The Virginia Coastal Energy Research Consortium

Legislative Briefing

Virginia Commission on Energy and Environment

Richmond, VA

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Presentation Outline

- **Virginia Coastal Energy Research Consortium (VCERC) background**
- **Comparing potential energy yields from offshore wind and from offshore natural gas on the Atlantic Outer Continental Shelf**
- **Virginia Energy Plan data on electricity imports and planned generation supply additions**
- **VCERC mapping of hypothetical offshore wind project footprints relative to other ocean uses:** ***Is there sufficient non-excluded area to support wind projects that can meet future state needs?***

Mission and Specific Strategies

Mission: The mission of the Virginia Coastal Energy Research (Working Group) is to identify and develop new coastal energy resources through multidisciplinary research collaborations and environmentally responsible strategies.

Strategies: Conduct research in areas consistent with a ***diversified portfolio*** of energy sources in coastal areas and offshore

Initial focus:

1. Offshore wind energy
2. Coastal Biomass for Biodiesel Production

VCERC Created by 2006 General Assembly to Bring Together Universities, State Agencies, and Industry

Virginia Coastal Energy Research Consortium

Virginia Tech 1872

Mechanical, electrical, materials, civil, and ocean engineering

Washington, DC area presence

Old Dominion University

Physical, chemical, & geological ocean sciences

Virginia Institute of Marine Science VIMS

Biological ocean sciences

James Madison University

Wind energy engineering

Renewable energy curriculum development

NSU Norfolk State University

High-tech workforce training

Entrepreneurship development

Non-University VCERC Board

DMME Virginia Department of Mines Minerals and Energy

Integration of marine renewables into Virginia Energy Plan

Virginia Marine Resources Commission

Ensuring compatibility with other marine uses and coastal resources

Virginia Manufacturers Association VMA

Identification of manufacturing job creation opportunities and industry benefits of long-term, price-stable energy supply

Hampton Roads Maritime Association Incorporated 1920

Identification of waterfront development opportunities

Three Additional Universities and Two New Industry Representatives Added in 2007

Virginia Coastal Energy Research Consortium

Rice Center for Environmental Life Sciences expertise on natural algal blooms

Integration of GIS tool into Coastal GEMS

Virginia Coast Reserve Long-Term Ecological Research Project

Chemical Engineering Department -- fuels testing and characterization

Research and development of alternative marine biofuels and bioproducts

Non-University VCERC Board

Interface with local high-tech industry, including advanced manufacturing, sensors, and control systems

Virginia Clean Cities and the Hampton Roads Clean Cities Coalition identify regional transportation needs and opportunities for fuels from algae and integration of offshore wind with plug-in hybrid electric vehicles

FY 2007- 08 VCERC Budget Distribution

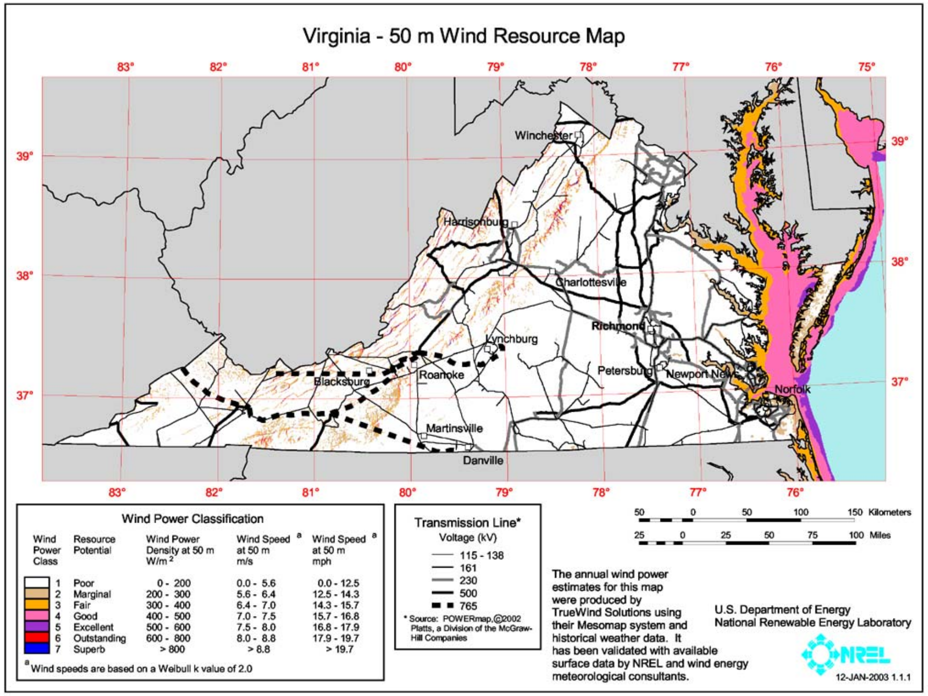
Project	VT-ARI	ODU	ODU (Industry)*	JMU	NSU	VIMS	Total
1	$200K	$150K	$50K	$15K	$0K	$0K*	$425K
2	$30K	$64K	$0K	$120K	$0K	$50K	$244K
3	$20K	$0K	$100K	$15K	$75K	$0K	$195K
4	$0K	$511K	$0K	$0K	$0K	$100K	$636K
Total	**$250K**	**$725K**	**$150K**	**$150K**	**$75K**	**$150K**	**$1,500K**

* VIMS anticipates being able to support Project 1 through its normal Sea Grant activities and with a subset of the GIS data produced under Project 2.

In Oct 2007, higher-education budget cut of 10.6% to VCERC budget amendment was applied uniformly across all projects and universities

* ODU Industry Partner is SAIC Maritime Operations

Wind Energy



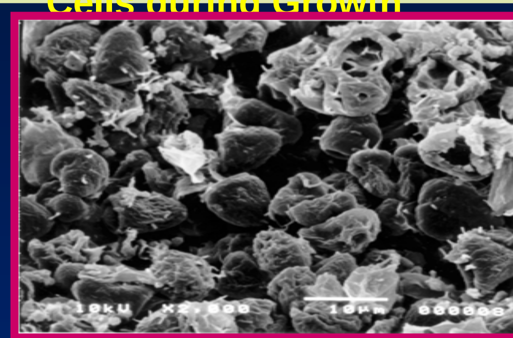
The best places for wind farms are in coastal areas, at the tops of rounded hills, open plains and gaps in mountains - places where the wind is strong and reliable.

To be worthwhile, you need an average wind speed of around 25 km/h.

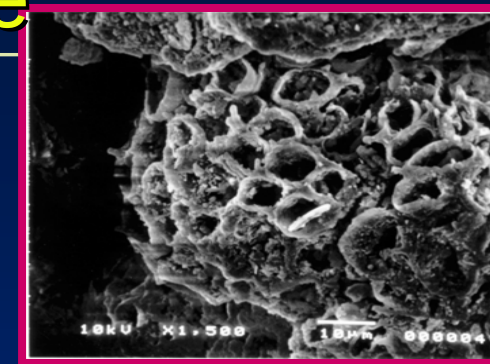
Coastal Biomass from Algae for the production of biodiesel or gasoline

Estimated cost: $1.40 to $4.40/gal

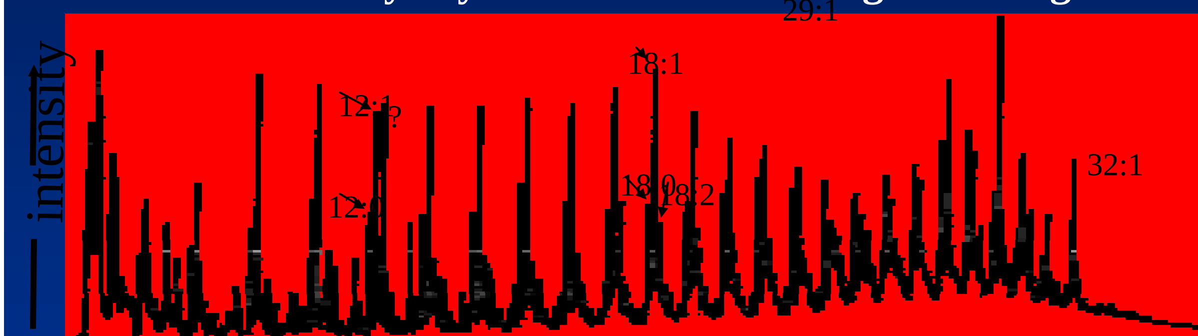
Cells during Growth

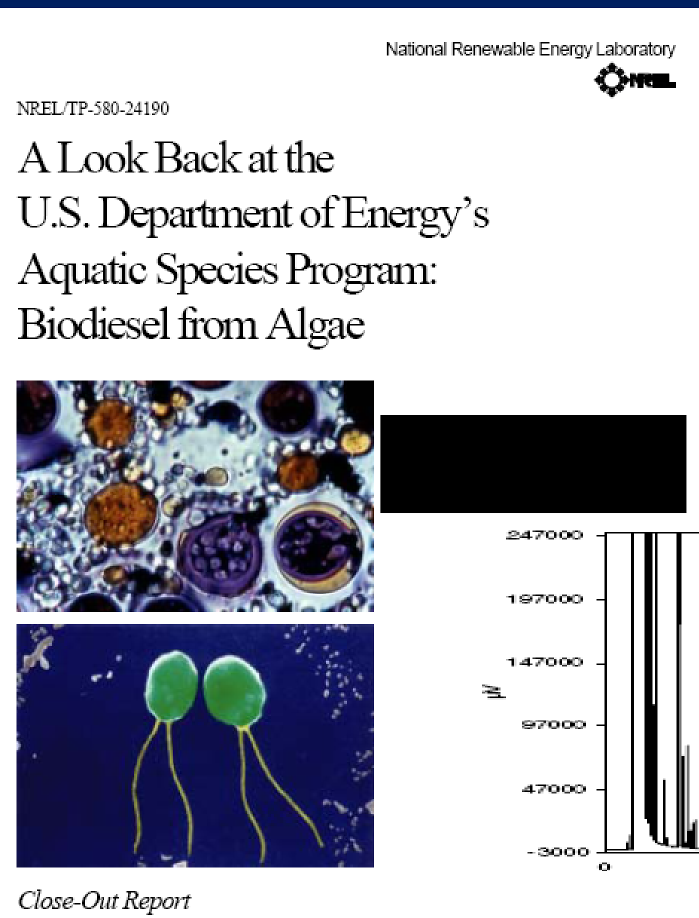


4-Million-Year-Old Fossilized Cell Walls



Pyrolysis/GC/MS chromatogram of algae




National Renewable Energy Laboratory

NREL/TP-580-24190

A Look Back at the U.S. Department of Energy's Aquatic Species Program: Biodiesel from Algae

Close-Out Report

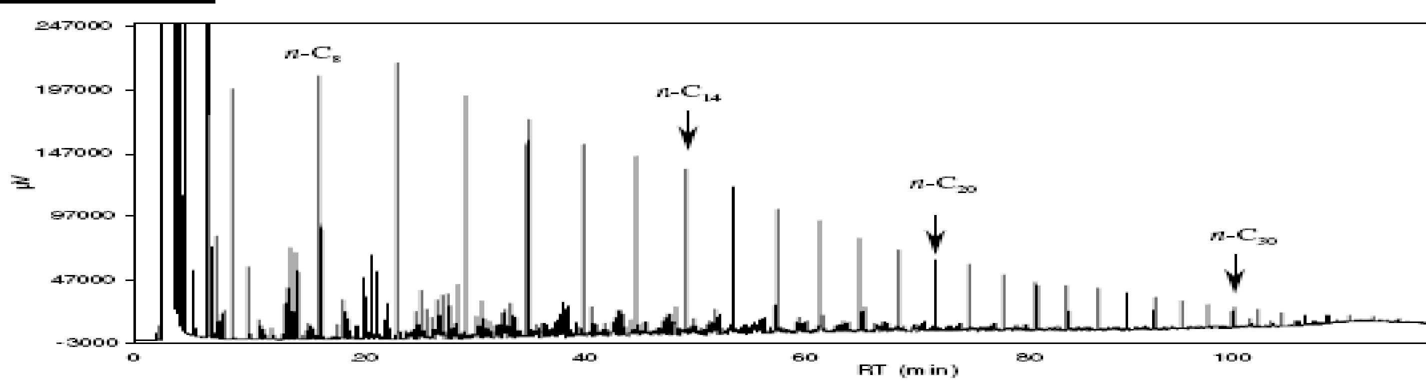


Fig. 1. GC trace of the total Safaniya oil.

Three Initial VCERC Projects
Focus on Offshore Wind

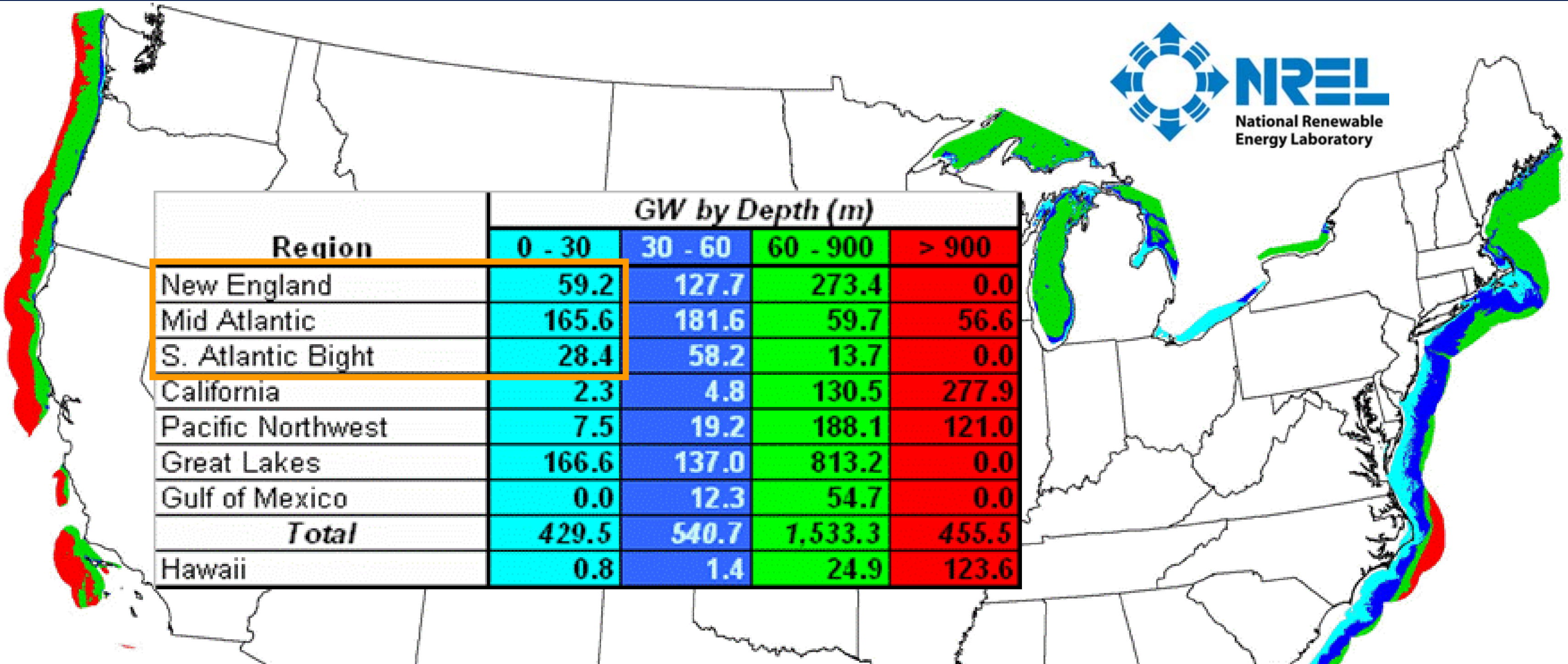
1. **Feasibility-level design and economic assessment**
   for a hypothetical reference baseline offshore wind power project

2. **Preliminary mapping of offshore areas**
   suitable for offshore wind power development, with identification of military training areas, shipping lanes, commercial fishing grounds, and marine and avian habitats

3. **Evaluation of economic development potential**
   of commercial offshore wind power development and associated workforce training needs, and planning for an ocean test bed

4. **Feasibility-level design and economic assessment**
   for an algae-to-biodiesel culture and processing system

US Offshore Wind Energy Potential Capacity Between 5 and 50 Nautical Miles Offshore



Region	GW by Depth (m)			
	0 - 30	30 - 60	60 - 900	> 900
New England	59.2	127.7	273.4	0.0
Mid Atlantic	165.6	181.6	59.7	56.6
S. Atlantic Bight	28.4	58.2	13.7	0.0
California	2.3	4.8	130.5	277.9
Pacific Northwest	7.5	19.2	188.1	121.0
Great Lakes	166.6	137.0	813.2	0.0
Gulf of Mexico	0.0	12.3	54.7	0.0
Total	*429.5*	*540.7*	*1,533.3*	*455.5*
Hawaii	0.8	1.4	24.9	123.6

Total potential installed offshore Atlantic OCS wind capacity in water depths <30 m is 253.2 GW. At an annual average capacity factor of 35%, total annual electrical energy production would be 776,300 GWh. With a gas-fired power plant heat rate of 8.0 BCF per GWh, the equivalent natural gas usage that could be displaced by Atlantic OCS shallow-water offshore wind is ~6,210,000 BCF per year. Only a fraction of this total wind potential can be developed, due to other ocean uses and environmental concerns.

U.S. EIA Estimates for Offshore Oil & Gas Potential in Areas Covered by Moratorium

Table 10. Technically recoverable undiscovered oil and natural gas resources in the lower 48 Outer Continental Shelf as of January 1, 2003

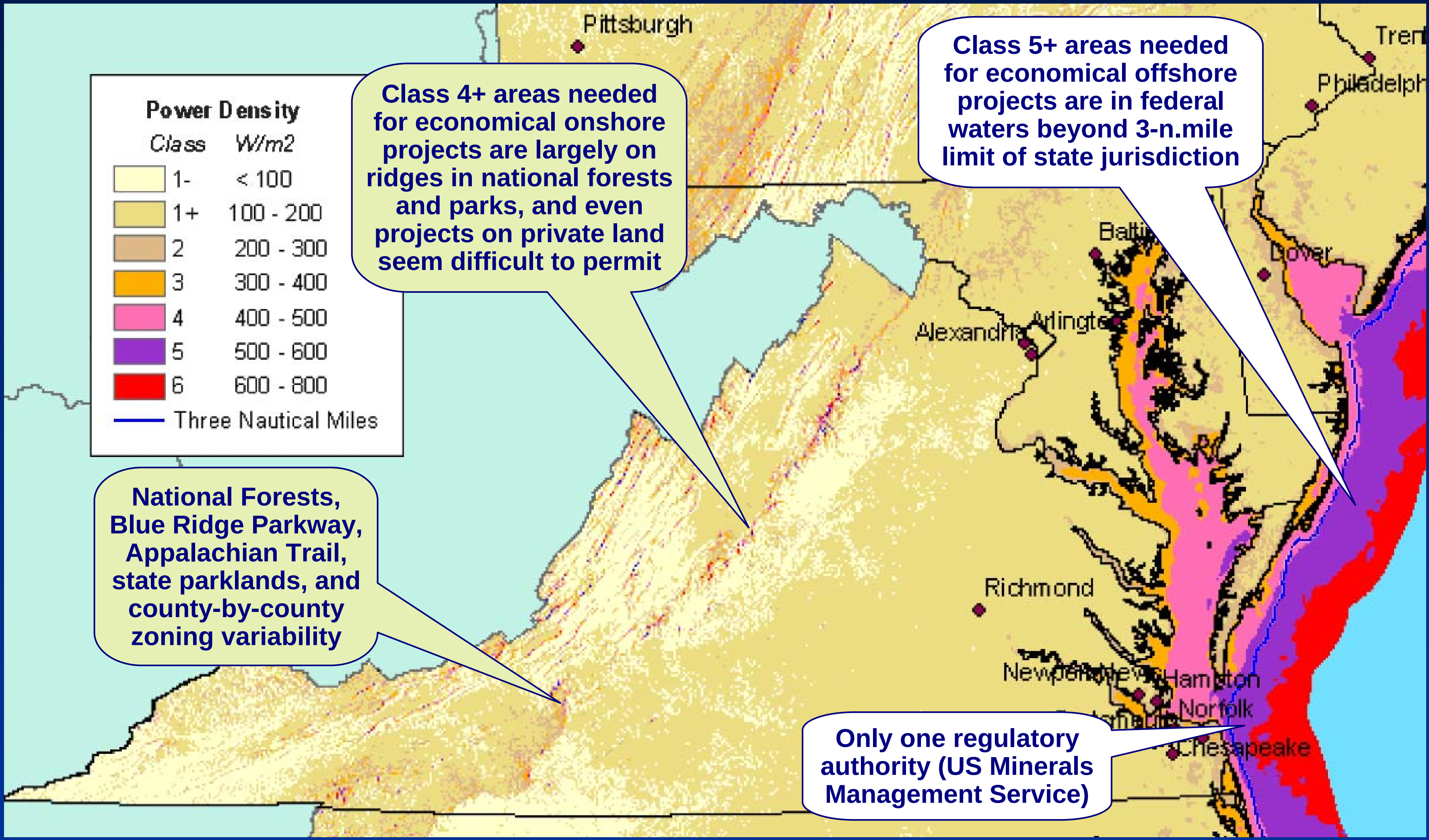
OCS areas	Crude oil (billion barrels)	Natural gas (trillion cubic feet)
Available for leasing and development		
Eastern Gulf of Mexico	2.27	10.14
Central Gulf of Mexico	22.67	113.61
Western Gulf of Mexico	15.98	86.62
Total available	**40.92**	**210.37**
Unavailable for leasing and development		
Washington-Oregon	0.40	2.28
Northern California	2.08	3.58
Central California	2.31	2.41
Southern California	5.58	9.75
Eastern Gulf of Mexico	3.98	22.16
Atlantic	3.82	36.99
Total unavailable	**18.17**	**77.17**
Total Lower 48 OCS	**59.09**	**287.54**

Source: www.eia.doe.gov/oiaf/aeo/otheranalysis/ongr.html

Developing just 0.6 % (= 37 / 6,210) of the total potential Atlantic OCS shallow-water offshore wind potential would generate the same amount of electricity as all of the potential natural gas that could be produced on the Atlantic OCS.

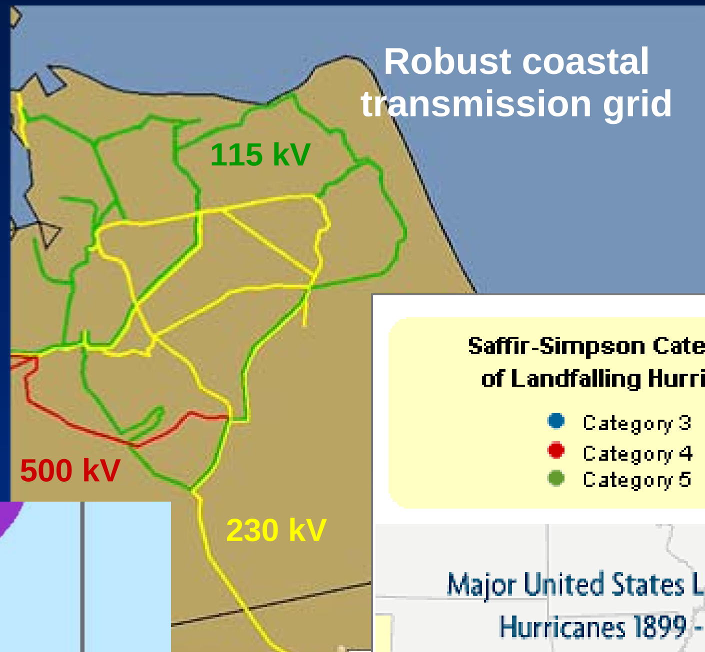
Therefore, the most valuable use of the Atlantic OCS fossil natural gas resource might be to enhance offshore wind profitability by reducing intermittency and providing a bridge to marine biogas.

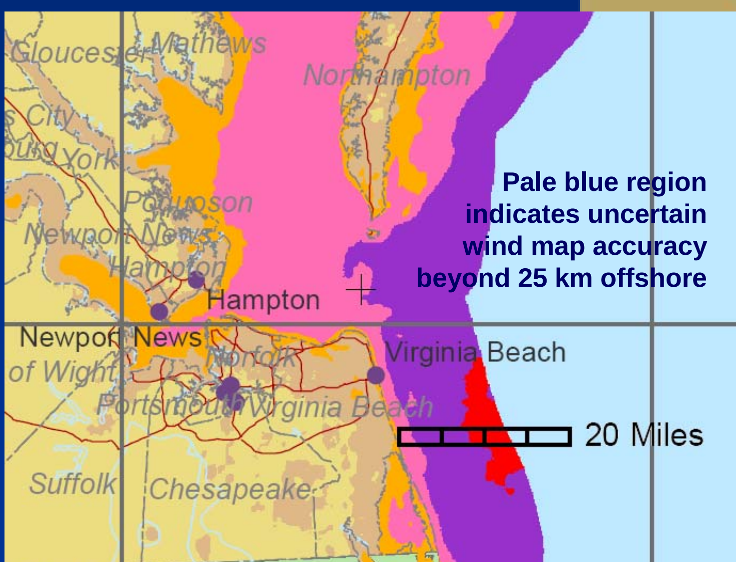
Virginia's Wind Energy Resources Offshore are Much Larger than on Land



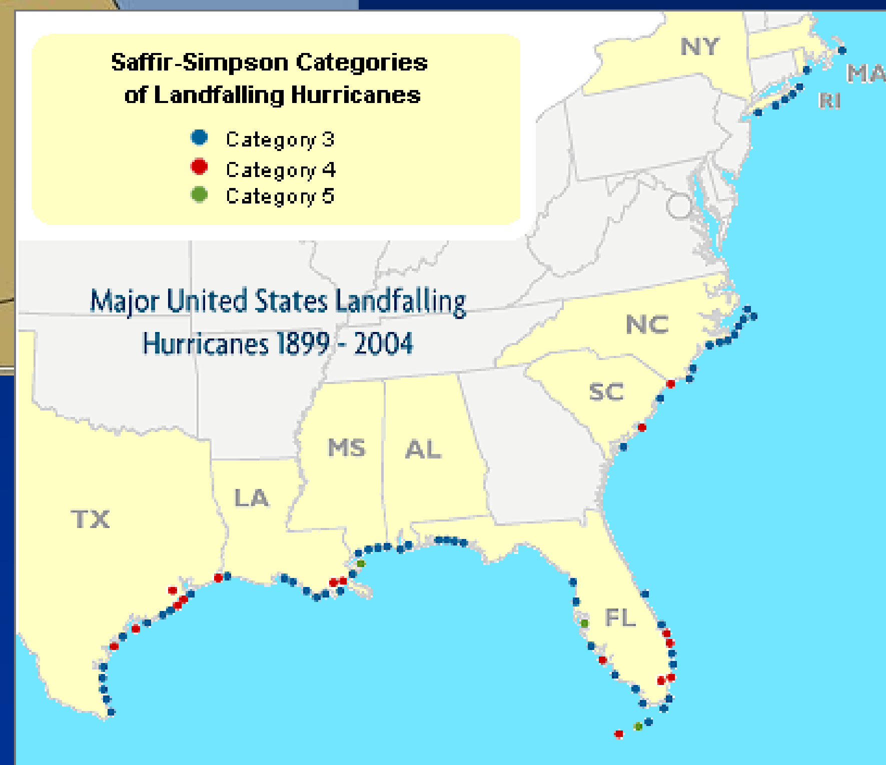
Hampton Roads Area has Unique Features Favorable for Offshore Wind Power Development

Class 6 (▬) wind energy resource located within 10-15 miles (16-24 km) of shoreline and close to major, growing centers of power demand

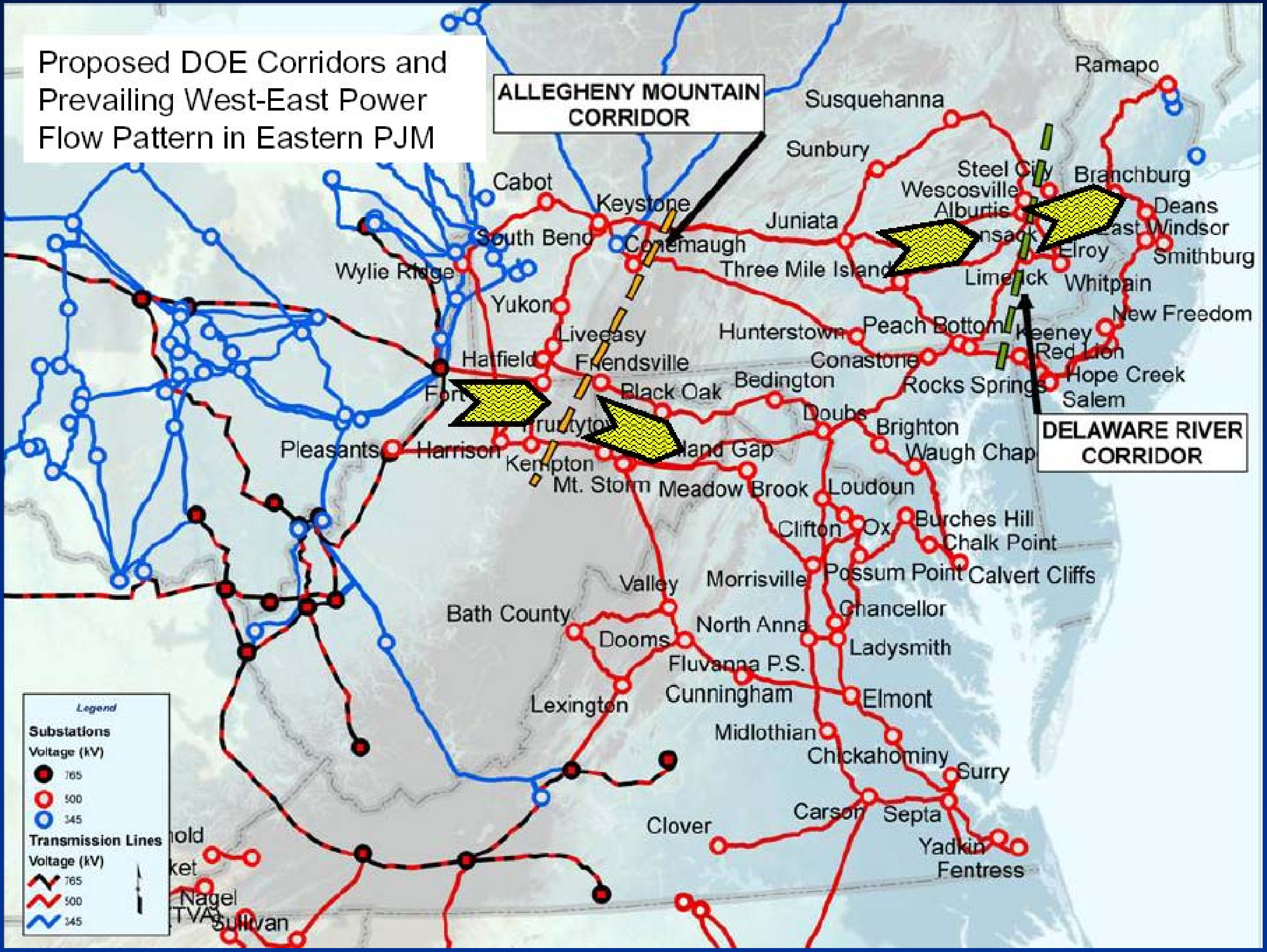




Minimal probability of major hurricane strike (Categories 3 through 5)



Offshore Wind Might Relieve PJM Transmission Constraints from West to East



Electricity Import Scenarios for Virginia

(www.dmme.virginia.gov/vaenergyplan.shtml, Table 2-4)

Scenario	Year	Peak Electrical Demand for Virginia (MW)	Conservation & Energy Efficiency Savings	Conservation & Energy Efficiency (MW)	Net Summer Generation Capacity (MW)	Net Generation Change (MW)	Electricity Imports (% of Total Capacity)
Base Case	2005	32,026	0%	0	22,599		29.4%
1	2016	39,250	0%	0	22,599	0	42.4%
2	2016	39,250	0%	0	27,697	5,098	29.4%
3	2016	33,755	14%	5,495	22,599	0	33.0%
4	2016	33,755	14%	5,495	23,819	1,220	29.4%
5	2016	33,755	14%	5,495	33,755	11,156	0%

If there is ***no*** demand reduction through conservation and energy efficiency measures, than nearly 5,100 MW of new generation will be needed by 2016, in order to maintain electricity imports at existing levels (Base Case = 29.4%).

To Keep Import % Constant, Approximately 3,600 MW of New Generation Capacity is Needed

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3	2016	33,755			22,599	5,098 - 1,500 = 3,598	
4	2016	33,755			23,819	1,220	29.4%
5	2016	33,755			33,755	11,156	0%

Virginia has established a target of meeting 10 percent of its 2006 electric demands through conservation by 2022. Prorating this target over the next ten years, the state should be able to meet 6 to 7 percent of this goal, or nearly 1,500 megawatts, by 2016.

If there is ***1,500 MW*** of demand reduction through conservation and energy efficiency measures, than new generation needed by 2016 is only ~3,600 MW, in order to maintain electricity imports at existing levels (Base Case = 29.4%).

Electric Generation Facilities Planned in Virginia

(www.dmme.virginia.gov/vaenergyplan.shtml, Table 4-3, modified)

Owner Name	Plant Name	Unit	County in Virginia	Primary Fuel	Nameplate Capacity (MW)	Estimated Commercial Online Date
Feasibility Stage (Planned new generator undergoing feasibility study)						
Hydro Matrix LP	Flannagan Hydroelectric Project	1	Dickenson	Water	5	Not available
Dominion Resources	North Anna	NB3	Louisa	Uranium	917	January 1, 2050
Proposed (New generator planned for installation)						
Virginia Electric & Power	Virginia City Hybrid Energy Center	ST1	Wise	Coal	**585**	June 1, 2012
Application Pending (Application filed for permits, regulatory approval pending)						
Dominion Resources	CPV Warren Power Generating	CC1	Warren	Natural Gas	520	June 1, 2010
Highland New Wind Development LLC	Highland County Wind	WT1 19	Highland	Wind	38	December 31, 2008
Dominion Resources	Ladysmith Generation Facility		Caroline	Natural Gas/Fuel Oil	300	August 2008
Dominion Resources	**Buckingham County**		**Buckingham**	**Natural Gas**	**580**	**Summer 2011**

Two landfill gas projects totaling 3.14 MW generation capacity are not shown here. Data on Buckingham County combined cycle plant are from www.dom.com/news/elec2008/pr0311a.jsp

At Least 1,600 MW of Additional Generation Needed by 2016 if Import % to Remain Constant

Planned large (>50 MW) generation projects likely to be operating by 2016 total ***1,985 MW***

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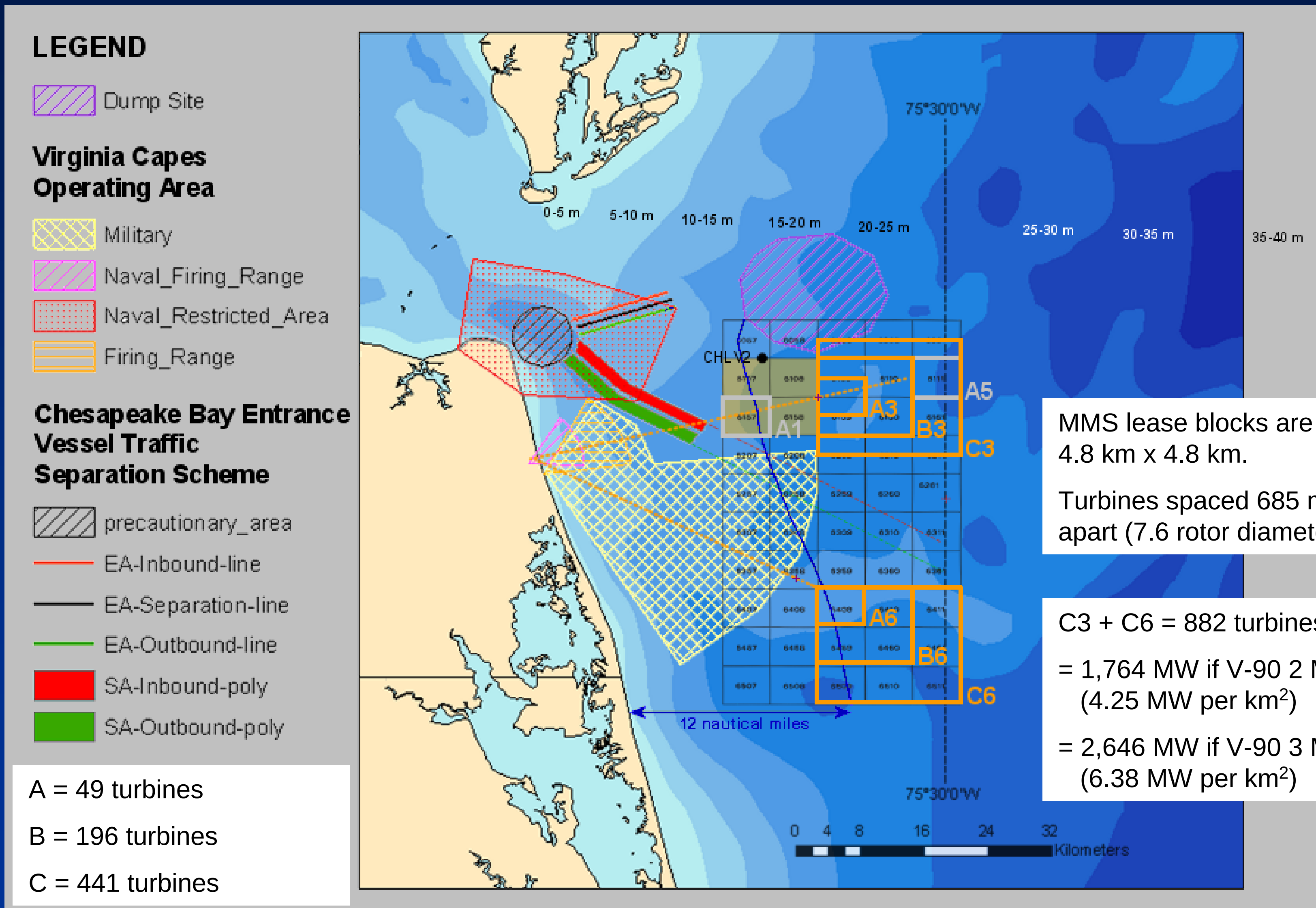
Accounting for Other Ocean Users, Offshore Wind Energy Potential Appears to Match State Needs



A = 49 turbines

B = 196 turbines

C = 441 turbines

MMS lease blocks are 4.8 km x 4.8 km.

Turbines spaced 685 m apart (7.6 rotor diameters)

C3 + C6 = 882 turbines

= 1,764 MW if V-90 2 MW (4.25 MW per km^2)

= 2,646 MW if V-90 3 MW (6.38 MW per km^2)

Thank You!

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