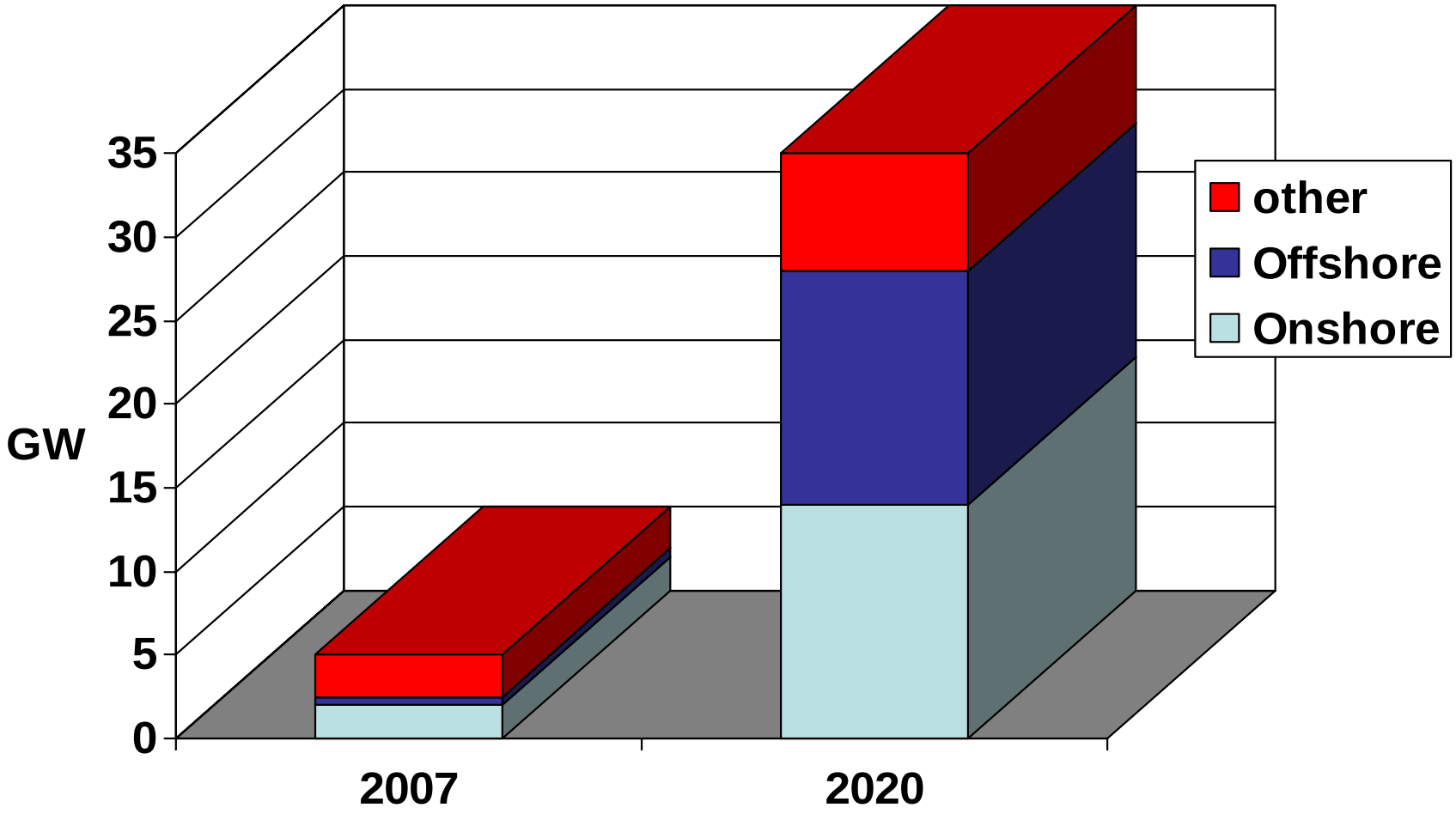
Onshore Wind - Progress 6GW



2020: A challenge on a different scale

- 15% of all energy from renewables (EU target)
- Renewable heat & transport starting at low base
- 35 - 40% renewable electricity by 2020
- Wind energy needs to deliver the lions share

2020: Breakdown of renewable electricity generation capacity



The problem for wind schemes

- 6% of wind schemes decided within 16 weeks – 70% of other major apps
- Average application takes 14 months at LPA – 26 months at Appeal
- 55% approval rate by Local Authorities
- 40% of cases decided at appeal – with 45% success rate

There is a real tension between nationally or regionally set priorities and locally taken decision making.

Economic opportunities for UK

- £60 billion of private investment
- 60,000 UK jobs in manufacturing, operations & maintenance
- Modern turbine 3MW puts £100,000 into local economy every year through maintenance, community payments, rates and rents.

Delivering a wind revolution

Onshore

- Keep the IPC & National Policy Statements
- Ring fence business rates for local authorities
- Strengthen NPS status
- Additional LPA resources & training
- Best practice by developers and improved engagement

Delivering a wind revolution

Offshore

- Speed up lengthy, uncertain & bureaucratic approvals process
- Transfer staff & responsibility for all offshore applications to IPC
- Using the SEA process to establish clearer marine planning framework

Delivering a wind revolution

Improving Grid Access

- Ofgem to allow National Grid to use assets to fund new access & connection networks
- National Grid to adopt 'predict & provide' investment strategy
- Guarantee connection and deeper reinforcement planning are heard by new IPC

BWEA

Jan Matthiesen
Head of Onshore
Tel: 0207 288 8377
jan@bwea.com

McCallum Sweeney Consulting
the geography of business

South Carolina Opportunities for Wind:

Industry Overview and Competitive Focus

Columbia, SC
July 13, 2009

Ed McCallum, Senior Principal

South Carolina

Presentation Overview

- Introduction to McCallum Sweeney Consulting
- The Wind Industry in General
- South Carolina's Place for Economic Development
- Challenges/Opportunities

McCallum Sweeney Consulting

Helping Companies Decide Where to Build

Introduction to McCallum Sweeney Consulting

McCallum Sweeney Consulting

Helping Companies Decide Where to Build

MSC Overview

- Specializes in site selection and incentive negotiation services
- Established in July 2000 by Ed McCallum and Mark Sweeney
- Brings more than 50 years of combined location consulting experience to our clients worldwide
- Provides clients with uncompromised service, conducting site selection and incentive negotiations with the highest standards of integrity

MSC C.I.R.C.L.E. of Values

Customer Service
•Unrestricted commitment to our clients
•Active involvement in every project by senior principals Ed McCallum and Mark Sweeney
•Independence, allowing sole focus on our clients' projects (not a platform to sell other services)

Integrity
•Emphasis on communication, with an "open process" allowing our clients to know what we are doing and why
•Redirection of any and all "location bonuses" from communities or developers to the benefit of our clients
•Policy not to pursue or accept economic development assignments in locations that are, or may be, under consideration by our siting clients

Excellence
•Maintaining the goal of MSC, as a company, to be the best in our business
•Creating and maintaining an operating environment based on the principles of continuous performance improvement
•Conducting our business with an unrestrained passion for quality

Respect
•For the values of our clients, and the responsibility we have in representing them
•For the stewardship role states, provinces, and communities have as part of their efforts in attracting and retaining investment and employment
•For each other here at MSC, creating a supportive and collegial environment that thrives on the unique strengths we each bring to the company, and striving to balance the demands of our profession with the rewards of a personal life

Leading-Edge Technology
•Maintaining in-house expertise in geographic information systems (GIS) technologies
•Supporting integration of GIS into all our assignments, exploring new ways to leverage its value for our clients
•Managing the technology as a powerful tool and avoiding the temptation to let it serve as a substitute for a sound and comprehensive site selection process

Creativity
•Maintaining a broad knowledge of successful location strategies
•Emphasizing the promotion of new ideas and finding value in them
•Committing to an operating environment that fosters innovation and nurtures its development

McCallum Sweeney Consulting

Helping Companies Decide Where to Build

MSC Wind Energy Clients

Does Not Include Confidential Clients with NDA's

MSC Project Experience

Project Experience

Commercial / Industrial Projects

Indicates State/location where commercial/industrial siting took place

		AL	AZ	AR	CA	CT	DE	FL	GA	IL	IN	IA	KS	KY	LA	MD	MA	MI	MS	MO	NE	NV	NJ	NM	NY	NC	ND	OH	OK	OR	PA	SC	SD	TN	TX	UT	VA	WA	WV	WI	WY
09	**Zarges Gmbh**			x								x																							x							
'08	**SLM Corp. (Sallie Mae)**						x									x															x											
'08	**Nordex**			x								x	x	x						x	x								x					x	x						
'08	**American Titanium Works**			x															x							x			x			x		x			x				
'08	**Austal**	x						x							x				x																							
'07	**Atlantic Marine**	x						x																																		
'07	Project C21													x												x					x		x			x					
'07	Project Heron								x																	x					x					x					
'07	**Oreck (headquarters)**														x																			x							
'07	Project Pioneer	x							x		x			x	x	x				x						x		x	x		x			x	x		x				
'07	**LM Glasfiber**			x																										x						x					
07	**Eastman Chemicals**																																x		x							
'07	**PACCAR, Inc.**	x		x					x										x	x									x						x		x				
'07	**Berg Steel Pipe Corp.**	x		x						x					x					x															x							
'06	**Cytec Engineered Materials**																																x		x					x		
'06	**Varian**				x																																					
'06	**International Shipholding**	x													x				x																							
'06	Project Jazz South	x							x						x				x																		x				
'06	**Oreck (Bus. Dev. Ctr.)**								x																		x								x	x					
'06	**Oreck**			x						x	x			x							x						x		x				x		x						
'05	Project Vanquish	x		x				x	x	x	x			x	x				x	x						x		x	x			x		x	x					
'05	**Alenia NA/L-3 Com.**	x	x					x											x												x	x			x						
'05	Project Cottonwood											x	x								x												x								x
'05	Project Spruce					x											x						x		x					x										
'05	**Nissan (headquarters)**				x																					x						x		x	x					
'05	Project Holly	x							x																																
'05	**Roberts Irrigation**								x																							x									
'04	Lakeshore Learning																																								
'04	**Michelin / TNT (distribution)**															x							x								x									
'04	**Dollar General**									x	x																														
'04	Project Jupiter			x					x											x									x			x			x		x			
'04	**INEOS/Innovene (BP)**									x																										x					
'04	Project Sun		x		x																	x														x				
'04	**Vought - Alenia**	x																											x			x			x					
'04	**Michelin / TNT (distribution)**														x														x						x					

MSC Project Experience (continued)

Project Experience

Commercial / Industrial Projects

Indicates State/location where commercial/industrial siting took place

		AL	AZ	AR	CA	CT	DE	FL	GA	IL	IN	IA	KS	KY	LA	MD	MA	MI	MS	MO	NE	NV	NJ	NM	NY	NC	ND	OH	OK	OR	PA	SC	SD	TN	TX	UT	VA	WA	WV	WI	WY
'03	**Dollar General**	x							x																	x						x									
'03	**Weil-McLain**													x												x								x			x				
'03	**Boeing**	x		x				x	x										x							x			x		x			x	x			x			
'03	Dollar General (Grizzly)					x											x						x		x						x									
'03	**Trex**			x										x					x	x						x								x						
'03	**Mitsubishi**	x							x	x				x					x							x						x		x						
'02	**MS Technology Alliance**																		x																					
'02	**Harley Davidson Financial**																					x													x					
'02	**Michelin / TNT** (distribution)									x	x																													
'02	**Kasle Steel**										x			x																										
'01	**Michelin** (earthmover tire)																															x								
'01	**Nissan** (distribution)																									x						x								
'01	**Tower**																		x															x						
'01	**Trex**																									x						x		x			x			
'01	**Comcast**																						x		x						x									
'01	**Project Beartooth**	x										x									x					x	x							x						
'00	**Flowserve**				x											x					x							x						x			x			
'00	**Nissan** (auto Assembly)	x							x										x													x		x						
'00	**Nissan** (assembly expansion	x																																x						
'00	**Nissan** (engine expansion)	x																																x						
'00	Datastream								x																							x								
'00	Trex													x				x										x												
'00	**Columbia Energy**													x				x										x										x		
'00	**Navistar Transportation Co.**	x												x												x		x				x								
'00	Confidential HQ Study																																	x						
'00	**Amtran**	x		x										x					x												x		x						

MSC Clients - Wind Energy

Completed/Engaged

Confidential 1 (Tower)

Confidential 2

Discussions/Negotiations

- Nacelle Assembler 1
- Nacelle Assembler 2
- Tower Manufacturer
- Gears/Shafts Manufacturer
- Blade Manufacturer 1
- Blade Manufacturer 2
- Electronics/Internals

The Wind Industry

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Helping Companies Decide Where to Build

Change in US Wind Energy

US is World's Largest Market

Installed Wind Energy Capacity

#	Nation	2005	2006	2007	2008[1]
1	United States	9,149	11,603	16,818	25,170
2	Germany	18,415	20,622	22,247	23,903
3	Spain	10,028	11,615	15,145	16,740
4	China	1,260	2,604	6,050	12,210
5	India	4,430	6,270	8,000	9,587
6	Italy	1,718	2,123	2,726	3,736
7	France	757	1,567	2,454	3,404
8	United Kingdom	1,332	1,963	2,389	3,288
9	Denmark (& Faeroe Islands)	3,136	3,140	3,129	3,160
10	Portugal	1,022	1,716	2,150	2,862

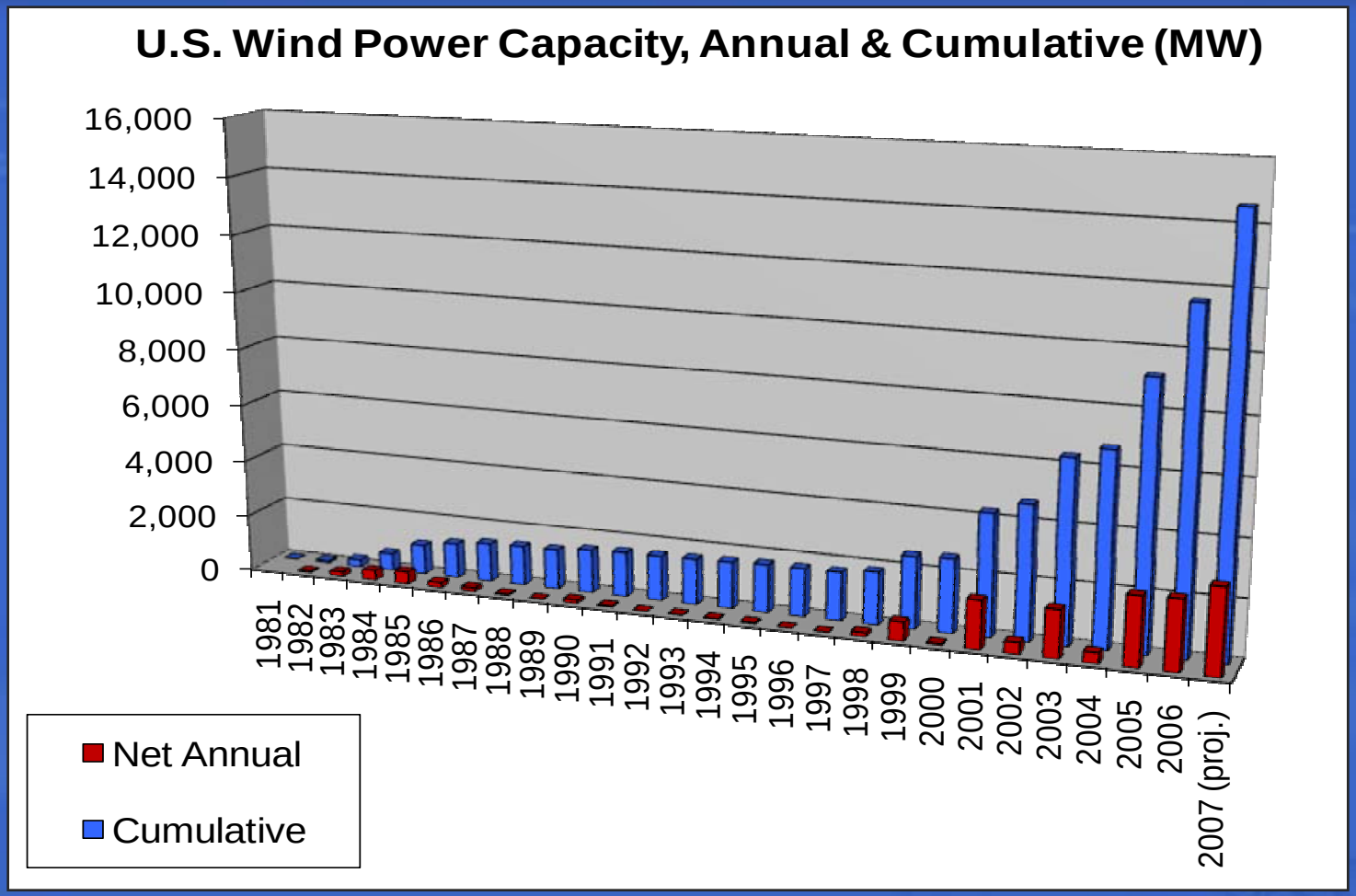
Source:

Global Wind Energy Council

http://www.gwec.net/uploads/media/0702_PR_Global_Statistics_2006.pdf

Growth Before Stimulus

20-30% Growth Every Year



Source American Wind Energy Association Database

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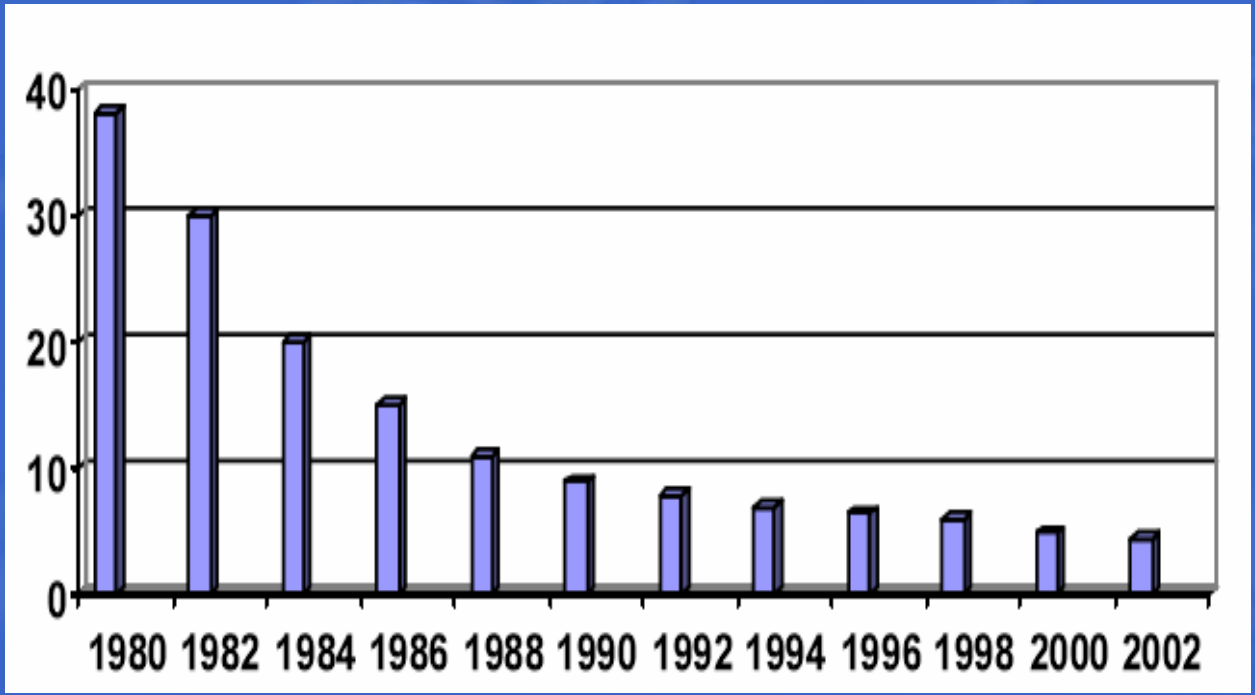
Helping Companies Decide Where to Build

Economics Make Sense

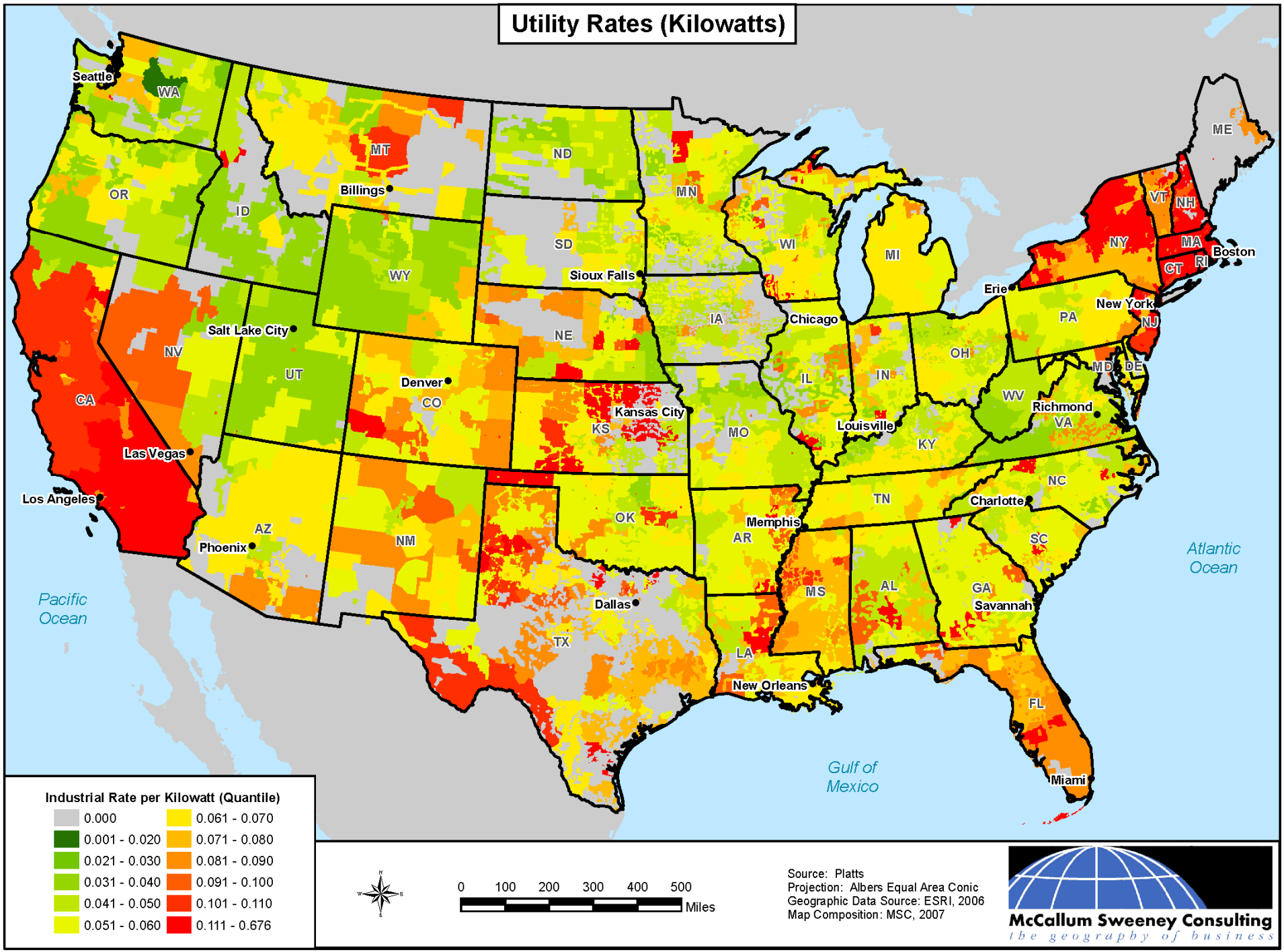
Wind Energy is Not a Flash in the Pan - Trend

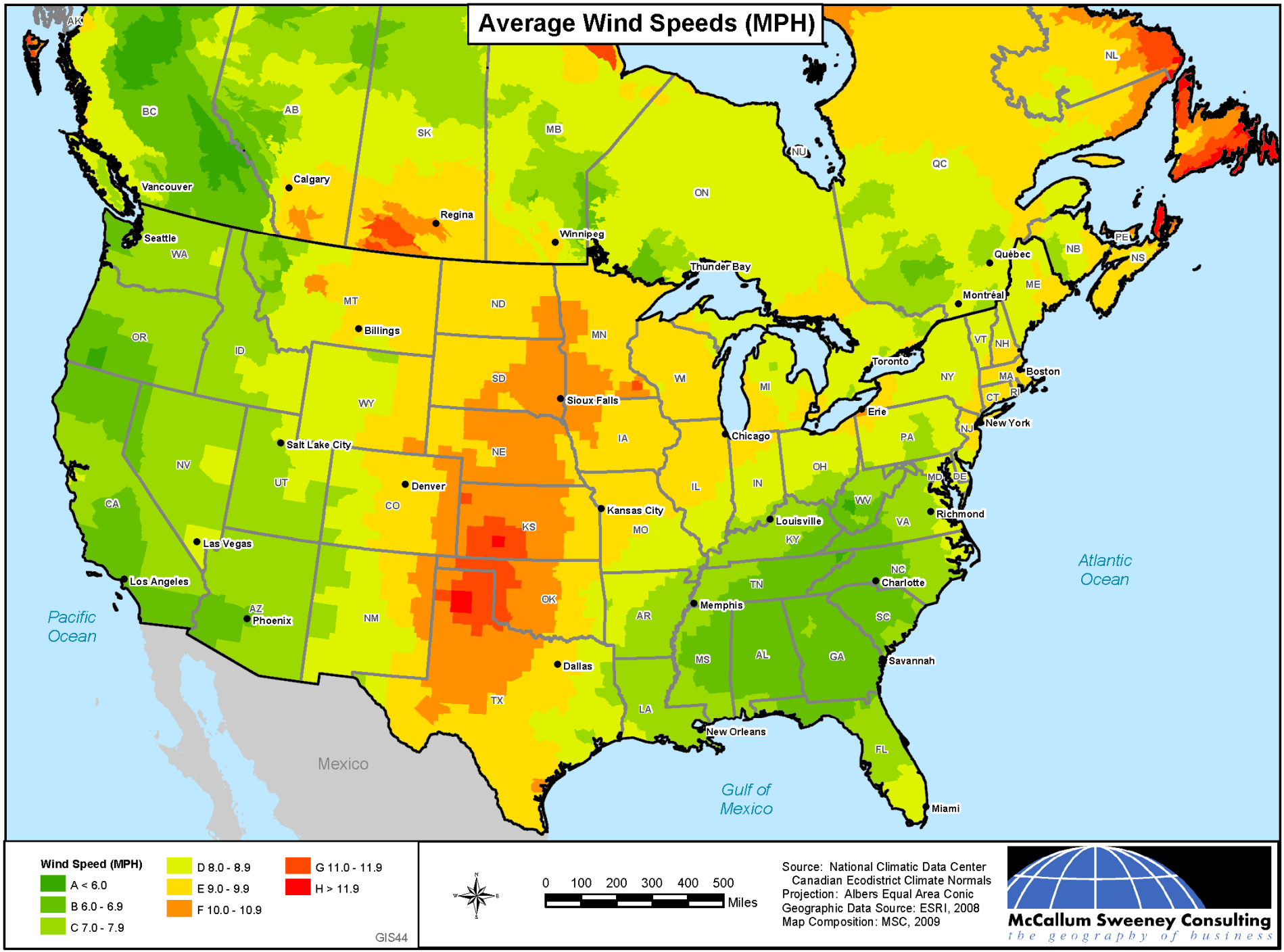
Cost of Wind Energy in Levelized Cents/Kwh

Assumptions: levelized cost at excellent wind sites, large project size, not including Production Tax Credits (PTC)



Source: American Wind Energy Association122 C Street, N.W., Washington, D.C. 20001, (202) 383-2500, fax (202) 383-2505, windmail@awea.org, http://www.awea.org.


Utility Rates (Kilowatts)
Seattle
WA
OR
CA
ID
NV
MT
Billings
WY
UT
AZ
CO
Denver
NM
Salt Lake City
Las Vegas
Los Angeles
Phoenix
ND
SD
Sioux Falls
NE
KS
Kansas City
OK
TX
Dallas
MN
IA
MO
AR
LA
New Orleans
WI
IL
Chicago
MS
MI
IN
KY
Louisville
TN
Memphis
AL
OH
WV
GA
Savannah
FL
Miami
SC
NC
Charlotte
VA
Richmond
PA
NY
New York
Erie
NJ
MD
DE
CT
RI
MA
Boston
VT
NH
ME
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
Industrial Rate per Kilowatt (Quantile)
0.000
0.001 - 0.020
0.021 - 0.030
0.031 - 0.040
0.041 - 0.050
0.051 - 0.060
0.061 - 0.070
0.071 - 0.080
0.081 - 0.090
0.091 - 0.100
0.101 - 0.110
0.111 - 0.676
0 100 200 300 400 500
Miles
Source: Platts
Projection: Albers Equal Area Conic
Geographic Data Source: ESRI, 2006
Map Composition: MSC, 2007
McCallum Sweeney Consulting
the geography of business


Average Wind Speeds (MPH)
AK
BC
AB
SK
MB
NU
QC
NL
Vancouver
Calgary
Regina
Winnipeg
ON
PE
NB
NS
Seattle
WA
Thunder Bay
Québec
Montréal
ME
MT
ND
Billings
OR
ID
MN
VT
NH
Toronto
NY
MA
Boston
SD
WI
MI
CT
RI
WY
Sioux Falls
Erie
NJ
New York
Chicago
IA
PA
Salt Lake City
NE
NV
OH
UT
Denver
IL
IN
MD
DE
CA
CO
WV
Kansas City
Richmond
KS
MO
VA
Louisville
KY
Las Vegas
NC
Charlotte
TN
Los Angeles
OK
Memphis
AZ
Phoenix
NM
AR
SC
MS
AL
GA
Savannah
Dallas
TX
LA
New Orleans
FL
Miami
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
Mexico
Wind Speed (MPH)
A < 6.0
B 6.0 - 6.9
C 7.0 - 7.9
D 8.0 - 8.9
E 9.0 - 9.9
F 10.0 - 10.9
G 11.0 - 11.9
H > 11.9
GIS44
0 100 200 300 400 500
Miles
Source: National Climatic Data Center
Canadian Ecodistrict Climate Normals
Projection: Albers Equal Area Conic
Geographic Data Source: ESRI, 2008
Map Composition: MSC, 2009
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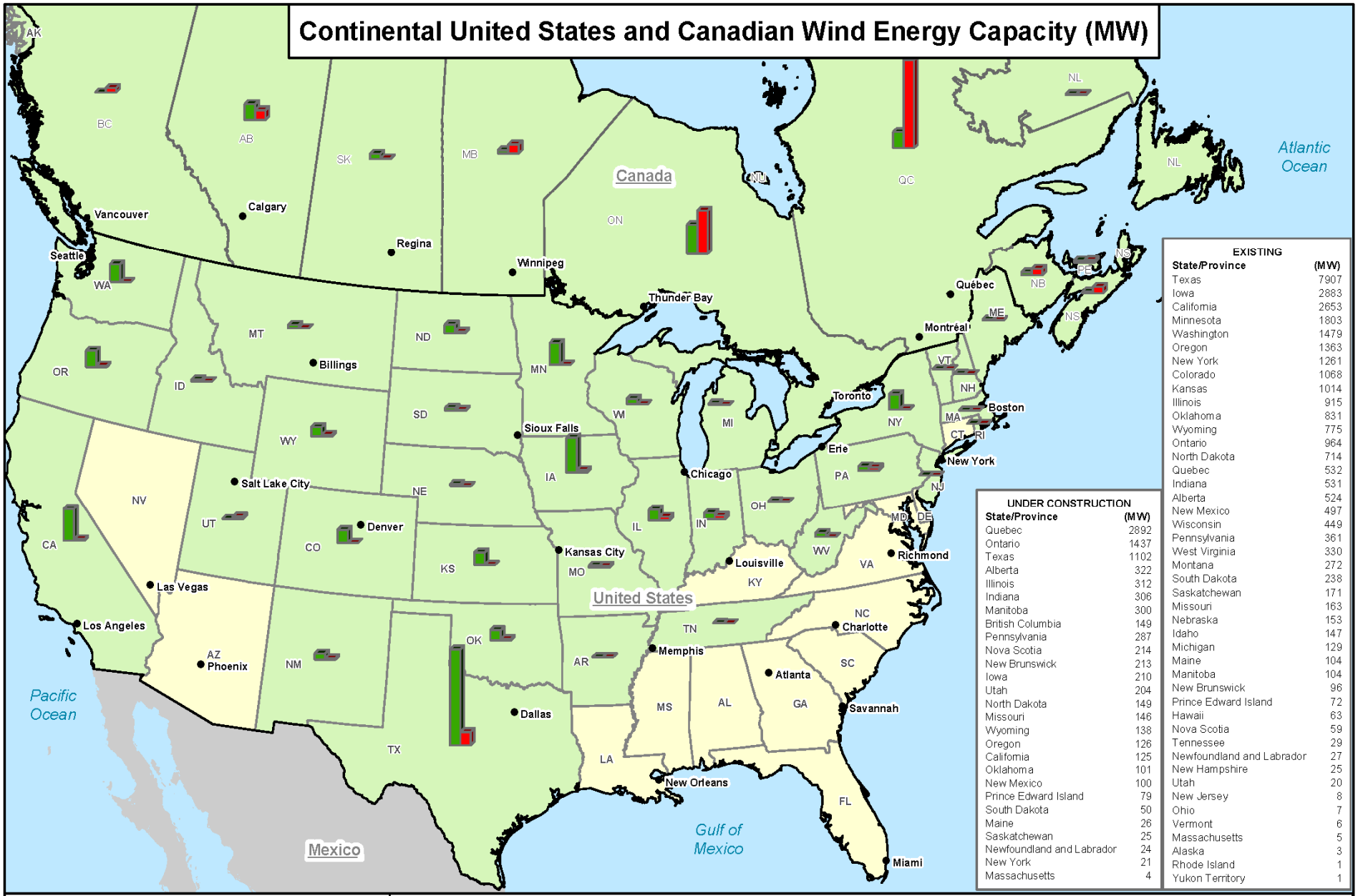
the geography of business

Continental United States and Canadian Wind Energy Capacity (MW)



EXISTING	
State/Province	(MW)
Texas	7907
Iowa	2883
California	2653
Minnesota	1803
Washington	1479
Oregon	1363
New York	1261
Colorado	1068
Kansas	1014
Illinois	915
Oklahoma	831
Wyoming	775
Ontario	964
North Dakota	714
Quebec	532
Indiana	531
Alberta	524
New Mexico	497
Wisconsin	449
Pennsylvania	361
West Virginia	330
Montana	272
South Dakota	238
Saskatchewan	171
Missouri	163
Nebraska	153
Idaho	147
Michigan	129
Maine	104
Manitoba	104
New Brunswick	96
Prince Edward Island	72
Hawaii	63
Nova Scotia	59
Tennessee	29
Newfoundland and Labrador	27
New Hampshire	25
Utah	20
New Jersey	8
Ohio	7
Vermont	6
Massachusetts	5
Alaska	3
Rhode Island	1
Yukon Territory	1

UNDER CONSTRUCTION	
State/Province	(MW)
Quebec	2892
Ontario	1437
Texas	1102
Alberta	322
Illinois	312
Indiana	306
Manitoba	300
British Columbia	149
Pennsylvania	287
Nova Scotia	214
New Brunswick	213
Iowa	210
Utah	204
North Dakota	149
Missouri	146
Wyoming	138
Oregon	126
California	125
Oklahoma	101
New Mexico	100
Prince Edward Island	79
South Dakota	50
Maine	26
Saskatchewan	25
Newfoundland and Labrador	24
New York	21
Massachusetts	4

Existing Wind Energy Capacity (MW)

Under Construction Wind Energy Capacity (MW)

GIS41

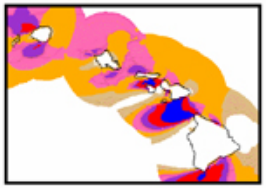
0 100 200 300 400 500 Miles

Data Source: www.awea.org, www.canwea.org (1Q 2009)
Projection: Albers Equal Area Conic
Geographic Data Source: ESRI, 2008
Map Composition: MSC, 2009

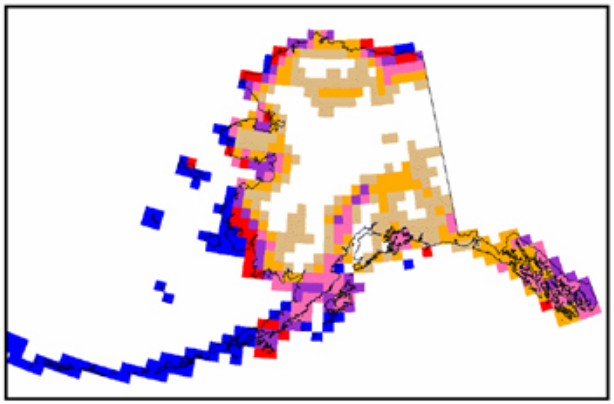
McCallum Sweeney Consulting
the geography of business

Wind Resources and Transmission Lines

NREL Updated Maps:
Arizona (2003)
California (2002)
Colorado (2004)
Connecticut (2001)
Delaware (2002)
Hawaii (2004)
Idaho (2002)
Illinois (2001)
Indiana (2004)
Maine (2001)
Maryland (2002)
Massachusetts (2001)
Michigan (2004)
Missouri (2005)
Montana (2002)
Nebraska (2005)
Nevada (2003)
New Jersey (2002)
New Hampshire (2001)
New Mexico (2003)
North Carolina (2002)
North Dakota (2000)
Ohio (2004)
Oregon (2002)
Pennsylvania (2002)
Rhode Island (2001)
South Dakota (2001)
Texas mesas (2000)
Utah (2003)
Vermont (2001)
Virginia (2002)
Washington (2002)
West Virginia (2002)
Wyoming (2002)



The remaining states use data from the 1987 "Wind Energy Atlas of the United States".



Transmission Lines
Voltage (kV)
345 - 499
500 - 699
700 - 799
1000 (DC)

Source: POWERmap, powermap.platts.com, ©2007 Platts, a division of the McGraw-Hill Companies

Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed [a] at 50 m m/s	Wind Speed [a] at 50 m mph
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

[a] Wind speeds are based on a Weibull k value of 2.0

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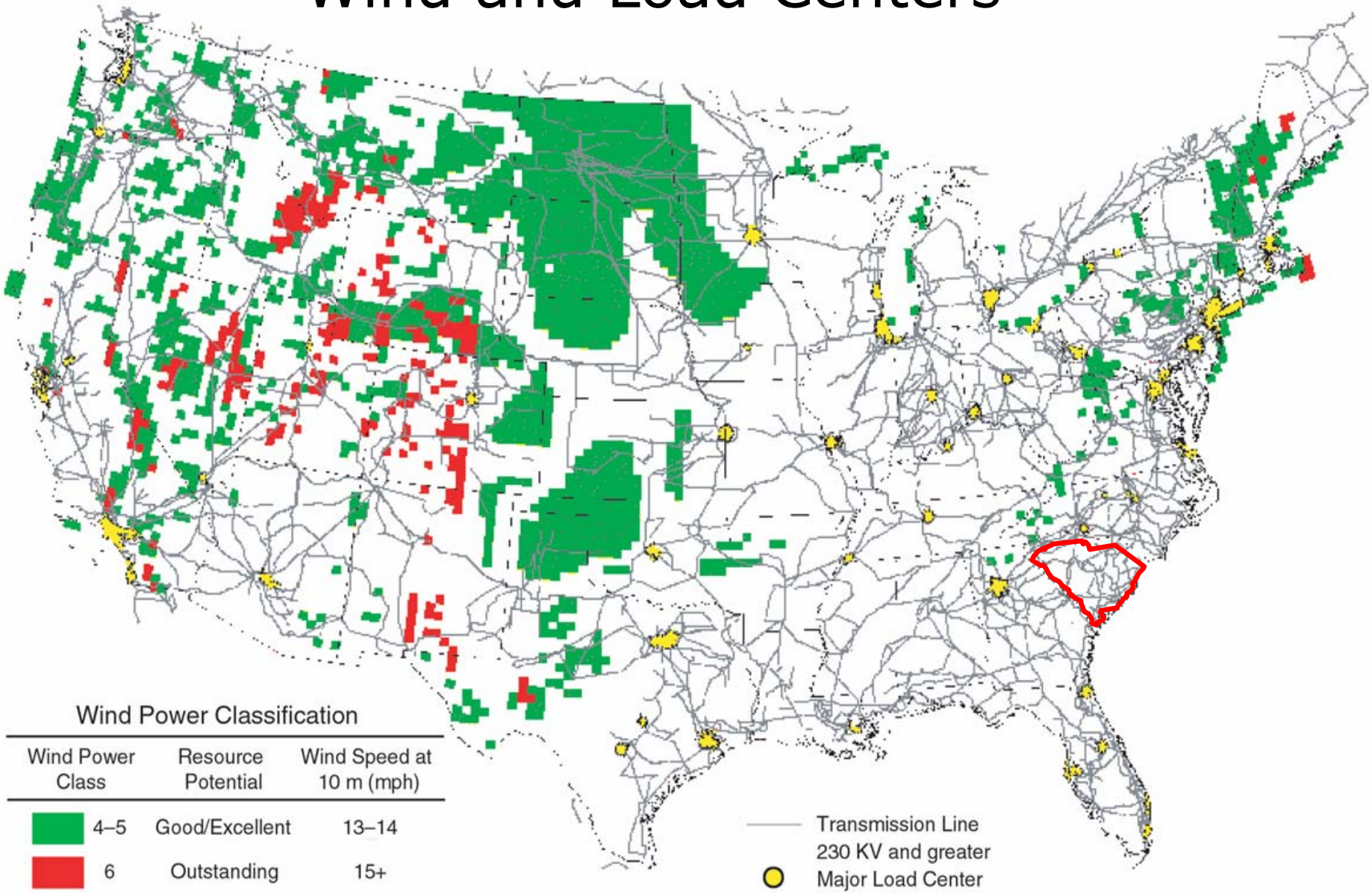
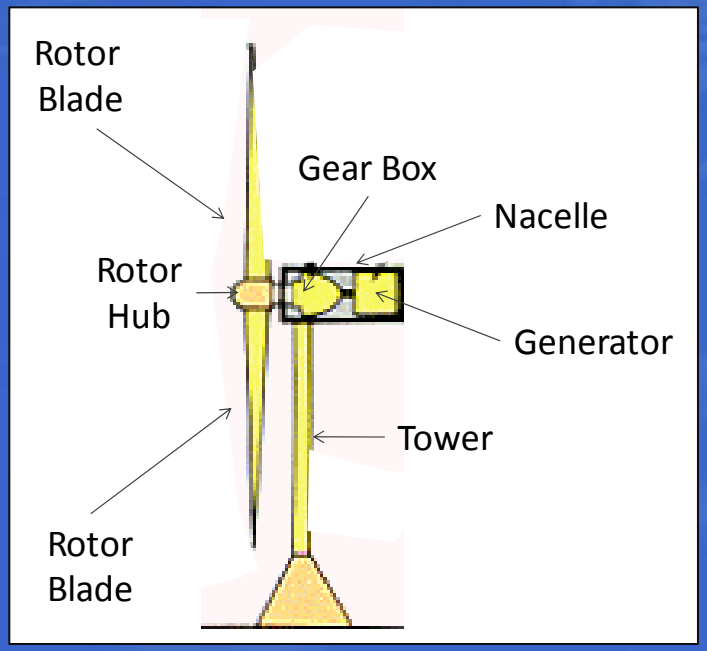
Wind and Load Centers



Basic Components

Expensive to Transport, Dimensional Size, Easily Damaged



Tower

Rotor Blade

Completed Nacelle

Rotor Hub

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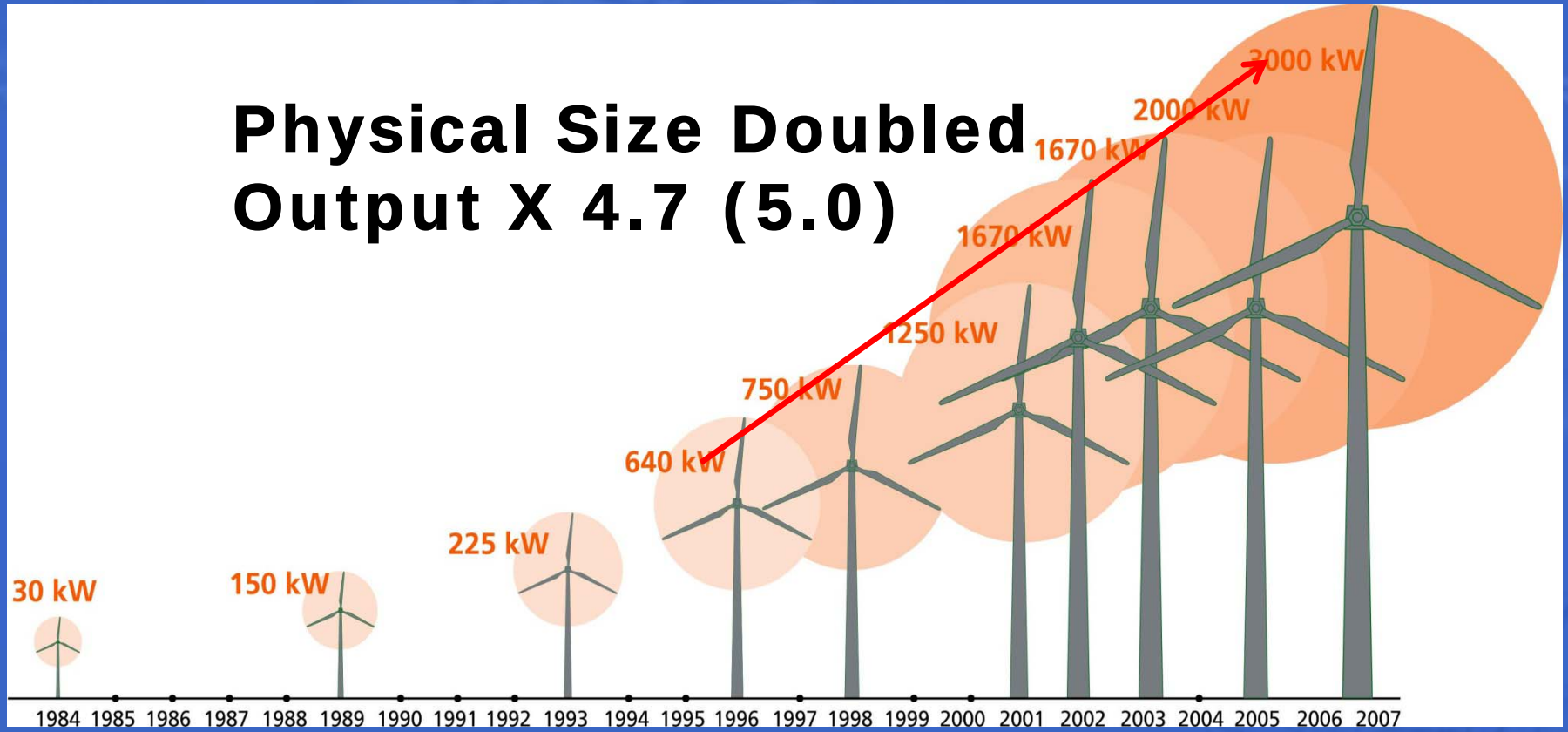
SPEED LIMIT
25

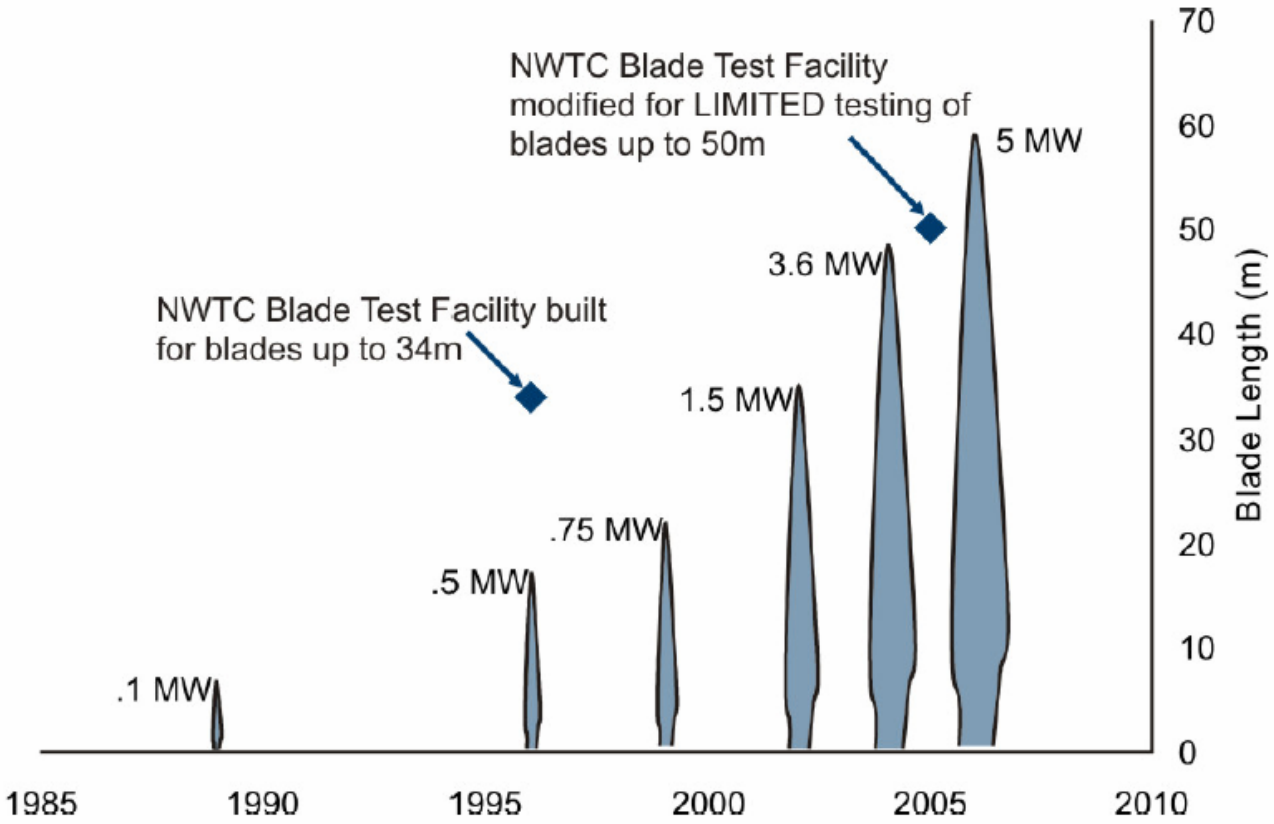
Wind Generation Units

Affecting Manufacturing Location and Logistics



Increasing Size

Figure 2-16. Blade growth and startup dates for U.S. blade test facilities



Source: US Department of Energy – 20% Wind Energy by 2030, http://www.20percentwind.org/20percent_wind_energy_report_revOct08.pdf

Size Considerations

Towers

Tower sections for the common 250-foot (80-meter) wind turbine tower in the United States can weigh more than 150,000 lbs (70 tons), be 120 feet long (36 meters) and have a diameter of 15 feet (4.5 meters). The next generation of 330foot (105-meter) towers will be 18 feet (5.4 meters) in diameter at the base.

Nacelles

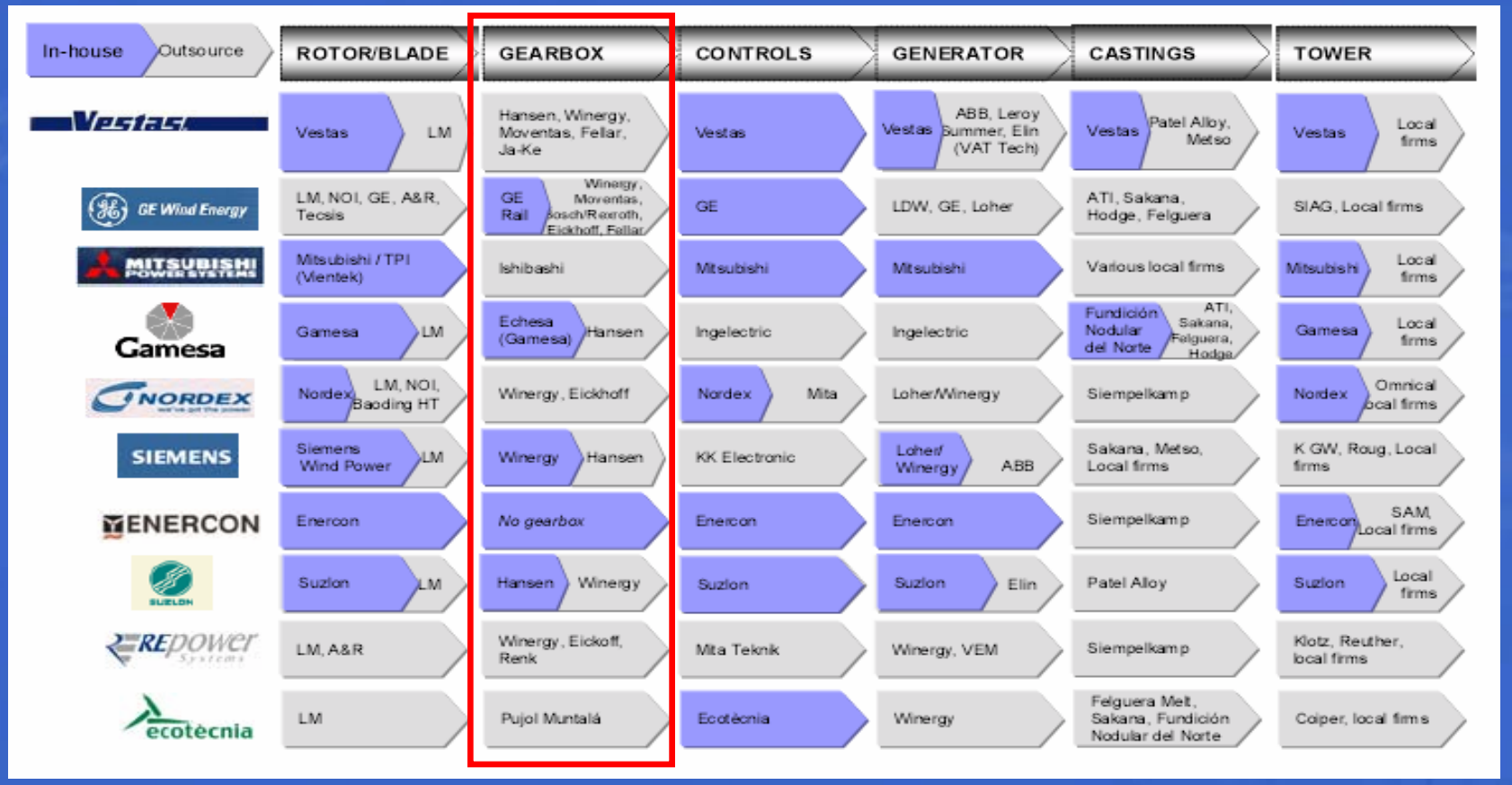
Nacelles commonly weigh 50-70 tons and can weigh 90 tons or more. Getting bigger.

Blades

For commercial scale projects, blades run from around 110 feet (33 meters) to 145 feet (44 meters). Blade lengths may continue to grow in the future, particularly for offshore wind projects. The largest blades are just over 200 feet long (60 meters-plus) for a 5-MW turbine scenario.

Major Component Supply Chain

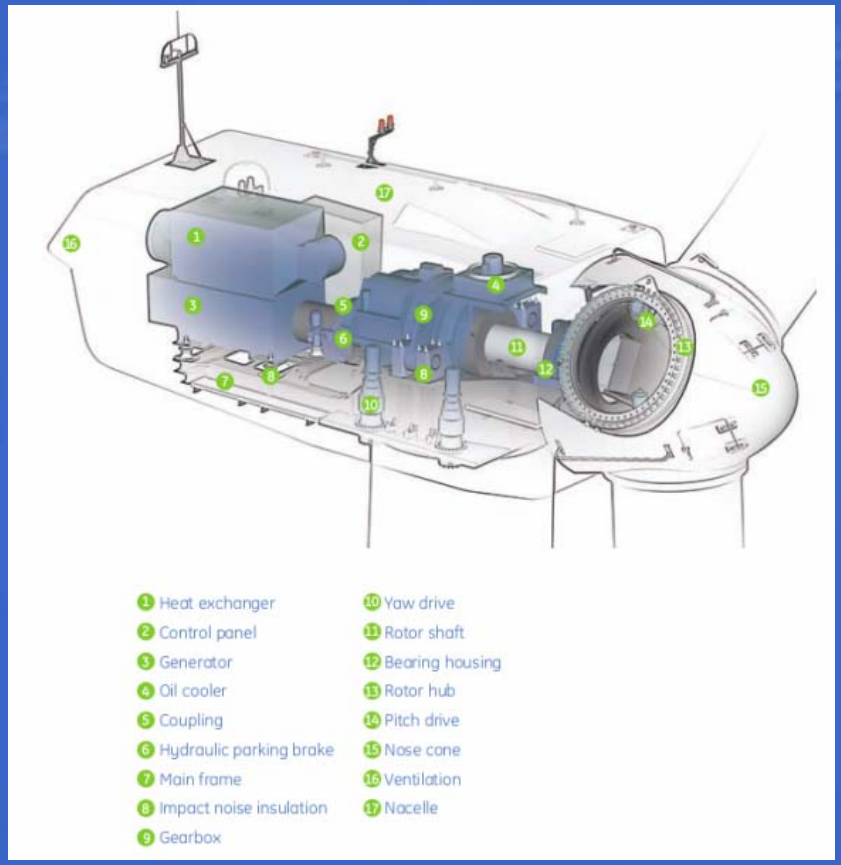
Bottleneck



In-house / Outsource	ROTOR/BLADE	GEARBOX	CONTROLS	GENERATOR	CASTINGS	TOWER
Vestas	Vestas / LM	Hansen, Winergy, Moventas, Fellar, Ja-Ke	Vestas	Vestas / ABB, Leroy Summer, Elin (VAT Tech)	Vestas / Patel Alloy, Metso	Vestas / Local firms
GE Wind Energy	LM, NOI, GE, A&R, Tecsis	GE Rail / Winergy, Moventas, Bosch/Rexroth, Eickhoff, Fellar	GE	LDW, GE, Loher	ATI, Sakana, Hodge, Felguera	SIAG, Local firms
Mitsubishi Power Systems	Mitsubishi / TPI (Vientek)	Ishibashi	Mitsubishi	Mitsubishi	Various local firms	Mitsubishi / Local firms
Gamesa	Gamesa / LM	Echesa (Gamesa) / Hansen	Ingelectric	Ingelectric	Fundición Nodular del Norte / ATI, Sakana, Felguera, Hodge	Gamesa / Local firms
Nordex	Nordex / LM, NOI, Baoding HT	Winergy, Eickhoff	Nordex / Mita	Loher/Winergy	Siempelkamp	Nordex / Omnical, local firms
Siemens	Siemens Wind Power / LM	Winergy / Hansen	KK Electronic	Loher/ Winergy / ABB	Sakana, Metso, Local firms	K GW, Roug, Local firms
Enercon	Enercon	*No gearbox*	Enercon	Enercon	Siempelkamp	Enercon / SAM, Local firms
Suzlon	Suzlon / LM	Hansen / Winergy	Suzlon	Suzlon / Elin	Patel Alloy	Suzlon / Local firms
REpower	LM, A&R	Winergy, Eickoff, Renk	Mita Teknik	Winergy, VEM	Siempelkamp	Klotz, Reuther, local firms
ecotècnia	LM	Pujol Muntalá	Ecotècnia	Winergy	Felguera Melt, Sakana, Fundición Nodular del Norte	Coiper, local firms

Source: Emerging Energy Research, Strategy White Paper, *Wind at a Crossroads – Supply Shortages Spark Industry Restructuring*, November 14, 2006 ID# GW 905-061114. www.emerging-energy.com

Nacelle Units – the Green OEM



Nacelle Component Parts

There are over 8,000 individual parts that make up a completed Nacelle unit much of which is shipped in and assembled; however, critical mass has been reached where it makes sense for the sub-component manufacturers to start considering additional locations on a regional basis – particularly for very large pieces. This scenario is not too much different than the automotive OEM scenario where a supplier base within close proximity is the desire of the OEM.

Jobs Throughout the Value Chain

Probably a Conservative Number

U.S. construction-related economic impacts from 20% wind

Average Annual Impacts	Jobs	Earnings	Output	
Direct Impacts	72,946	$5,221	$12,217	
Construction Sector Only	47,020	$3,547		
Manufacturing Sector Only	22,346	$1,446		
Other Industry Sectors	3,580	$228		
Indirect Impacts	66,035	$3,008	$11,377	
Induced Impacts	119,774	$4,483	$15,749	
Total Impacts (Direct, Indirect, Induced)	258,755	$12,712	$39,343	
Total Construction Impacts 2007-2030	**Jobs**	**Earnings**	**Output**	**NPV of Output**
Direct Impacts	1,750,706	$125,305	$293,197	$111,153
Construction Sector Only	1,128,479	$85,129		
Manufacturing Sector Only	536,305	$34,706		
Other Industry Sectors	85,922	$5,471		
Indirect Impacts	1,584,842	$72,197	$273,057	$103,541
Induced Impacts	2,874,582	$107,591	$377,984	$143,367
Total Impacts (Direct, Indirect, Induced)	6,210,129	$305,093	$944,238	$358,061

Source:
20% Wind Energy by 2030 - Increasing Wind Energy's Contribution to U.S. Electricity Supply. DOE/GO-102008-2567 • July 2008

http://www1.eere.energy.gov/windandhydro/pdfs/41869.pdf

Takeaway

- Large structures getting bigger
- Transportation infrastructure is critical
  - Rail
  - Highways
  - River/Ocean
- OEM and Supplier scenario exists
- There will be lots of companies in this space (for a while)

South Carolina's Place in Wind Energy for Economic Development

McCallum Sweeney Consulting

Helping Companies Decide Where to Build

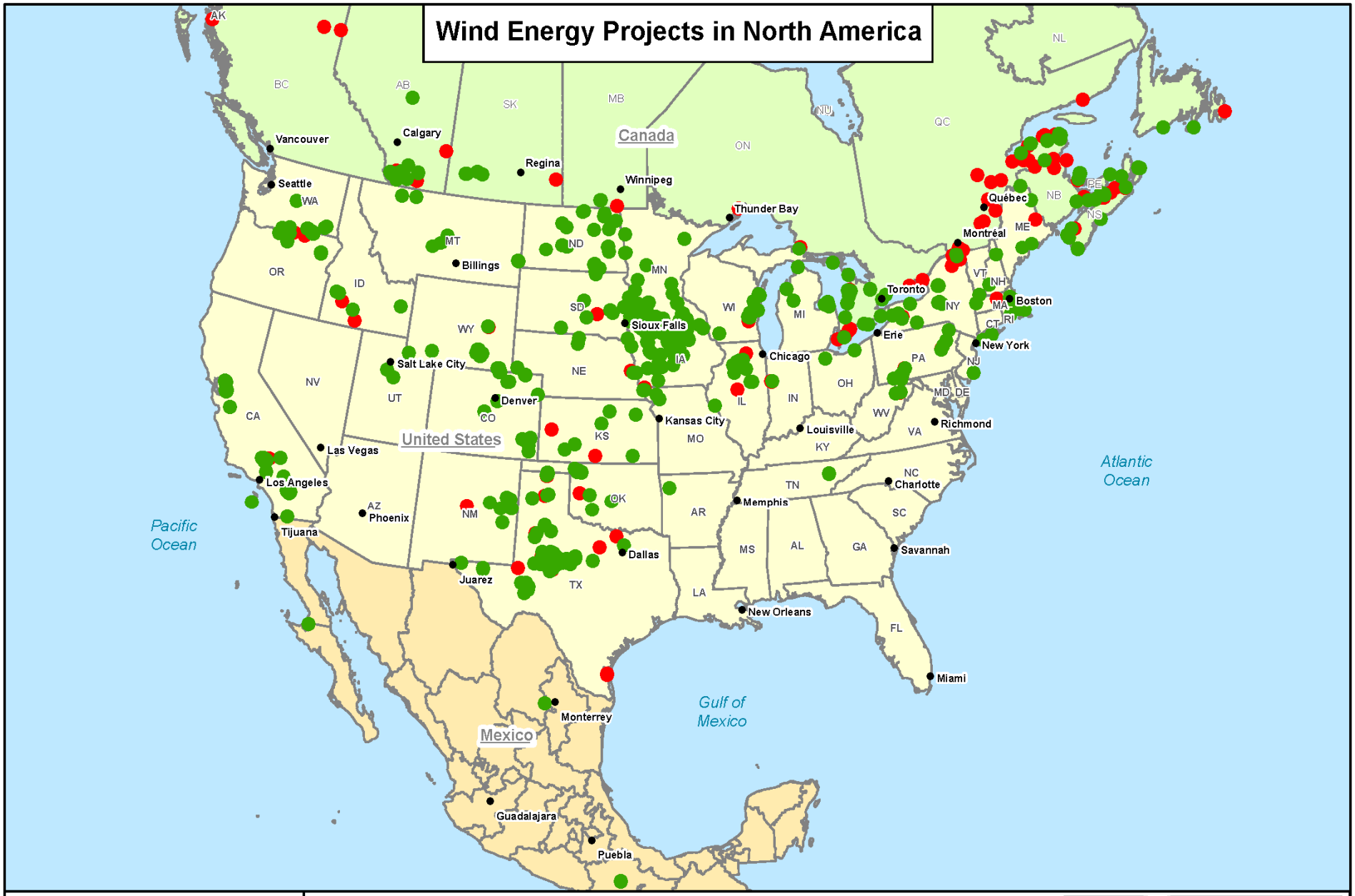
Question:

Is South Carolina a Major Play in Wind?

Answer:

Yes and No

Wind Energy Projects in North America



Wind Energy Projects

- Existing
- Under Construction

GIS40

0 100 200 300 400 500 Miles

Data Source: www.awea.org, www.canwea.org
Projection: Albers Equal Area Conic
Geographic Data Source: ESRI, 2008
Map Composition: MSC, 2009

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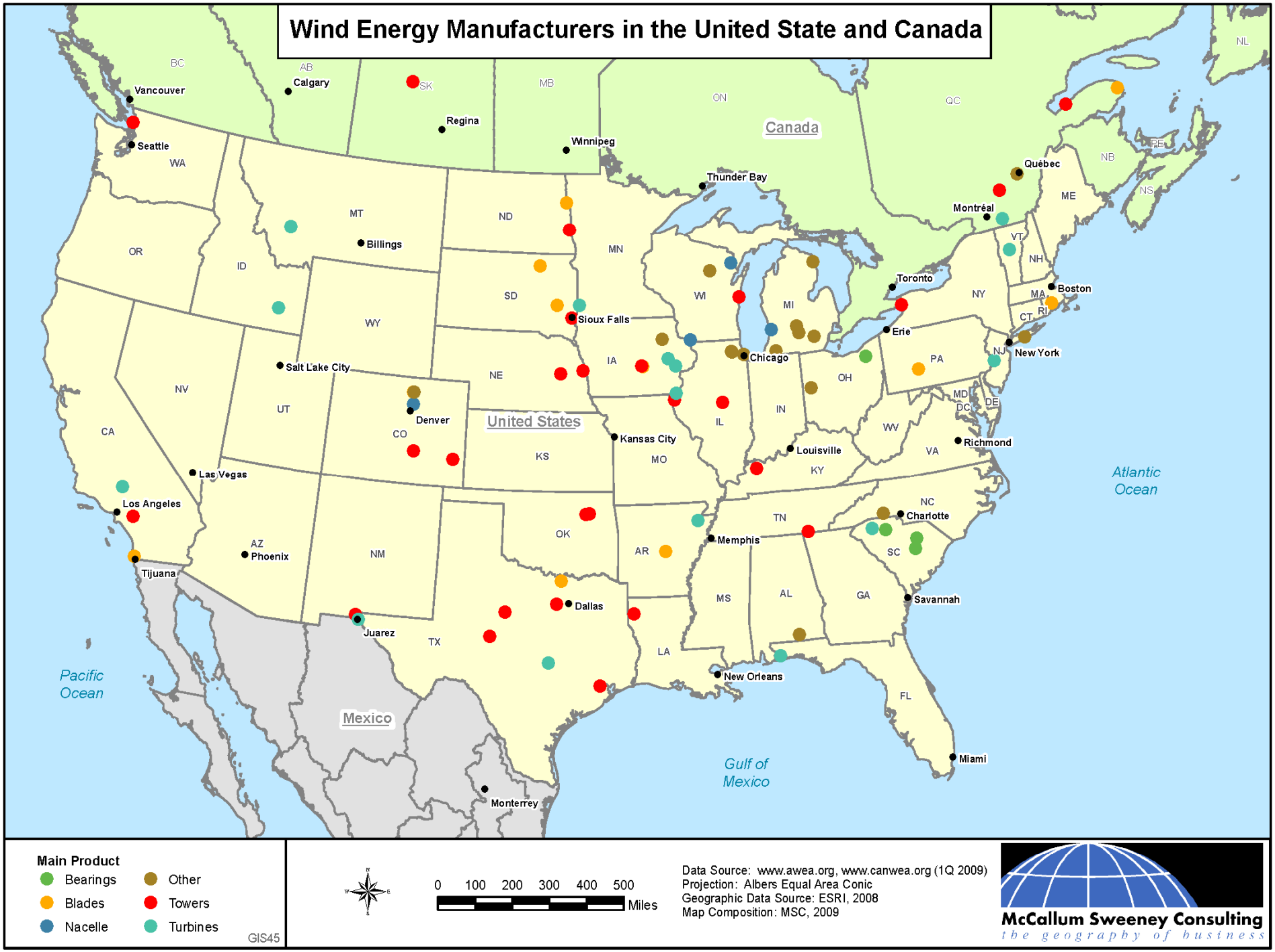
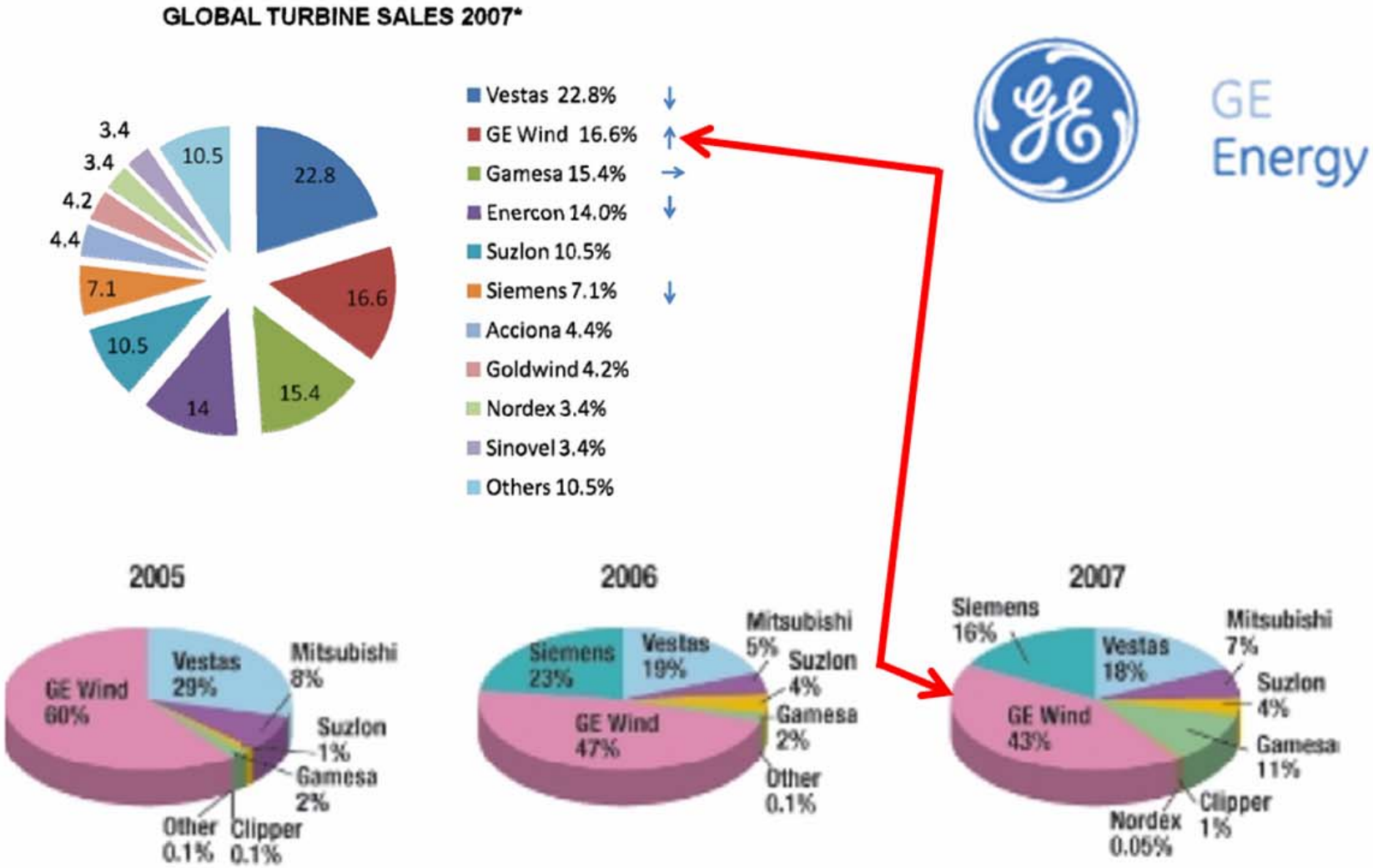
the geography of business


Wind Energy Manufacturers in the United State and Canada
Canada
United States
Mexico
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
BC
AB
SK
MB
ON
QC
NL
PE
NB
NS
ME
VT
NH
MA
RI
CT
NY
NJ
PA
MD
DC
DE
WV
VA
NC
SC
GA
FL
AL
MS
LA
TN
KY
OH
IN
IL
MI
WI
MN
IA
MO
AR
OK
KS
NE
SD
ND
MT
WY
CO
NM
AZ
UT
NV
CA
OR
WA
Vancouver
Calgary
Regina
Winnipeg
Thunder Bay
Québec
Montréal
Toronto
Boston
Erie
New York
Chicago
Sioux Falls
Billings
Salt Lake City
Denver
Kansas City
Louisville
Richmond
Charlotte
Memphis
Savannah
Las Vegas
Los Angeles
Phoenix
Tijuana
Juarez
Dallas
New Orleans
Miami
Monterrey
Seattle
Main Product
Bearings
Blades
Nacelle
Other
Towers
Turbines
GIS45
0 100 200 300 400 500
Miles
Data Source: www.awea.org, www.canwea.org (1Q 2009)
Projection: Albers Equal Area Conic
Geographic Data Source: ESRI, 2008
Map Composition: MSC, 2009
McCallum Sweeney Consulting
the geography of business



Source: http://www.repp.org/articles/static/1/binaries/WindLocator.pdf

Challenges/Opportunities for SC

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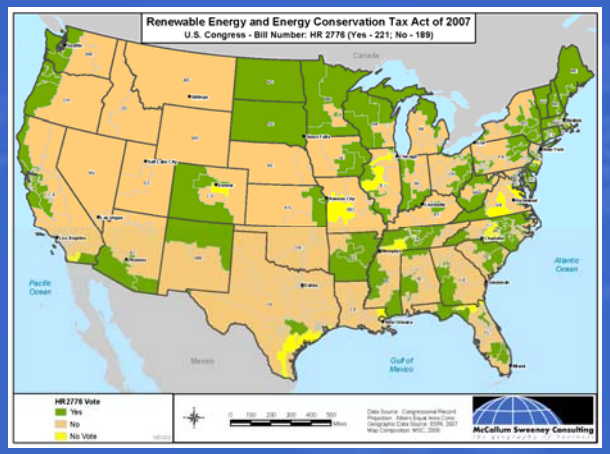
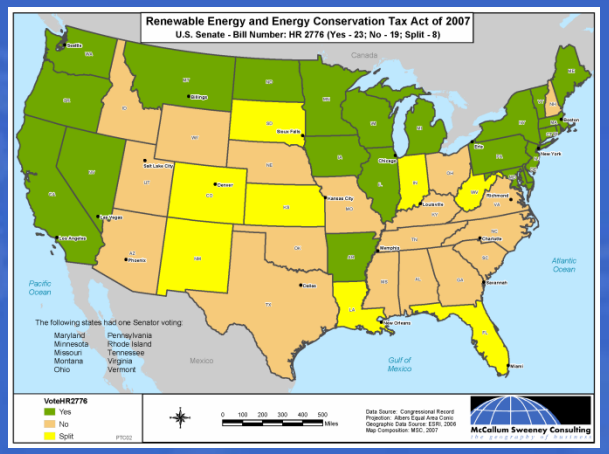
Support the Industry

2007 vs. 2008 PTC Vote

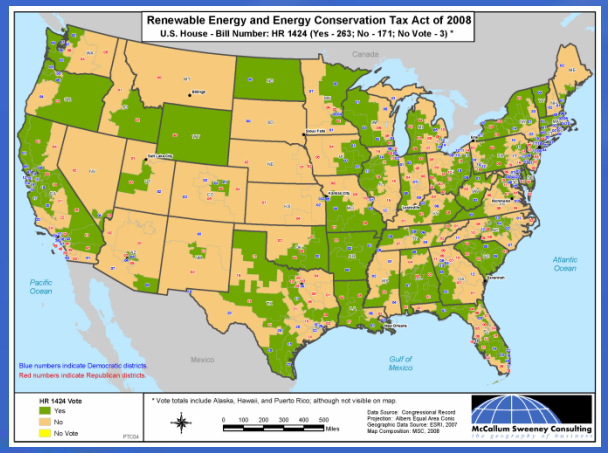
House of Representatives

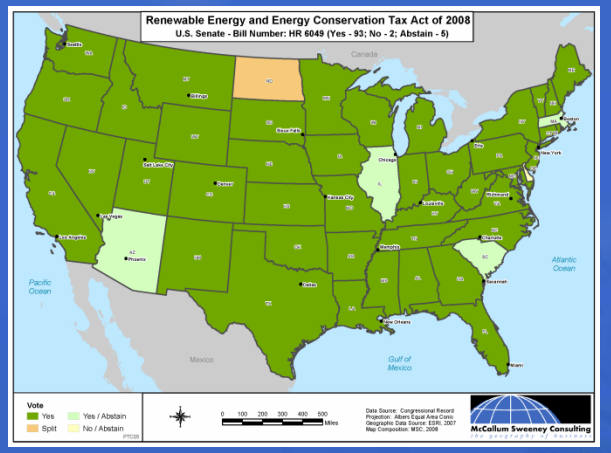
Senate





2007





2008

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Helping Companies Decide Where to Build

Electric Market Overview: Renewable Portfolio Standards

Federal Energy Regulatory Commission • Market Oversight @ FERC.gov

30 States* including D.C. have Renewable Energy Portfolio Standards (RPS)

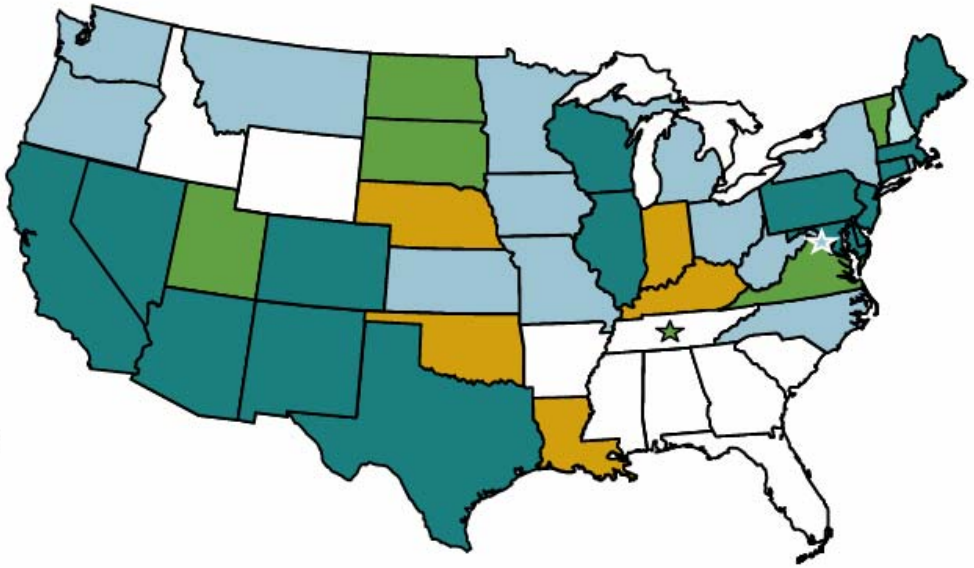
ND: 10% by 2015
SD: 10% by 2015
NE: studying an RPS
KS: 20% by 2020
OK: Studying an RPS

MN: 25% by 2025
IA: 105 MW
MO: 15% by 2021
WI: 10% by 2015
IL: 25% by 2025

MI: 10% MWh and 1,100 MW by 2015
IN: different bills pending
OH: 12.5% by 2025
WV: 25% by 2025
KY: Report recommends RPS

WA: 15% by 2020
OR: 25% by 2025
CA: 20% by 2010; Exec order: 33% by 2020
MT: 15% by 2015
NV: 25% by 2025
UT: 20% by 2025
CO: 20% by 2020
AZ: 15% by 2025
NM: 20% by 2020
TX: 5,880 MW by 2015

HI: 20% by 2020



ME: 40% by 2017
NH: 23.8% by 2025
VT: 25% by 2025
MA:15% by 2020
RI: 16% by end 2019
CT: 27% by 2020
NY: 25% by 2013
PA: 18% by 2020
NJ: 22.5% by 2020
DE: 20% by 2019
DC: 20% by 2020 ☆
MD: 20% by 2022
VA: 12% by 2022
NC: 12.5% by 2021
TVA: 50% by 2020 ★

Updates at: http://www.ferc.gov/market-oversight/mkt-electric/overview/elec-ovr-rps.pdf

- RPS
- Accelerated or strengthened RPS
- Voluntary standards or goals
- Proposed RPS or studying RPS

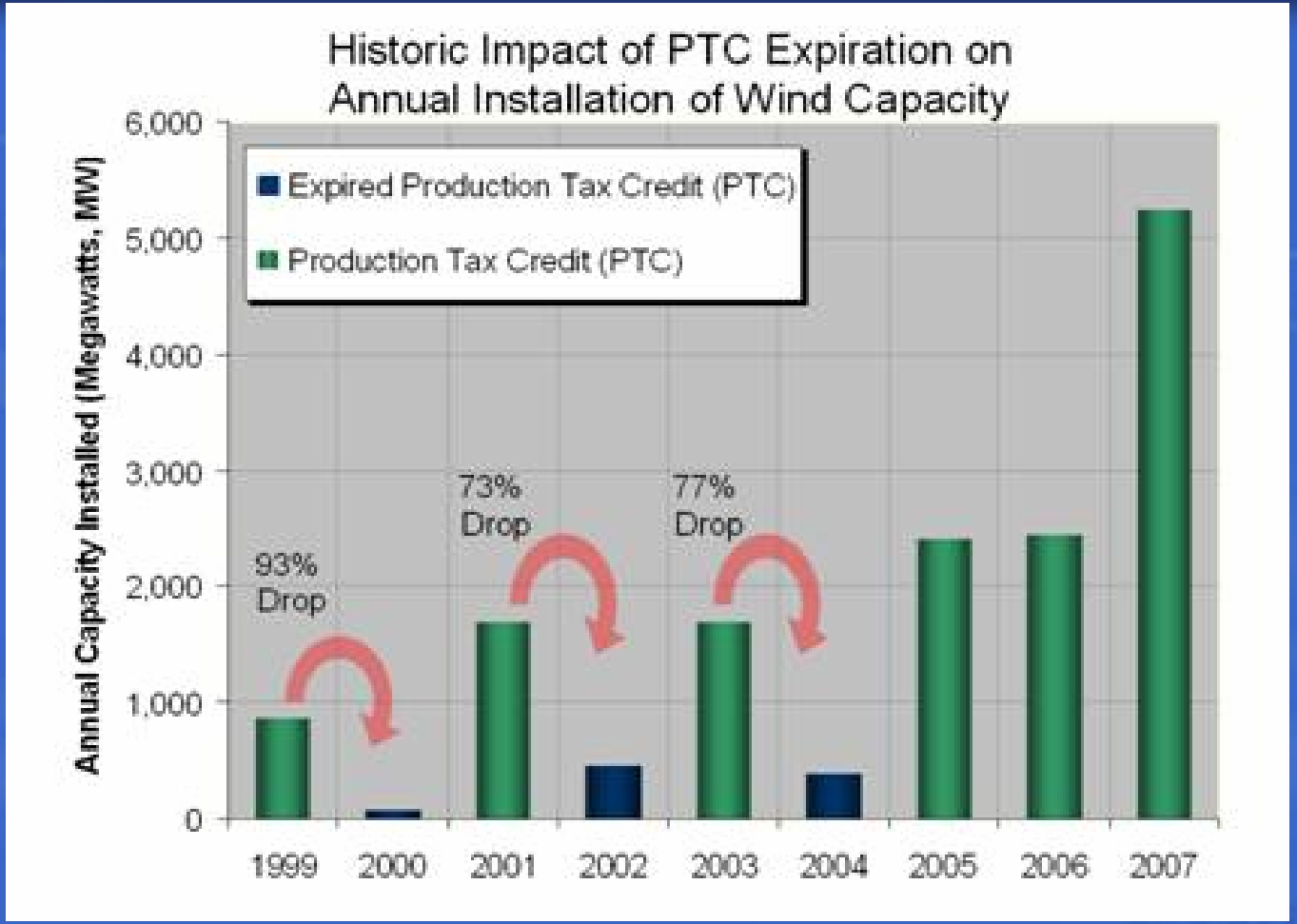
Notes: ***31 states if WV**'s Governor signs the Alternative & Renewable Energy Portfolio Act, passed 6/2/09.
An RPS requires a percent of an electric provider's energy sales (MWh) or installed capacity (MW) to come from renewable resources. Most specify sales (MWh). Map percents are final years' targets. *TVA's goal is not state policy; it calls for 50% zero- or low-carbon generation by 2020. Alaska has no RPS.
Sources: Derived from data in: LBNL, *RPS in the U.S. through* 2007 (4/08), PUCs, State legislative tracking services, Pew Center, and the Union of Concerned Scientists. Details, including timelines, are in the Database of State Incentives for Renewables and Energy Efficiency: http://www.dsireusa.org

Updated June 8, 2009

1109

PTC Renewed for 3 Years

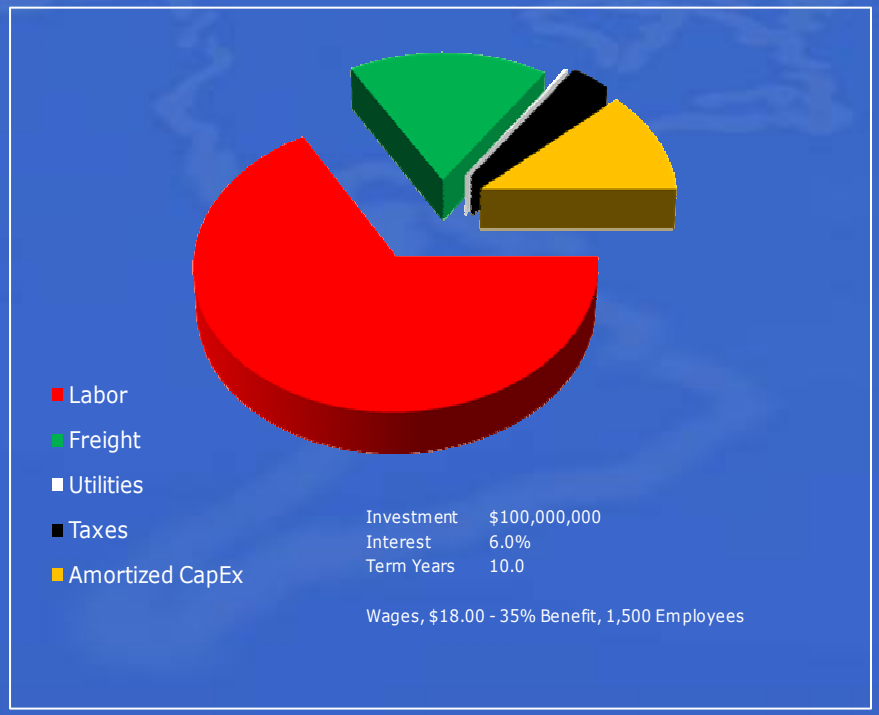
What happens when the support stops



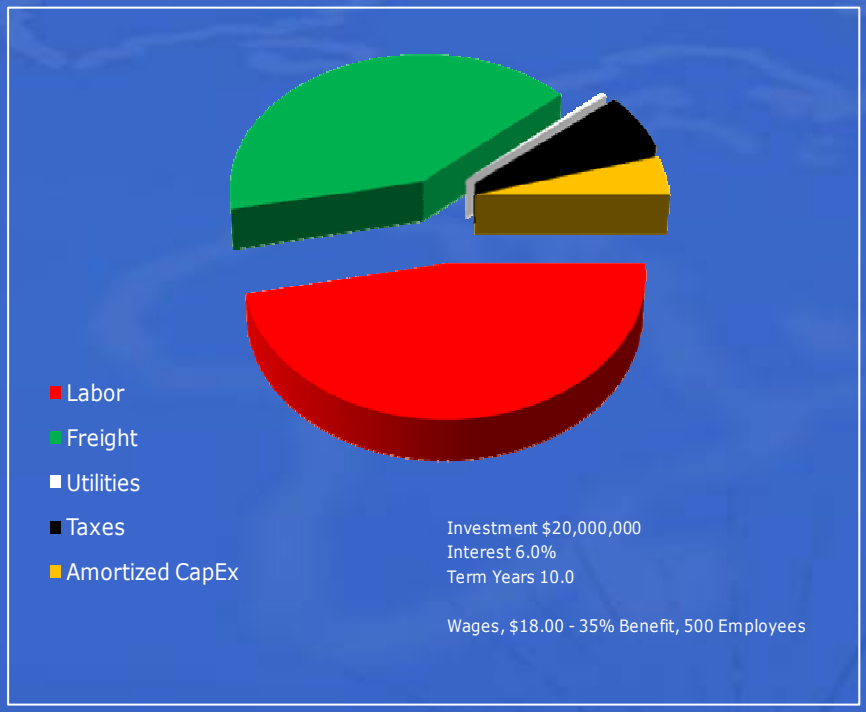
Source: American Wind Energy Association122 C Street, N.W., Washington, D.C. 20001, (202) 383-2500, fax (202) 383-2505, windmail@awea.org, http://www.awea.org.

Freight and Labor is a Needle Mover

Example Blade Manufacturing Facility



Example Nacelle Assembly Facility



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Helping Companies Decide Where to Build

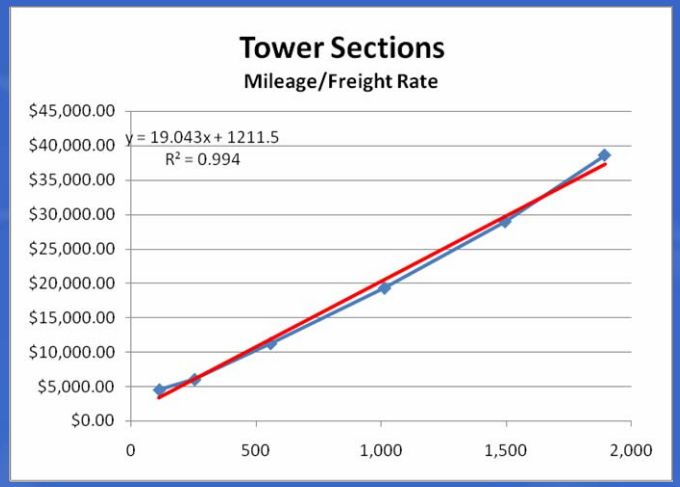
The Case for Rail

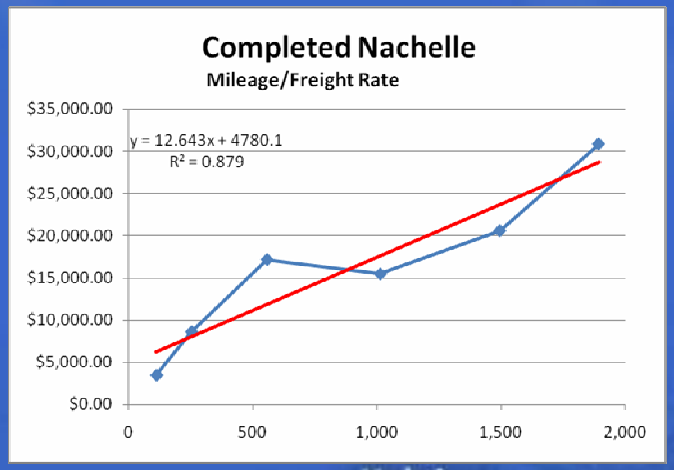
Logistics Cost and Complications Affect Access to Inland Markets

Truck Transport Costs

Due to the length and weights of the towers and blades, customized trailers and heavy haul tractors are required. Each trailer is customized requiring a significant amount of investment from the carriers. The cost of each combined trailer and heavy haul tractor unit can reach $500,000 to $750,000. Escort vehicles are also required for the trucks. Depending upon the state, the number of escort vehicles varies but typically range from one to three escort cars per truck for the blades or towers.

Rail Transport Cost Curves





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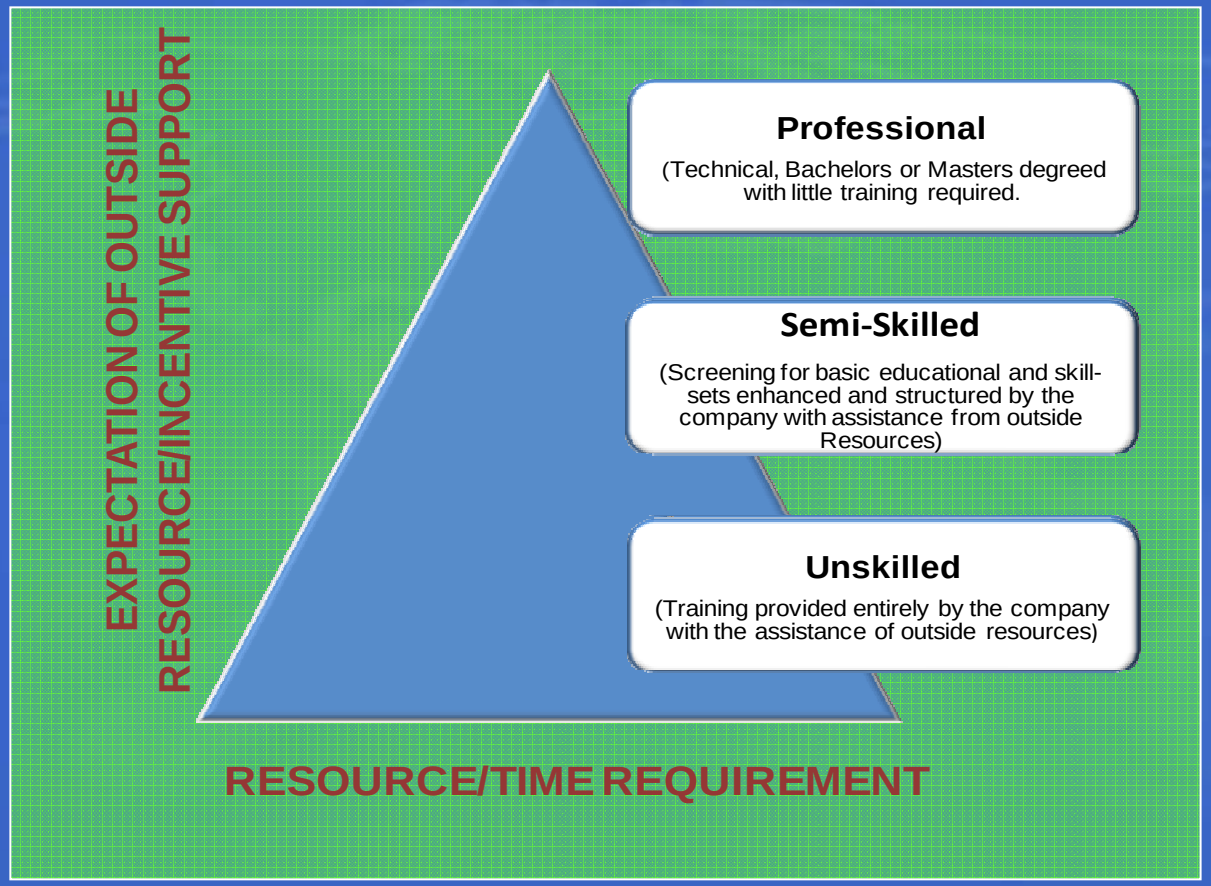
Helping Companies Decide Where to Build

Skills vs. Training

Assistance/Resources Relationship



Professional

Engineering and Design
Project Management
Logistics
Etc.

Skilled

Nacelle Assembly and Testing
Electronics Troubleshooting/Testing
Mechanical Troubleshooting/Testing
Machining (Gears and Shafts)
Bearings
Gear Box Assembly

Semi-skilled

Rotor Blade Technicians
Nacelle Covering
Control Box Assembly
Towers
Castings

Wind Resources and Transmission Lines

NREL Updated Maps:
Arizona (2003)
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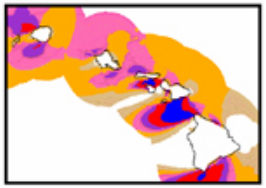
Nevada (2003)
New Jersey (2002)
New Hampshire (2001)
New Mexico (2003)
North Carolina (2002)
North Dakota (2000)
Ohio (2004)
Oregon (2002)
Pennsylvania (2002)
Rhode Island (2001)
South Dakota (2001)
Texas mesas (2000)
Utah (2003)
Vermont (2001)
Virginia (2002)
Washington (2002)
West Virginia (2002)
Wyoming (2002)



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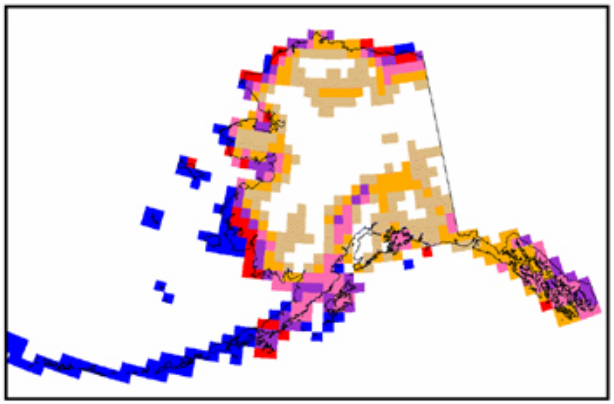

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1000 (DC)

Source: POWERmap, powermap.platts.com, ©2007 Platts, a division of the McGraw-Hill Companies

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7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

[a] Wind speeds are based on a Weibull k value of 2.0

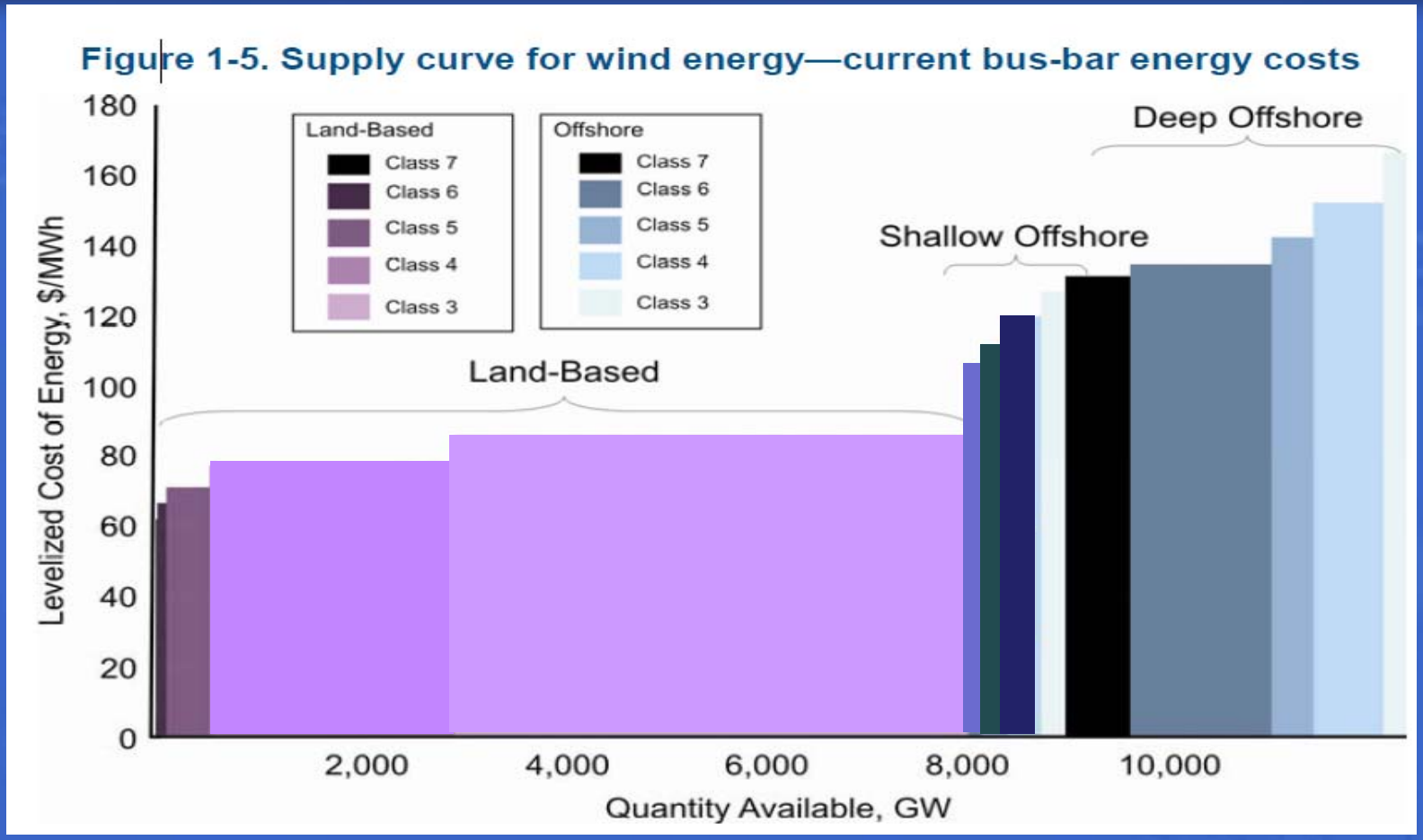
U.S. Department of Energy
National Renewable Energy Laboratory

NREL

19-APR-2007 1.5.9

South Carolina and Offshore Wind

Technology Improvements will Capture Opportunity



Source:
20% Wind Energy by 2030 - Increasing Wind Energy's Contribution to U.S. Electricity Supply. DOE/GO-102008-2567 • July 2008

http://www1.eere.energy.gov/windandhydro/pdfs/41869.pdf

McCallum Sweeney Consulting

Helping Companies Decide Where to Build

Offshore Wind is SC's Greatest Immediate Opportunity

- Incumbent OEM that can serve the market immediately
  - Access to the Port of Charleston is imperative from Greenville, SC as turbine size increases
  - In the absence of rail clearance to the Port of Charleston – adequate property in close proximity
- Leverage ability to manufacture components, import parts/assemble/ship, and "project manage large" developments
  - General electric, Timken, Bosch, and others
  - Port of Charleston access (North America and Beyond)
  - Engineering, Procurement, Construction (EPC) Presence
- Recruit and Develop the Supply Chain
  - Combination of component imports, manufacturing expansions, and recruitment
- Legislative support for industries – Federal, State
  - Industry support to promote and assist innovation
  - Tailored to assist in recruitment

MSC Contact Information

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McCallum Sweeney Consulting

Helping Companies Decide Where to Build

Charleston Green Committee

The case for SC to become a wind power industrial hub is compelling and urgent. The need combined with the opportunities we have at this moment, creates a critical mass for success in these areas:

- Jobs
- Stewardship
- Economic Revitalization

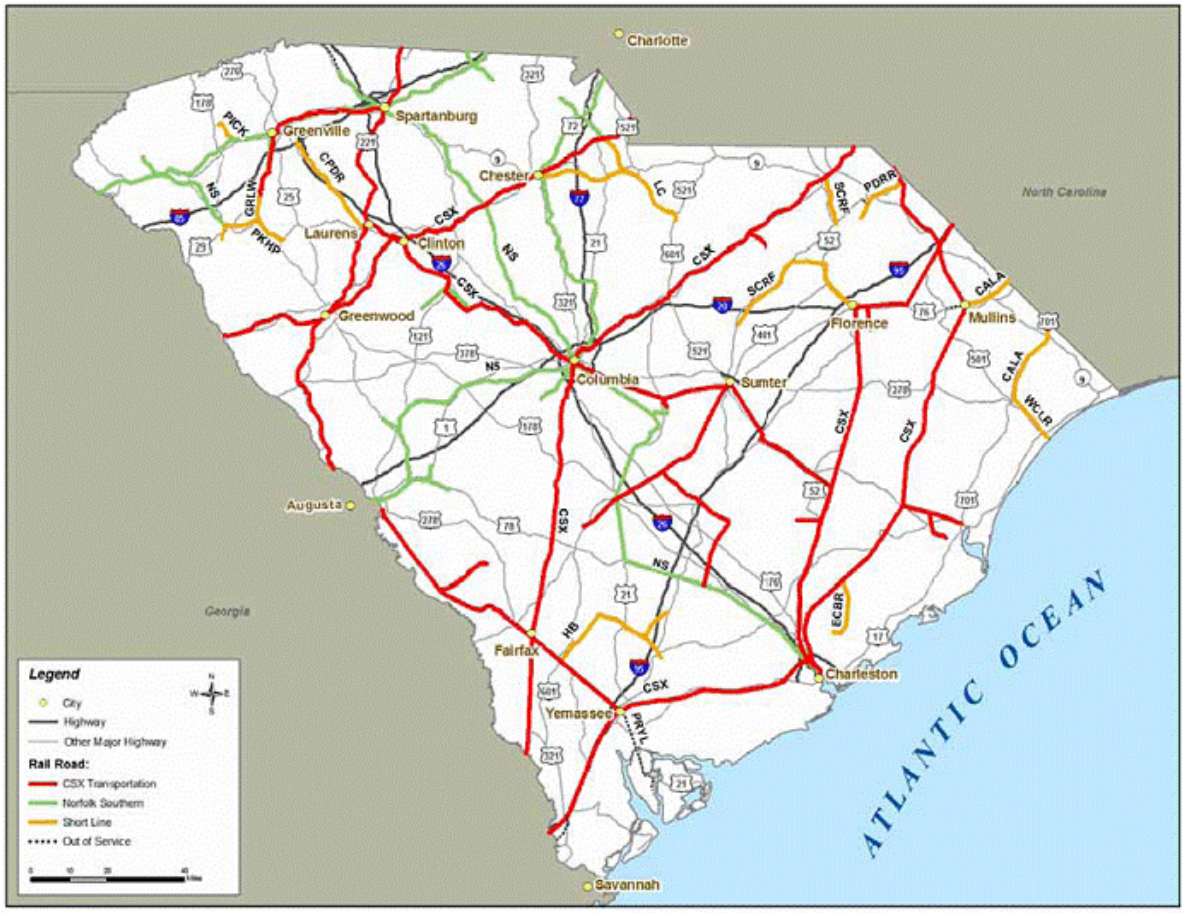
Charleston Green Committee

Our Starting Place

Important factors in developing an offshore wind farm

- Wind power capacity
- Shallow waters
- Proximity to the Port

We have an existing rail & interstate system to transport components.

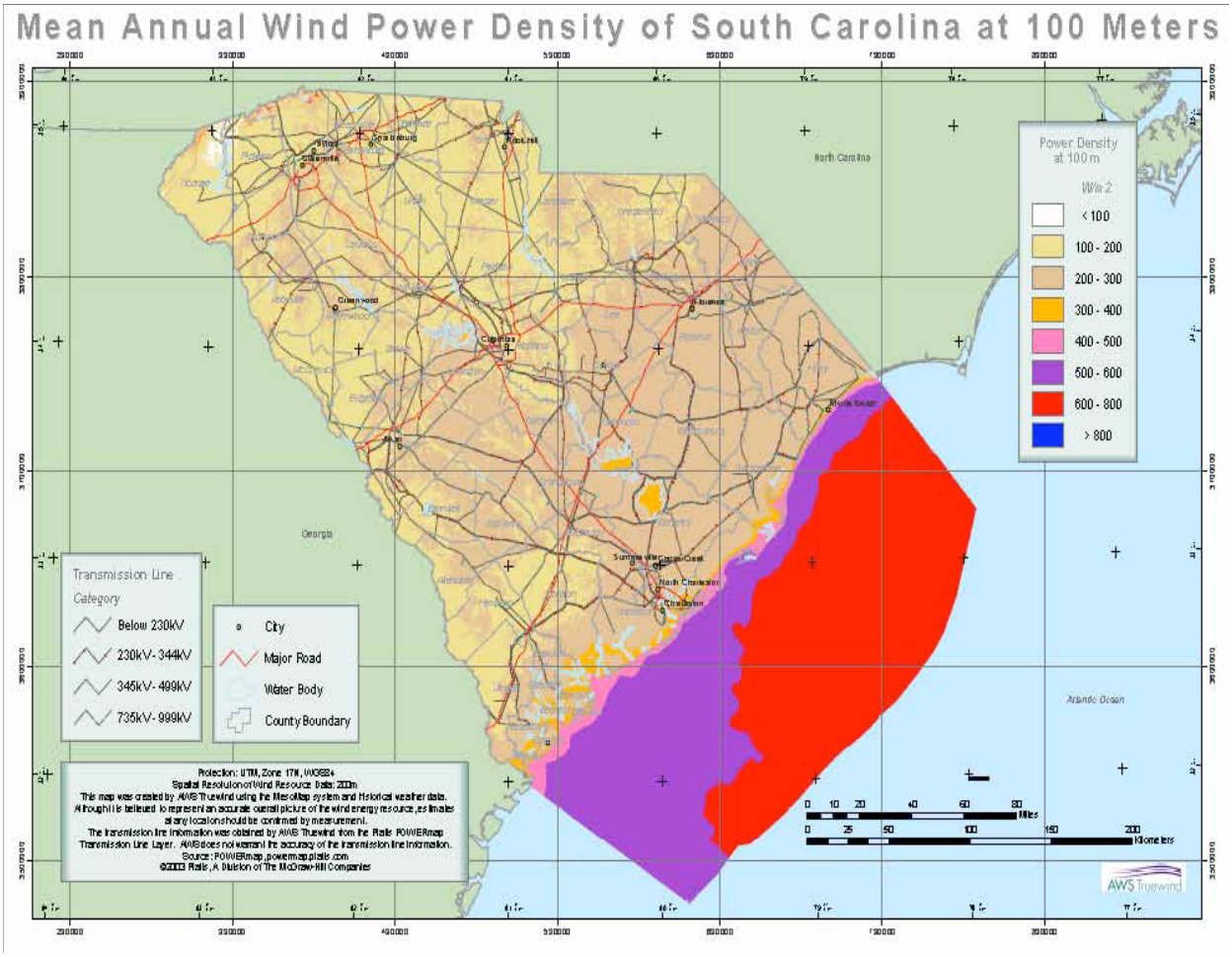


Charleston Green Committee

The Science

Wind power becomes practical at Class 4 wind power density – we have Class 5 & 6 indicated by violet and red in the key below.

We could generate 210% of our usage.



Courtesy of Dr. Nick Rigas

Charleston Green Committee

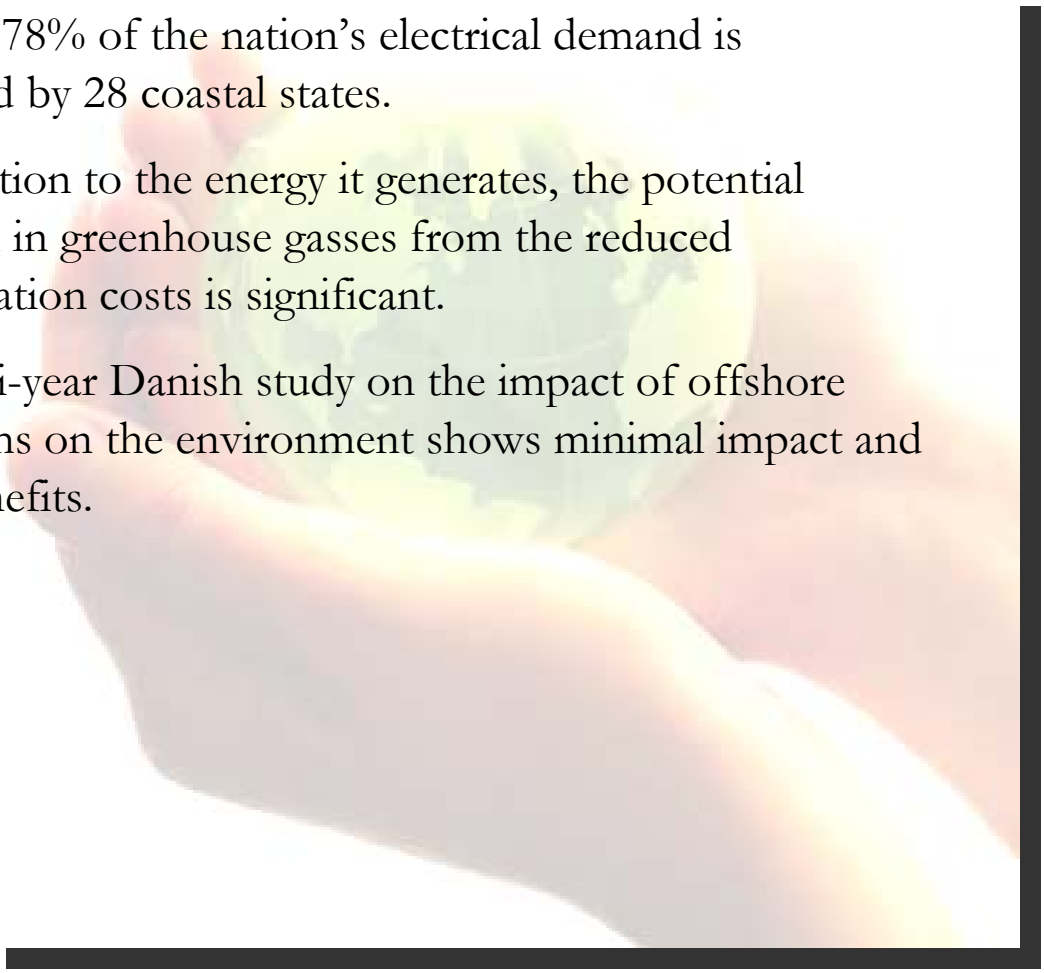
Jobs

- According to the Department of Energy, manufacturing wind turbines and their components in South Carolina could result in 10,000 to 20,000 new manufacturing jobs.
- We have an existing manufacturing base.
- There is an existing pro-forma for a community college program for training technicians.
- Key industry players such as GE, Fluor, Nucor, and others are already established in SC
- Existing large-scale shipbuilding facilities.
- Low-cost manufacturing environment.

Charleston Green Committee

Stewardship

- Wind power is clean, renewable and does not create the disposal problems associated with nuclear power.
- Dependence on foreign energy sources makes the US more vulnerable.
- An estimated $1.5 billion per day leaves the US for oil.
- Nearly 78% of the nation's electrical demand is consumed by 28 coastal states.
- In addition to the energy it generates, the potential reduction in greenhouse gasses from the reduced transportation costs is significant.
- A multi-year Danish study on the impact of offshore wind farms on the environment shows minimal impact and many benefits.



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Economic Revitalization

- Wind power is the fastest growing renewable energy market in the world.
- The trend toward plug-in-electric cars will require increased demand for electricity.
- Economic impact on manufacturing, construction, operations and maintenance, and rural economic development
- The technology has been proven.
- An off shore industrial cluster could potentially capture locally up to 50% of the costs associated with building a wind farm.

Charleston Green Committee

Opportunities Will be Lost

- Taking action now will prevent the need for companies like GE, Fluor and others to relocate to areas more invested in the technology.
- Vestas, the world leader in turbine manufacturing, established their industrial hub to service land-based wind farm development in Denver due to its rail infrastructure, access to Midwest markets, and manufacturing base.

- **October 8, 2008**

BREVINI: Firm to bring 455 high-paying jobs

By Aleasha Sandley, Herald Bulletin Staff Writer

October 08, 2008 11:07 pm

— MUNCIE — Italian manufacturer Brevini Power Transmission will bring 455 high-paying jobs to East Central Indiana in the next three years, drawing upon the region's skilled work force.
Brevini founder and CEO Renato Brevini will locate his company's U.S. headquarters to Delaware County's Park One Business Park at the Interstate 69/Indiana 332 interchange, a $62 million investment in the area. The

Charleston Green Committee

Opportunities Will be Lost

- **June 23, 2009** Secretary Salazar announces 5 exploratory leases for offshore wind energy development off the coasts of New Jersey & Delaware.

- **June 25, 2009** Secretary Chu announces 154M in recovery act funding to support energy efficiency and renewable energy projects in California, Missouri, New Hampshire, and North Carolina.

- **June 28, 2009** A groundbreaking ceremony for the construction of 3 - 1.5 MW turbines spinning on 250 foot high towers in Maine's first island wind power project.

- **June 29, 2009** North Carolina moves on coastal wind power legislation. Also, the North Carolina Coastal Resources Commission moved to create an exception for wind farm construction while still protecting the visual and natural characteristics of the beach.

- **July 1, 2009** Massachusetts draws zones for coastal wind farms.

- **July 13, 2009** What will South Carolina do?

Charleston Green Committee

The Moment

- The leadership position of Jim Clyburn is ideal.
- The framework for a regulatory roadmap is completed.
- The market forces are making wind power more competitive every day.
- Both American and European demand for components is growing.
- We have relationships with research institutions including Coastal Carolina University, Clemson (including the Restoration Institute in Charleston,) College of Charleston Furman, University of South Carolina, Wofford, Savannah River National Laboratory, Oak Ridge National Laboratory, The Citadel, and technical schools throughout the state.
- Delaware, Rhode Island, and New Jersey have successfully navigated the process and we can learn from their experience.
- The climate change question is no longer a debate.

Charleston Green Committee

Mayor Riley understands the challenges that come with this mission and is committed to meeting it head on. He believes Nick Rigas says it well in his 2008 paper "An Offshore Wind Power Industrial Cluster for South Carolina."

"South Carolina must strategically market its strengths to both American and European manufacturers before the opportunity is lost. Key industry, academic, environmental, and community leaders along with municipal, county and state elected officials must come together to form an alliance to attract this emerging new industry to the state."

Charleston is committed to taking a leadership role in this process and understands the tremendous economic and environmental rewards that will follow.

The information in this document is based on research by Dr. Nicholas Rigas PhD., Adjunct Professor, Clemson University Restoration Institute and VP of Project Development, Eco Energy LLC. He has given us permission to use it.

Wind Power

Onshore Wind Energy Along the Grand Strand

NORTH MYRTLE BEACH
CHAMBER OF COMMERCE
Convention & Visitors Bureau

THE CITY OF NORTH MYRTLE BEACH SOUTH CAROLINA

COASTAL CAROLINA UNIVERSITY

SRNL
SAVANNAH RIVER NATIONAL LABORATORY

Where is the opportunity besides off shore?

We’re looking at the rooftops along the ocean front

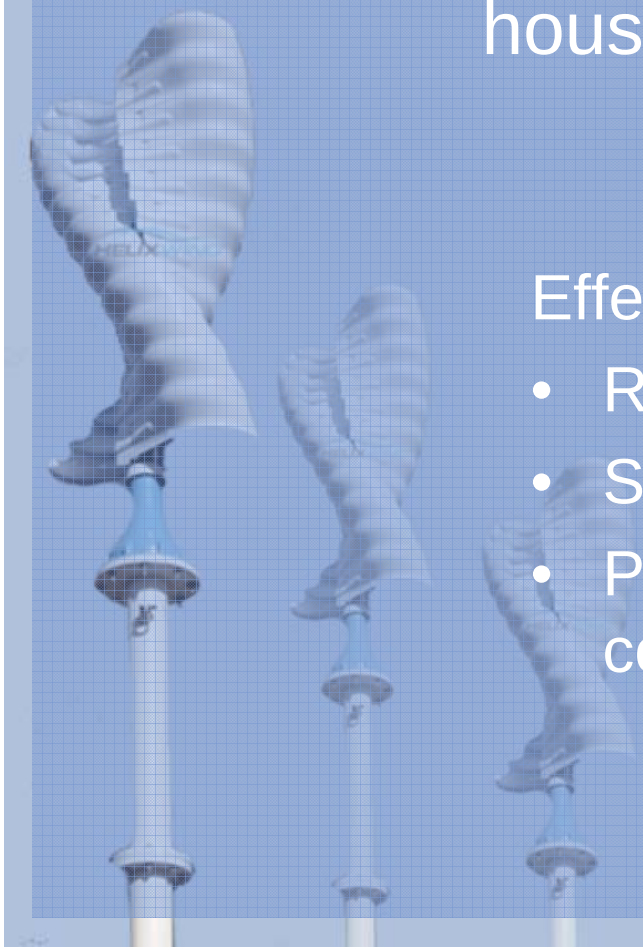
The Grand Strand has hundreds of ocean front towers, many 200 feet tall

Harnessing the wind brings two levels of economic opportunity…

- Micro – benefits to ***individual*** building owners
- Macro – benefits to the ***city***, region and state

Micro level of opportunity

Simply provide free power to offset the house account of a condo building



Effects:

- Reduce the expense to the condo investor
- Shores up the value of the asset
- Protects the property tax valuations for the county and city

Macro level of opportunity

- Provide a viable market for the vertical axis turbine industry
- Provides a key component to a future smart grid system

Windspire: Vertical Axis Wind Turbine, Made in the USA by Mariah Power

How do we maximize the economic impact for the state of South Carolina?

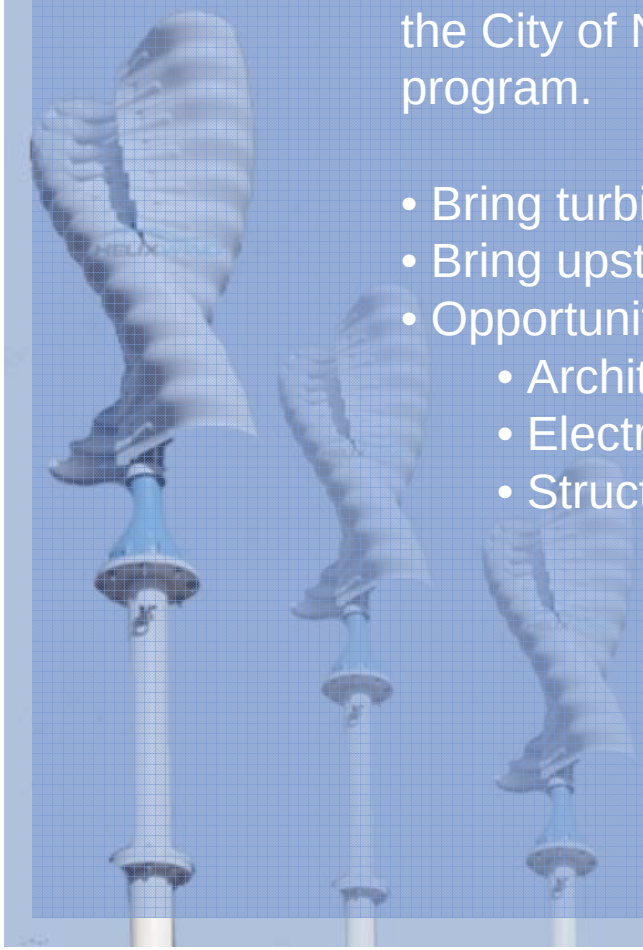
Build a wind industry commons…

•Build a collective area for the benefit of the industry to supply…

- research and development
- innovation in engineering

• Provide structure for the industry to supply the product for local installation and export

Wind Energy Incubator Program



The North Myrtle Beach Chamber of Commerce in partnership with the City of North Myrtle Beach stands ready to facilitate this program.

- Bring turbine companies to innovate for an oceanfront application
- Bring upstart businesses to learn installation and maintenance
- Opportunity for new areas in:
    - Architecture
    - Electrical engineering
    - Structural engineering

Where are we now?

- Is there enough wind on the rooftops?
- We are conducting tests
- We are establishing a wind index (Apache pier)
    - Allows shorter survey periods
    - Allows easy comparative analysis between buildings
    - Offers an academic frame for a business perspective

Roof Tests

NORTH MYRTLE BEACH
CHAMBER OF COMMERCE
Convention & Visitors Bureau

THE CITY OF
NORTH MYRTLE BEACH
SOUTH CAROLINA

COASTAL CAROLINA UNIVERSITY

SRNL
SAVANNAH RIVER NATIONAL LABORATORY
TM

Concepts for the future

We are constantly asking: “is there enough wind to feasibly install the wind turbines?”

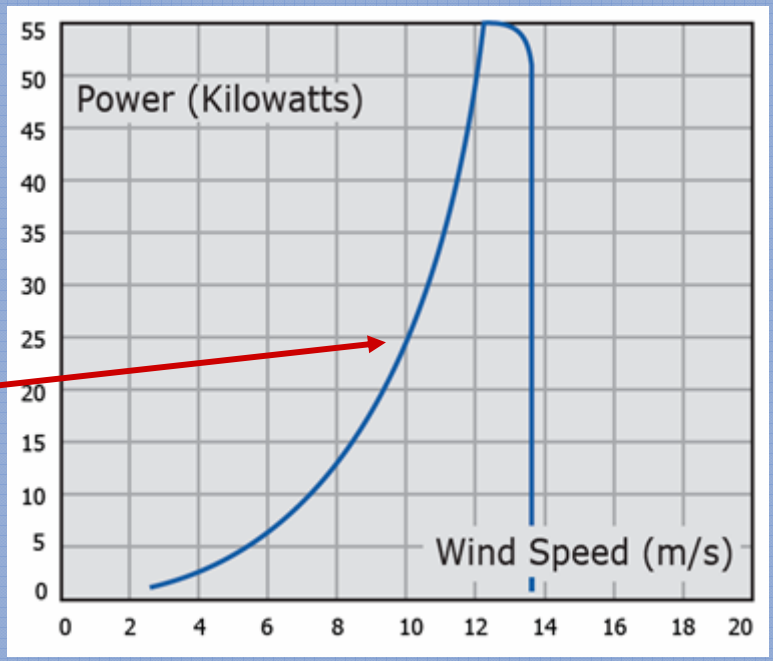
But…

… what if the wind can be manipulated to our advantage?

Any increase in wind speed brings exponential returns…

Power in the area swept by the wind turbine rotor:

$P = 0.5 \times rho \times A \times V^3$



where:

P = power in watts (746 watts = 1 hp) (1,000 watts = 1 kilowatt)
rho = air density (about 1.225 kg/m3 at sea level, less higher up)
A = rotor swept area, exposed to the wind (m2)
V = wind speed in meters/sec (20 mph = 9 m/s) (mph/2.24 = m/s)

A beautiful example of unintended consequences

Avista Resort – North Myrtle Beach

A design by Architect Derrick Mozingo

Part of the new industry commons is a new future in architecture and structural engineering along the ocean front

… and it is exportable!

Strata/London

The City of North Myrtle Beach, in conjunction with its partners, fully endorses and stands ready to support this Onshore Wind Energy project

- Furthermore, North Myrtle Beach seeks additional support and funding to become a “Demonstration City for the Advancement of Wind Energy Production”

NORTH MYRTLE BEACH
CHAMBER OF COMMERCE
Convention & Visitors Bureau

North Myrtle Beach Chamber of Commerce is on record in the support of seeking alternative energy solutions

- Working cooperatively with our local, state, and federal governments
- Supporting the research being conducted by Coastal Carolina University in the development of wind and tidal energy sources

Contact Information

North Myrtle Beach Chamber of Commerce

- Marc Jordan – President/CEO
- Monroe Baldwin – Chairman of the Economic Development Council

Phone: (843) 281 – 2662

Email: Marc@NorthMyrtleBeachChamber.com

THANK YOU !

Wind Energy Production Farms Feasibility Committee
209 Gressette Office Building
Columbia, SC
September 21, 2009
1:00 PM – 4:00 PM

I. Introductions

II. Review and Discussion of Draft Report

III. Presentations:

Offshore-Wind Project in South Carolina: The Potential Natural Resource Impacts
Bob Perry, South Carolina Department of Natural Resources

Examples of National Environmental Protection Act and Environmental Impact Statement compliance procedures
Doug Heatwole, Ecology and Environment, Inc.

Federal Aspects of Marine Spatial Planning and Territorial Sea Planning: How state policy can line up with federal policy
Steve Kopf, Pacific Energy Ventures

Recommendations from Regulatory Task Force for Coastal Clean Energy
Catherine Vanden Houten, SC Energy Office
Blair Williams, Office of Coastal Resource Management, SC Department of Health and Environmental Control

IV. Other Discussion Items

V. Next Meeting

VI. Adjourn

An Offshore Wind Project in South Carolina: *The Potential Natural Resource Impacts*

Presented to the
The Wind Energy Productions Farms
Feasibility Study Committee

Presented on Behalf of the
Regulatory Task Force for
Coastal Clean Energy

September 21, 2009

Presentation Objective:

To further introduce to the Feasibility Study Committee a list of potential natural resource impacts that may be associated with a wind energy production farm located off the north upper coast of South Carolina.

Potential Environmental Impacts

- An offshore wind farm will create an affected action in the marine, near-shore and associated upland environments.
- There will be any number of potential environmental impacts.
- These impacts are covered under Federal or State environmental laws or regulations.
- The impacts will be analyzed under the stepwise process outlined in the National Environmental Policy Act (NEPA).

Potential Environmental Impacts

The stepwise process identified in NEPA.

- Identify the purpose and need of a project.
- Identify the potential environmental impacts.
- Avoid the potential environmental impacts.
- Minimize those impacts that cannot be avoided.
- Mitigate for those impacts that cannot be minimized.
- Compensate for those impacts that cannot be mitigated.

Potential Environmental Impacts

The fundamental questions –

- Where and what will they be?
- Are there any show stoppers?

- It all depends on location, location, location!
- Location for the wind farm and distribution systems.

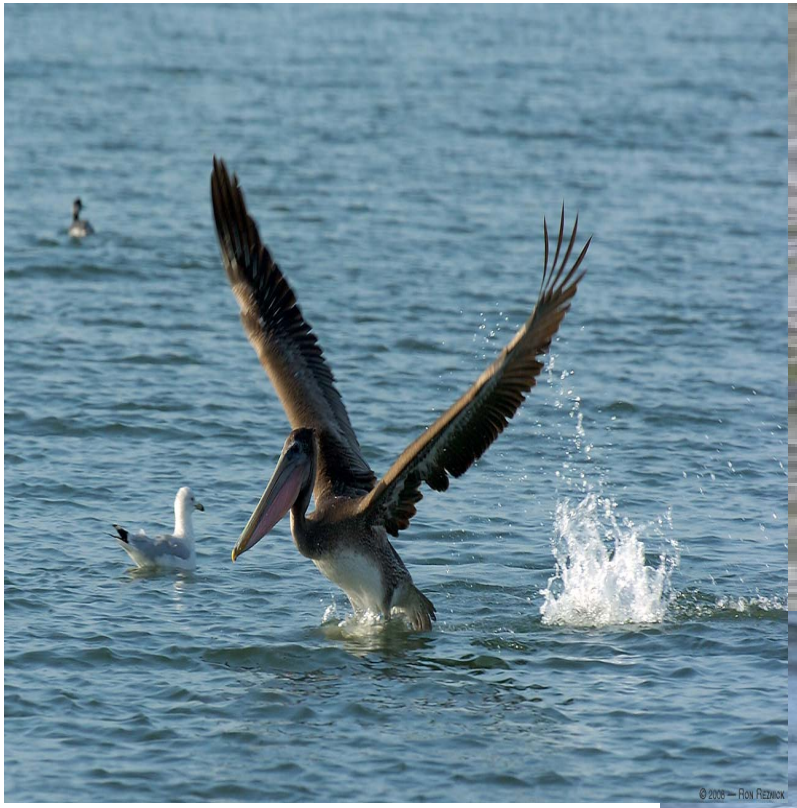
Potential Environmental Impacts

➢Where and what will they be?

1. Marine Environment: From site location to the high water mark
   a) Above the surface
   b) Surface
   c) Water column
   d) Bottom
2. Near-shore Environment: From the high water mark to inland connection destination(s)
3. Upland Environment: From the near-shore to inland connection destination(s)

Potential Environmental Impacts Marine – Above the surface

Potential Environmental Impacts Marine – the surface



Potential Environmental Impacts Marine – The water column

Potential Environmental Impacts Marine – The bottom

Potential Environmental Impacts Marine – The water column: Essential Fish Habitat (EFH)

Both the water column and the bottom habitat essential to long-term survival and health of fisheries resources. Includes bottom types such as sandy or rocky bottoms, vegetation or structurally complex coral or oyster reefs. Includes habitats for different life stages of each managed species. Encompasses those habitats necessary to ensure healthy fisheries now and in the future.

Potential Environmental Impacts Marine – The water column and bottom

Potential Environmental Impacts

Marine – The water column and bottom: transmission lines/cabling

Potential Environmental Impacts Near-shore Environment

Potential Environmental Impacts Near-shore Environment

Potential Environmental Impacts
Upland Environment: Protected Areas

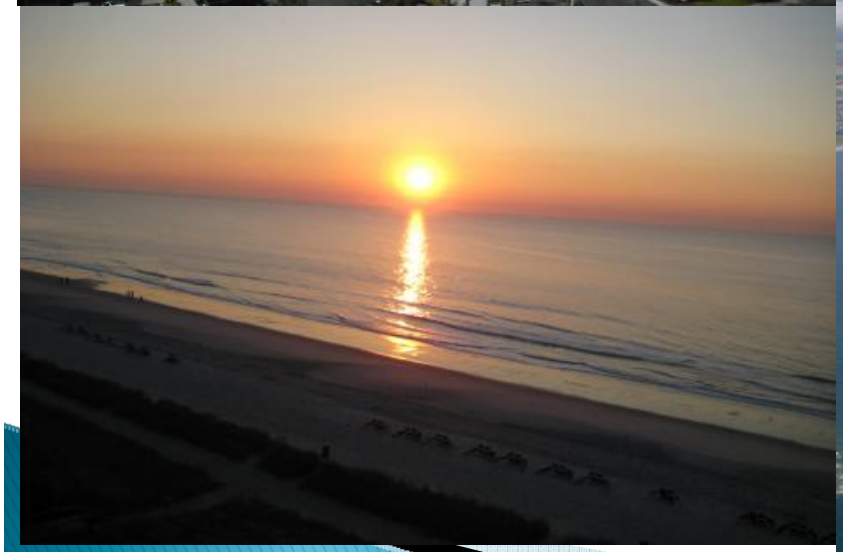
Potential Environmental Impacts
Upland Environment:
Protected areas

Potential Environmental Impacts Geophysical Issues

Potential Environmental Impacts Human Dimensions

Potential Environmental Impacts Human Dimensions

Potential Environmental Impacts Human Dimensions



Potential Environmental Impacts

➢Are there any show stoppers?

- Uncertain at this time, but probably not.
- Environmental decisions are based on balancing the need for any particular proposal with identifiable impacts.
- While there will be impacts, many of them can be avoided by selecting a location having desired wind but fewer environmental impacts.
- Where impacts cannot be avoided, they usually can be minimized by site selection.

Conclusions

Potential Environmental Impacts

- Location will determine environmental impacts.
- There are multiple potential environmental impacts to habitats, species, and the physical and human environment.
- The NEPA process will determine which environmental impacts apply.
- There may be difficult issues to work through, but there are no showstoppers believed to be present based on the information known at this time.

Questions?

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Laurel Barnhill
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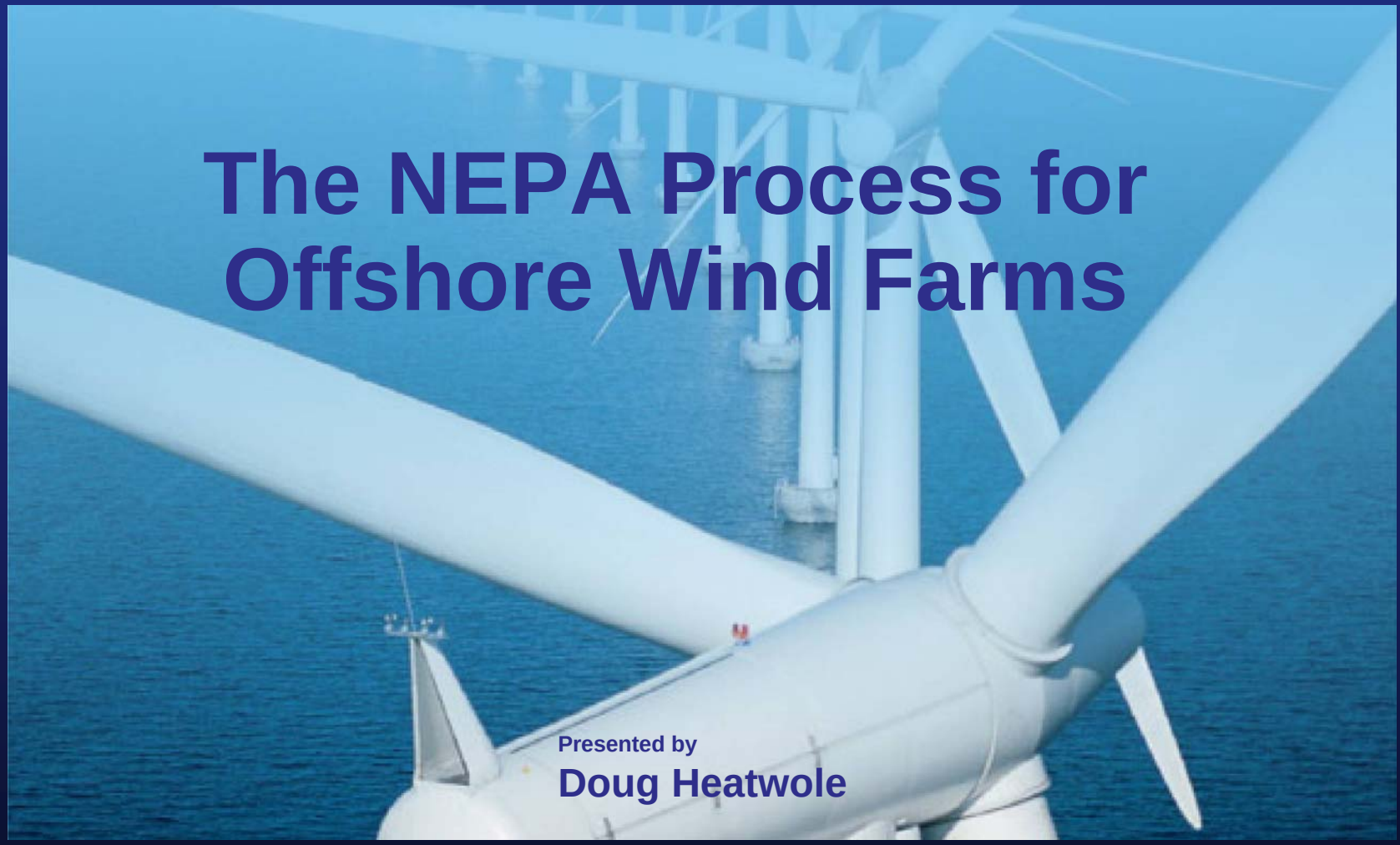
Regulatory Task Force
for Coastal Clean Energy

The NEPA Process for Offshore Wind Farms



Presented by

Doug Heatwole

Presented to

South Carolina Wind Energy Production Farm Feasibility Committee

September 21, 2009

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Agenda

- Who Regulates Offshore Wind?
- What is NEPA?
- EIS Contents
- NEPA Process
- Public Involvement
- MMS Regulatory Framework
- MMS NEPA Documents
- Cumulative Impacts
- Adaptive Management

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Who Regulates Offshore Wind?

- Within 3 miles of shore, State has authority
- From 3 to 200 miles offshore, Minerals Management Service (MMS) has authority (conveyed by Energy Policy Act of 2005)
- MMS issues renewable energy leases, easements, and rights-of-way under Outer Continental Shelf Lands Act

What is NEPA?

- National Environmental Policy Act of 1969
- Requires federal agencies to consider the environmental consequences of their actions
- Law of disclosure
- Procedural act

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What is NEPA?

- **NEPA documents**
  - **Environmental Impact Statement (EIS)**
  - **Environmental Assessment (EA)**
- **Key elements:**
  - **Identifying significant impacts**
  - **Considering alternatives to the proposed action**
  - **Cooperating and consulting with other agencies**
  - **Public involvement**

EIS Contents

- Purpose and Need for Action
- Alternatives including the Proposed Action
- Affected Environment
- Environmental Consequences
- Mitigation and Monitoring
- Appendices
  - EFH Assessment
  - ESA Section 7 Consultation
  - CZM Consistency Determination
  - Avian and Bat Monitoring Plan

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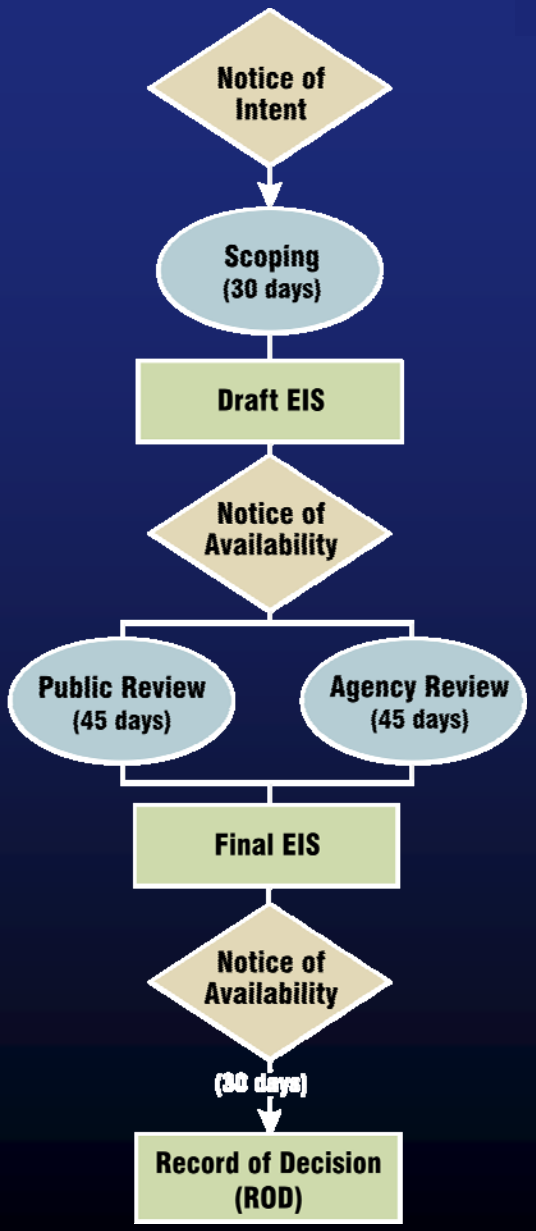
EIS Process



Opportunities for Public Input

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Public Involvement

- Scoping Meetings
- DEIS Public Hearings
- Regulator/Stakeholder Workshops

- Cooperating Agencies
- Endangered Species Act Consultations
- Essential Fish Habitat Consultation

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Public Involvement

Stakeholders

- Coastal states
- Agencies
- Fishermen
- Recreational boaters
- Commercial shipping
- Waterfront landowners
- Marine/coastal advocacy groups
- Utilities/power generators

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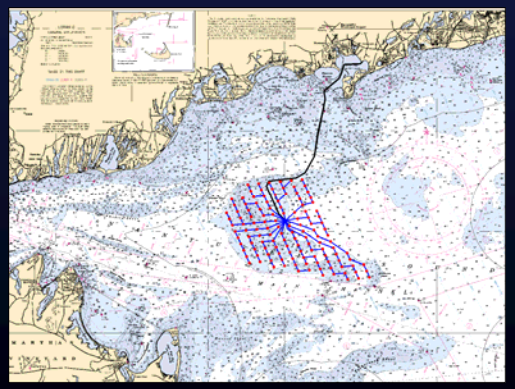
MMS Regulatory Framework

- Programmatic EIS for Alternative Energy/Alternative Use (Nov. 2007)
- Record of Decision adopting 15 interim policies & 52 best management practices (Jan. 2008)
- Renewable Energy/Alternate Use Regulations (30 CFR 285) (April 2009)
  - Leases (commercial & limited)
  - Right-of-Way Grants
  - Right-of-Use and Easement Grants
- Guidelines for MMS Renewable Energy Framework (July 2009)

MMS Regulatory Framework

- Surveys permitted under USACE (likely no NEPA document)
- Lease sale and site assessment activities (MMS EIS)
- Applicant-required plans (MMS EIS's, EA's)
  - General Activities Plan (GAP)
  - Site Assessment Plan (SAP)
  - Construction and Operation Plan (COP)



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MMS Regulatory Framework

Plan Information Required

- Hazards
- Water quality
- Biological resources
- Threatened and endangered species
- Sensitive biological resources or habitats
- Archaeological resources
- Socioeconomic information
- Coastal and marine uses

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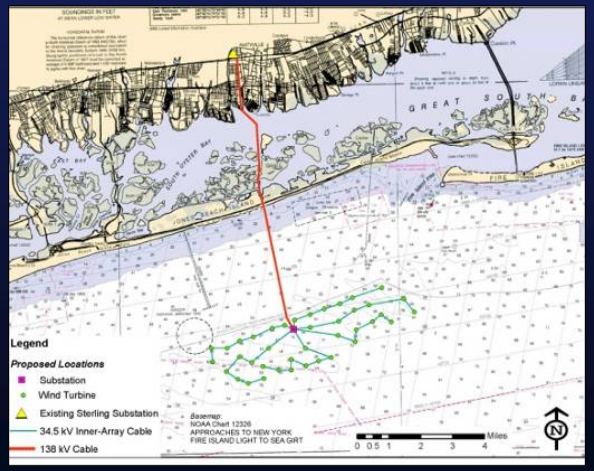
MMS Regulatory Framework

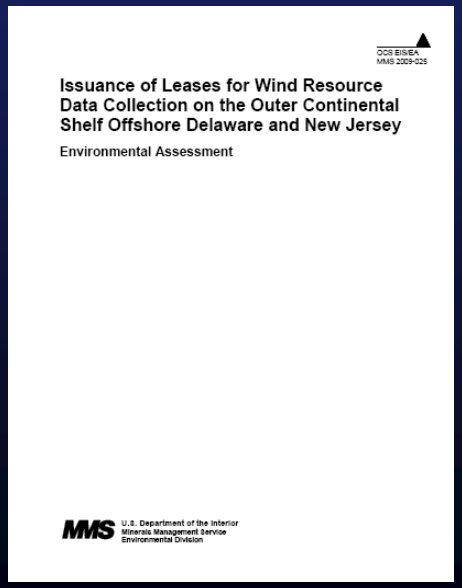
MMS NEPA Documentation

Type of Lease	MMS Process	NEPA Documentation
Competitive Commercial	Conduct lease sale & issue decision on plans	1. Lease Sale/SAP EIS 2. COP
Noncompetitive Commercial	Negotiate and issue lease	1. Lease Issuance/SAP 2. COP
Competitive Limited	Conduct lease sale & issue decision on plan	1. Lease Sale 2. GAP
Noncompetitive Limited	Negotiate and issue lease	1. Lease Issuance/GAP

MMS NEPA Documents

- Programmatic EIS for Alternative Energy/Use (2007)
- EIS for Cape Wind (USACE 2004, MMS 2008)
- EIS for Long Island Offshore Wind Park (NOI, 2006)
- EA for Issuance of Leases for Wind Resource Data Collection on the OCS Offshore DE and NJ (2009)




OCS EIS/EA
MMS 2009-025

Issuance of Leases for Wind Resource Data Collection on the Outer Continental Shelf Offshore Delaware and New Jersey

Environmental Assessment

MMS U.S. Department of the Interior Minerals Management Service Environmental Division

USACE's 3,800 page Cape Wind DEIS

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Cumulative Impacts

- Consideration of past, present, and reasonably foreseeable future actions
- Assessed at each stage of environmental review
  - Lease sale
  - Expansion of pilot projects to commercial arrays
  - Addition of multiple wind farms
- Cumulative impacts from geographically distant projects affecting the same resources (e.g., marine mammals)

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Adaptive Management

- MMS adopted a policy of adaptive management
- Uncertainty of impacts requires "learn as you go"
- Need well-designed monitoring programs
- Phased development facilitates adaptive management

"Try blowing on it."

Questions?

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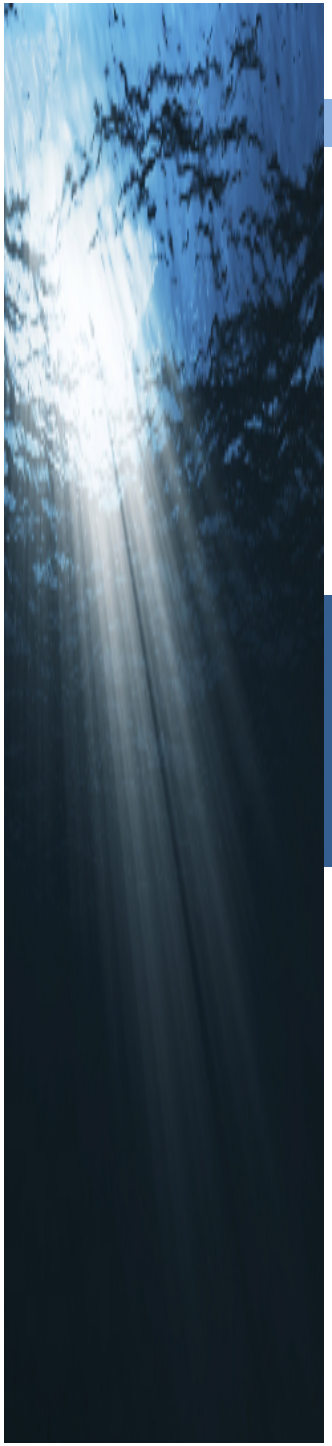


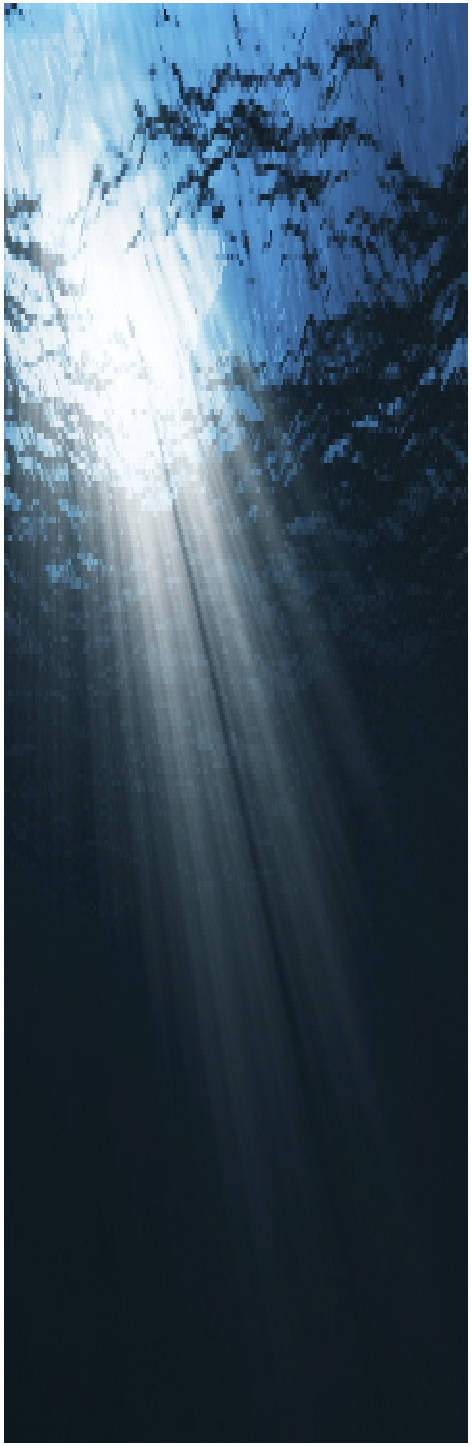
Federal Aspects of Marine Spatial Planning and Territorial Sea Planning:
How state policy can line up with federal policy

Wind Energy Production Farms Feasibility Committee

pacific ENERGY VENTURES

STEVE KOPF

SEPTEMBER 21, 2009



Pacific Energy Ventures, LLC

Services

- Project Development
- Regulatory Coordination
- Stakeholder Engagement
- Utility Integration

Project Highlights

- Regulatory Policy (USDOE)
- Wave Energy (Oregon)
- Tidal (Washington)
- NW Biomass

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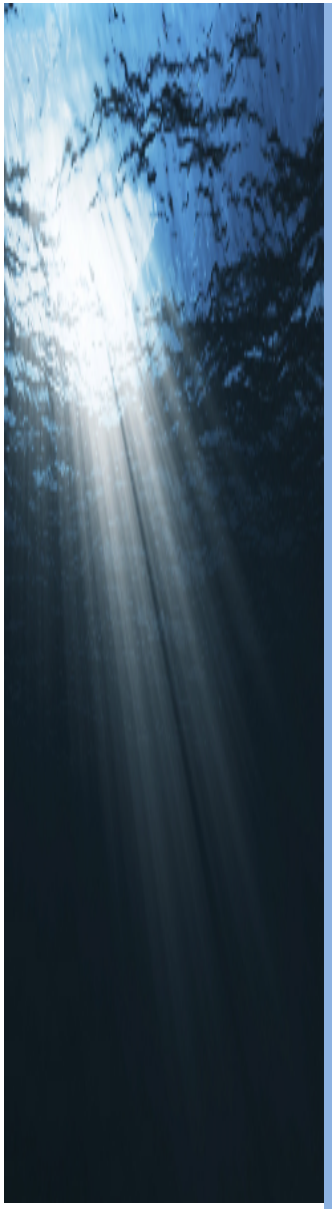

Pacific Energy Ventures

- **Bicoastal** – Portland, OR and Charleston, SC
- **Focused** – specialize in ocean energy
- **Already Engaged** – OWET, DOE, Private Developers
- **Networked** – WCGA, NROC, CEQ, NOAA, OWET, OREC, OREG, Congress, stakeholders
- **Strong Team** – working together for 3+ years

Focused on Market Acceleration

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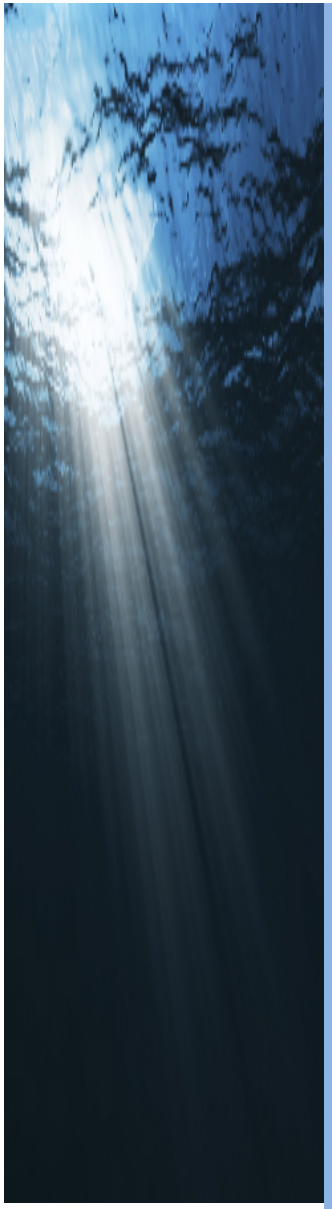
HDR



Steve Kopf, Partner

Experience

- **Led development of Ocean Power Technologies' US projects.**
- Negotiated complex, multi-party stakeholder Settlement Agreement.
- PM for DOE Siting Protocols
- **Testified to Senate Energy Committee on ocean renewable development.**
- Participating in CEQ Ocean Policy Task Force.

Qualifications

- BS Aerospace & Ocean Engineering
- Board Member – Oregon Wave Energy Trust
- 23 Years in new business development.
- **Member – WCGA.**
- Signer – EDF Coalition Principles Document.
- Active in Ocean Energy since 2005.
- Holds patents in wind turbine blade and control system design.
- Avid sailor.

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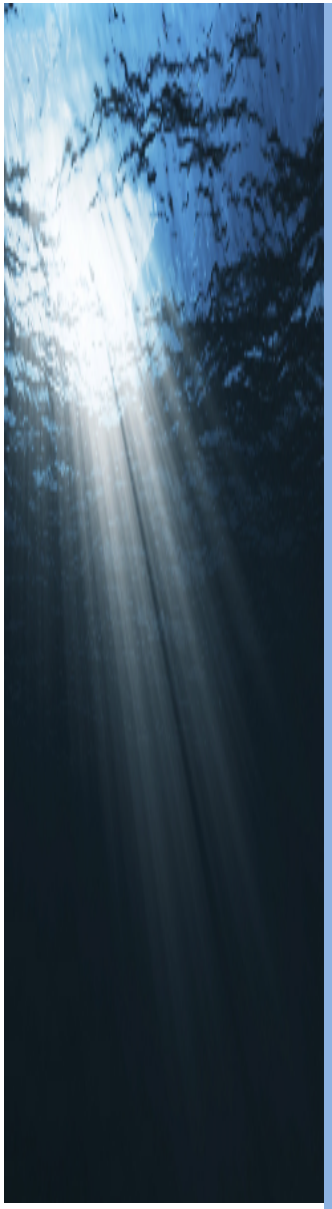

Justin Klure, Partner

Experience

- Develops ocean energy related policy initiatives.
- **Founder and former director of Oregon Wave Energy Trust.**
- International liaison for technology transfer and R&D.
- Successfully secured State and Federal dollars to advance renewable energy industry.
- Facilitates multi-disciplined stakeholder groups.

Qualifications

- Master's in Business.
- BS in Environmental Science.
- Twelve years experience in energy policy and governmental affairs.
- Strong project management background.
- **Member of Oregon's Territorial Sea Plan Advisory Committee.**
- Held senior policy position with Oregon Department of Energy.
- Active in Ocean Energy since 2005.
- **Strategic advisor to the Northwest National Marine Renewable Energy Center (NNMREC).**

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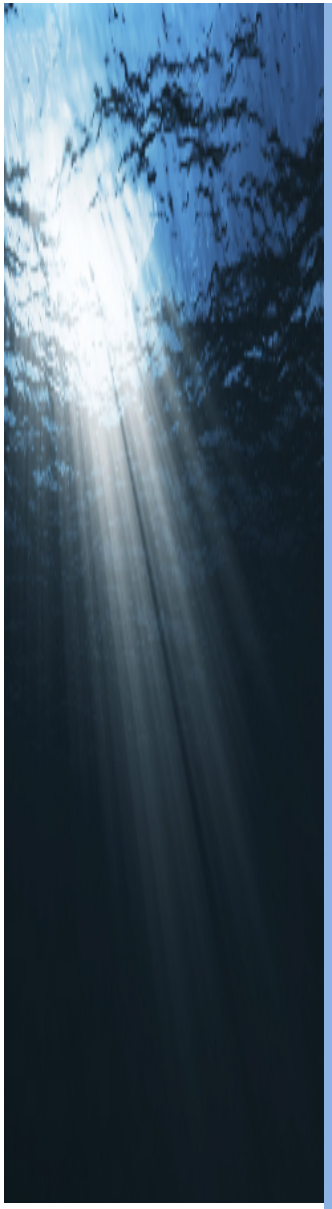

Therese Hampton, Senior Associate

Management Experience

- Led 120-person team to implement $175M/year fish and wildlife program
- Managed 45-person team responsible for short and long term planning of 29 hydroelectric dams and a nuclear plant
- **Led a 35-person organization responsible for securing 30-50 year operating licenses, committing approx $2B over the life of the licenses**

Qualifications

- MS Economics, Portland State University
- 15 Years in Utility Industry
- Manages Large Diverse Teams
- **Facilitates Complex Negotiations and Settlements**
- Active in Ocean Energy since 2006
- Led Oregon Solutions process for OPT's Reedsport project
- **Facilitated more than 50 ocean energy stakeholder meetings**

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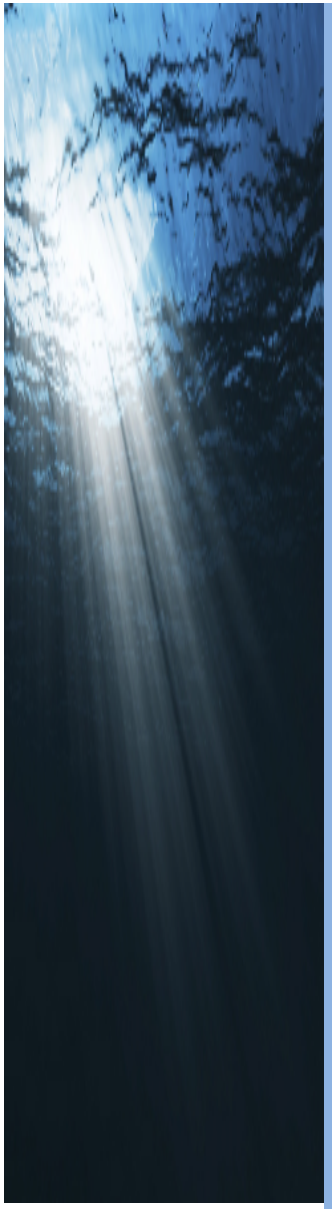

Greg McMurray, PhD, Sr. Associate

Experience

- **Led State of Oregon agencies in the development of study plans, adaptive management plan, and Settlement Agreement for OPT wave project in Reedsport.**
- Organized Ecological Effects Workshop for ocean energy.

Qualifications

- PhD Marine Biology
- 30 years experience in ecological risk management in marine and coastal environments.
- **Initial co-chair of WCGA Renewable Energy Ocean ACT.**
- Co-chair Coastal State Organization Working Group on Ocean renewable Energy.

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Anna Hofford, Associate

Qualifications

- Bachelors in Communications
- Maintains PEV Sharepoint site and website.
- **Analyzed MMS draft and final rules. Summarized and cataloged stakeholder comments.**

Experience

- **Developed regulatory handbook as part of DOE funded project that integrates State and Federal regulatory policy.**
- Conducted stakeholder interviews to assess needs and interests of existing users, resource agencies, developers, and utilities.

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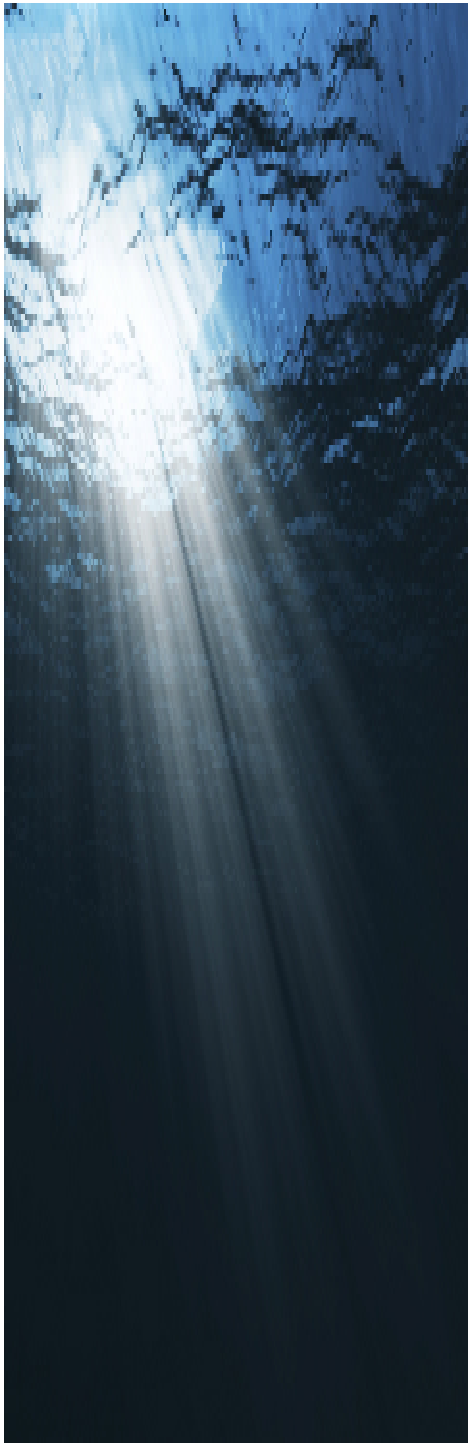

Industry Imperatives

- Balance new and existing ocean uses
- Establish consistent and appropriate regulatory process
- Understand project effects – environmental and socioeconomic
- Coordinate industry needs and prioritize research and development
- Identify resource gaps – workforce and maritime infrastructure
- Develop market support

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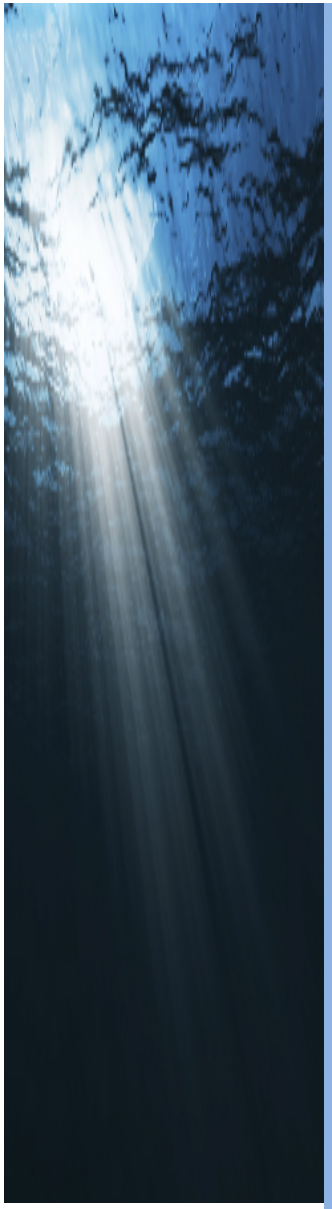

Renewable Energy Policy

- **Price Support Mechanisms**
- **Proactively amend the Territorial Sea Plan**
- **Invest in Regulatory Roadmaps**
- **Clearly define offshore leasing rules and procedures.**
- **Initiate Marine Spatial Planning of the Territorial Sea.**

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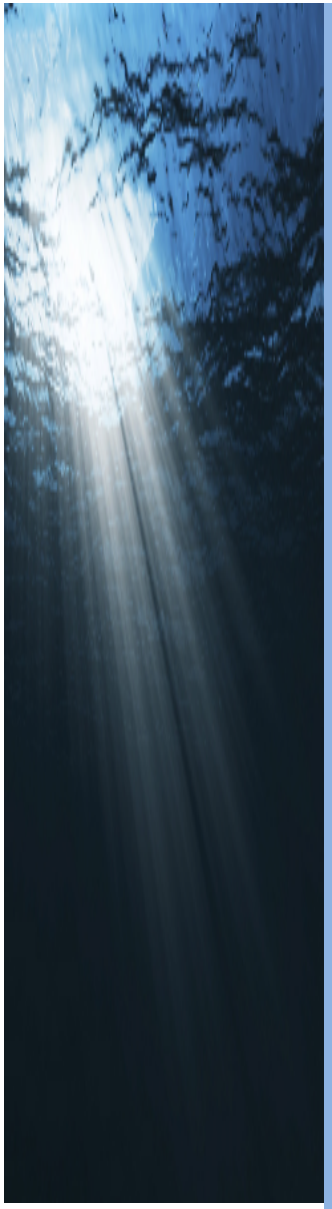

Price Support Mechanisms

- **Consider an RPS – provides confidence to investment community.**

- **Need PUC commitment to above market costs. Look at Delaware model for offshore wind.**

- **Use carve outs or multipliers to incent early stage technologies**

- **Consider a South Carolina Investment Tax Credit to incent investment and leverage Federal incentives. Look at Oregon model.**

- **Need to quantify the aggregate above market costs.**

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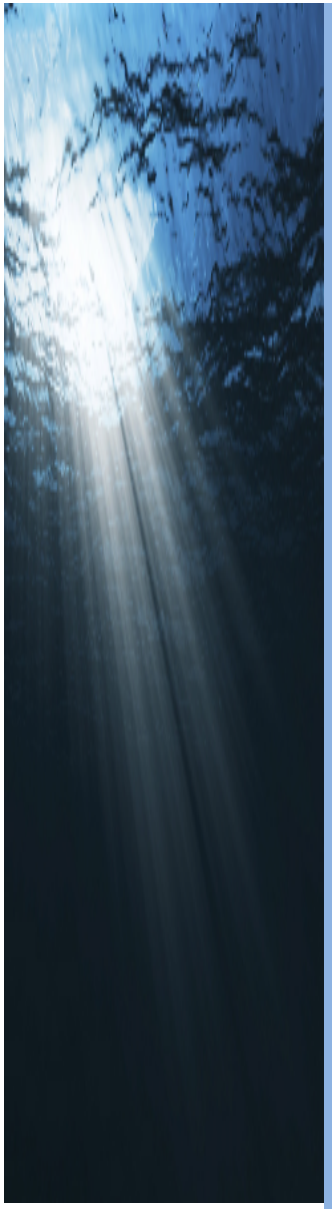

Roadmaps

- **Need to overlay State and Federal processes.**
- **Helps identify regulatory gaps and legislative needs.**
- **Helps inform all stakeholders.**
- **Include outreach and education.**
- **May be DOE or MMS support.**

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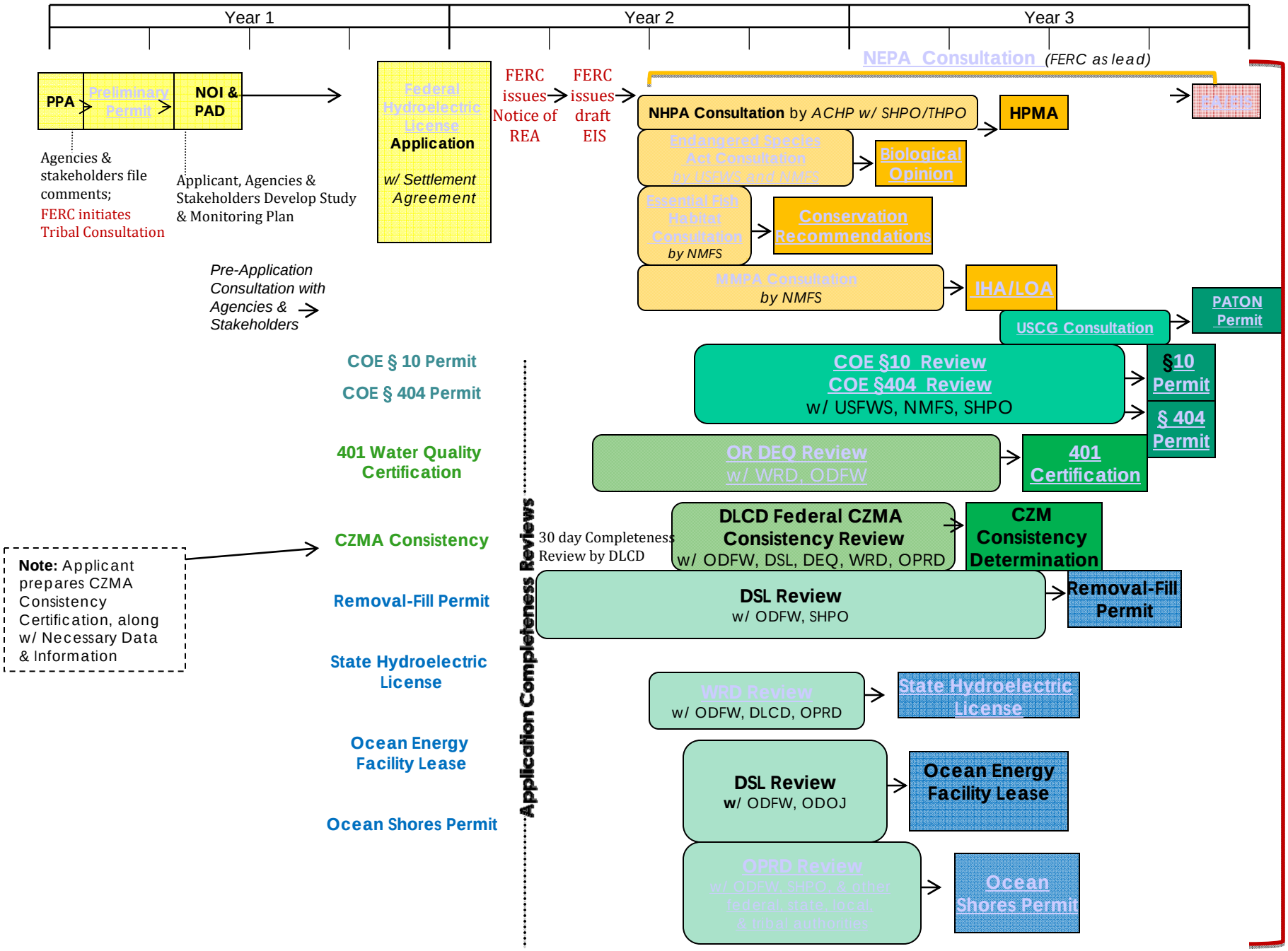
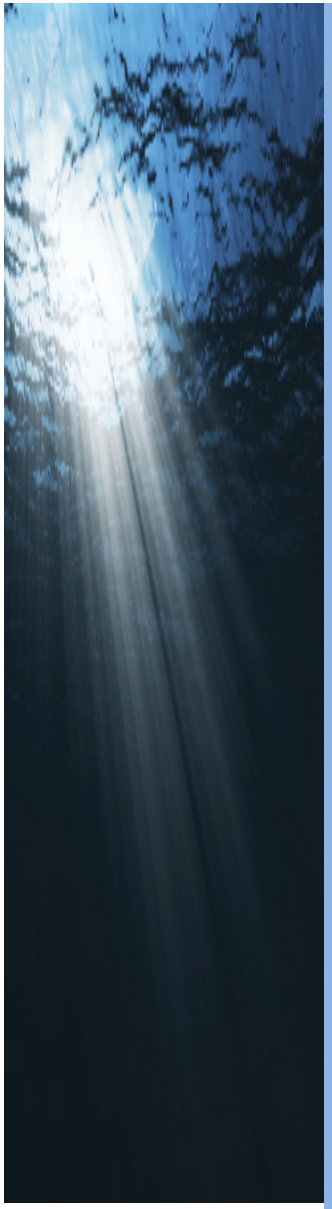
Grid-Connected, Commercial Project Within OR Territorial Sea





Proactively Amend Territorial Sea Plan

- **Federal law only requires developers to be consistent with State's current TSP.**

- **Amend to provide clarity and consistency for developers.**

- **Timing – Obama's Ocean Policy Task Force is currently making recommendations on governance and planning.**

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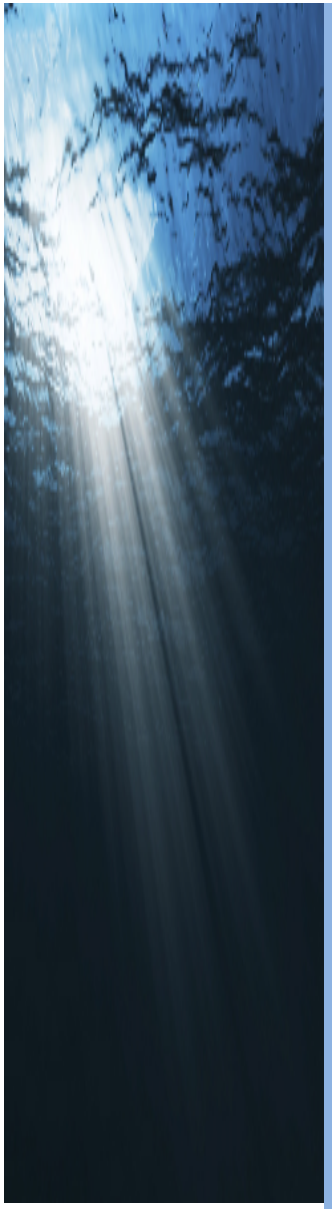

Territorial Sea Leasing

- **Need to develop clear policies and procedures for ocean leasing for renewables.**

- **Need to avoid MMS model which is based on extraction of a non-renewable resource.**

- **Lease rate needs to reflect the public benefit. Should be commensurate with terrestrial wind.**

- **Should have a clawback provision for environmental studies.**

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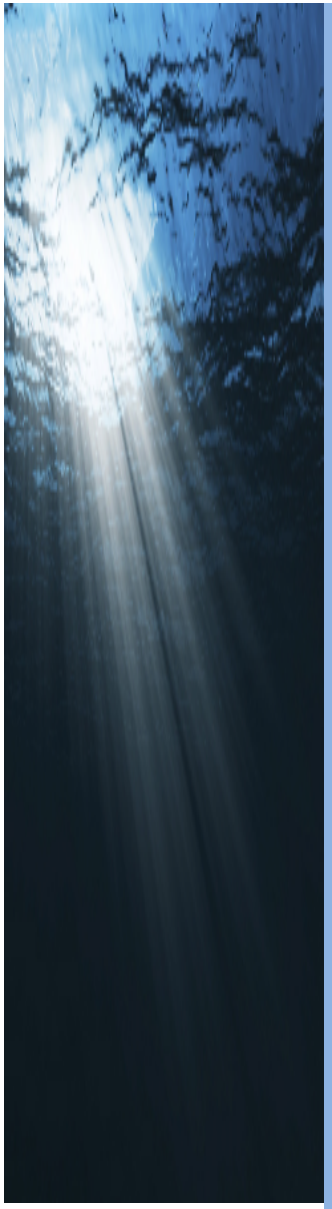

Initiate Marine Spatial Planning

- **Policy Decision – Planning or Zoning?**
- **Invest sooner rather than later.**
- **Involve all stakeholder groups.**
- **Coordinate with MMS**
- **Pay attention to Senate Commerce Committee bill. Authorizes $100M for NOAA.**
- **Engage in CEQ Ocean Policy Task Force.**
- **Evaluate OR, RI and NC approach.**

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Regulatory Task Force for Coastal Clean Energy

Catherine Vanden Houten
South Carolina Energy Office

Blair Williams
Office of Coastal Resource Management, SCDHEC

September 21, 2009

Regulatory Task Force Overview

DOE Wind Grant

- 2008
- U.S. Department of Energy
- South Carolina Roadmap to Gigawatt-Scale Coastal Clean Energy Generation: Transmission, Regulation & Demonstration

DOE Wind Grant

- Goal: to overcome existing barriers for coastal clean energy development for wind, wave and tidal energy projects in South Carolina.

DOE Wind Grant

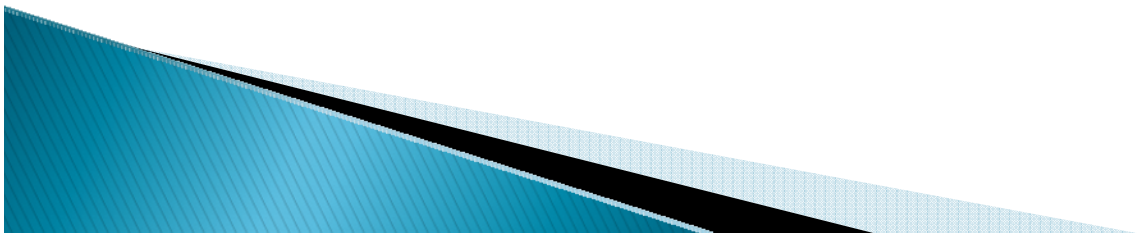
- 1: offshore wind transmission study
- 2: wind, wave & current study
- 3: Regulatory Task Force for Coastal Clean Energy

Regulatory Task Force

- Mission: to create a regulatory environment conducive to wind, wave and tidal energy development in state waters

Regulatory Task Force

- Established in April
- Regular meetings since May
- Regulatory Working Group
- Scientific/Technical Advisory Group



Regulatory Task Force

- Federal Aviation Administration
- U.S. Army Corps of Engineers
- U.S. Coast Guard
- U.S. Environmental Protection Agency
- U.S. Fish & Wildlife Service
- Minerals Management Service
- National Marine Fisheries Service, NOAA
- SCANA
- S.C. DHEC, Bureau of Water
- S.C. DHEC, Office of Coastal Resource Management
- S.C. Department of Archives & History
- S.C. Department of Natural Resources
- S.C. Office of Regulatory Staff

Regulatory Task Force

- Clemson University Restoration Institute
- Coastal Carolina University
- EcoEnergy, LLC
- North Carolina State University
- Research Planning, Inc.
- SCANA
- Santee Cooper
- Savannah River Ecology Lab
- Southern Environmental Law Center
- S.C. Coastal Conservation League
- S.C. Sea Grant Consortium
- University of South Carolina, Marine Science Program
- University of South Carolina, School of the Environment

Need for Renewable Energy Policy

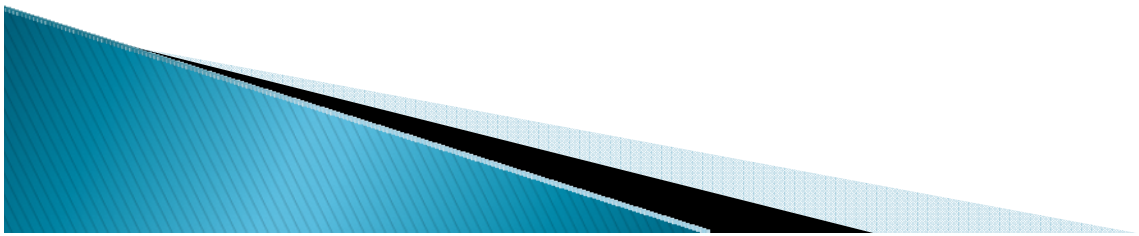
Recommendation

- South Carolina needs to establish a policy of support for the renewable energy

- Various approaches
  - Executive
  - Legislative

Renewable Energy Policy

- 8 states have offshore wind initiatives
- 6 of them are in states with renewable portfolio standards
- 24 states have a renewable portfolio standard
- 5 states have nonbinding goals for renewable energy



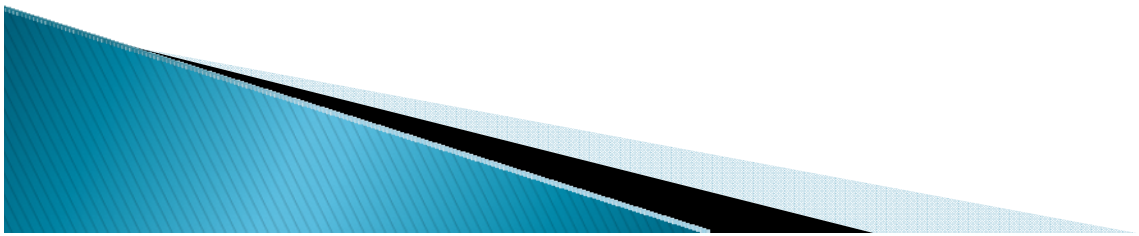
Regulatory Roadmap for Offshore Wind Projects

Blair Williams
Office of Ocean and Coastal Resource Management, SCDHEC

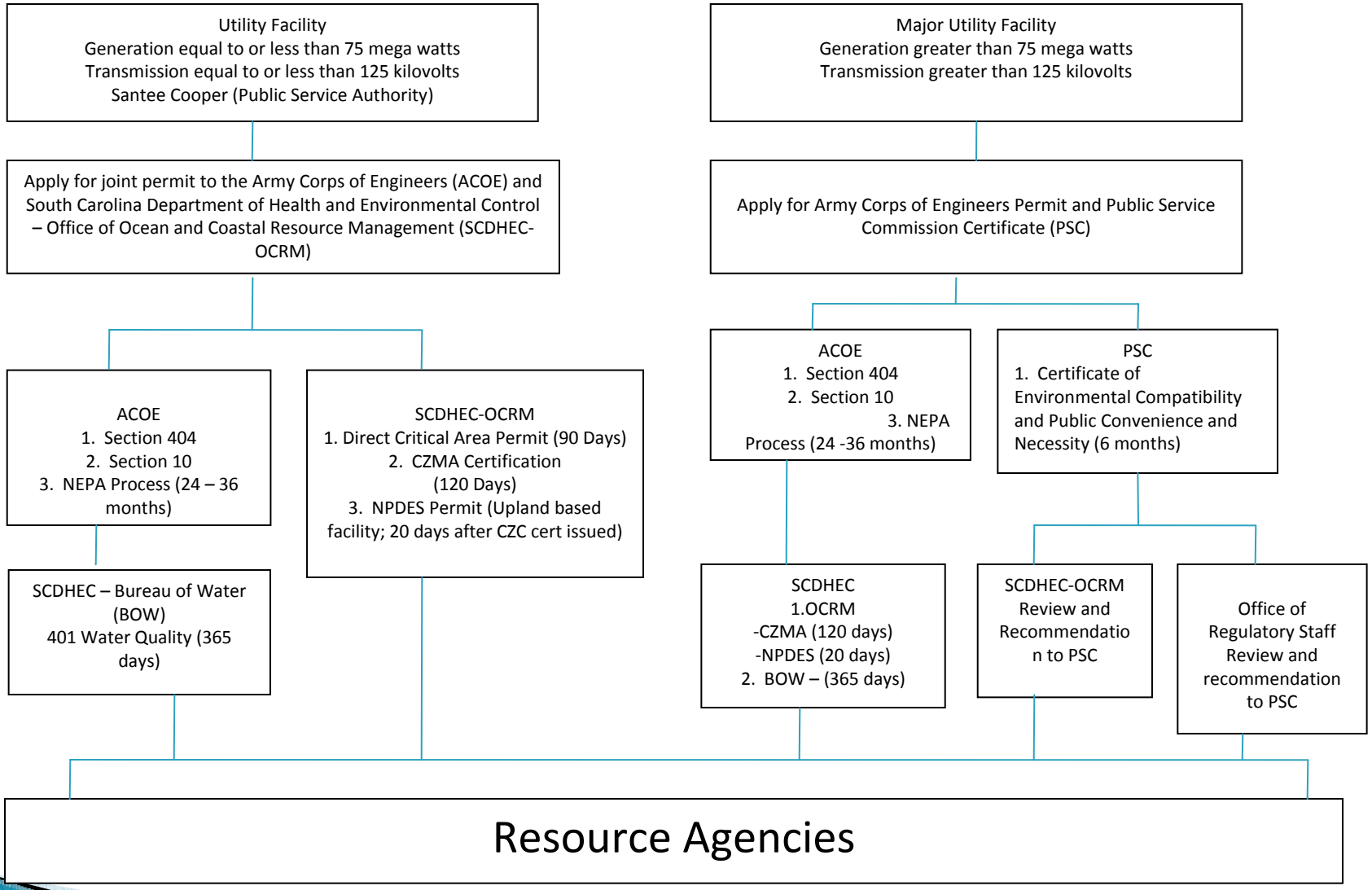
September 21, 2009

Objectives

- Review Regulatory Road map for an Offshore Wind Farm in South Carolina (author Jennifer Banks)
- Identify lead permitting authorities
- Identify timeframes associated with regulatory permitting
- Identify regulatory gaps



Projects in State Waters



Resource Agencies

- Federal Aviation
- Environmental Protection Agency
- Advisory Council on Historic Preservation
- U.S. Department of Defense
- U.S. Coast Guard
- U.S. Fish and Wildlife Service
- Department of Energy
- Army Corps of Engineers
- Mineral Management Services
- National Oceanic and Atmospheric Administration
- Federal Energy Regulatory Commission
- South Carolina Department of Health and Environmental Control
  - Environmental Quality Control
  - Office of Ocean and Coastal Resource Management
- South Carolina Department of Natural Resources
- South Carolina Public Service Commission
- Office of Regulatory Staff
- South Carolina Department of Transportation
- State Historic Preservation Office
- South Carolina Institute of Archaeology and Anthropology

Conclusions and Recommendations

- Timeframes have been clarified
- Regulatory Gaps
  - Former Memoranda of Agreement may need to be strengthened and updated (e.g. MOA PSC & SC Coastal Council, 1978).
- Management/Planning Gaps
  - Marine Spatial Planning (MSP)
    - Geospatial information about ocean resources, uses and conditions for comprehensive planning.
    - SC Ocean Planning Work Group – looking at needs for MSP in SC waters (Other states using MSP: NC, MA, RI, CA)
- Leasing program

Need for Leasing Framework

Regulatory Task Force Findings

- No regulatory gaps identified
- However, 2 issues remain:
  - Permitting may not address entirety of issues
  - Permitting process complicated & cumbersome

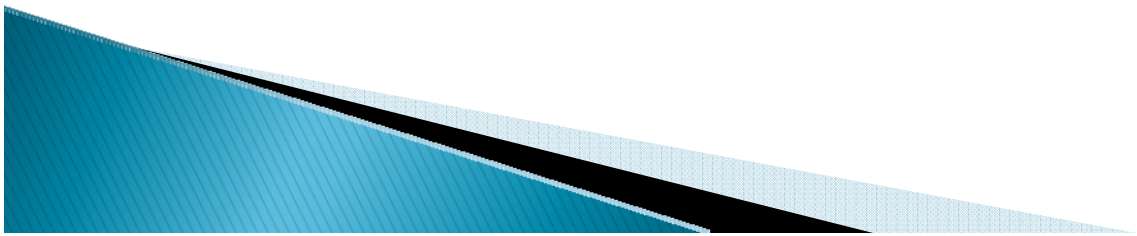
Regulatory Task Force Findings

Permits

Permit attributes

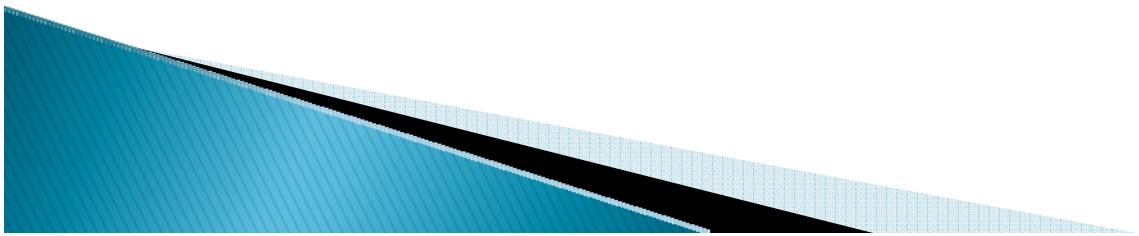
- permitting structure is in place, however…
- permits are short-term
- permits do not protect user investment
- permits do not provide exclusivity
- permits can be withdrawn
- permits do not allow compensation to the state

Result: uncertainty for both state & investor



Recommendation

- South Carolina should develop a leasing framework to create a more **comprehensive** process



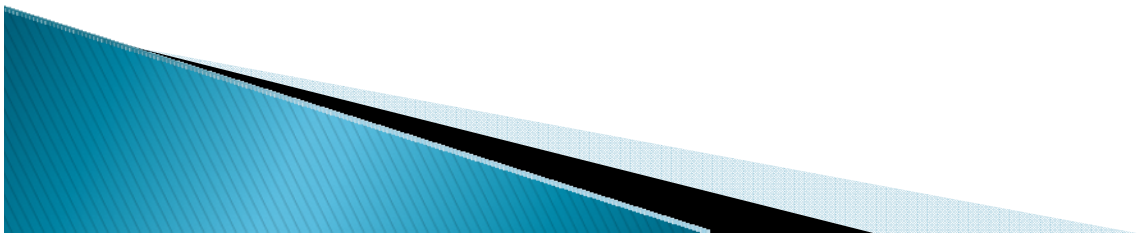
Leasing Framework

Leases

Lease attributes

- Eligibility
- Geographic scope
- Types of leases
- Lease duration
- Exclusivity
- Performance
- Compensation

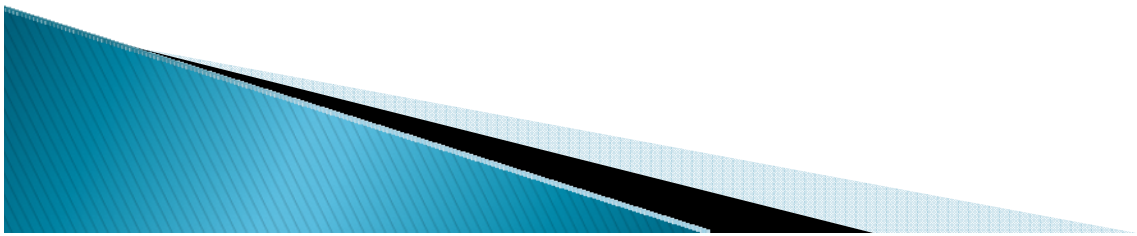
- **Result**: certainty for state & investor



Leasing Framework

- SC should establish an offshore leasing program in state waters for wind energy.

- It would provide benefits – and certainty – to both the state and the investor.



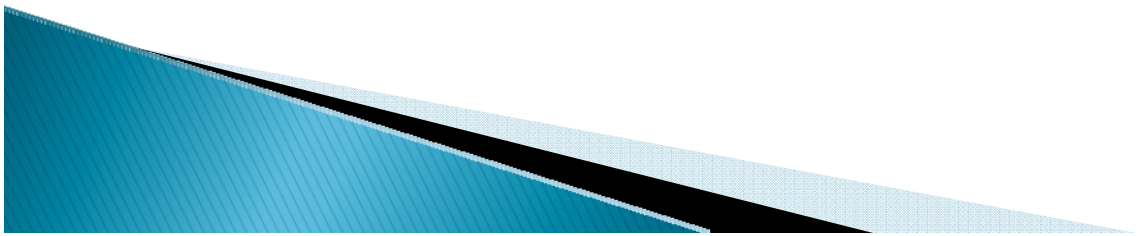
Need for One-Stop-Shop

Recommendation

- South Carolina should develop a more **efficient** process by establishing a one-stop shop

One-Stop Shop

- SC should establish a one-stop shop to coordinate the permitting/leasing process
  - Non-regulatory entity
  - One application
  - Guide investor through process



One-Stop Shop

- Model already exists in SC for aquaculture
- Permit Assistance Office within the SC Department of Agriculture (Section 46-51-10)

Examples from Federal Government and Other States

Federal Waters

- Offshore lease program already in place at federal level
- An offshore wind project in federal waters would require a federal lease
- Administered by the Minerals Management Service
- Royalties to federal government
- Other requirements

State of Texas

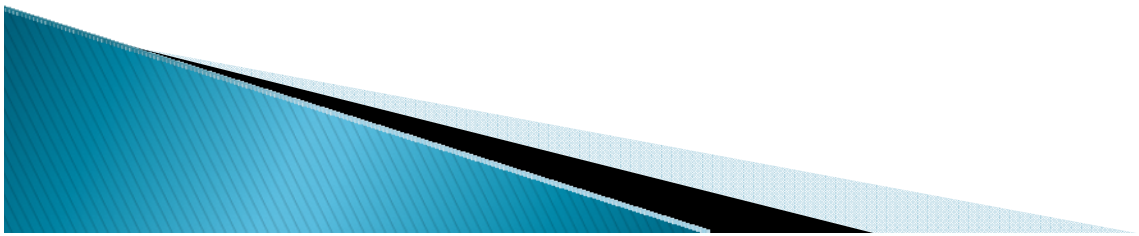
- The only state that has established a wind energy leasing program
- Long history – associated with oil and gas
- Flexibility for investor
- Protection for state/ compensation

State of Michigan

- Great Lakes Wind Council –report issued September 1, 2009
- Recommendation: enact new statute that specifically regulates leasing and permitting for offshore wind.
- Recommendation: establish a single agency to facilitate the permitting, leasing, construction and monitoring of offshore wind projects

State of North Carolina

- NC General Assembly commissioned UNC study released August 2009
- Recommendation: enact a new statute that specifically addresses the multitude of issues associated with leasing State-owned submerged lands for wind projects
- Recommendation: Need to provide a clear, consistent legal framework for investors and developers.



Commonwealth of Virginia

- *Virginia Offshore Energy Development Law and Policy Review and Recommendations*
- December 2008
- Obstacles to offshore alternative energy development in some states from the lack of straightforward path for planning, evaluation and permit coordination.
- Recommendation: establish a single administrative process that coordinates the development and review of energy facilities in state and federal coastal waters

Conclusions

Regulatory Task Force Recommendations

SUMMARY

- Need for state policy on renewable energy
- Need for a comprehensive leasing framework
- Need for a one-stop shop for permitting & leasing wind energy projects

Regulatory Task Force

Additional Comments

- Under Sea Warfare Training Range (USWTR)
- Minerals Management Service programs

Questions?

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williabn@dhec.sc.gov

Catherine Vanden Houten
South Carolina Energy Office
cvandenhouten@energy.sc.gov

santee cooper

PALMETTO RESEARCH PROJECT

WIND

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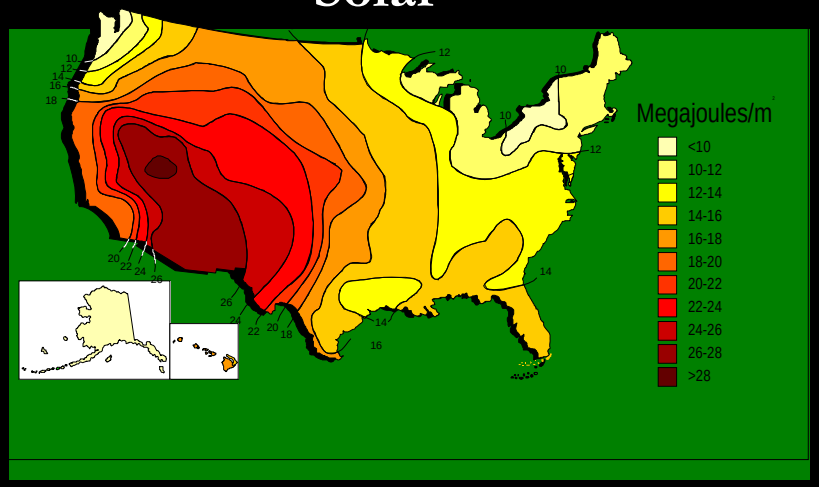
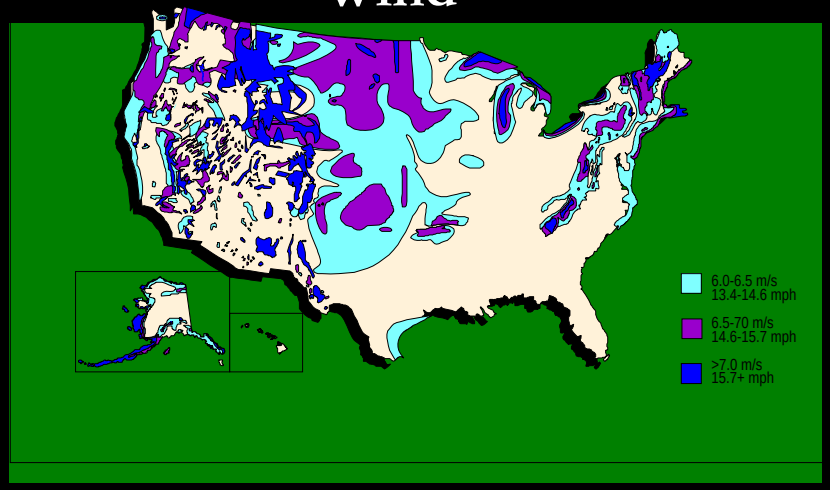
U.S. Renewable Energy Resources

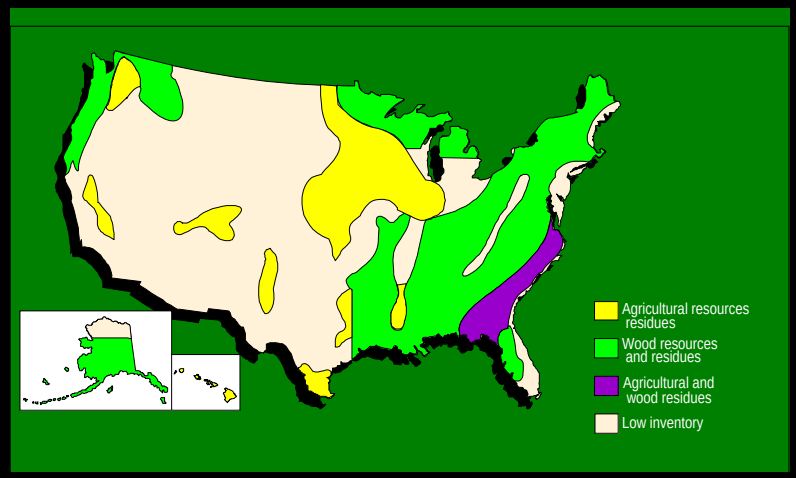
Solar



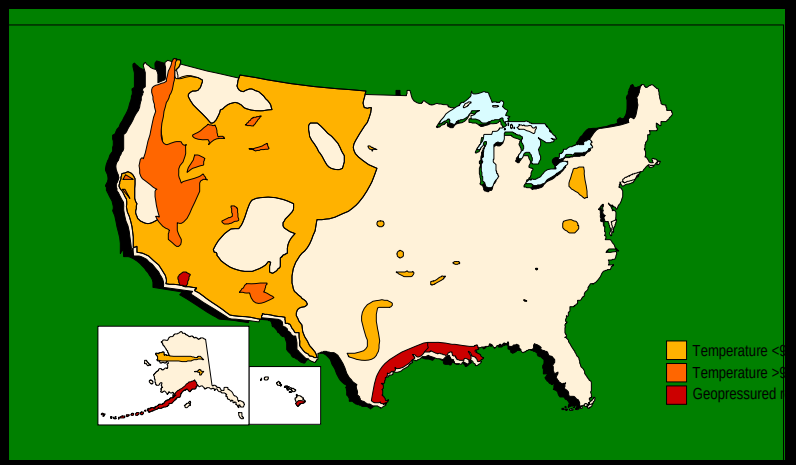
Wind



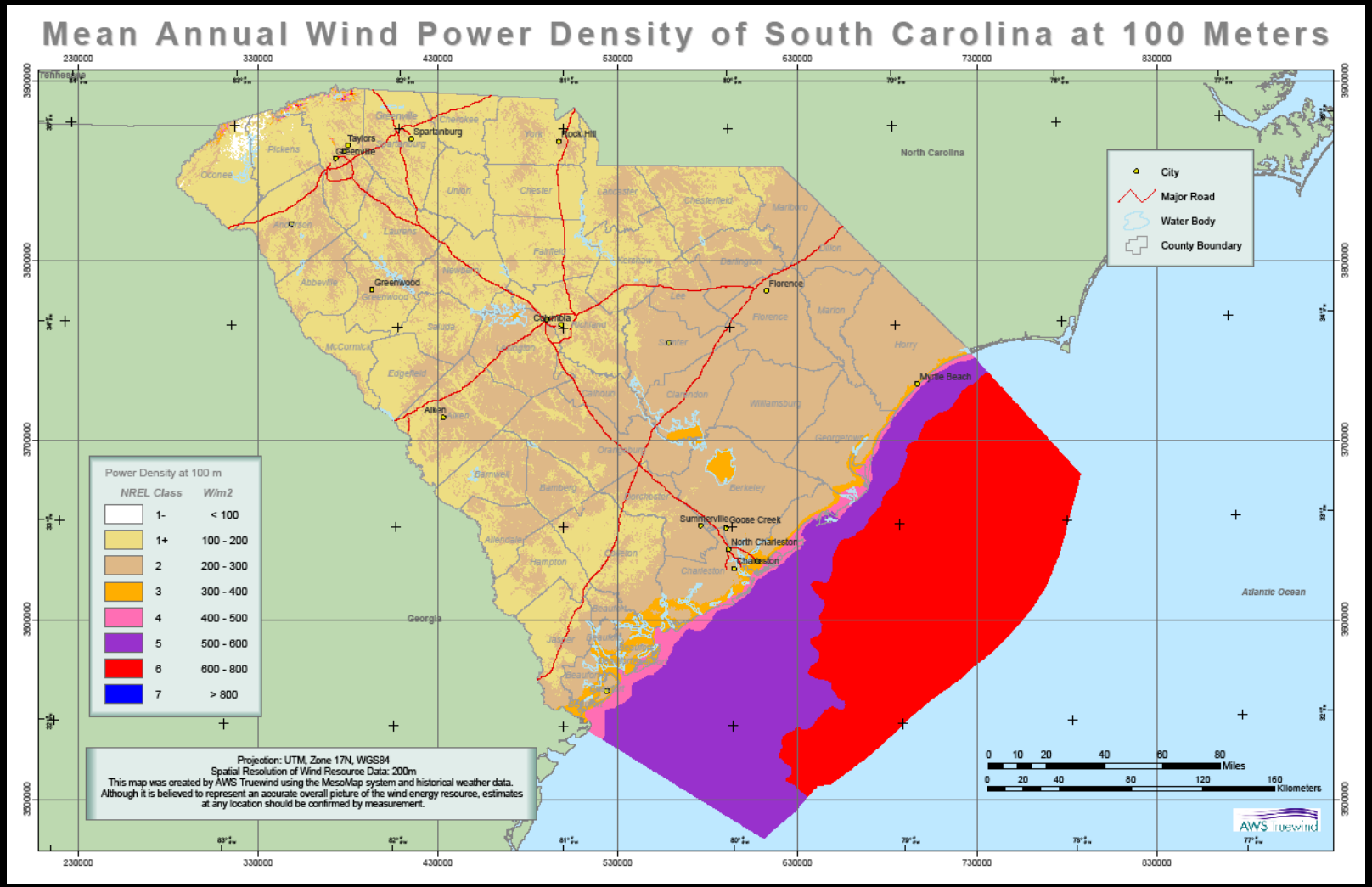
Biomass



Geothermal



Wind Map of South Carolina



santee cooper

WHAT RENEWABLES COST

Generating Technology	2008 Cost $/MWh	Capacity Factor
Coal	$ 45-65	90%
CC Gas Turbine	$ 55-110	75%
Landfill Gas	$ 59-90	85%
Biomass	$ 94-135	85%
Offshore Wind	$ 119-156	35%
Solar PV	$ 393-529	21%

Source: Renewable Resource Potential, GDS & LaCapra Study

Project To Date

- Wind Mapping
- Inland Anemometer Stations
- Coastal Wind for Schools Program
- Extensive Study of Offshore Wind Potential
  - Buoys
  - Anemometer Station
  - Transmission
  - Regulation

Palmetto Winds Offshore Research Project

- DOE grant + Santee Cooper funding
- 6 instrumentation buoys, 2 shore-based observation stations
- Related tracks:
  - Regulatory
  - Transmission

Partners:
Santee Cooper CCU
SCEO NCSU Clemson SCIES

Anemometer Station

- Proposals under review
- Early 2010 construction
- Data collection for 1 year

PALMETTO RESEARCH PROJECT WIND

Wind Energy Production Farms Feasibility Committee
209 Gressette Office Building
Columbia, SC
December 11, 2009
1:00 PM – 4:00 PM

I. Introductions

II. Presentations:

Preliminary Findings of the Offshore Wind Transmission Study
Dr. Adly Girgis and Dr. Elham Makram, Clemson University Electric Power Research Association

U.S. Department of Energy Wind Drivetrain Testing Facility Award & Comparison of other State Incentives
Nicholas Rigas, Clemson University Restoration Institute

III. Review of Final Draft Report

IV. Selection of Final Committee Recommendations

V. Other Discussion Items

VI. Adjourn

Coastal Clean Energy Impact on South Carolina Transmission System

By
Adly Girgis & Elham Makram

Electric Power Research Association

Definitions

- **KV (KiloVolt) :** unit for voltage
- **MVA (MegaVoltAmper):** unit for apparent power
- **MW (MegaWatt):** unit for active power
- **MVAR(MegaVoltAmperReactive):** unit for reactive power
- **P.U. :** per unit (dimensionless)
- **R :** resistance in Ohms
- **X :** reactance in Ohms
- **Interface bus:** injection point of wind energy

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Electric Power Research Association

Scope of the project

- Study consists of 3 phases
  - I: 80 MW in state water by 2014
  - II: 1080MW in federal water by 2020
  - III: 3080MW in federal water by 2030
  - The project uses the provided data which is 2018

CLEMSON UNIVERSITY

Electric Power Research Association

Overview of phase I

- 80 MW injected into the coastal network at 115KV buses
- Six different 115 KV coastal buses are available
- Two wind farms – One interface bus per wind farm

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Electric Power Research Association

Overview of phase II

- 1080MW is injected into Power system by 2020
- The same six 115 KV coastal interface buses
- Two wind farms–same idea as for phase I

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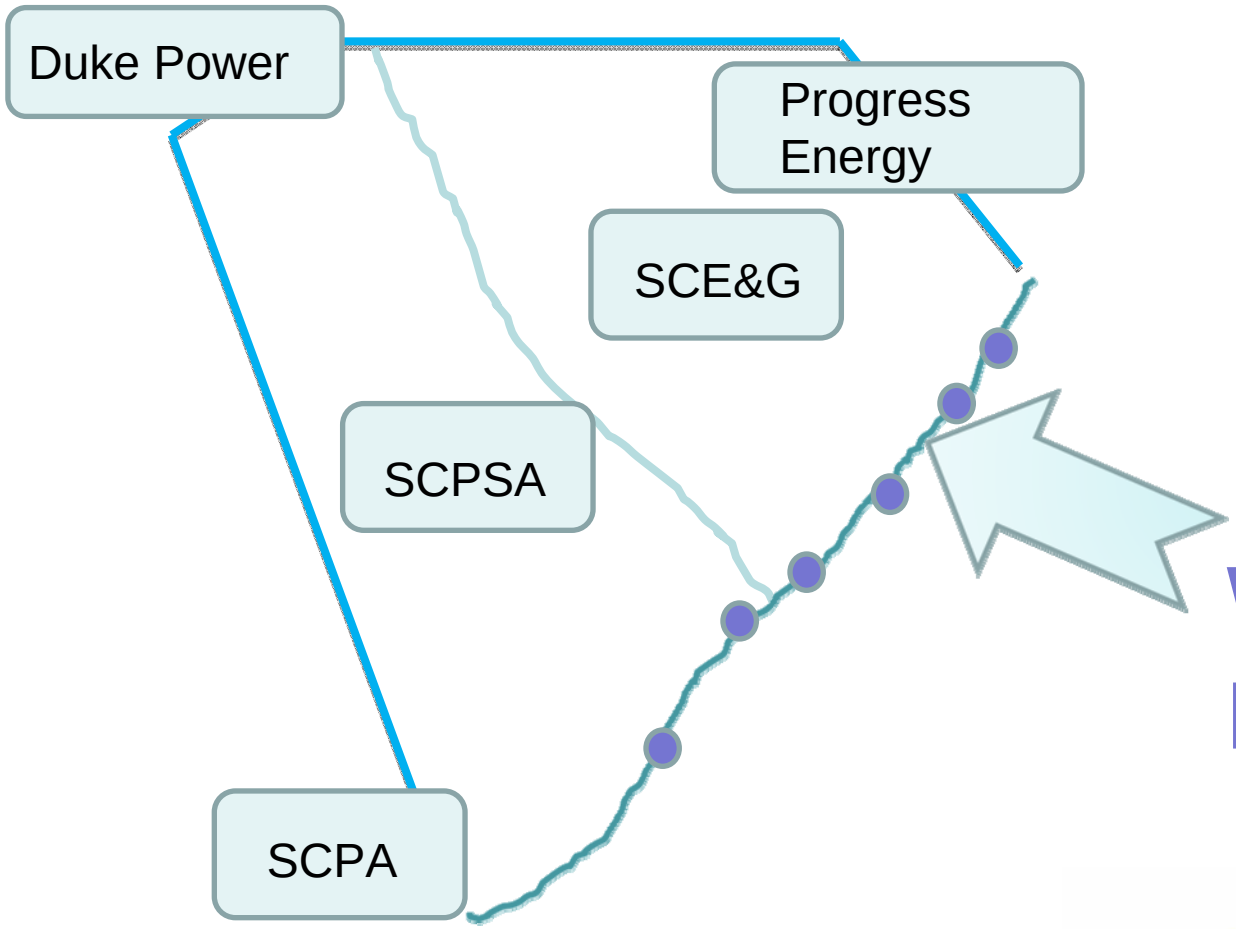
Electric Power Research Association

Wind energy distribution



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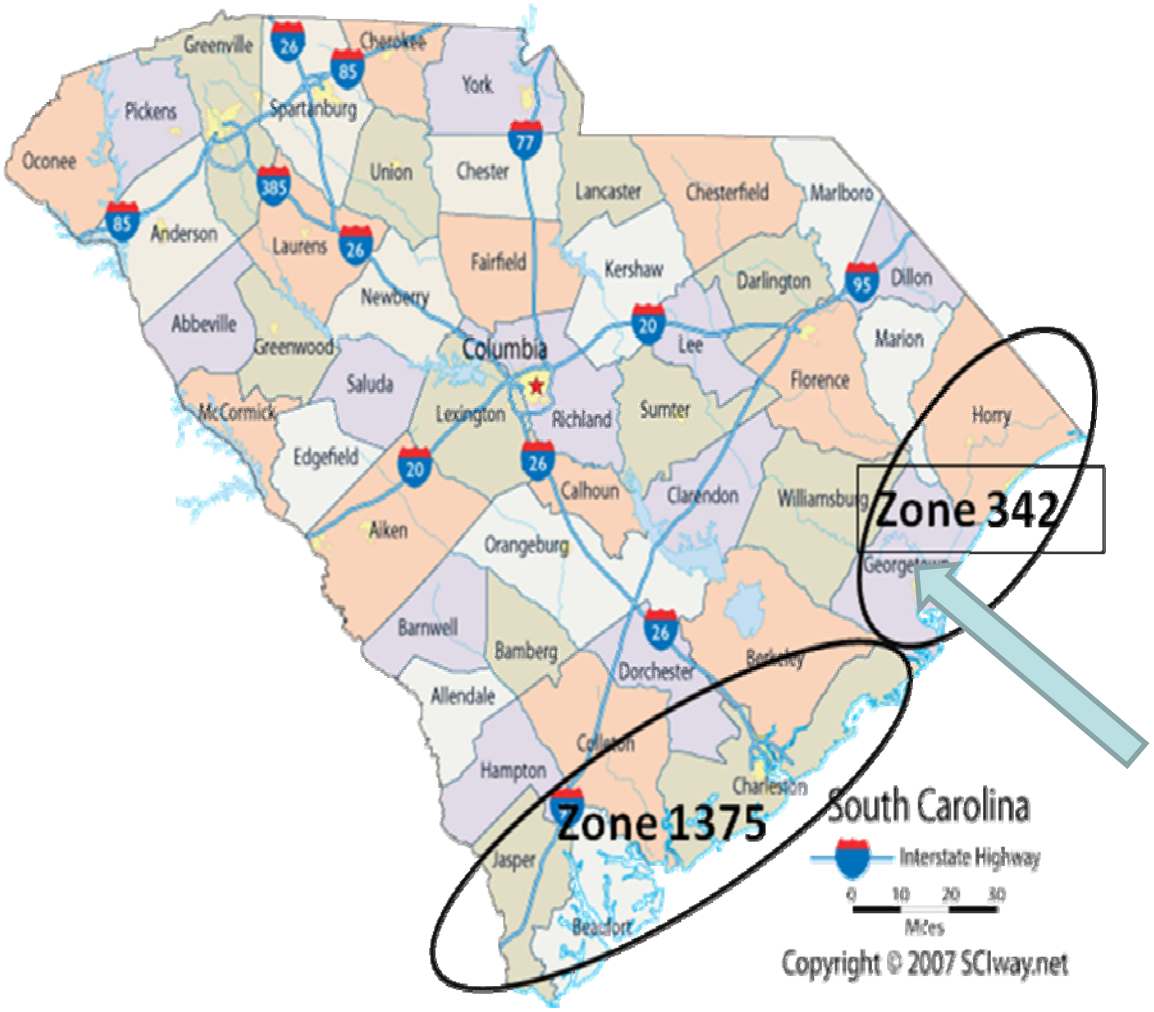
Electric Power Research Association



Map of South Carolina with wind penetration in zone 342

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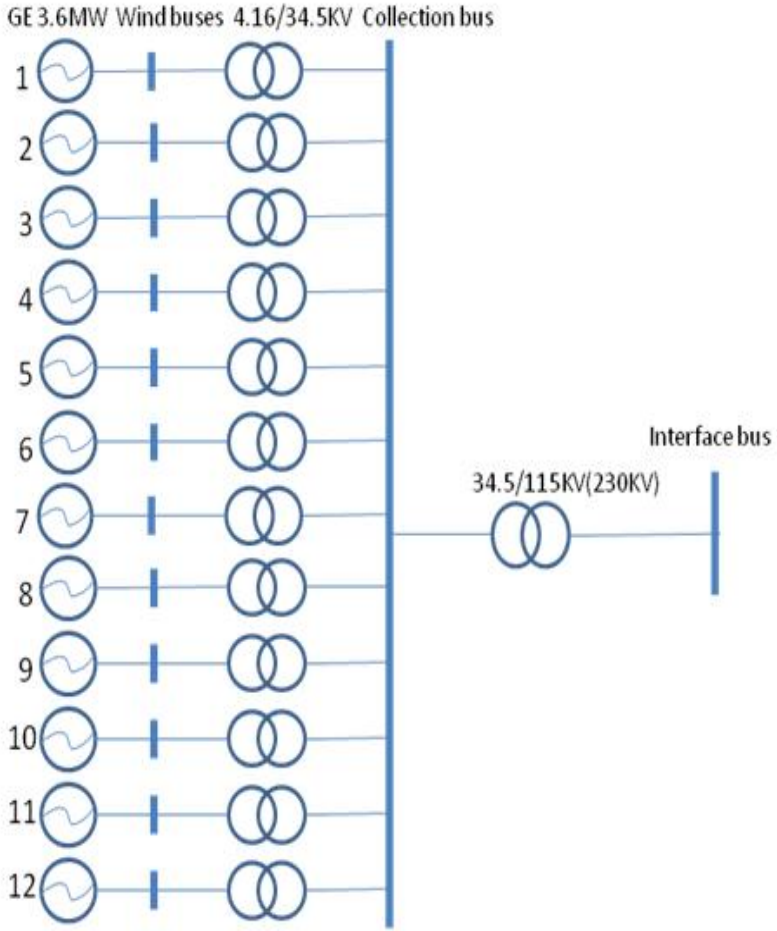
Wind turbine parameters

GE 3.6 Wind turbine	value
Qmax	1.74MVAR
Qmin	-1.74 MVAR
Rating capacity	4MW
Pmax	3.6MW
Pmin	0.5MW
R	0
X	0.302 p.u.
Power factor	0.9

Electric Power Research Association

Wind farm connection



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Simulation-PSSE / PowerWorld

- Phase I
  - 2013 summer
  - 2013/14winter
- Phase II
  - 2018summer
- Compare result based:
  - Voltage violation (V<0.94 p.u. or V>1.06 p.u.)
  - Branch loading condition (must be less than 100%)

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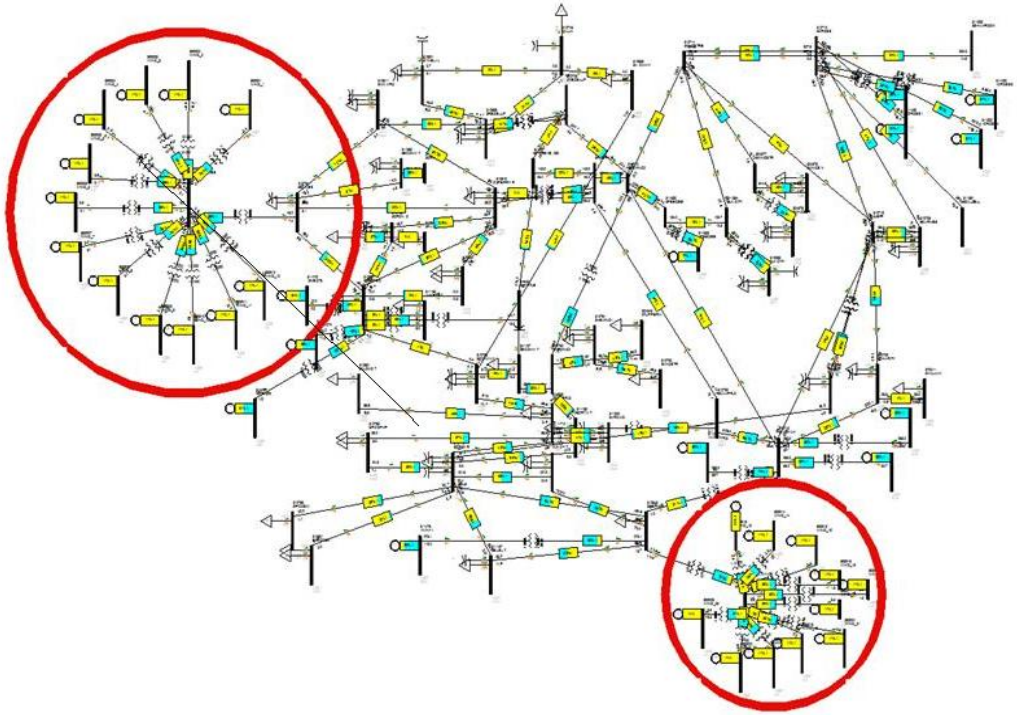
Effect of 80 MW injection



Power flow diagram with 80 MW injection

- No transmission line or transformer loaded at or above 100% its rating
- The voltage violations are the same in as the original system

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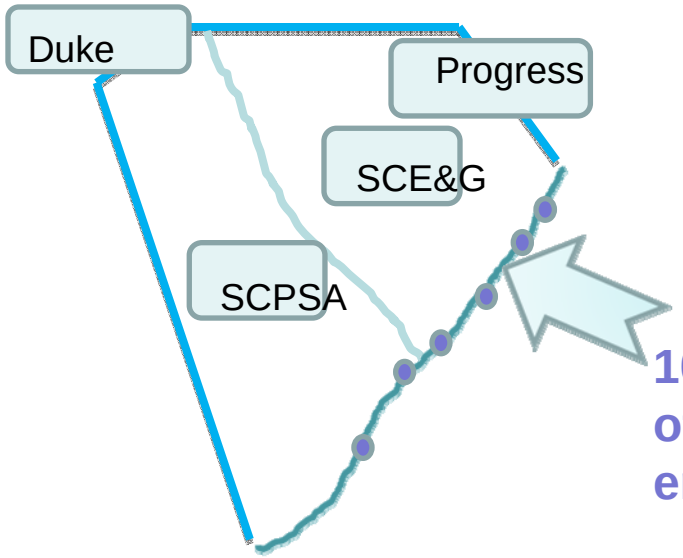
Wind energy distribution for phase II



- According to the load ratio of the four utilities using the summer 2009 base case

Area Name	Area #	Zone # Range	Bus # Range	P Load (MW)	Load ratio	Load ratio In Percent	Wind energy (MW)
SCEG	343	1375 - 1384	370000 – 371999	4673.967	0.1158	12%	120
SCPSA	344	340 – 349	311000 – 312999	4774.263	0.1183	12%	120+80
CP&L-E	340	315 – 324	304000 – 305999	11961.915	0.2964	30%	300
DUKE	342	325 - 339	306000 – 309999	18948.089	0.4695	46%	460
Total				40358.234	1	100%	1080

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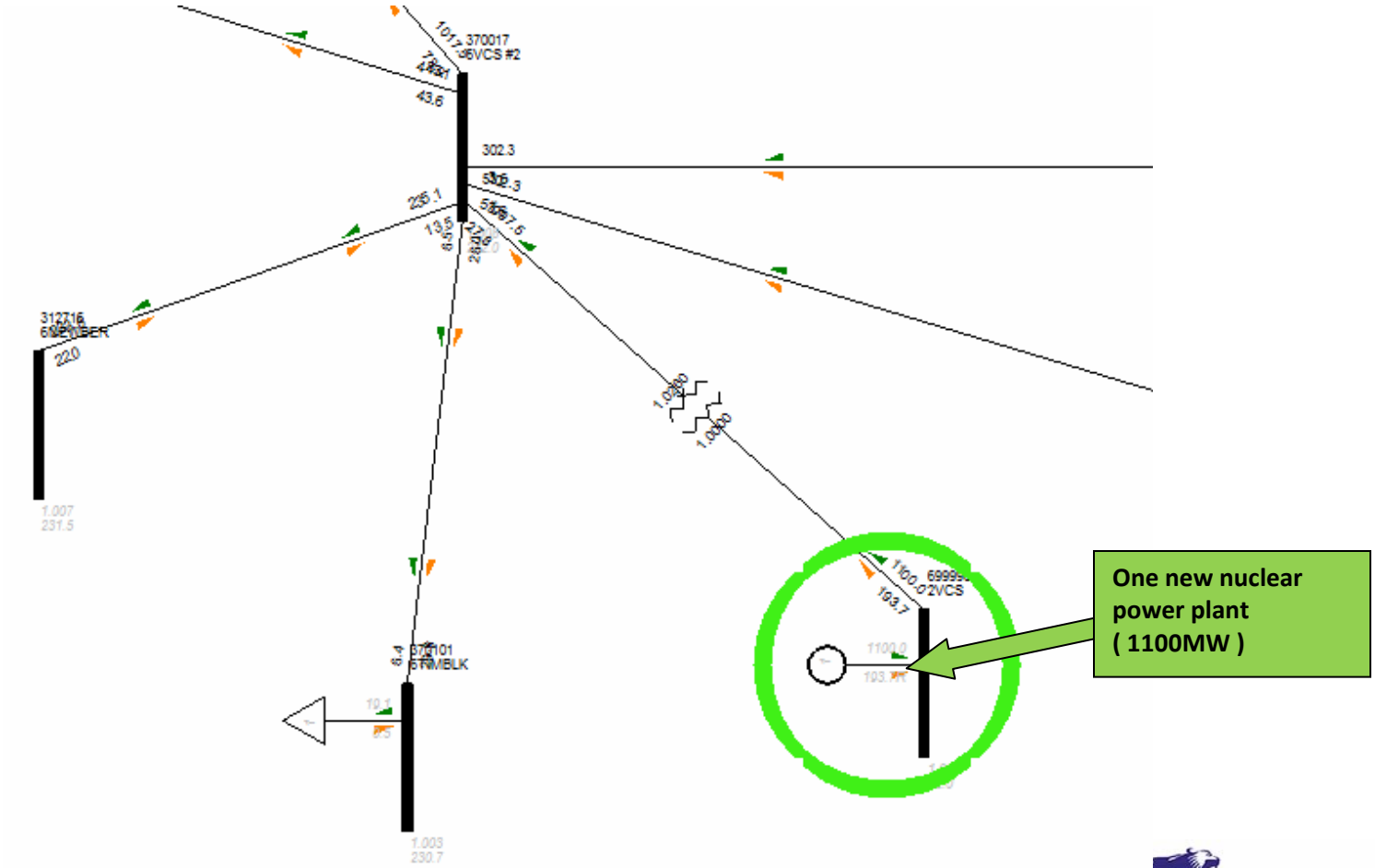
One new nuclear power plant



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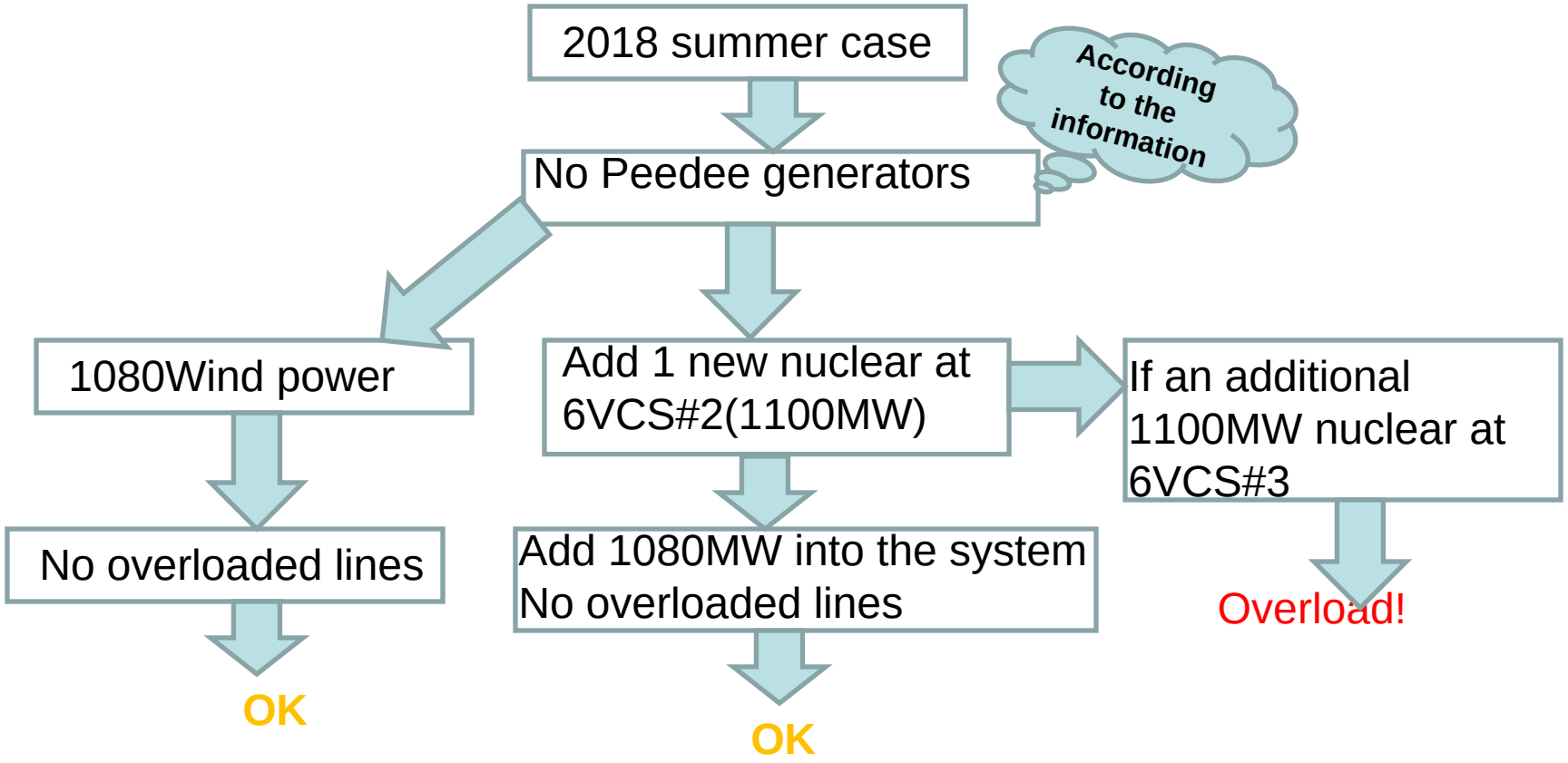
Simulation results



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Conclusion

- The state of South Carolina can easily handle the addition of 80 MW by 2014
- It can also sustain an additional 1 GW wind energy when the generation reduction in Santee Cooper system is done at the Rainey plant.

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Future research

- Phase 3 will be completed
- Recommendation for redesigning or upgrading the transmission system
- The following studies will be evaluated:
  - Voltage stability
  - Transient stability
  - Contingency and short circuit analysis

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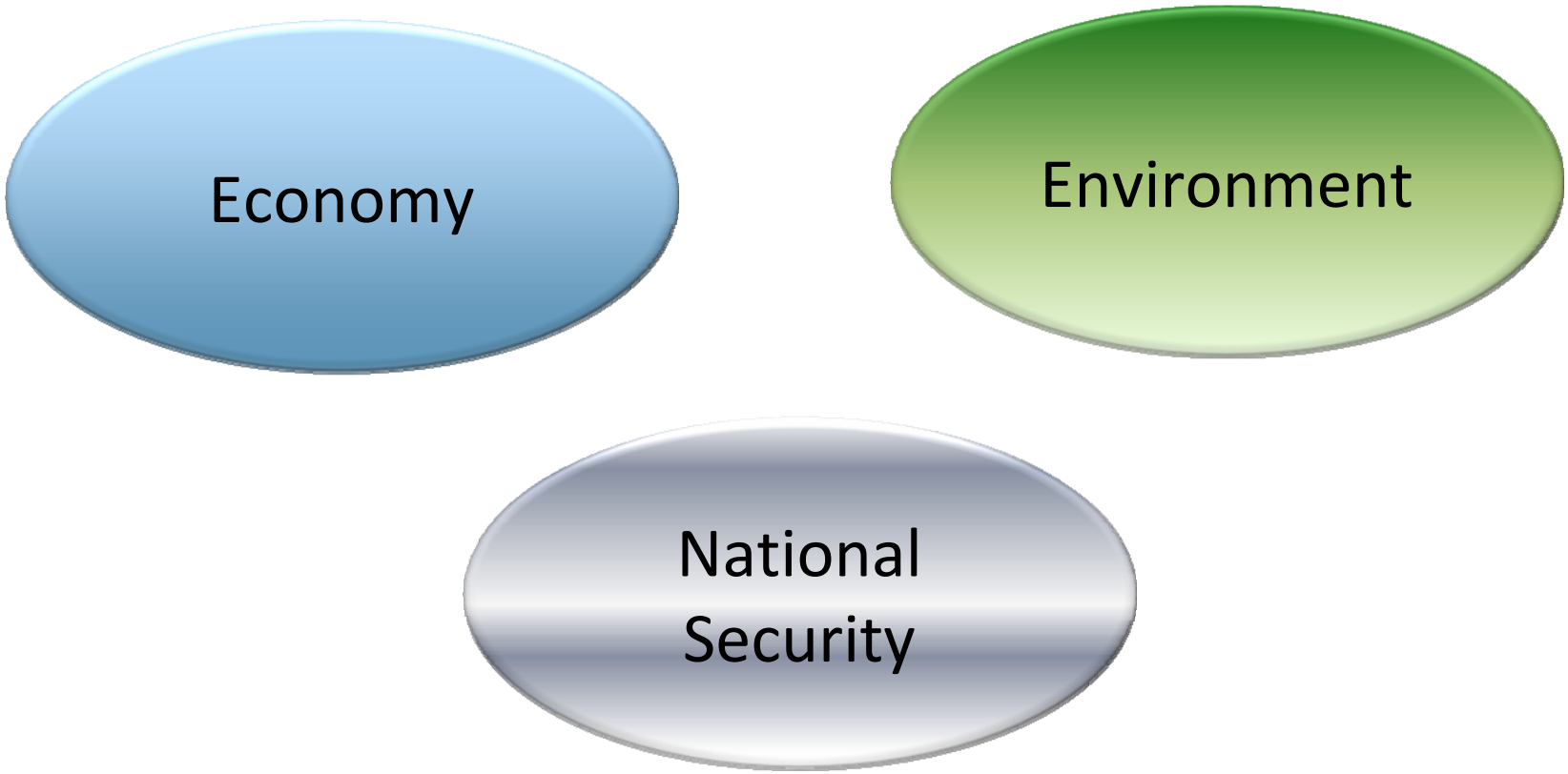
RESTORATION INSTITUTE

Offshore Wind Power

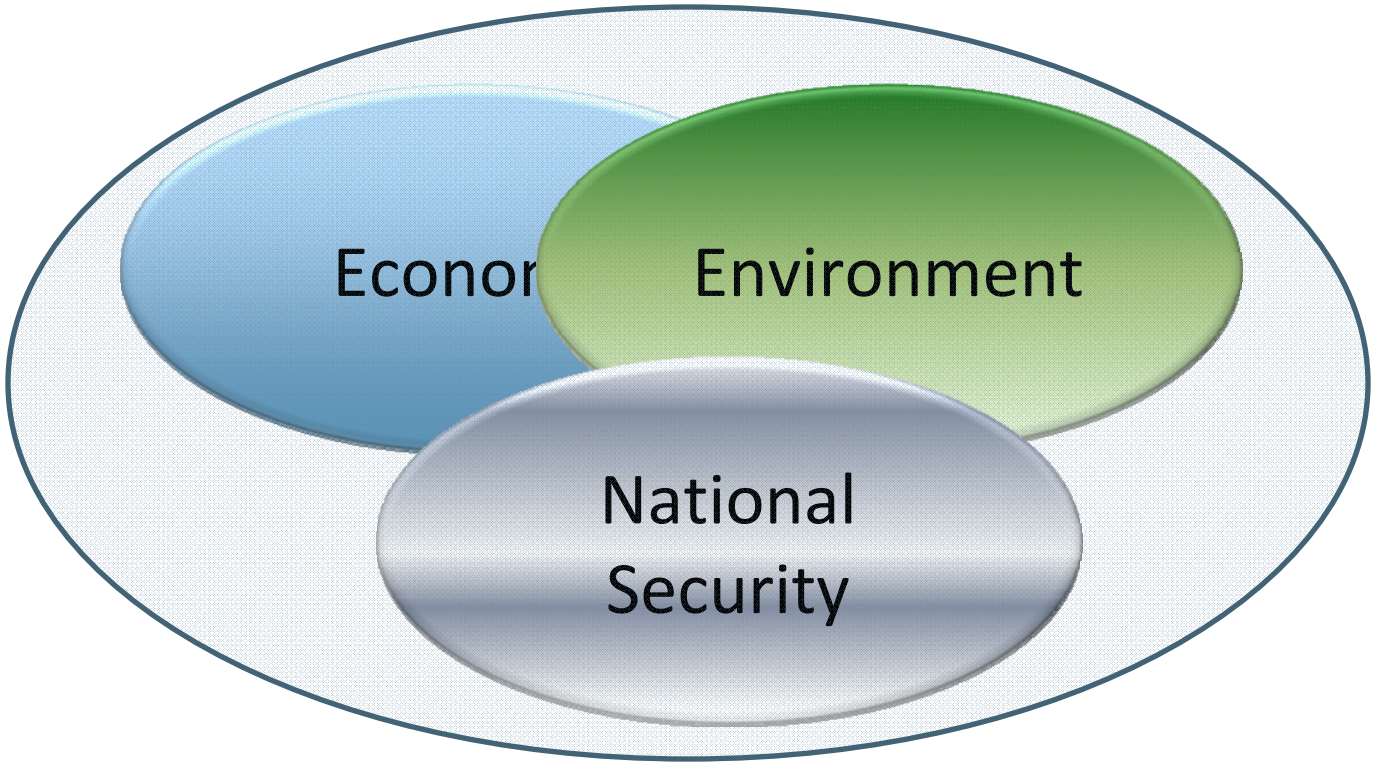
An Opportunity for South Carolina

Dr. Nicholas C Rigas
Director Renewable Energy - CURI
Clemson University Restoration Institute

Historically independent drivers



.. have merged to drive new thinking



Integrated Energy Policy
Opportunities for Economic Development
Innovation

What are the drivers behind the 'Green Economy' ?

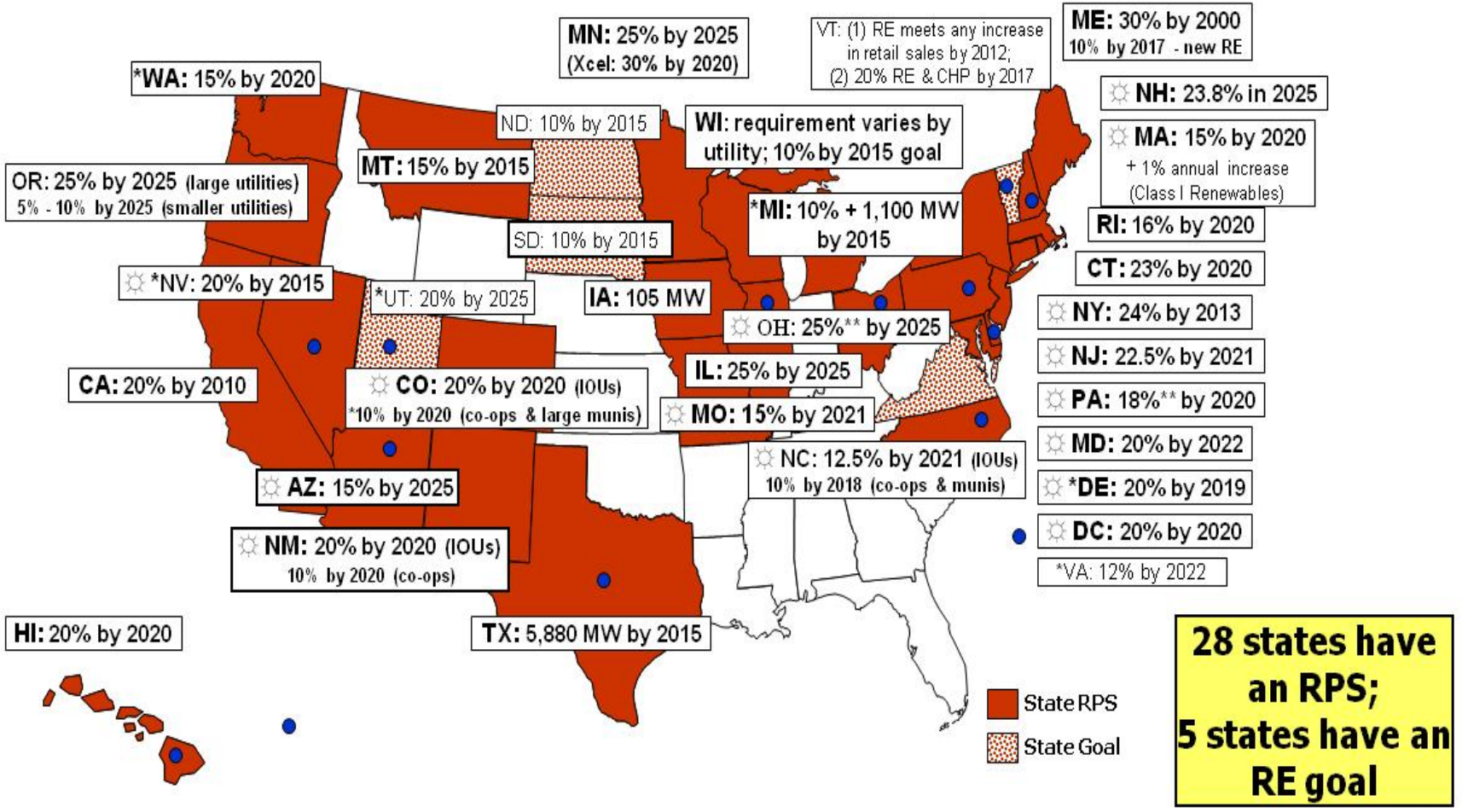
- Diversify energy supply
- Energy security
- Reducing imports
- Environmentally responsibility
- Sustainability
- Economic development
  - Innovation / Research
  - Manufacturing
  - Operations
  - Installation
  - Maintenance

State RPS stimulate 'Green Economy'

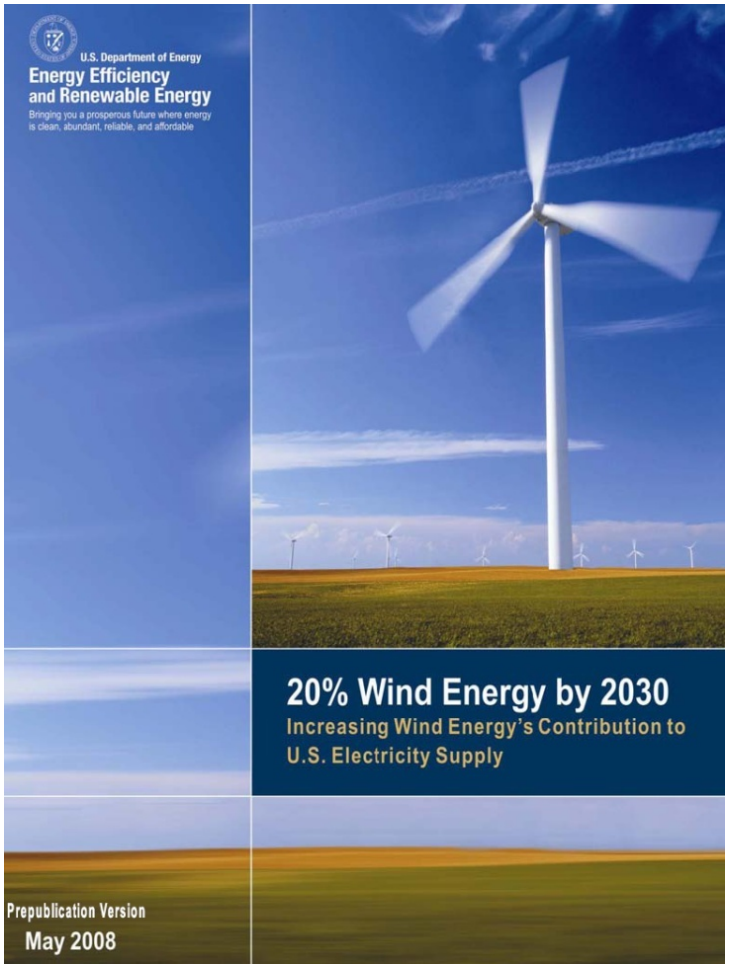
DSIRE: www.dsireusa.org

February 2009

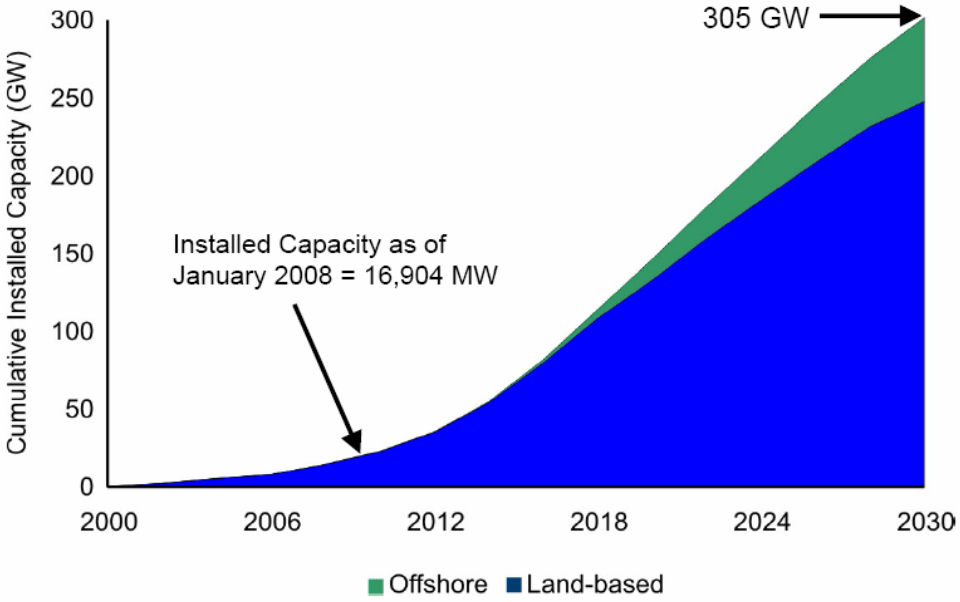
Renewables Portfolio Standards



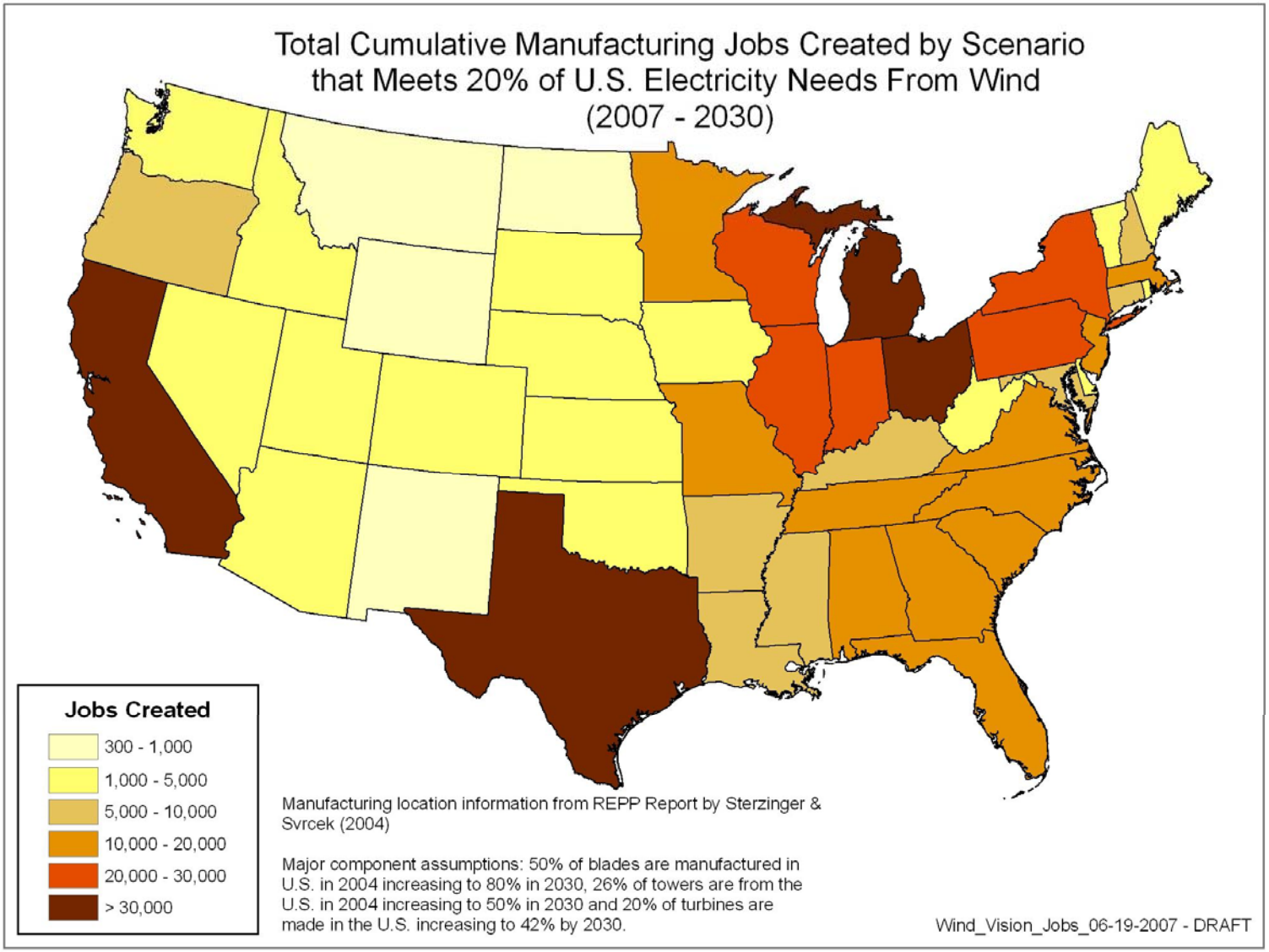
DOE outlines a plan for 20% wind power by 2030



- Requires 290 GW of new wind to reach goal
- 50 GW of offshore along NE and SE
- >$175Bn in investment
- SC potential identified at 1-5 GW offshore
- Technology and infrastructure improvements
- GHC reductions and water savings
- Economic development

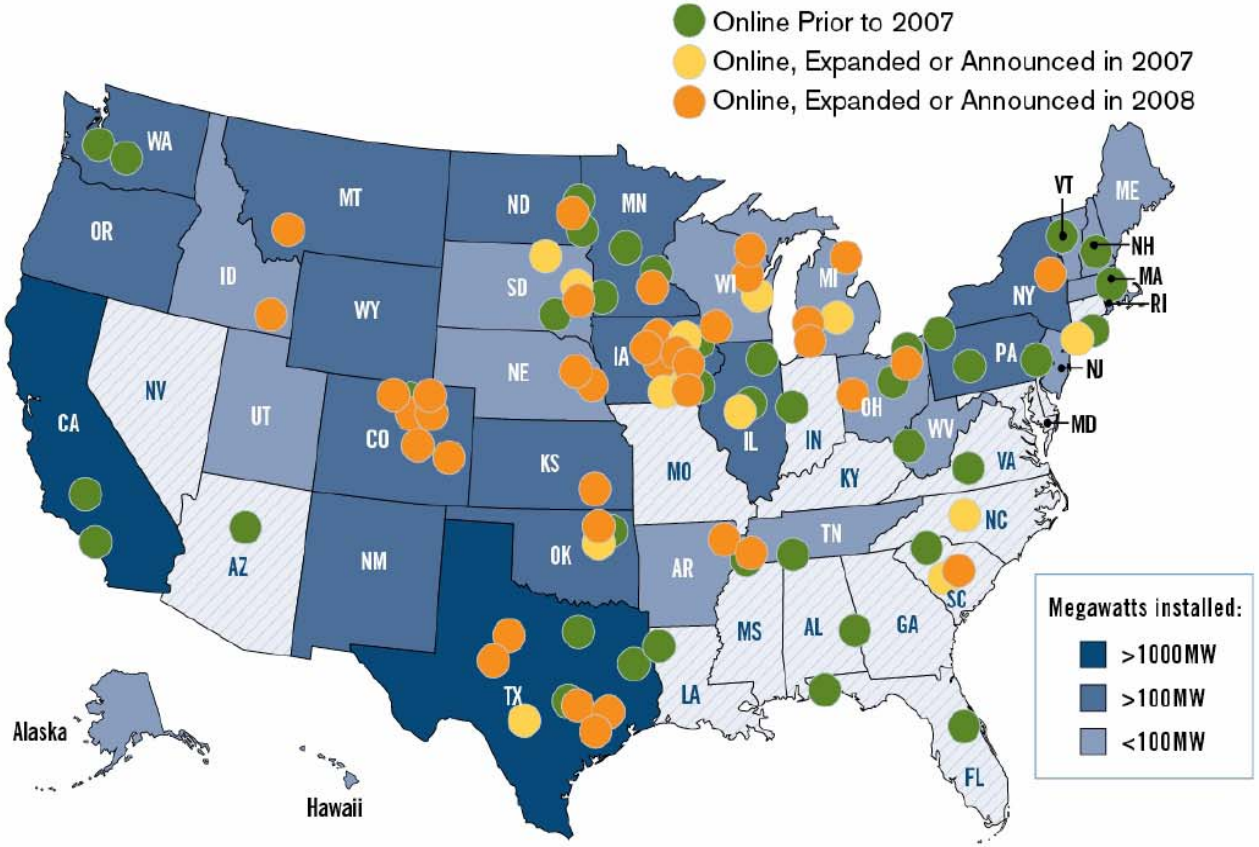


SC Stands to Gain 10-20,000 New Jobs



Market demand spurs growth

Over 50 U.S. Manufacturing Facilities Opened, Expanded or Announced Since January 2007



Source: AWEA, Sample of Manufacturing Facilities, November 2008

Strengths of South Carolina

- Outstanding port facilities and rail
- Large scale ship rebuilding facilities
- Low cost manufacturing
- Company friendly environment
- Excellent research institutions
- Raw material providers (steel)
- Key industry players
  - GE Energy
  - Fluor
  - Ilgin
  - Timken
- Entrepreneur spirit

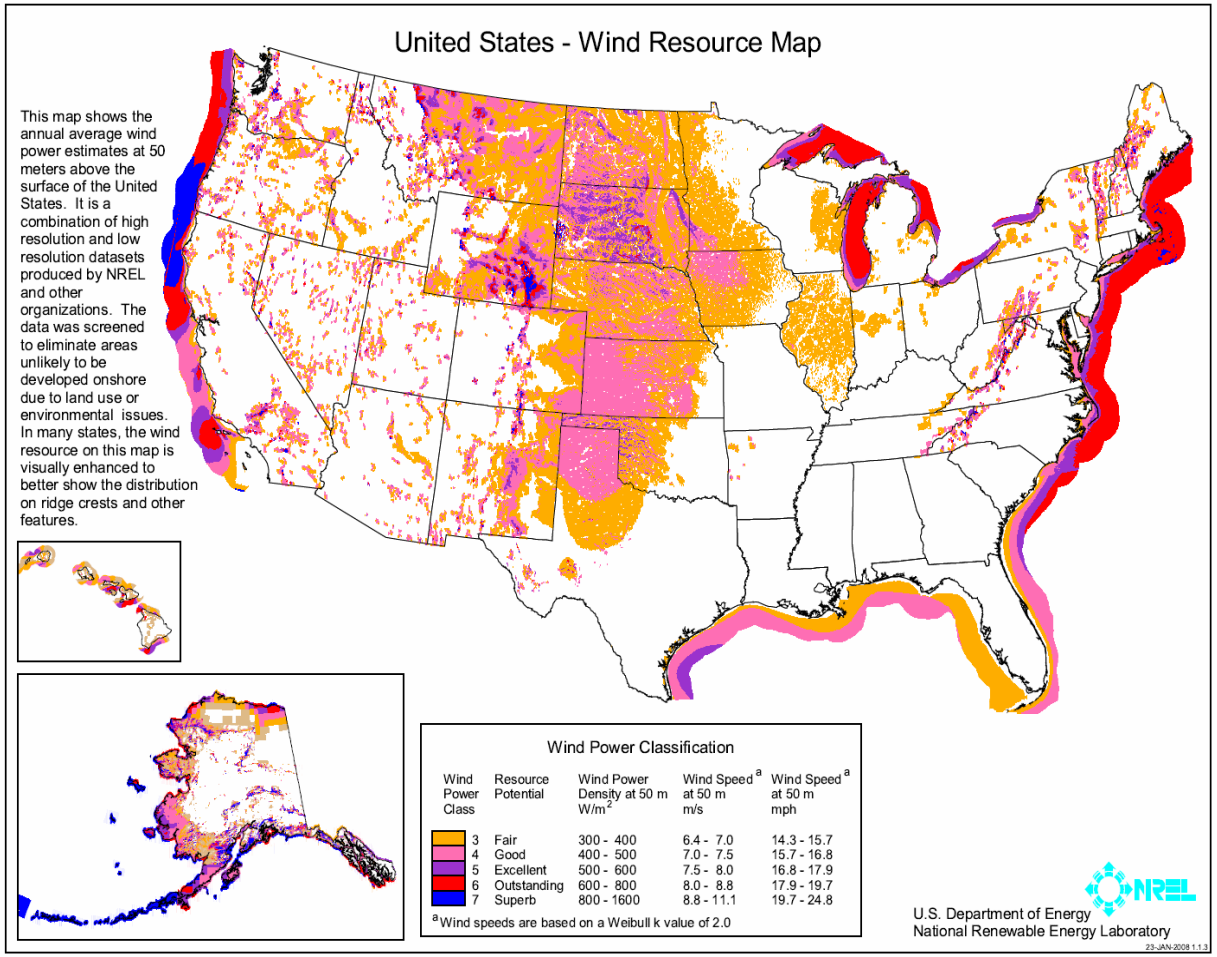
Offshore wind resources near demand centers

28 Coastal States consume over 78% of the electrical demand in the United States.

Only 6 have significant land-based wind resources.

26 of the states have offshore wind resources to meet 20% scenario.

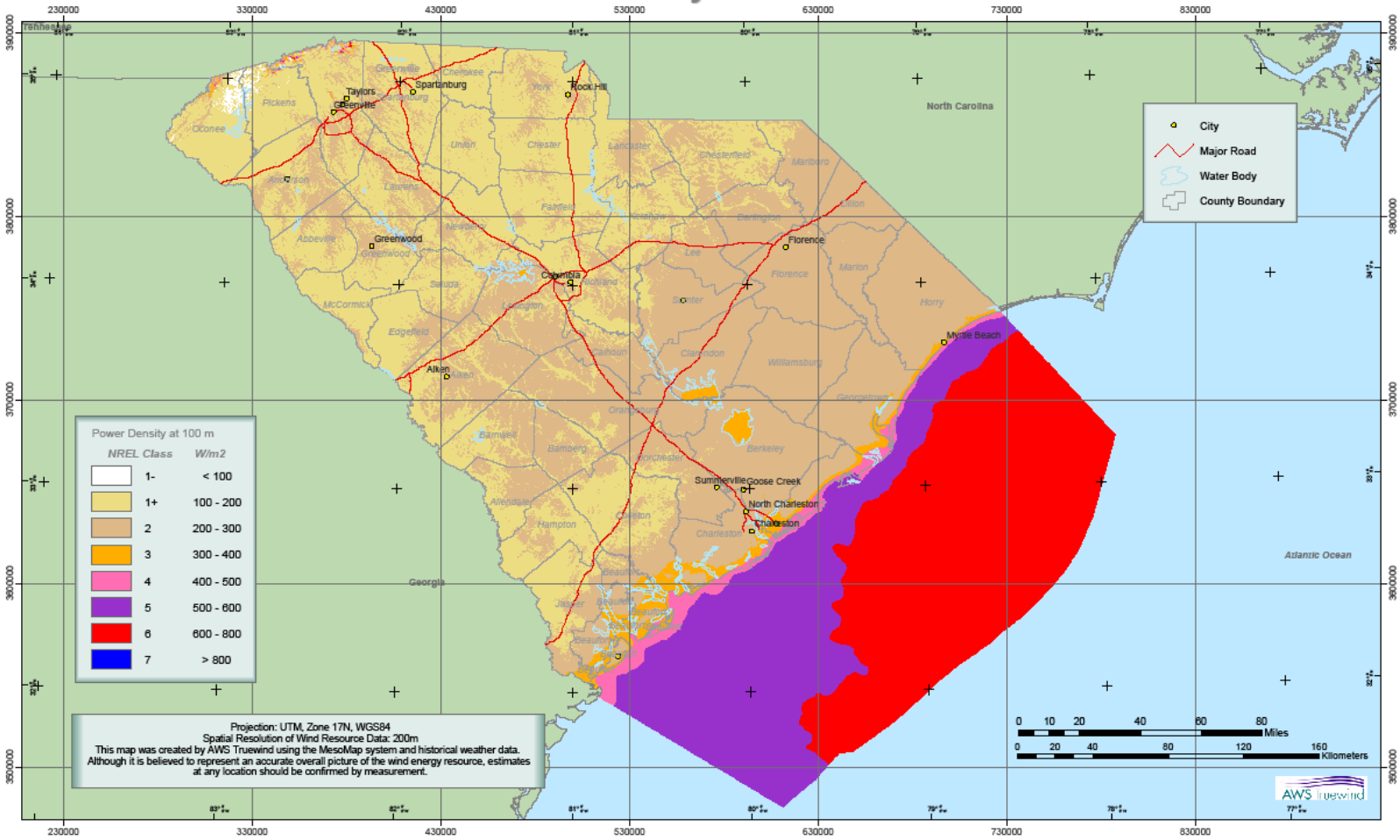
Offshore environment offers higher and more consistent winds with no land constraints.



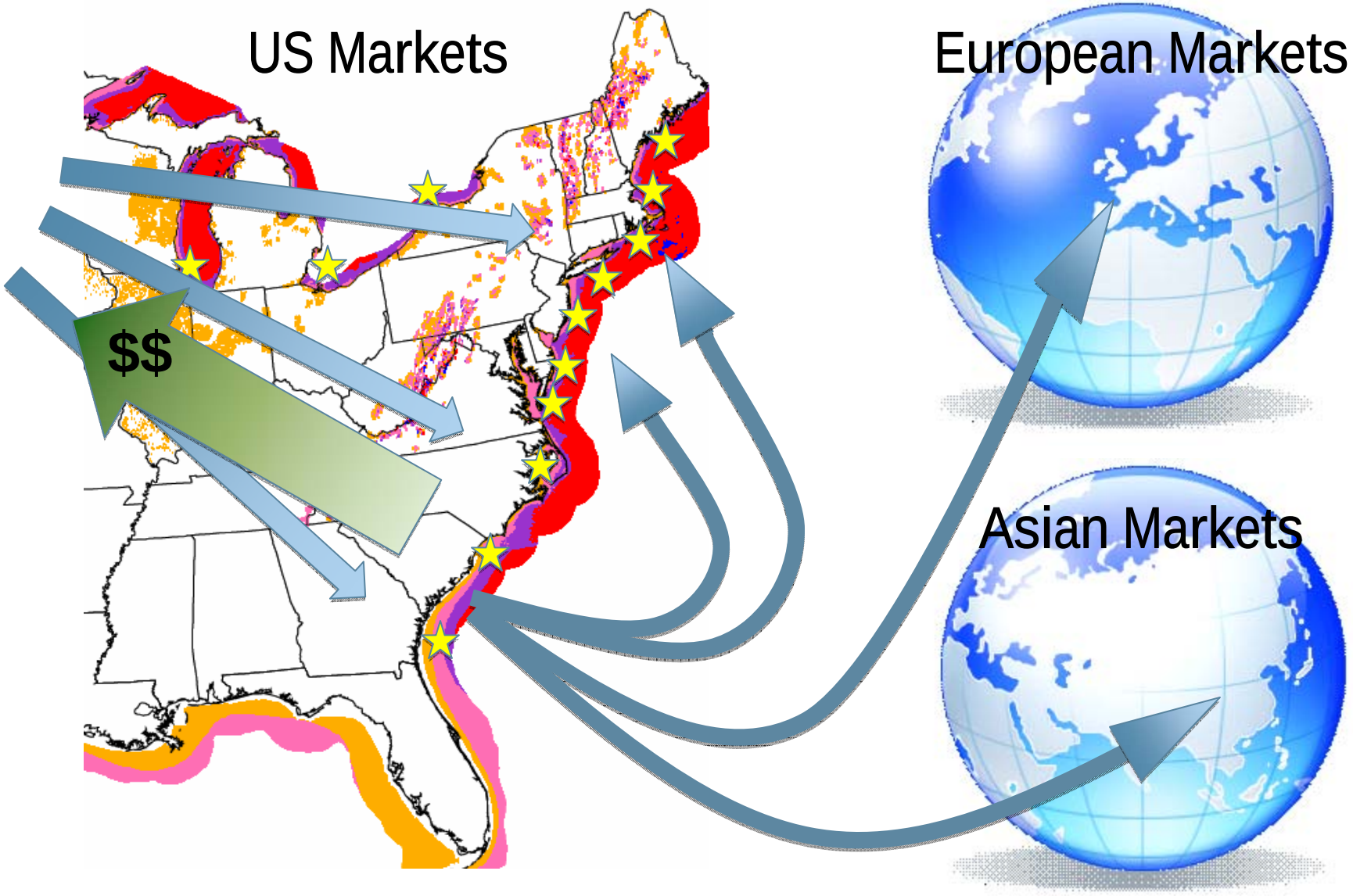
Markets (demand centers) near the resource

Natural Resources – Offshore Wind Power

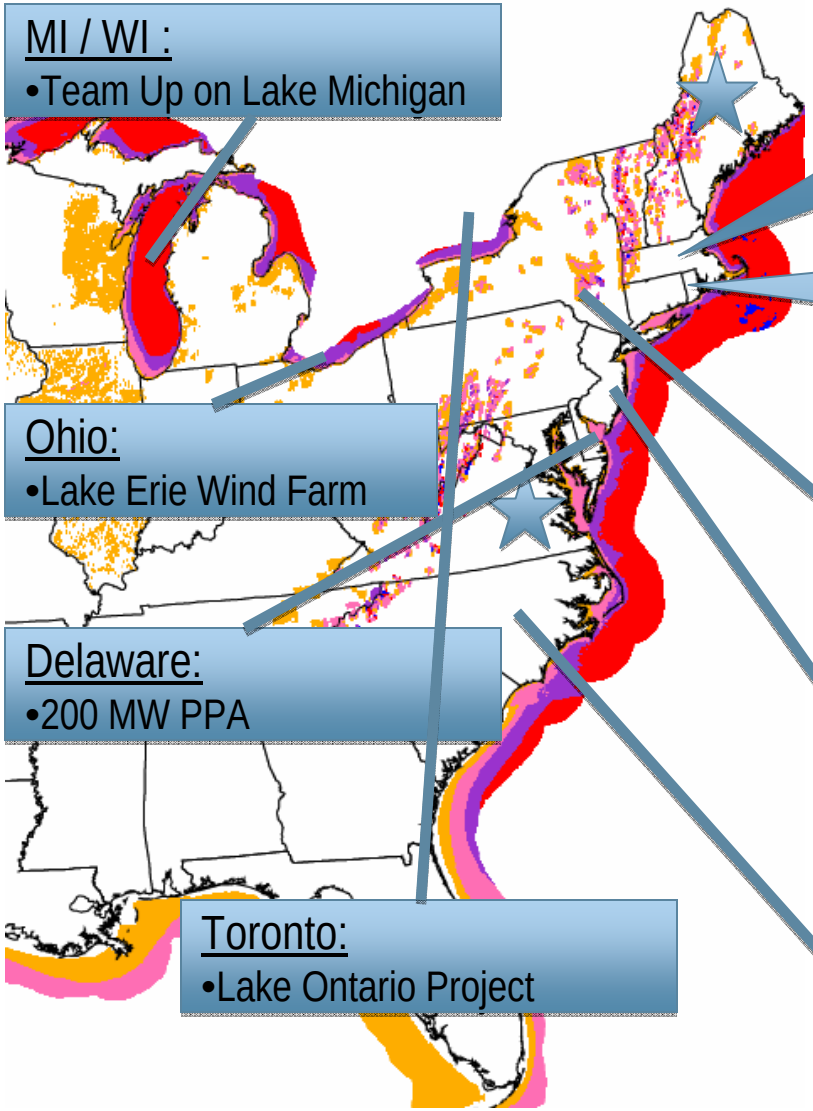
Mean Annual Wind Power Density of South Carolina at 100 Meters



SC Manufacturing Cluster to service markets



State Programs



MI / WI :
- Team Up on Lake Michigan

Ohio:
- Lake Erie Wind Farm

Delaware:
- 200 MW PPA

Toronto:
- Lake Ontario Project

Massachusetts:
- RE Certificate Incentive
- RE Equipment Sales Tax Exemption
- Sustainable Energy Economic Development Initiative

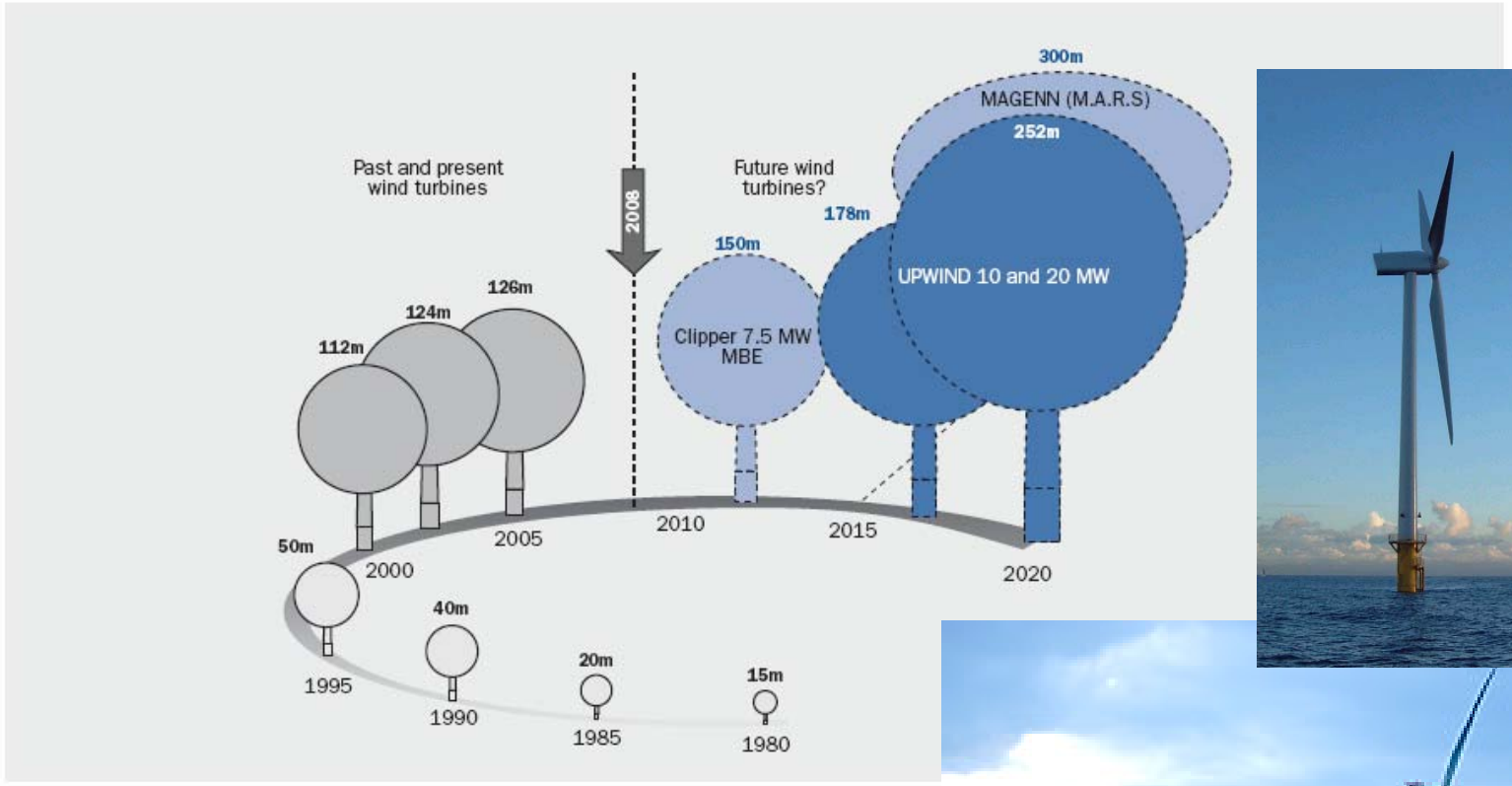
Rhode Island:
- 15% RE
- 10 possible sites
- 1.3 MWhr RFP

New York:
- RE Certificate Incentive
- RE Equipment Sales Tax Exemption
- Sustainable Energy Economic Development Initiative

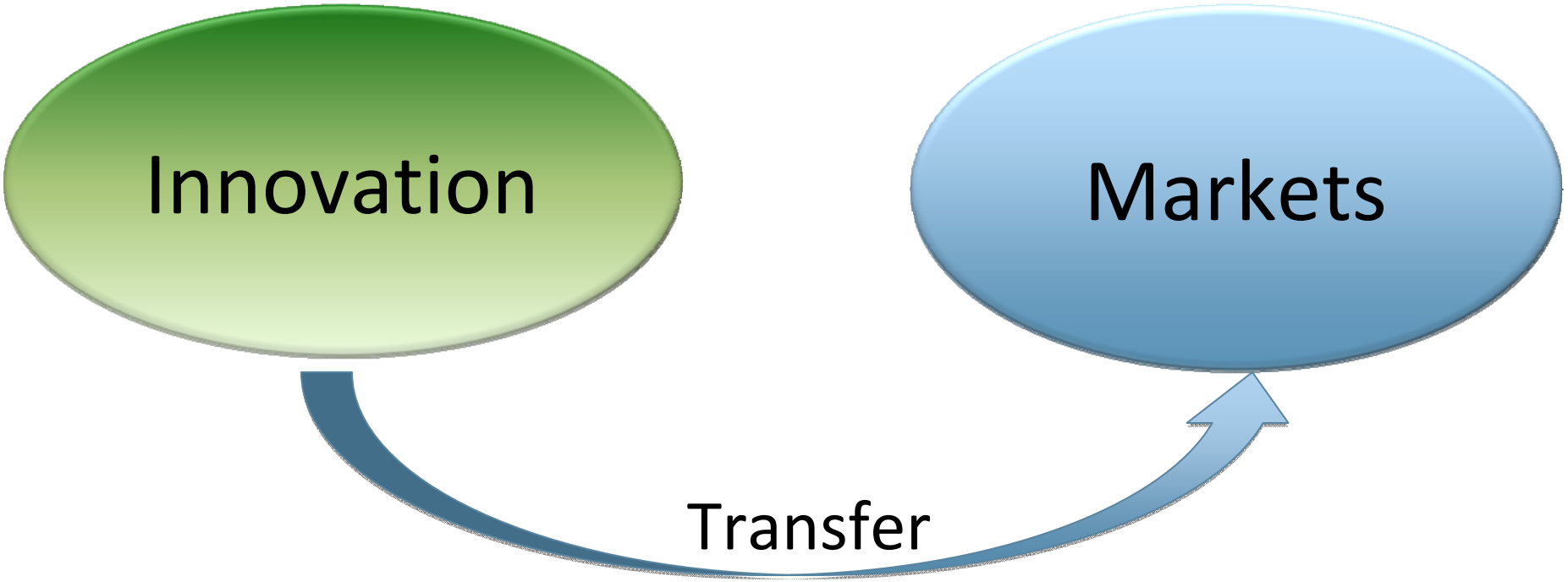
New Jersey:
- $4M Grant for 345 MW Wind Farm Study
- $19M, 5 Yr. Production Tax Credit

North Carolina:
- RE Corporate Tax Credit
- State /Duke Energy for Pamlico Sound Project

Technology continues to evolve



Global economy requires strategy for global competition



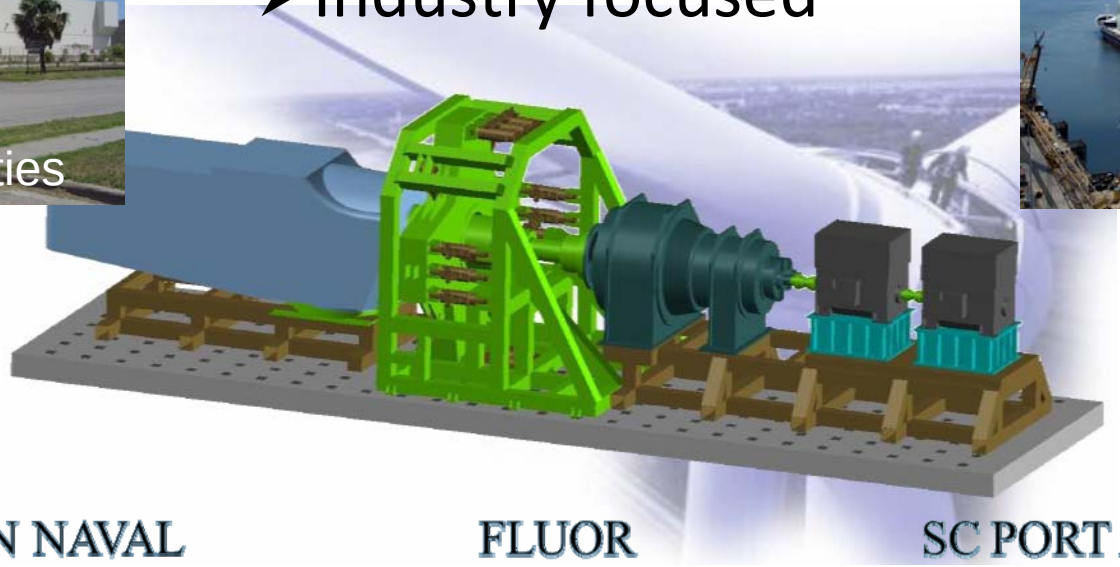
Job Training

Incubate New Enterprises

Competitive Advantage

Clemson DTTF - Project

- Innovation driven
- Industry focused



CHARLESTON NAVAL COMPLEX RDA

FLUOR

SC PORT AUTHORITY

SCE&G

SRNL

NORTH CHARLESTON

PRIVATE DONORS

CMMC

CHARLESTON

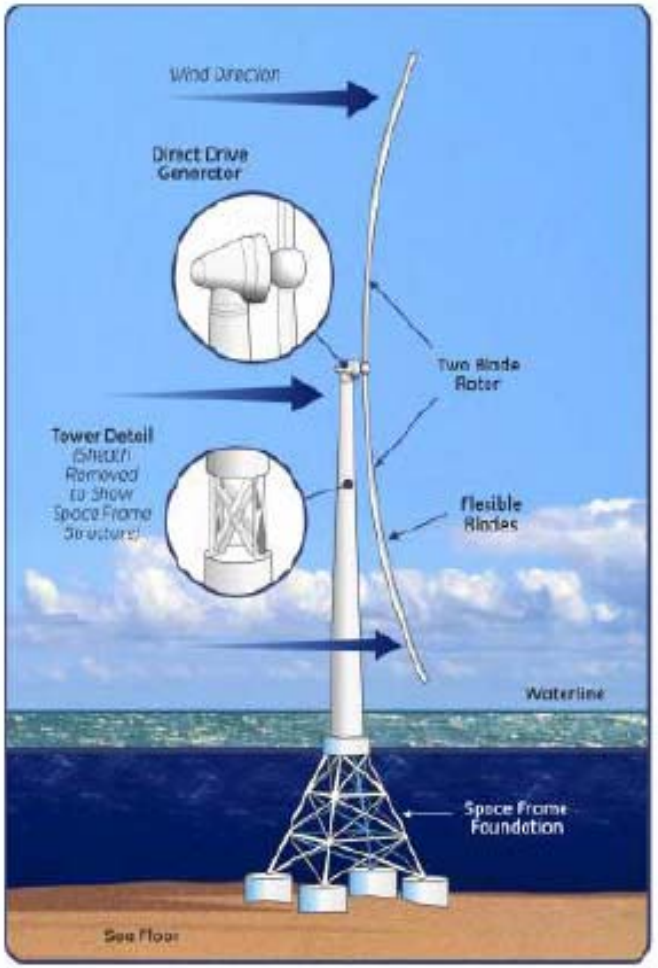
SC PUBLIC RAILWAYS

STATE OF SOUTH CAROLINA

RENK LABECO

Equipment logistics was key

Technology is massive



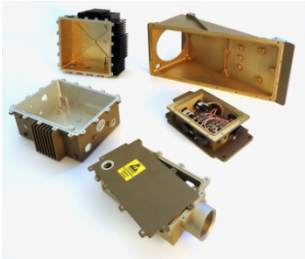
..getting bigger and more complex

Offshore Wind Turbine Manufacturing and Services Cluster

Tower Fabrication

Cable Laying

Turbine Assembly



South Carolina serves as the manufacturing hub

Component Manufacturing

Logistics

Blade Manufacturing

Construction

Foundation Fabrication

In Summary

For South Carolina to be successful:

- Compete globally
- Innovative
- Build on existing infrastructure
- Work force development
- Sustainable public policies

In Summary

*..the 'Green Economy' train is leaving or may have already left the station, the **key** is whether **South Carolina** helps to drive that train, is on board for the ride or is left at the station.*

Appendix D: Status of US Offshore Wind Development Activities by State

US Offshore Wind Collaborative

September 2008

Status of US Offshore Wind Development Activity by State

Public sector initiatives and responses to development proposals

State	Responsible Party	Action	Status
NORTHEAST			
Maine **Contact:** Todd Burrowes, Maine Coastal Program todd.burrowes@maine.gov	Maine Department of Environmental Protection and Land Use Regulation Commission (state agencies with primary permitting authority); and State Planning Office/Maine Coastal Program	Executive Order 31 FY 06/07, established the *Governor's Task Force on Wind Power Development,* to examine the regulatory processes and financing options currently applicable to wind power projects proposed in Maine and to recommend changes to state policies, regulatory requirements and financial incentives necessary to facilitate siting wind power projects in Maine in a way that generates the benefits of this indigenous, renewable energy resource for Maine without undue adverse effects on other natural resources values and uses.	In April 2008, Task Force's legislative recommendations were enacted, including setting ambitious goals for wind power capacity by 2020 – 300 MW from offshore wind. http://www.maine.gov/windpower (link to Task Force's report and resulting legislation)
New Hampshire **Contact:** Ted Diers, NH Coastal Program ted.diers@des.nh.gov	NH Office of Energy & Planning; NH Dept. of Environmental Services	NH has a "one stop" process for energy siting; procedures being developed for streamlined on-shore wind permitting that could be adapted to offshore.	Offshore wind development is more likely in adjacent state waters; high interest in developing regional siting criteria, research and technology testing.

State	Responsible Party	Action	Status
Massachusetts **Contact:** Greg Watson, Senior Advisor for Clean Energy Technology Greg.watson@state.ma.us	Energy & Environmental Affairs	Energy Facilities Siting Board approved cabling and grid connection Secretary of EEA signed-off on the Final EIR for Cape Wind.	Permitting process for project components in state waters is on-going. MMS issued a Draft Environmental Impact Statement (DEIS) received public comment; FEIS anticipated by the end of the year.
Contact: Deerin Babb-Brott, Asst. Secretary for Oceans, Deerin.babb-brott@state.ma.us		In May 2008 the *MA Ocean Management Act* became law, mandating the development of a comprehensive plan for state waters, including identification of offshore wind development sites,, by December 2009	The Ocean Renewables Interagency Working Group is one of several identifying sector-specific resources and needs to support the planning process. A MA Ocean Council and Science Advisory Council has been appointed. http://www.mass.gov/czm/oceanmanagement/index.htm
Contact: Nils Bolgen, Program Manager bolgen@masstech.org	Mass Technology Collaborative	Providing $1.7 million in a forgivable pre-development loan to the Town of Hull Municipal Light Plant (HMLP) to do preliminary environ. & engineer. studies for a four turbine wind farm approximately 1.5 miles from shore	Hull submitted an Environmental Notification Form (ENF); Secretary issued Scope for a Draft Environmental Impact Report (DEIR). Technical analysis on-going.
		Completed business plan and providing $150k funding for formation stage for a national Offshore Wind Collaborative, to execute the tech, environ, econ and policy agenda outlined in the Framework for Offshore Wind Energy in the United States	MA Energy and Environmental Affairs now an active participant (previous administration not supportive). 8 member self-selected steering committee (AWEA, Mass Audubon, CESA, Batelle, NOAA, MTC, EEA, MIT) to meet in March 2008 to draft a six-month launch strategy
	MTC, U Mass; Energy & Environmental Affairs; Economic Affairs	Responded to the NREL CRADA to construct a Blade Test Facility at the Massport Carport;	Proposal selected for development, along with Texas; design under way
Rhode Island	Office of Energy Resources (OER)	Results released from a 2006 Governor-commissioned wind siting study to assess the feasibility of meeting 15% of state's energy needs from wind. Conclusions included that in gross terms wind could provide 75% of need, much of it from offshore sites. ID'd 10 potential sites. Also suggested that RI would benefit from establishing a RI Power Authority. Initiated stakeholder process to review the 10 possible sites.	OER issued Offshore Wind Stakeholders Final Report in Feb 2008. Identified issues to be considered in siting and questions requiring analysis.

State	Responsible Party	Action	Status
		In January 2008 OER signed MOU with URI, providing $200,000 to fund the RI Energy Partnership and the creation of a Center of Excellence in Research for Offshore Renewable Energy.	The center was approved and created in May 2008 and research and public outreach activities launched in Fall 2008.
		Issued an RFP seeking proposals from companies to *design, build, finance and operate a wind generation facility in the waters off [Rhode Island's] coast to supply not less that 15% of the energy consumed by RI's electricity customers* (not less than 1.3 million MW-hrs./yr.) The presumptive preferred site is identified in *RIWINDS, Phase I: Wind Energy Siting Study*, but other sites may be considered.	Seven proposals were submitted. On September 26, 2008 Governor Carcieri announced Deepwater Wind was chosen as the developer.
	Coastal Resources Management Council (CRMC)	Will define use zones for Rhode Island's offshore waters, including "wind energy zones," through a research and planning process that integrates the best available science and coastal/ocean management experience with open public input and involvement. In partnership with 60-member multi-disciplinary team from URI. $1.6 million initial funding from the State Energy Office. The two-year commitment from OER is $3.6 million.	Launched
New York	Long Island Power Authority	Pursued development of a 40-turbine wind farm off Jones beach. FPL was successful respondent to an RFP requesting a developer in 2004. LIPA conducted initial baseline assessment, identified development area, and intended to construct the cable.	Project tabled over concerns about escalating construction and materials costs.
		In September 2008, formed a working group with Con Edison to explore the feasibility of an up to 300 MW wind farm, possibly at a location 10 miles off the Rockaways in Queens NY.	Development of the project, which is 2X the size of the initial LIPA proposal will hinge on economic feasibility.
	NYSERDA	Funded studies to explore the feasibility of developing offshore wind in near shore Lake Erie; and consider jurisdictional issues.	In process

State	Responsible Party	Action	Status
	Governor's Office	Directed state agencies to work with Great Lakes Wind Collaborative to develop a framework and action plan for NYS Offshore Wind State agencies engaged in regulatory review of 10 MW wind farm in Gardiners Bay (Winergy).	In process
MID-ATLANTIC			
New Jersey	Department of Environmental Protection	Issued RFP for an 18 month, $4.5 million Ocean/Wind Power Ecological Baseline Study. Study area is waters offshore New Jersey out 20 miles (approx. 100-ft. contour), excluding Delaware Bay and other specified areas. Fulfilling recommendation of Blue Ribbon Panel on offshore wind development, to assist in determining areas for development.	Award to GMI, Inc. studies, beginning January 2008, include acoustical, oceanographic, radar and thermal imaging.
	Board of Public Utilities	Issued Solicitation for Proposals to Develop Offshore Wind Renewable Energy, offering a $19 million, 5-year production credit for construction and operation of an up-to 350 MW facility. Ten percent to be made available up front to support studies and permitting.	5 proposals submitted. Expect an award to one of the five applicants in October. 5 sites offshore New Jersey selected by MMS for wind assessment work under the Interim Rule.
Delaware **Contact:** Mark Finfrock, Delmarva Power and Light 202-872-2680	Delmarva Power and Light	After a competitive bidding process, Delmarva was directed by consensus of the Delaware Public Services Commission, Office of Management and Budget, State Controller & Natural Resource/Enviro. Control Dept. to negotiate a long term power purchase agreement with Bluewater Wind to provide needed power supply in the state through construction of a 200 - 300 MW offshore wind farm.	The state recently announced the first ever offshore wind Power Purchase Agreement between Delmarva Power and Bluewater Wind for 200 MW of offshore wind, 12 miles off the coast of Delaware
	University of Delaware	Conducted an assessment of offshore wind resources from MA to N Carolina, keyed to technology-limiting factors and accounting for exclusion zones (wildlife, shipping lanes, etc.).	Published. Estimates an average 330-gigwatt output; suggests an integrated offshore grid to address fluctuations in output across a large region.
Maryland	Maryland Energy Administration	Issued informal expressions of interest to offshore wind developers	Ongoing

State	Responsible Party	Action	Status
Virginia	Virginia General Assembly	In 2006, established the Virginia Coastal Energy Research Consortium, through passage of the VA Energy Plan, "to serve as an interdisciplinary study, research and information resource for the Commonwealth on coastal energy issues.". Board of Directors has 8 university members and 6 government and industry partners.	FY 08 appropriation of about $750,000 for offshore wind, renewed for FY09. First year results to be published in October.
SOUTHEAST			
North Carolina	NC Wind Working Group	General outreach and education on wind issues; participated in joint DOE application for regional transmission studies re: offshore wind.	expansive shallow, state waters in NC, SC and GA offer significant potential opportunity, despite lesser wind speeds compared to NE
South Carolina **Contact:** South Carolina Energy Office (803) 737-8030.	Informal research-industry-developer-utility group	Monitoring 50-meter coastal anemometer towers; results will likely support further work offshore; applied to MMS for offshore 2 sites under the interim rule; Santee Cooper (public utility) has an offshore wind feasibility study underway, and several other physical and economic factors are being considered in partnership with several local universities	Draft feasibility report to be released shortly. Assessment site not selected in 1st MMS round; will resubmit.
Georgia	Georgia Wind Working Group	Promotes responsible development and use of wind power. Fifty members including utilities, wind developers, government, universities, and other stakeholders. Oversees a Georgia offshore-coastal wind committee.	Convened successful offshore wind roundtable in 2006, planner's workshop and public forum in 2007. Filed public comments on MMS proposed interim testing policy and leasing rule.
	Southern Winds Project: Georgia Tech Strategic Energy Institute/Southern Company	Conducted a 2-year feasibility study assessing all aspects of constructing and operating wind farm off the Georgia Coast. Identified promising sites based wind resources, geophysical characteristics, environmental considerations, competing usage, distance from shore and comparative costs (public acceptance v. cost of additional cabling)	Final report issued in 2007. Conclusion stated that the concept is feasible, but that regulatory issues, cost and insurability issues remain. Three offshore Georgia sites selected by MMS for offshore wind related assessment work under the interim rule. An interim lease was granted and Southern Company is proceeding with the process. The first stakeholder meeting involving state and local agencies, MMS, Southern Co. and the public is scheduled for November, 2008.
GULF COAST			
Texas	Texas General Lands Office	The GLO currently has five active leases being explored for wind generation, They conducted the first open bidding for leases in 2006	Resource assessment work in process

State	Responsible Party	Action	Status
	Lone Star Wind Alliance (Texas Lands Office; U Houston; others)	Responded to the NREL CRADA to construct a Blade Test Facility	Proposal selected for development, along with Massachusetts
GREAT LAKES			
	Great Lakes Wind Collaborative	Established in 2008 to build consensus, identify and address issues affecting the planning, development and operation of wind power facilities in the Great Lakes region. First year funding from Wind Powering America and a major wind company ($100k total). GLWC has been formally adopted as an initiative of the Great Lakes Commission, which will serve as Secretariat, providing staff support. Membership includes 9 states/provinces; US and Canadian agencies, industry, academic, environmental and stakeholder interests.	GLWC established an offshore wind working group
Indiana	Department of Natural Resources	Responded to an email inquiry concerning the possibility of building an off-shore wind facility in Lake Michigan.	Recommended the developer go through a more formal early coordination process with IDNR.
Ohio	Cuyahoga County Regional Energy Development Task Force	Issued an RFQ for development of a 20 MW offshore wind demo project in Lake Erie near downtown Cleveland + feasibility study of establishing an R&D center for utility scale wind technology. As recommended in Feb 8, 2007 report Building a New Energy Future.	$1,041,454 contract approved with JW Great Lakes Wind llc. Study to be completed in 2009.
	Office of Coastal Management (ODNR)	Drafting offshore regulations for submerged lands	In process
Michigan	State Wind Outreach Team (DOE sponsored)	Conducted a permitting dry-run on 2 hypothetical sites on Michigan's Great Lakes	

State	Responsible Party	Action	Status
Wisconsin **Contacts:** John Shenot - Policy Advisor, Public Service Commission of Wisconsin 608 267-3798 John.shenot@wisconsin.gov David Siebert – Director, Wisconsin Department of Natural Resources 608 264-6048 David.siebert@wisconsin.gov	PSCW Office of Energy and Environmental Analysis, WDNR	Governor's Global Warming Task Force Recommended a study of the potential for offshore wind development. In response, the Public Service Commission, with cooperation from the State DNR, has convened a high-level panel (Wind on Water – W.O.W) to consider the full range of legal/regulatory, environmental, community, technical and economic issues related to developing offshore wind.	Commission will report to the Governor in late 2008.
WEST COAST			
California	Stanford University, Civil and Environmental Engineering Department	Conducted a study of CA offshore wind energy potential. Concluded that despite steep bathymetry, significant development potential exists, particularly with new floating platform designs currently under development. Identified significant potential at 200 meter depths; assumes a 15-20 yr. time horizon for development	Published.