Marine Renewable Energy Technology Update

Virginia Joint Commission on Technology and Science

12 December 2006

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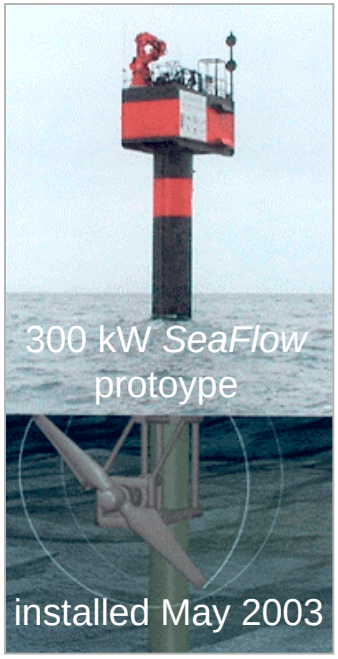
Science Applications International Corporation

Emerging Marine Renewables

Tidal Currents

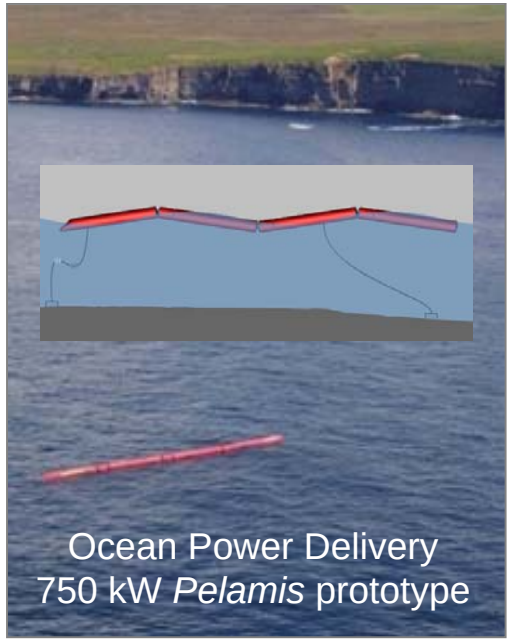


Devon, UK

Offshore Winds

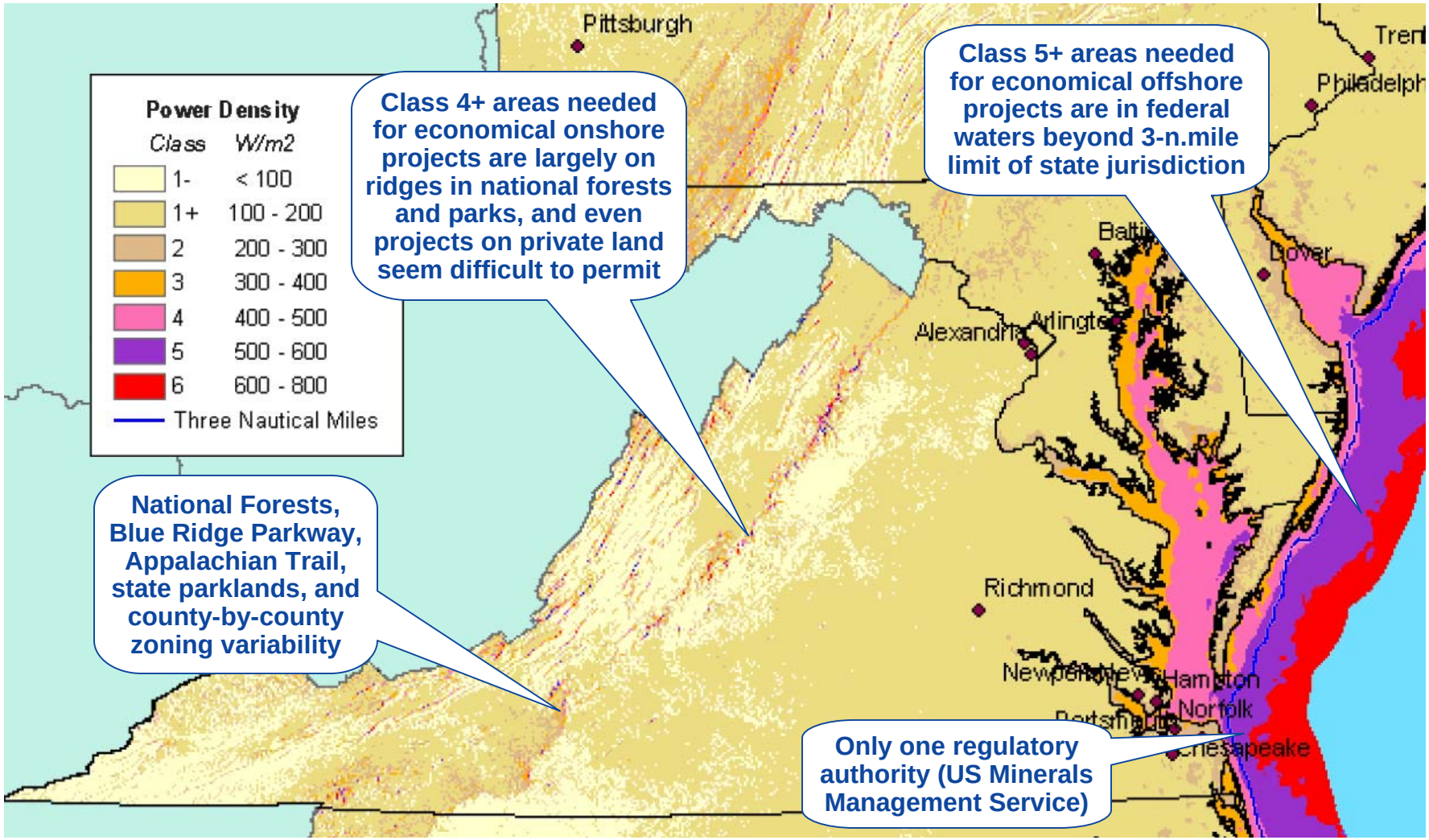
North Hoyle, UK

Ocean Waves



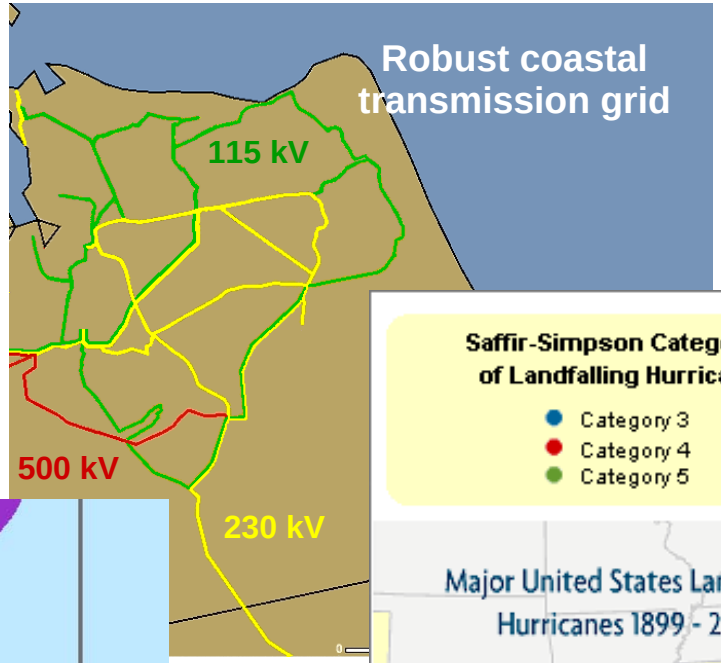
Stromness, UK

Virginia's Offshore Wind Potential is Vast

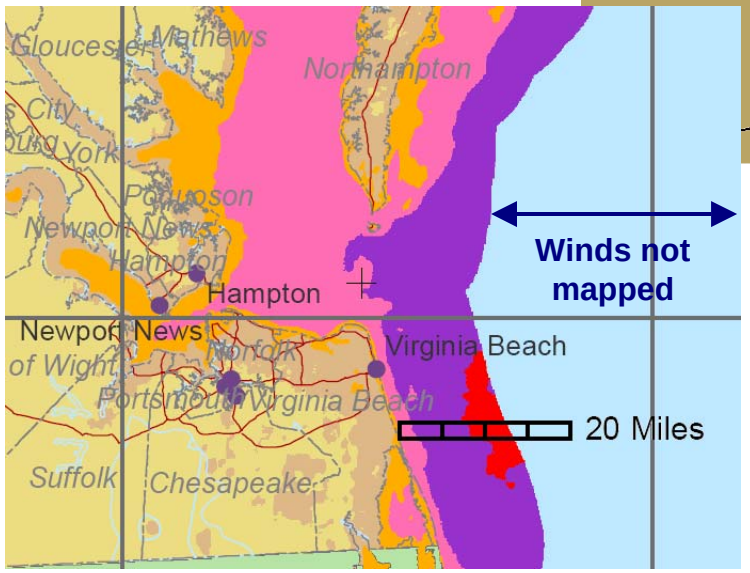


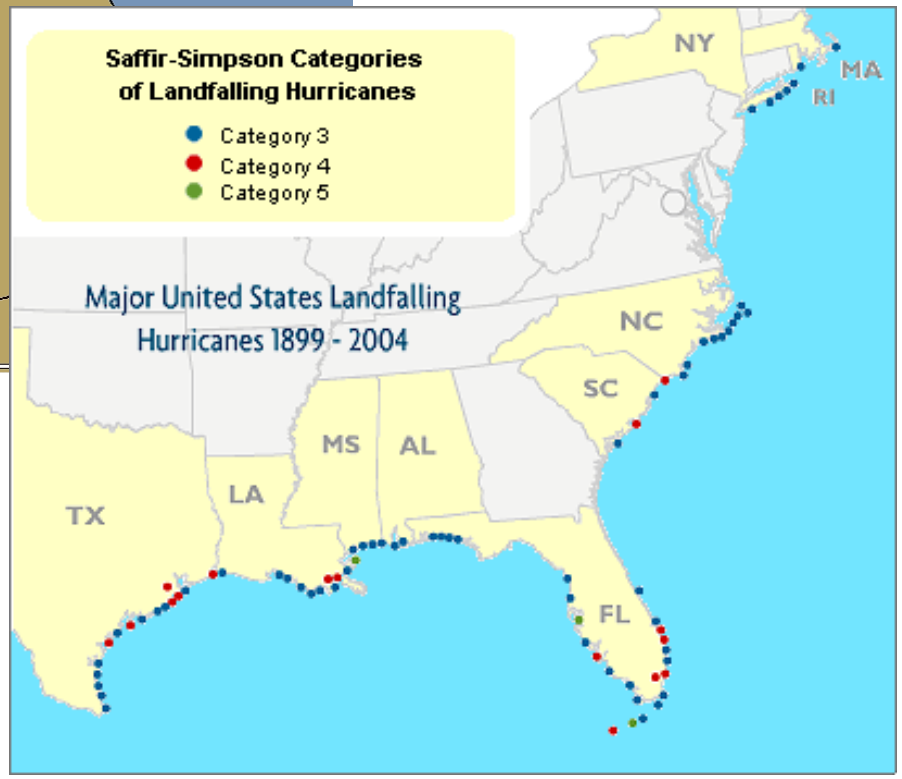
Virginia has Unique Features Favorable to Offshore Wind Power

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

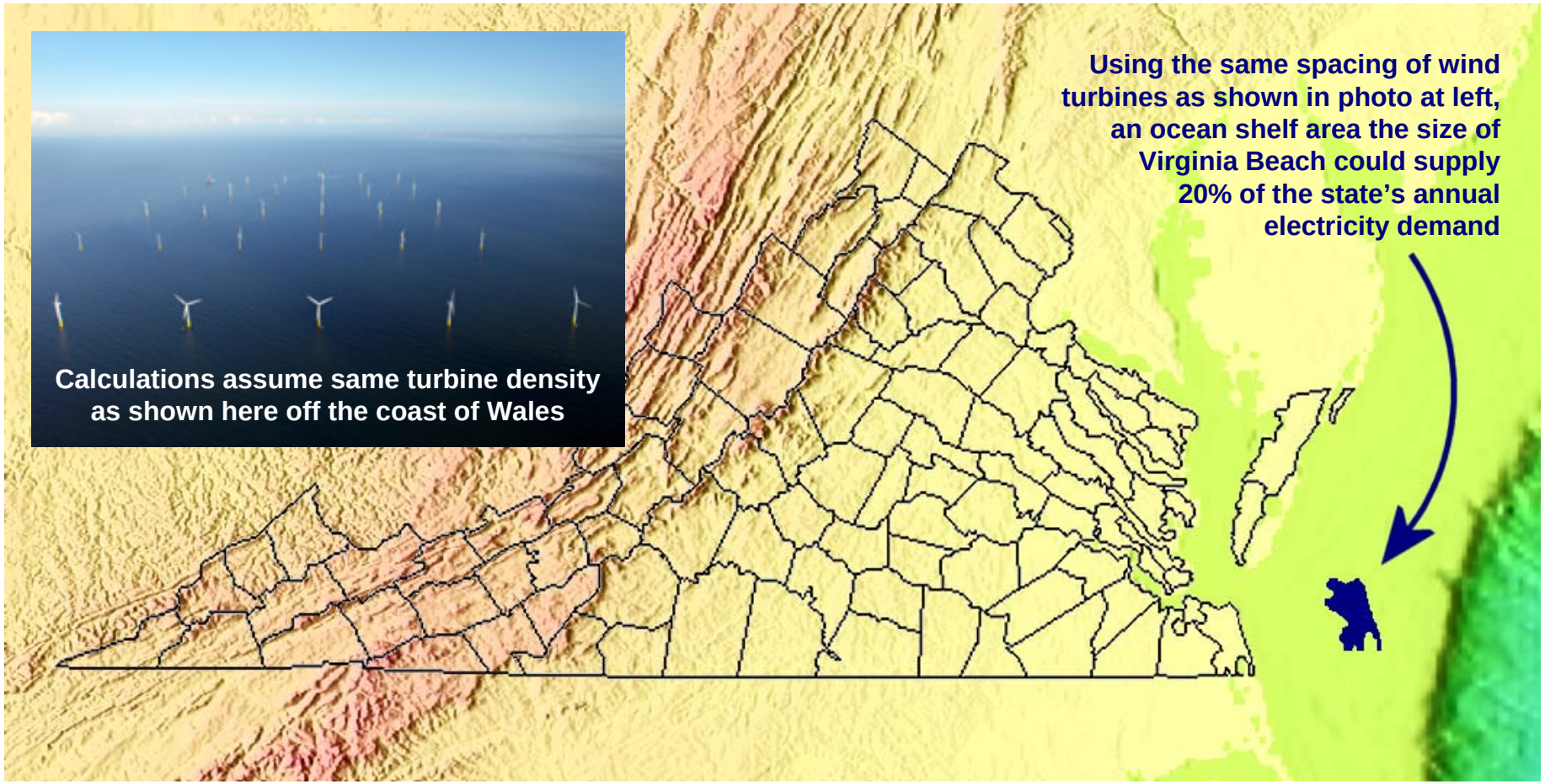


Minimal probability of major hurricane strike (Categories 3 through 5)





Offshore Wind Can Meet a Large Portion of Virginia's Energy Demand



Wind turbines installed at a density of 10 MW per sq.km in an ocean area of 640 sq.km could produce 21,000 GWh/yr, compared with state consumption of 104,200 GWh/yr.

Visual Impact can be Mitigated by Siting Turbines Farther Offshore

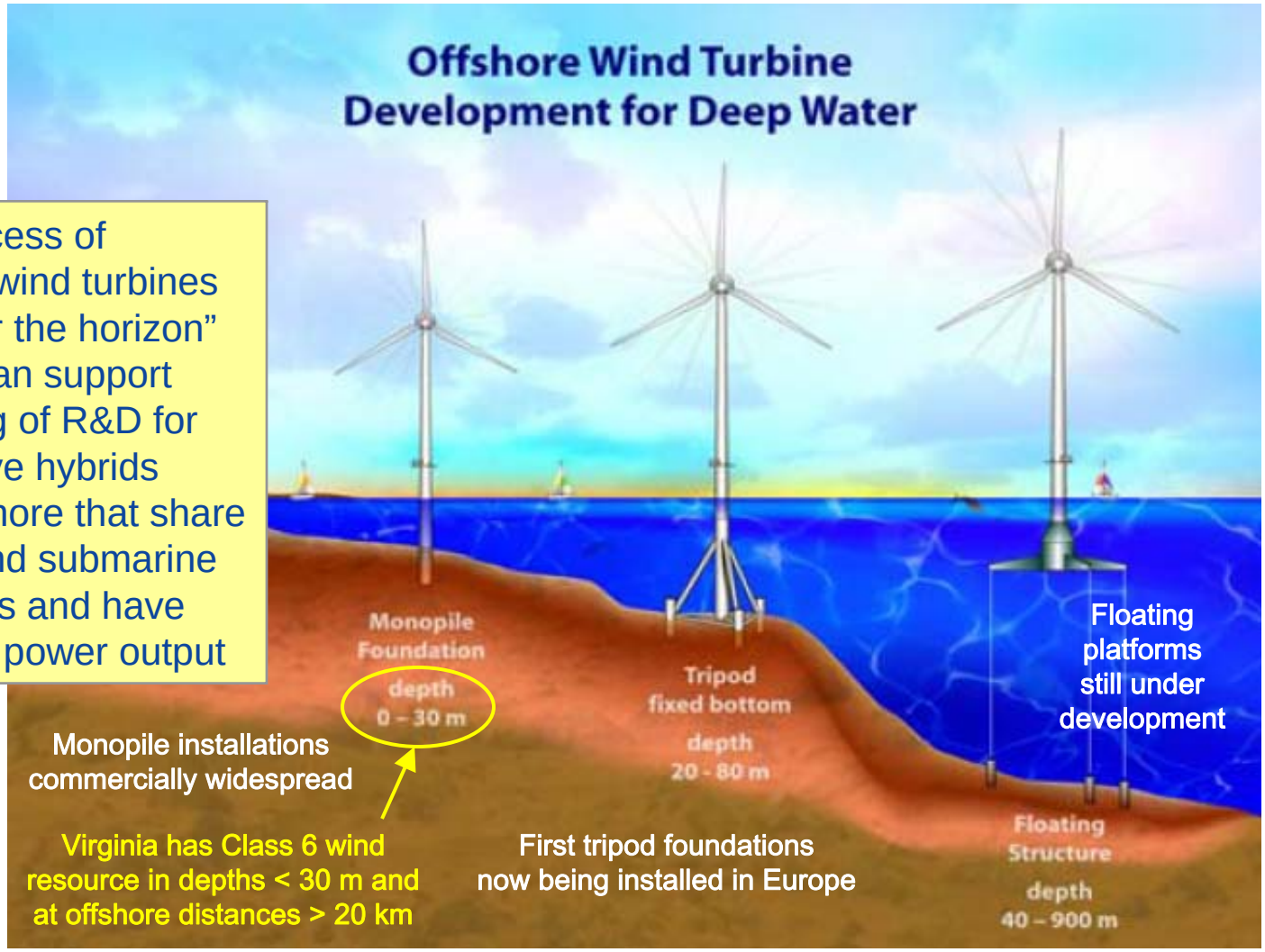
Natural sea haze and humidity, more common during summer tourist season, will obscure horizon details

Meteorological Optical Range Table		
Code No.	Weather	Distance
0	Dense fog	Less than 50
1	Thick fog	50 - 200 yards
2	Moderate	200 - 500 yards
3	Light fog	500 - 1000 yards
4	Thin fog	.5 - 1.0 nm
5	Haze	1.0 - 2.0 nm
6	Light Haze	2.0 - 5.5 nm
7	Clear	5.5 - 11.0 nm
8	Very Clear	11.0 - 27.0 nm
9	Exceptionally Clear	Over 27.0

Photo simulation for Long Island offshore wind project suggests negligible visual impact beyond 11 n.mi (20 km)

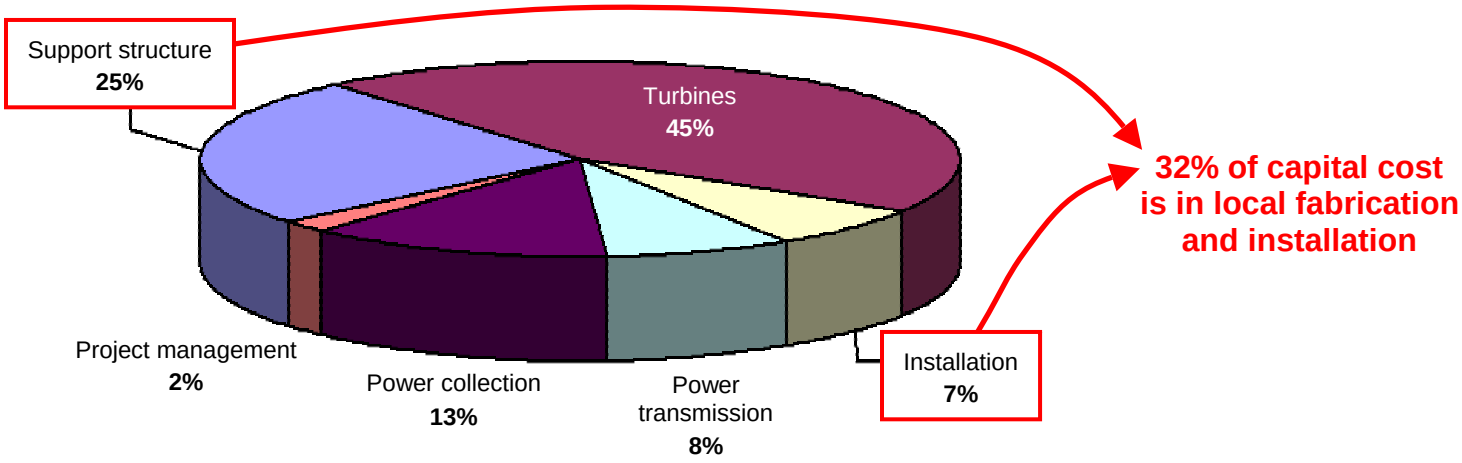
Virginia Continental Shelf Offers Path to Floating Hybrid Installations

Commercial success of monopile-based wind turbines in Virginia's "over the horizon" shallow waters can support corporate funding of R&D for floating wind-wave hybrids even farther offshore that share same platform and submarine power cable costs and have more continuous power output



Sustainable New Maritime Business Potential of $150-200 Million per Year

Typical capital cost breakdown for monopile-based offshore wind project



Estimated maritime industry value of fabrication, installation, and service contracts to supply 20% of Virginia's electricity:

- **Total installed turbine capacity = 6,500 MW**
- **At $1,600 per installed kW, total capital investment = $10.4 billion**
- **Assuming an installation rate of 325 MW per year= $520 million per year over 20-year build-out**
- **Value of local fabrication and installation contracts = $166 million per year <u>until</u> fully built out**
- **Value of local offshore service contracts (at $30/kW/yr) = $195 million per year <u>after</u> fully built out**

Accomplishments

Oct, 2005: SAIC initial presentation to JCOTS Advisory Committee

Jan – Mar, 2006: SAIC and VT-ARI estimate potential energy and economic development benefits of Virginia's offshore wind resource as rationale for establishing university-industry-state partnership to conduct research necessary for potential benefits to be realized

Mar – Sep, 2006: SAIC presents these findings to key state legislators and the Secretaries of Commerce, Technology, Natural Resources, and Education, as well as the Governor's staff

May, 2006: Virginia Energy Plan legislation (S262) enacted, establishing the Virginia Coastal Energy Research Consortium (VCERC), but there is ***no state funding provided*** (all efforts this year internally funded)

Jun - Aug, 2006: SAIC meets with U.S. Navy Atlantic Command to explore possibility of offshore wind energy projects co-existing with military training and exercise areas off Virginia; preliminary results are encouraging

Accomplishments (continued)

Sep, 2006: U.S. Representative Thelma Drake convenes field hearing at Old Dominion University, inviting VCERC industry representative (from SAIC) and university representatives (from ODU and VT-ARI) to testify on marine renewable energy issues before the House Subcommittee on Energy and Mineral Resources

Oct, 2006: VCERC university partners collaboratively develop and propose $1.95 million VCERC implementation budget through Secretary of Education for Governor to submit with higher education budget request

Oct – Dec, 2006: JMU leads and VT-ARI supports development of collaborative proposal for a large-blade test facility near Hopewell, VA, in response to competitive CRADA solicitation from National Renewable Energy Laboratory; award announcement anticipated by 31-Dec-2006

Dec, 2006: SAIC updates JCOTS on activities and requests support for VCERC implementation funding

VCERC Established as a University–Industry–State Partnership

Virginia Coastal Energy Research Consortium

Mechanical, electrical, materials, civil, and ocean engineering

Washington, DC area presence

Physical, chemical, & geological ocean sciences

Biological ocean sciences

Wind energy engineering

Renewable energy curriculum development

High-tech workforce training

Entrepreneurship development

Non-University VCERC Directors

Integration of marine renewables into Virginia Energy Plan

Ensuring compatibility with other marine uses and coastal resources

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

Identification of waterfront development opportunities

State Support Now Needed for Enabling Research

University studies to establish baseline knowledge and identify gaps as research priorities

- Offshore physical and geological environment
- Potential environmental effects
- Other uses of sea space (stakeholder involvement is critical)

Integration with long-term energy planning

- Utility grid interconnection and intermittency issues for power generation
- Offshore “wind to wheels” study of potential for increasing transportation energy security via plug-in hybrid vehicle recharging

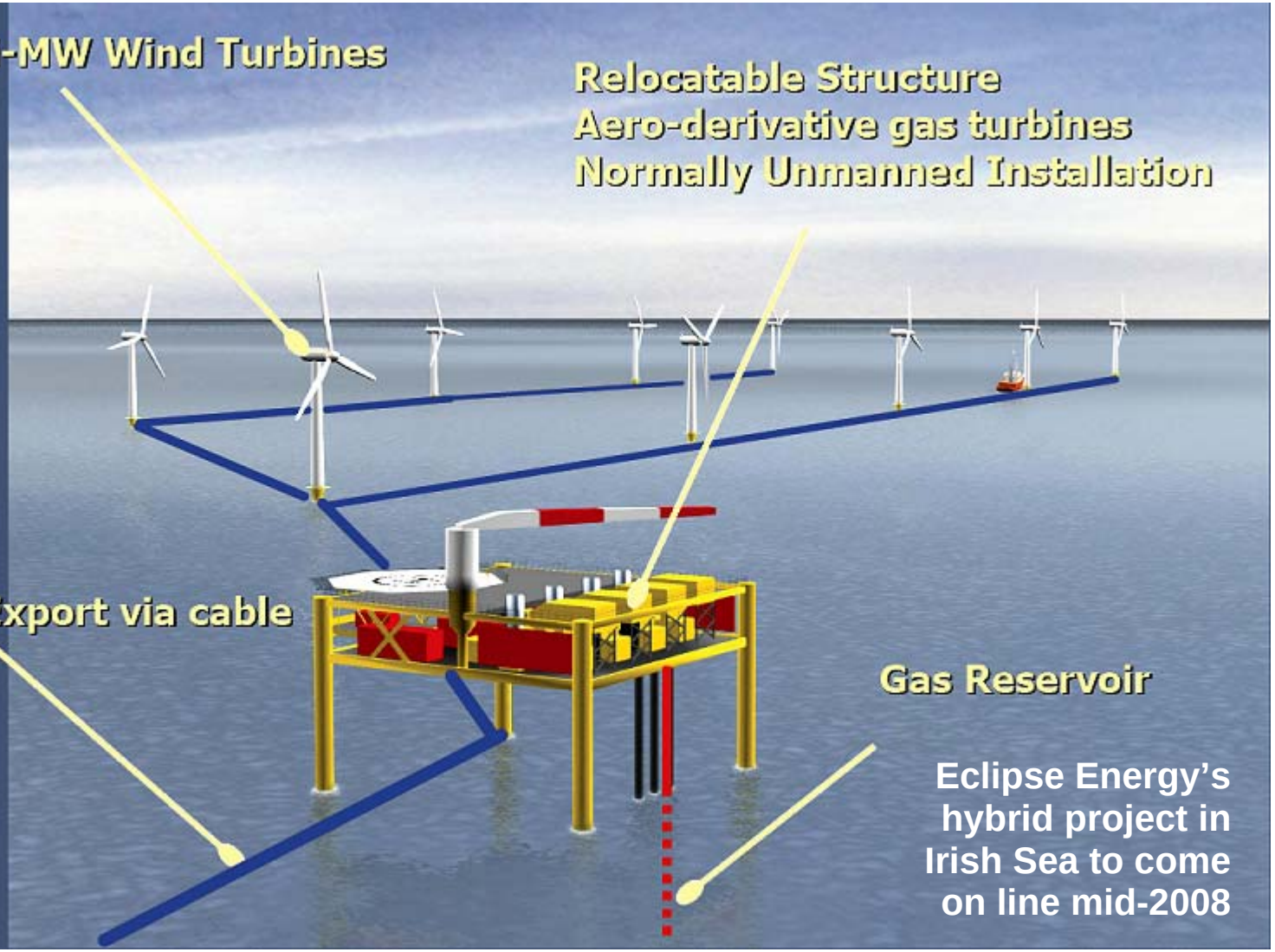
Industry support

- SAIC Maritime Operations – lead systems integrator
- Shipyards provide independent fabrication cost and production analysis

Hybridizing Marine Renewables with Offshore Gas for Baseload Power

ADVANTAGES:

- Provides high-value baseload power
- Avoids utility need for land-based "spinning reserve" to accommodate wind variability
- Submarine power cable to shore more secure, with less environmental impact than gas pipeline
- Avoids onshore siting challenge of finding cooling water for land-based gas power plants
- Prolongs offshore gas reservoir life to bridge into marine biogas era



Eclipse Energy's hybrid project in Irish Sea to come on line mid-2008

Summary

Energy and economic benefits to Virginia

- Credible prospects for supplying 20% of Virginia's electricity demand
- Credible prospects for $150-200 million in new maritime business
- Enabling research needs state funding to realize these benefits

Potential to attract corporate research funding

- JMU and VT-ARI collaboration on proposal to build and operate large-blade testing facility for offshore wind turbine industry
- VT-ARI funded by Arlington-based Verdant Power to support tidal current resource studies addressing export market

Potential to attract large-scale federal funding

- ARPA-E demonstration project funding opportunity
- Hybridization with offshore gas production as fossil fuel bridge to sustainable marine biogas production for baseload offshore power