Purchasing Offshore Wind Power: When will it be possible and how much will it cost?

2011 Annual Meeting

Virginia Energy Purchasing Governmental Association (VEPGA)

Richmond, VA

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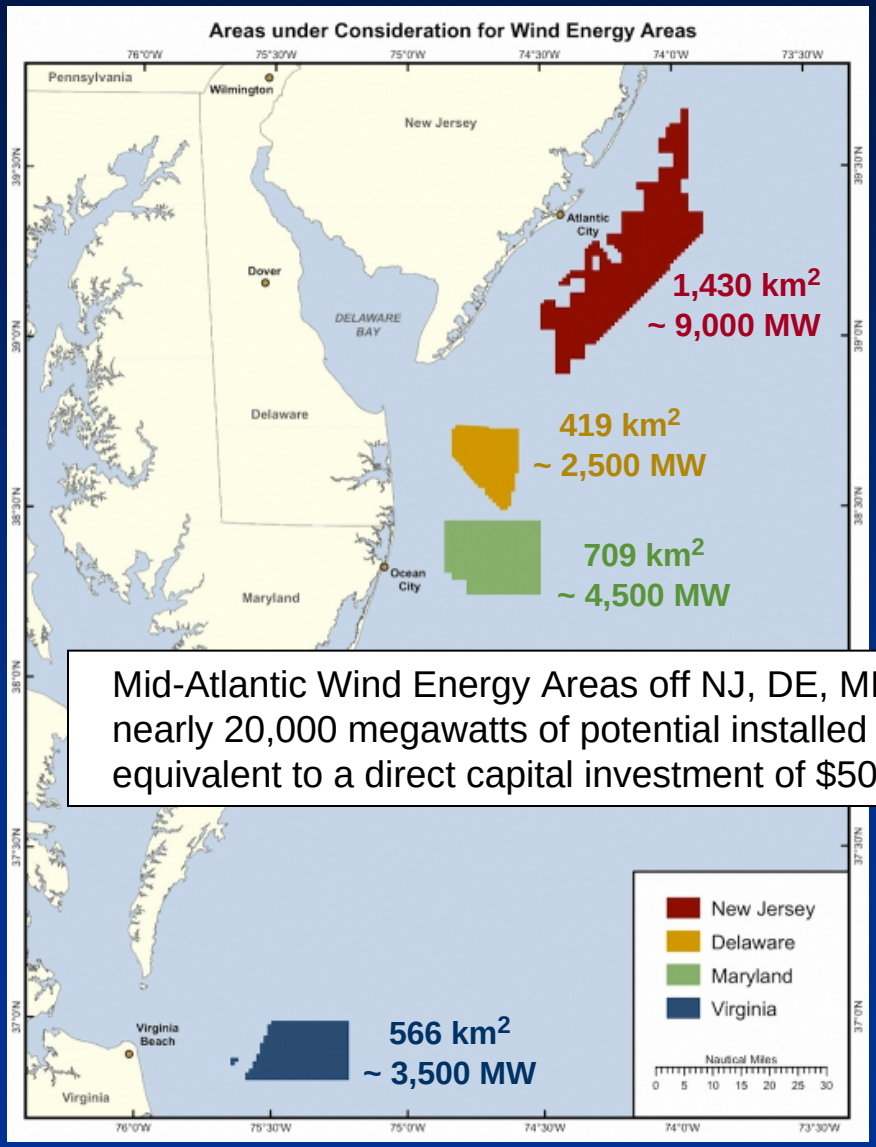
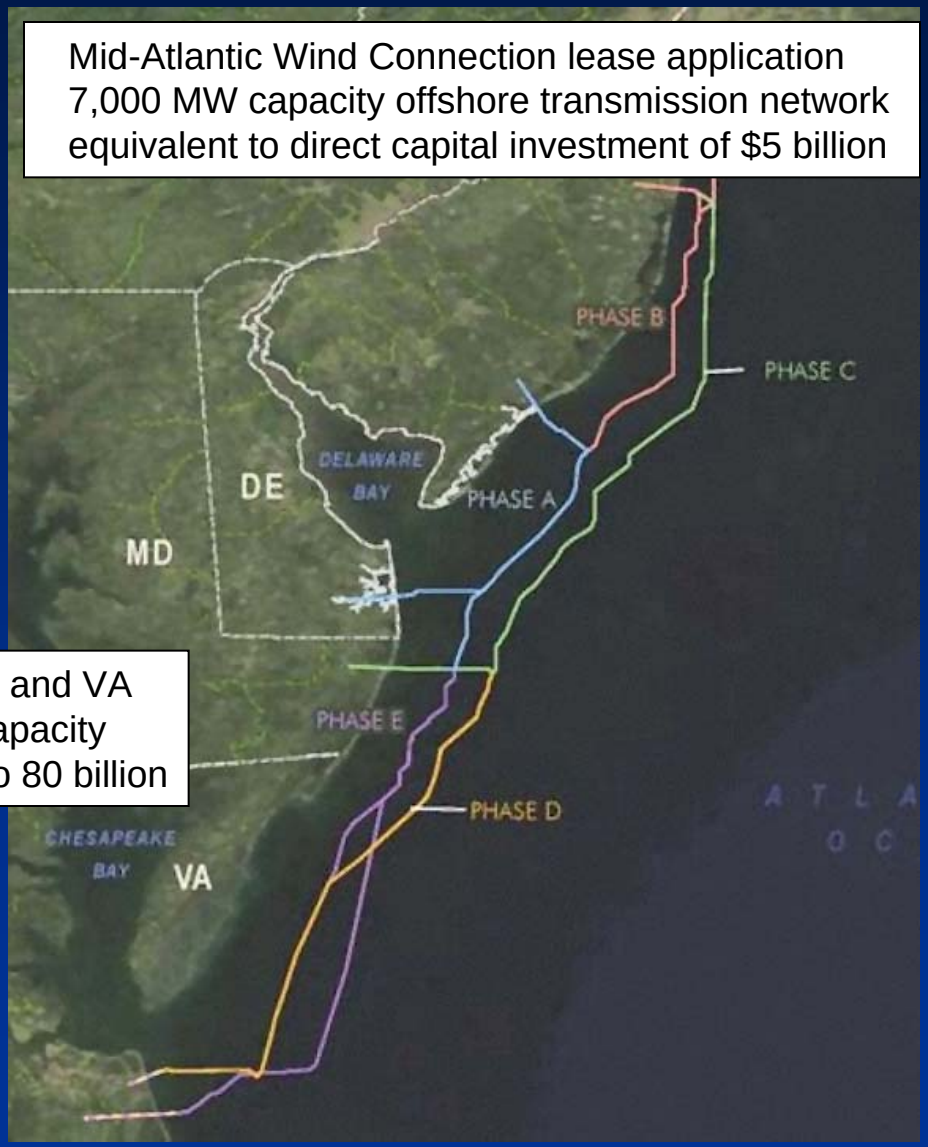
US Commercial Offshore Wind Prospects

US Offshore Wind Projects		
Project	**State**	**MW**
Cape Wind	MA	468
Hull Municipal	MA	15
Buzzards Bay	MA	300
Rhode Island	RI	400
New Jersey	NJ	350
NRG Bluewater	DE	350
Southern Company	GA	10
W.E.S.T.	TX	150
Cuyahoga County	OH	20
TOTAL		2,068

Mid-Atlantic Offshore Wind Potential Lease Areas



Mid-Atlantic Wind Energy Areas off NJ, DE, MD, and VA nearly 20,000 megawatts of potential installed capacity equivalent to a direct capital investment of $50 to 80 billion



Development of Greater Gabbard: 504 MW (UK)

December 2003
•Fluor/Airtricity JV awarded 500MW Greater Gabbard Offshore Wind Farm Project

Greater Gabbard Offshore Winds Ltd

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•Grid Connection Offer received from National Grid for connection at Sizewell, Suffolk

October 2005
•Consents application submitted

February 2007
• All onshore and offshore consents received
• Siemens selected for wind turbines

May 2008
•Financial Close & Notice to Proceed

October 2003
•Bids submitted for UK Round 2

Airtricity FLUOR

2004
•Conceptual design
•Offshore Site Surveys
•Environmental
•Geophysical

September 2005
•Met Mast installed

Summer 2006
•Offshore geotechnical survey

October 2007
•Project definition completed
•Estimate prepared

FLUOR®

From lease award to construction start = 4.5 years

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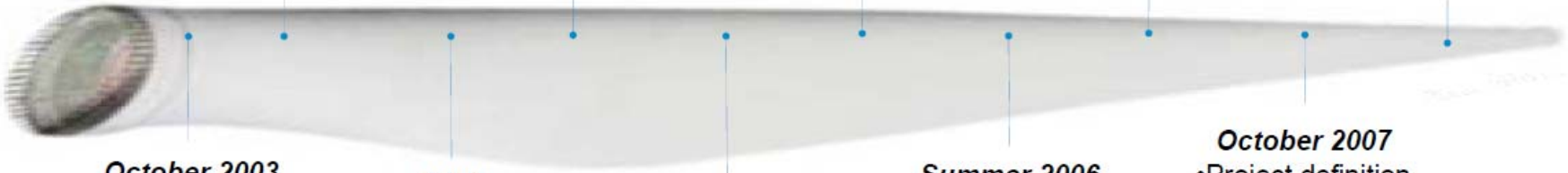

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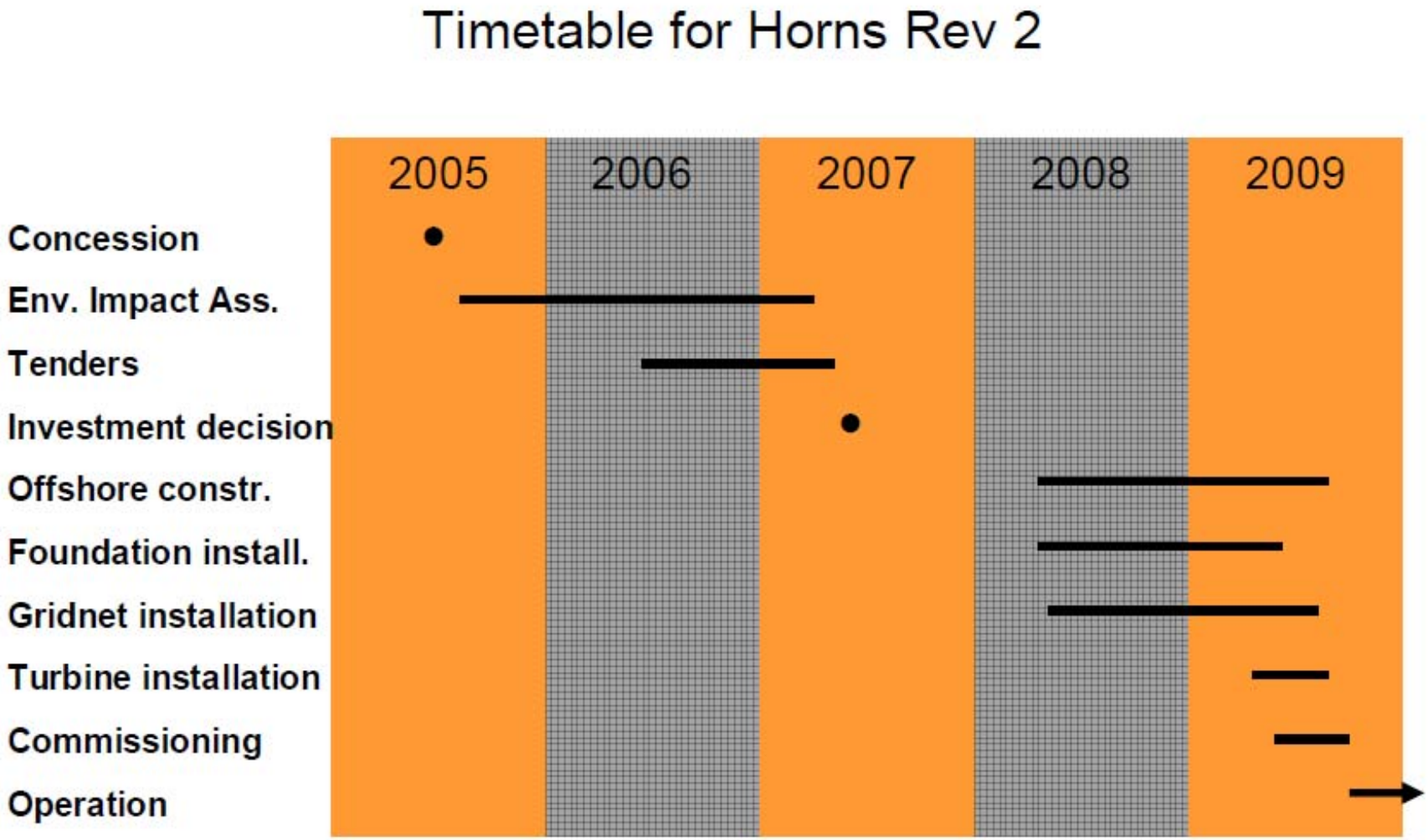
Construction Timetable

Onshore work starts: mid-2008
Offshore work starts: mid-2009
First phase power: mid-2010
Full project power: end 2011

FLUOR®

From construction start to full project power = 2.5 years

Development of Horns Rev II: 209 MW (Denmark)

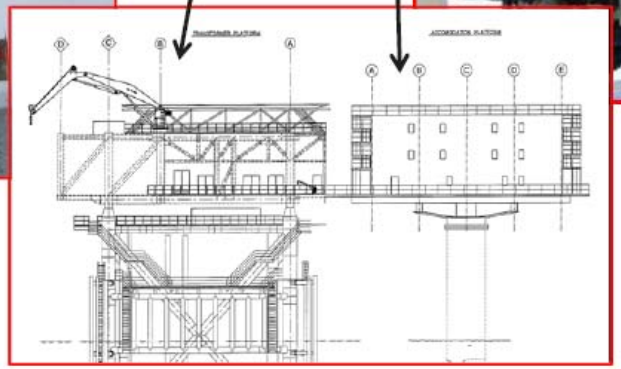


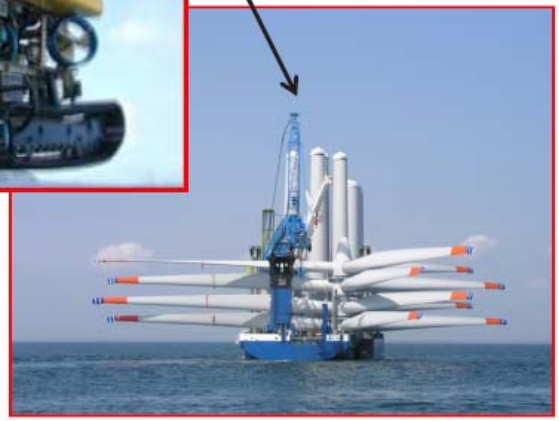
From lease award to construction start = 2.5 years

Construction of Horns Rev II: 209 MW (Denmark)

Horns Rev 2 – Plan for construction

Task Name	2009												2010											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Start of marine works	◆ 19-04																						
Foundation installation																							
Internal grid installation																							
Transformer installation																							
Accomodationplatform installation																							
Commissining of Transformer														◆ 01-05									
Turbine installation																							
Commissioning																							
Final take over																						◆ 15-01	





From construction start to fully commissioned = 1.5 years

DONG energy

Dominion Meets Approximately a Third of its Demand by Purchasing Wholesale Power in PJM

6,038
substations

KEY STATISTICS

PJM member companies	550+
millions of people served	51
peak load in megawatts	144,644
MWs of generating capacity	164,895
miles of transmission lines	56,499
GWh of annual energy	729,000
generation sources	1,287
square miles of territory	168,500
area served	13 states + DC

26% of generation in
Eastern Interconnection

23% of load in
Eastern Interconnection

19% of transmission assets
in Eastern Interconnection

19% of U.S. GDP produced in PJM

NERA Study of Fossil Generation Portfolio in PJM

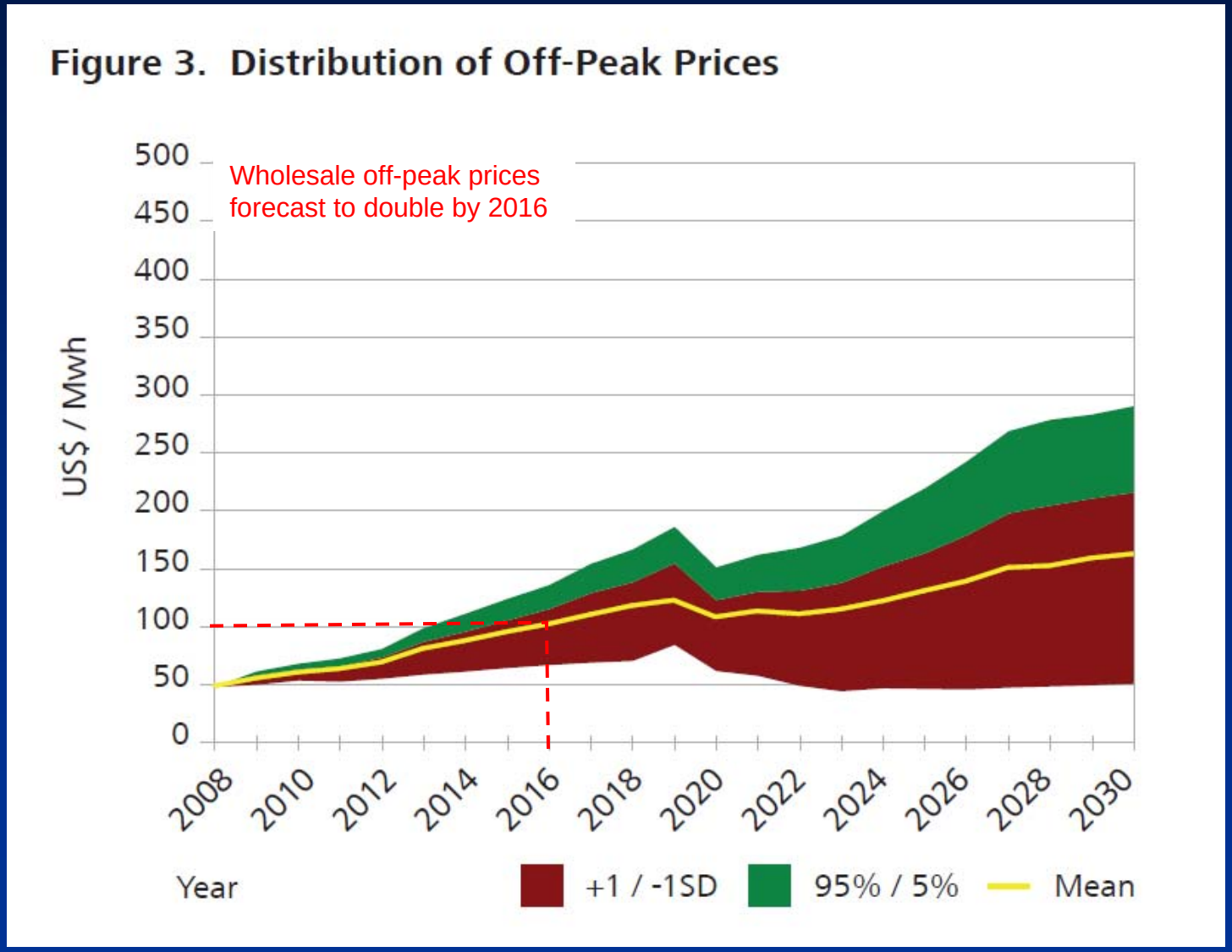
Virginia imports approximately one-third of the power needed to meet state-wide demand from the PJM regional market.

When might offshore wind provide stably priced energy at a cost that is competitive with purchased wholesale power in PJM?

Case Study

The following case study highlights our assessment process for an actual portfolio of coal-fired and gas-peaking plants located in the PJM region. On a MW basis, the existing portfolio consists of approximately two-thirds coal-fired assets and one-third peaking assets. Our case study incorporates uncertainty related to fossil fuel prices, RPS standards, greenhouse gas regulations, load growth and power plant replacement costs. In the case study, each of the key variables had three associated forecasts. This created 729 potential permutations or cases.

PJM Long-Term Electricity Price Forecast



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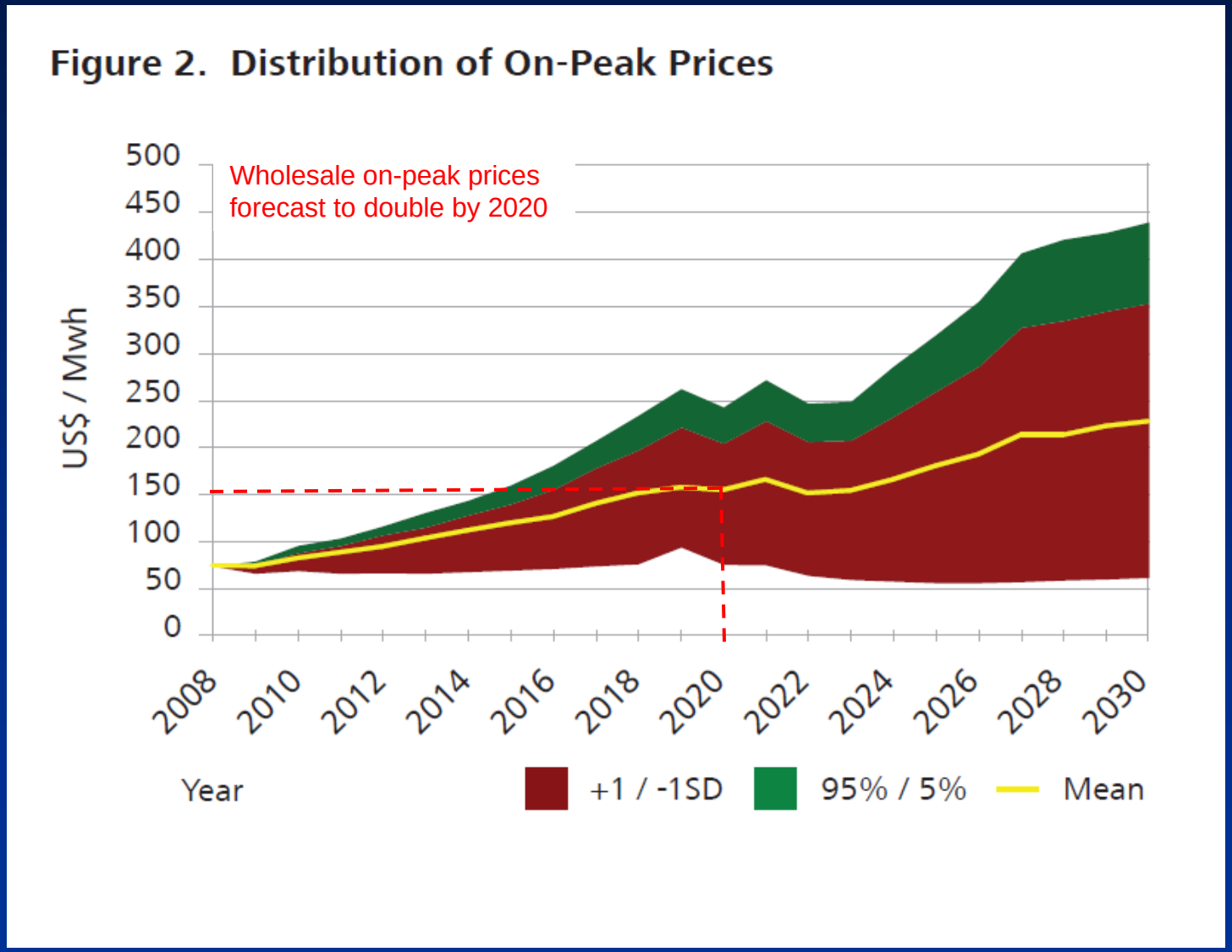
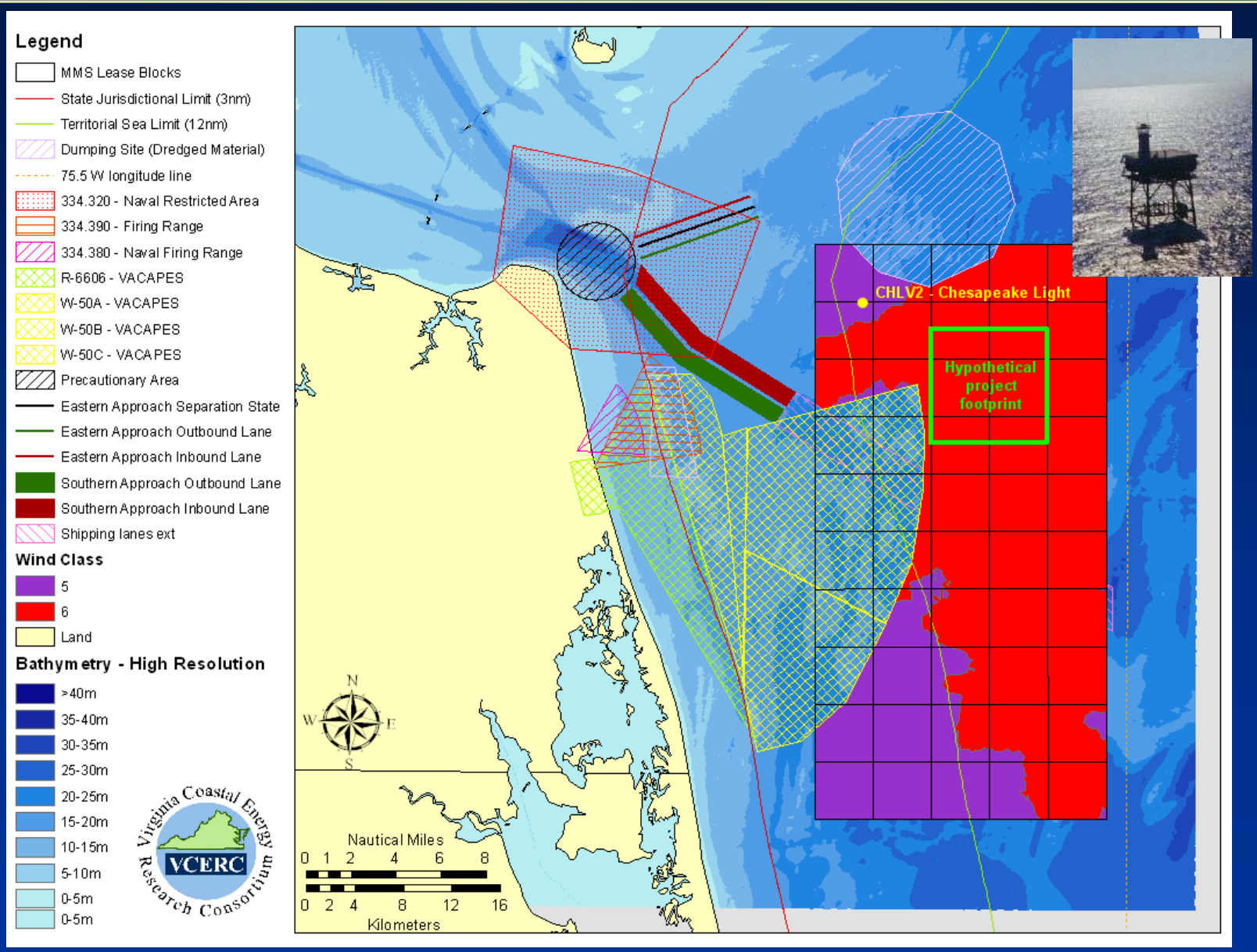


Hypothetical Offshore Wind Project Location for Cost & Performance Evaluation



Offshore Wind Project Cost Estimated by VCERC Cost Model

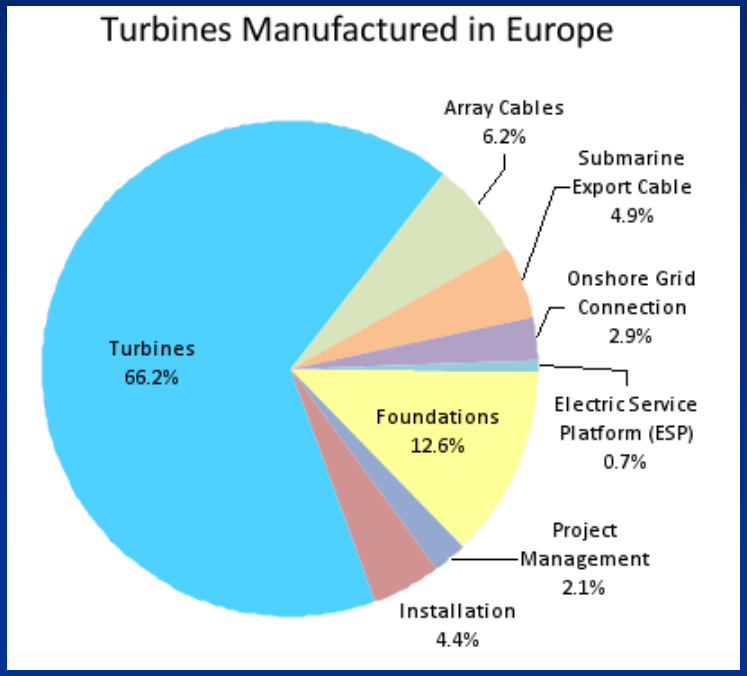
Capital cost estimated in March 2008 dollars using NREL parametric model for wind turbine & tower, Virginia maritime supplier bids for foundations & installation, and published data for balance of plant

- *Plant cost at offshore busbar: $ 1,763 million*
- *Transmission cost to Fentress: $ 153 million*
- *Total project investment: $ 1,916 million (~ $3,260 / kW)*

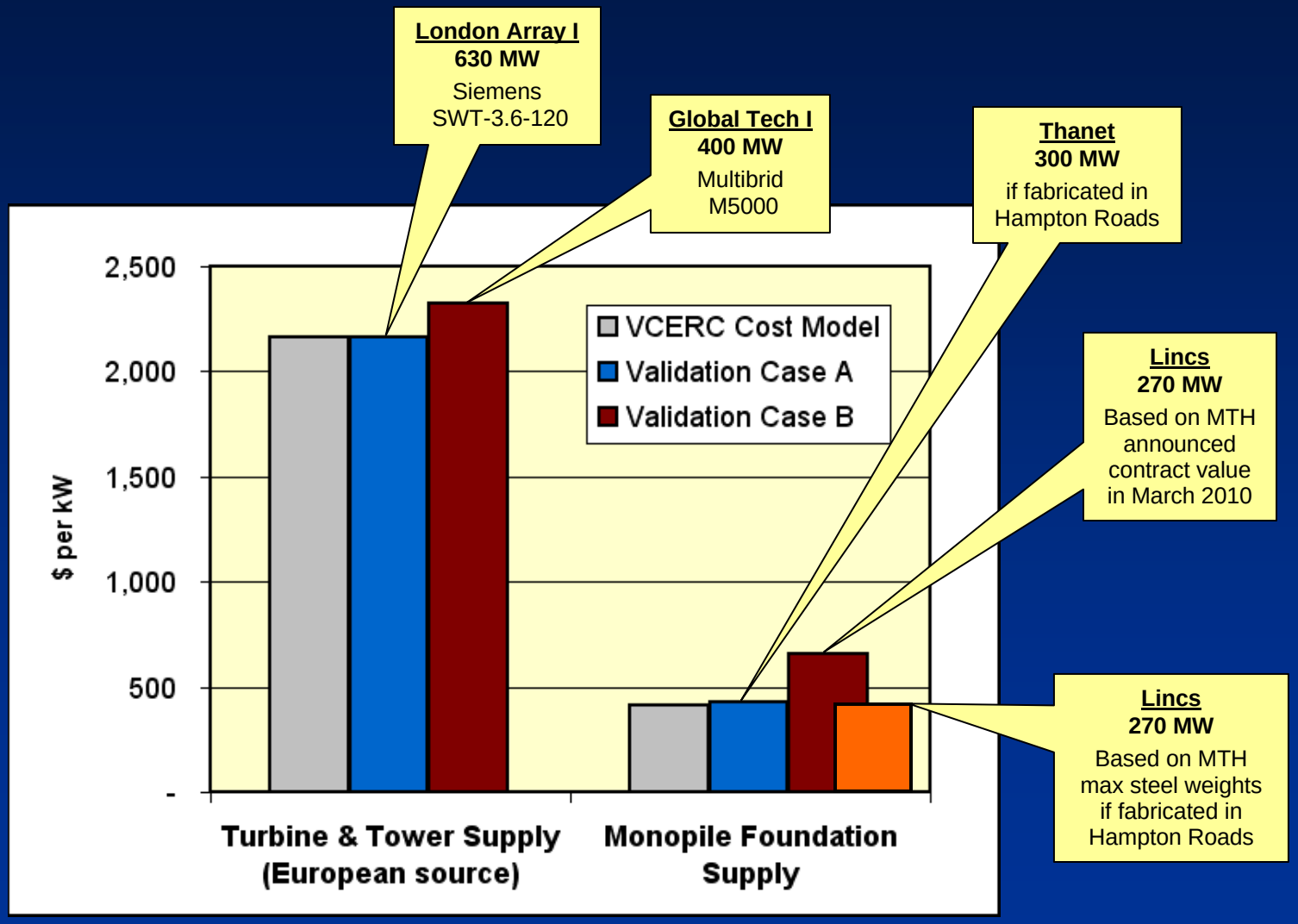
588 MW installed rated capacity *(7 x 7 turbines per lease block)*

38% annual capacity factor

20% PJM summer capacity factor *(JJA 3pm – 6pm)*



VCERC Modeled Capital Costs Compared with European Project Data for Major Cost Centers



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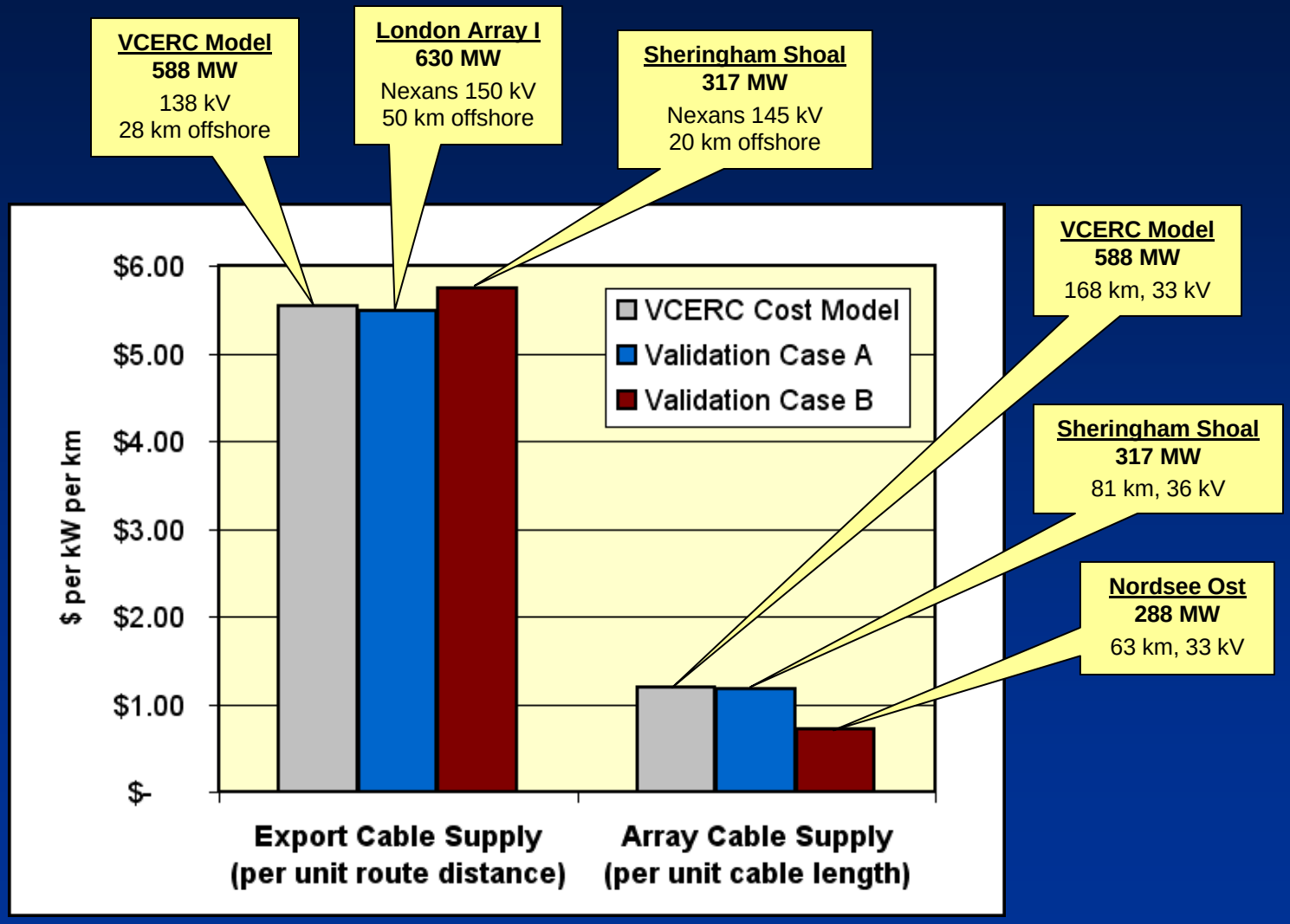
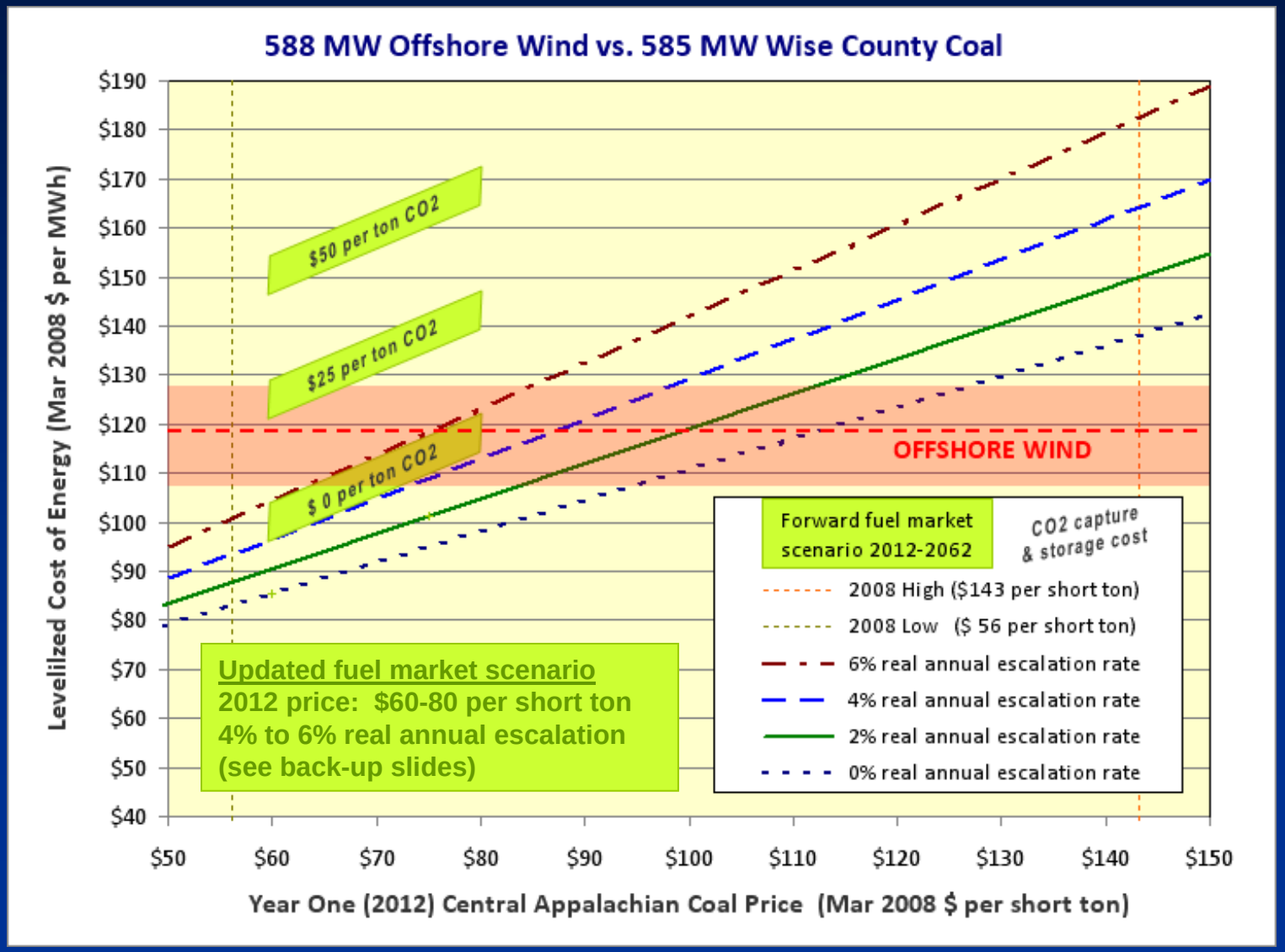


Cost of Energy Comparison Between Offshore Wind and New Coal-Fired Generation



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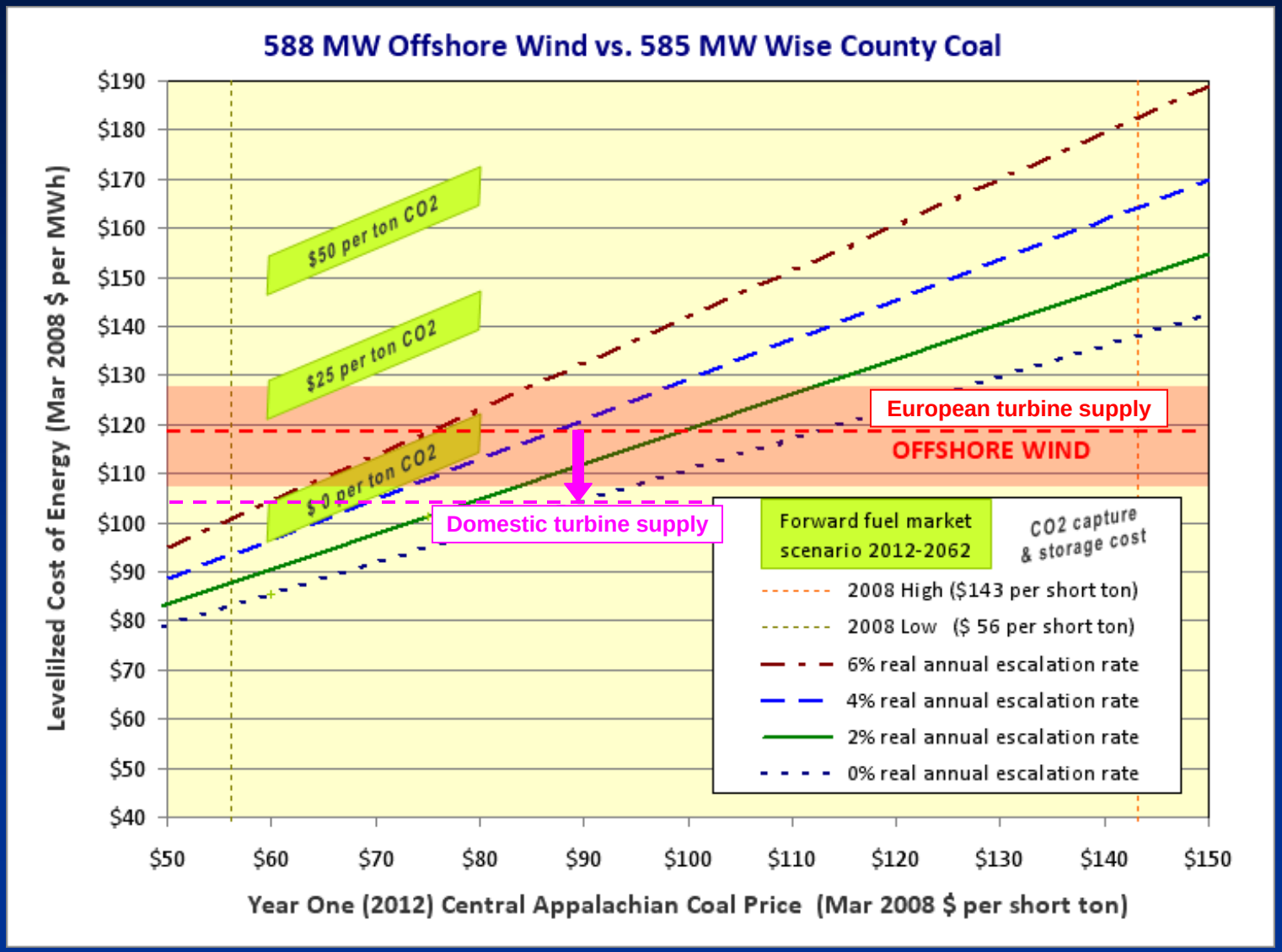
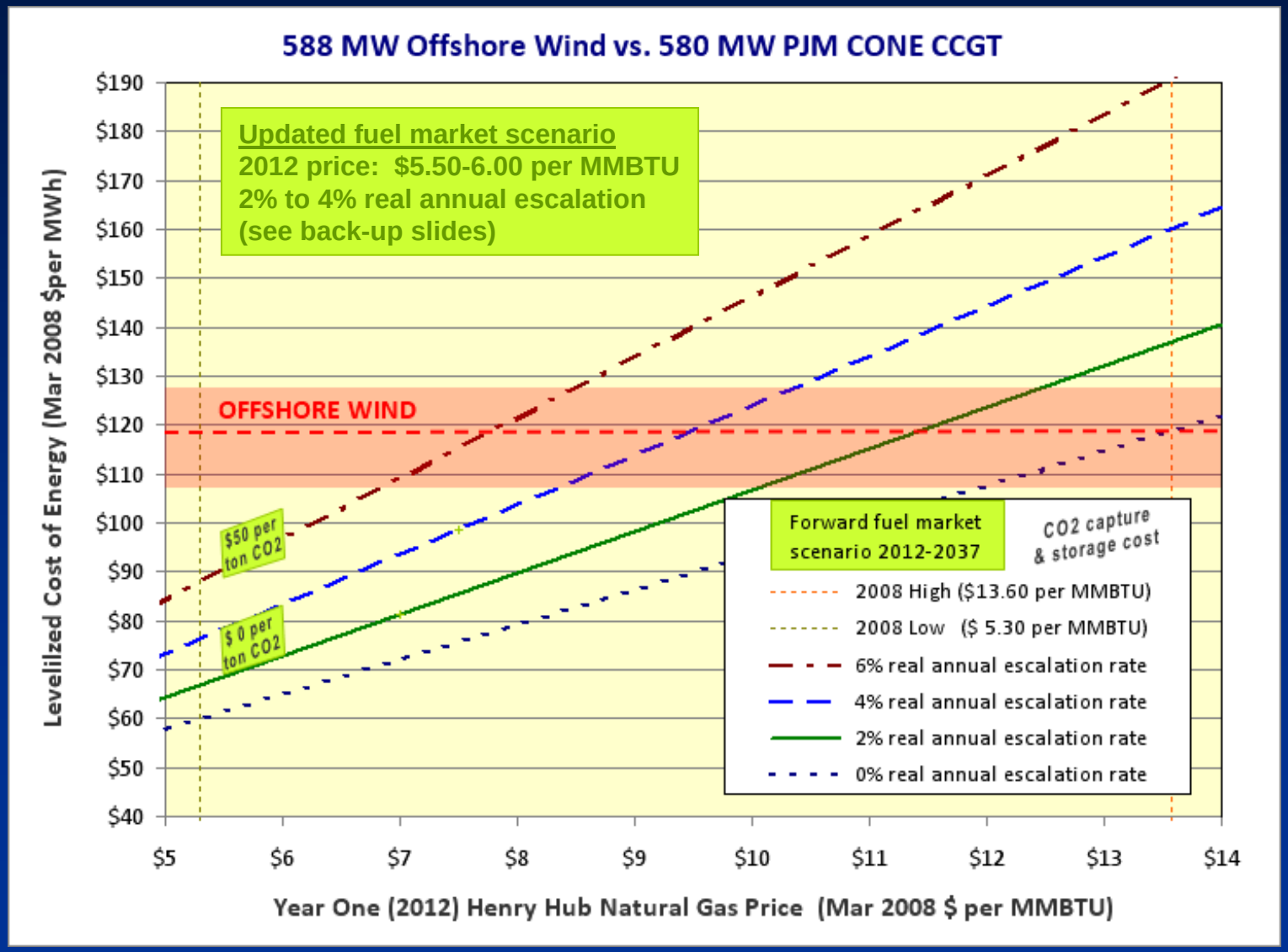


Cost of Energy Comparison Between Offshore Wind and New Gas-Fired Generation



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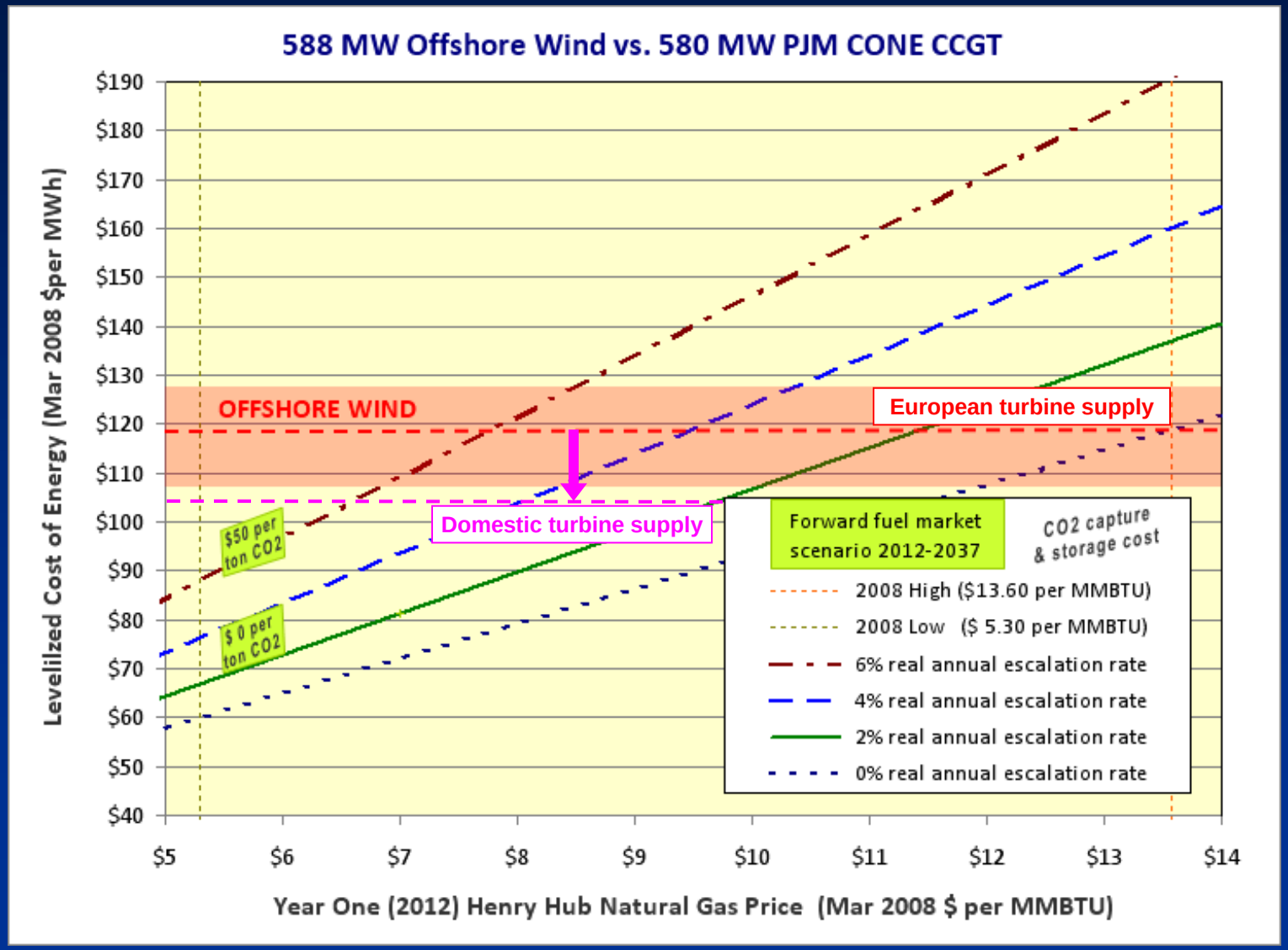
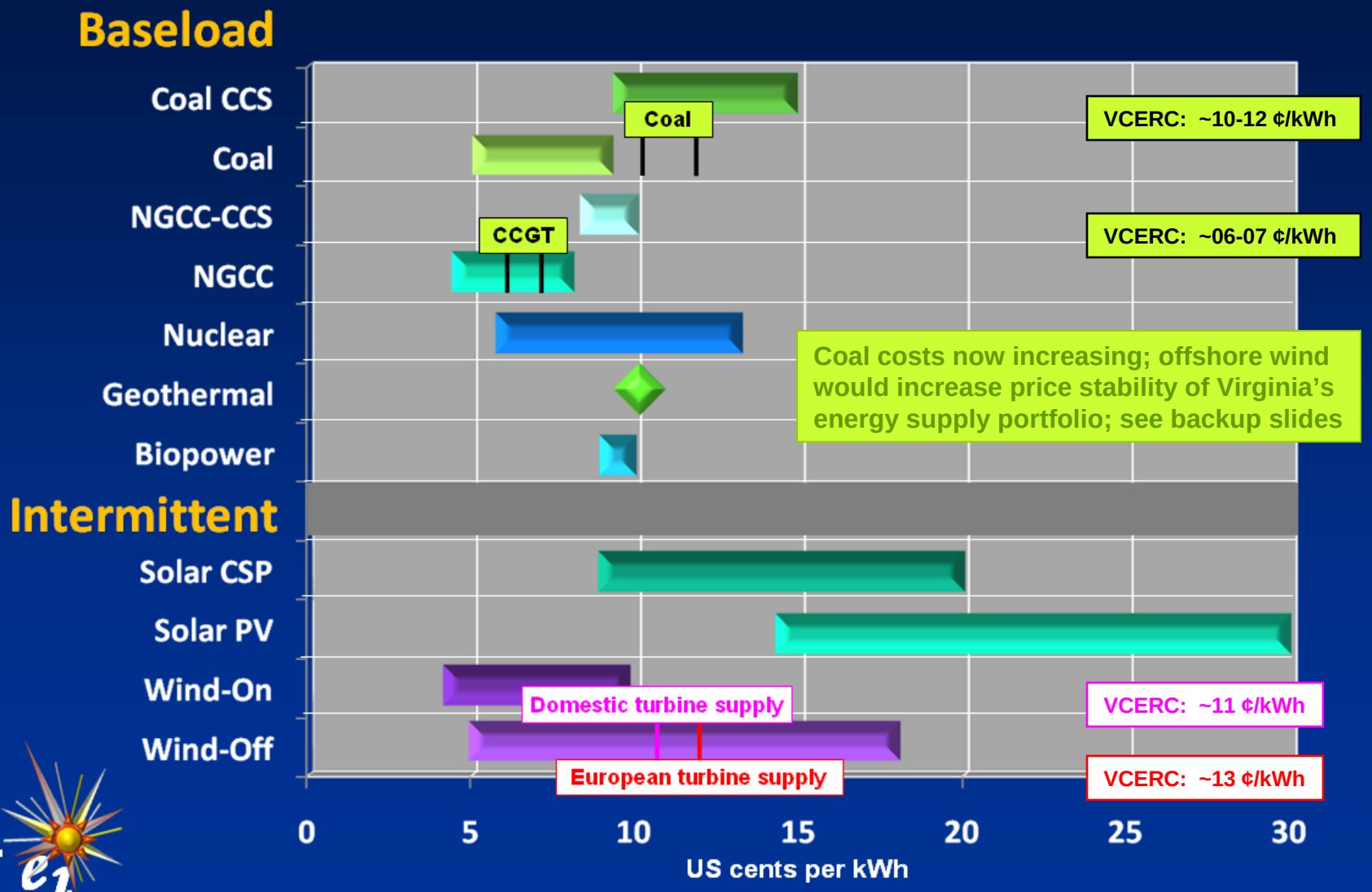


VCERC Results Compared with Recent National Academy of Sciences Study

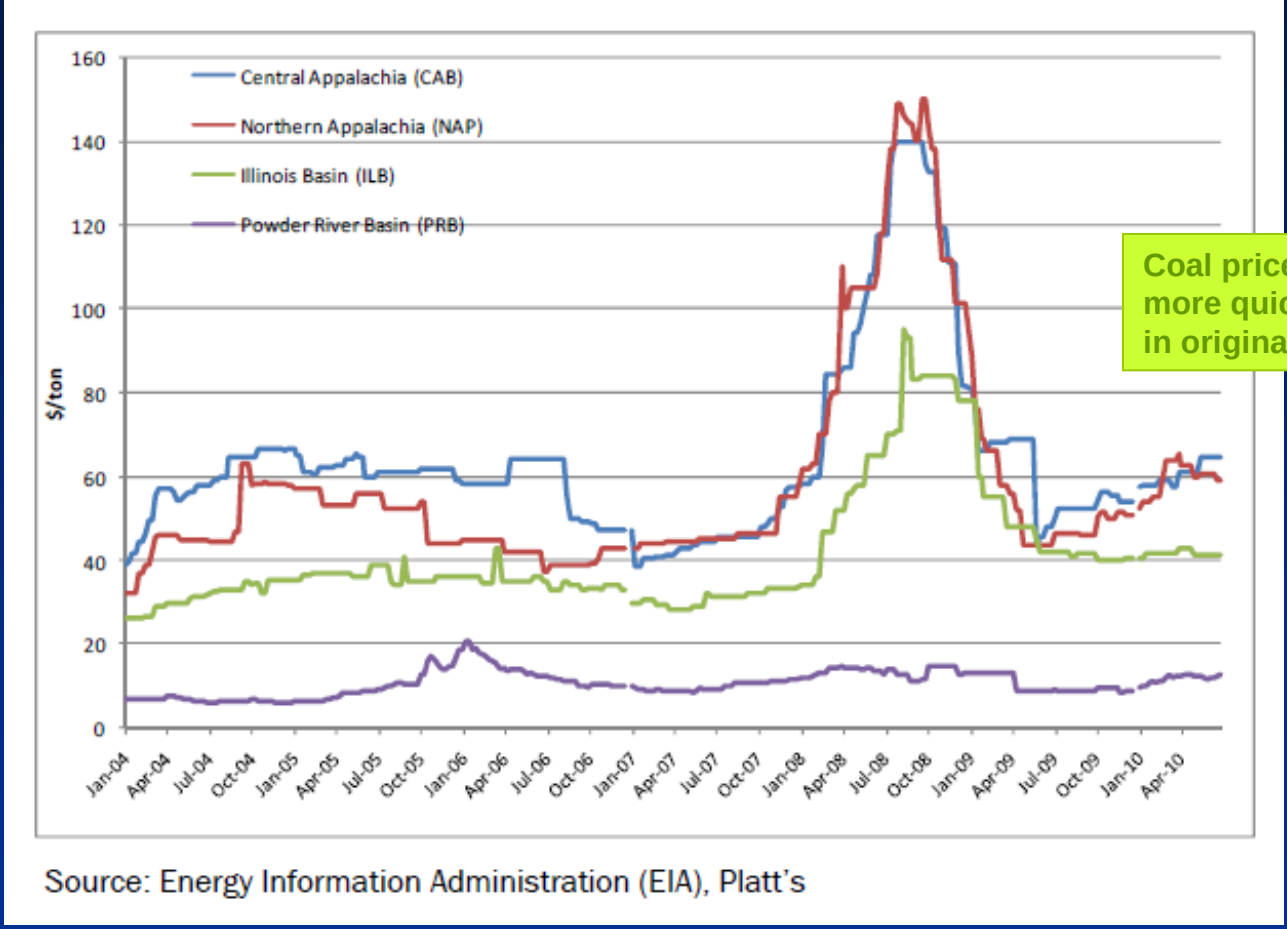


National Academy, America's Energy Future, 2009

Thank You!

Email: hagerman@vt.edu

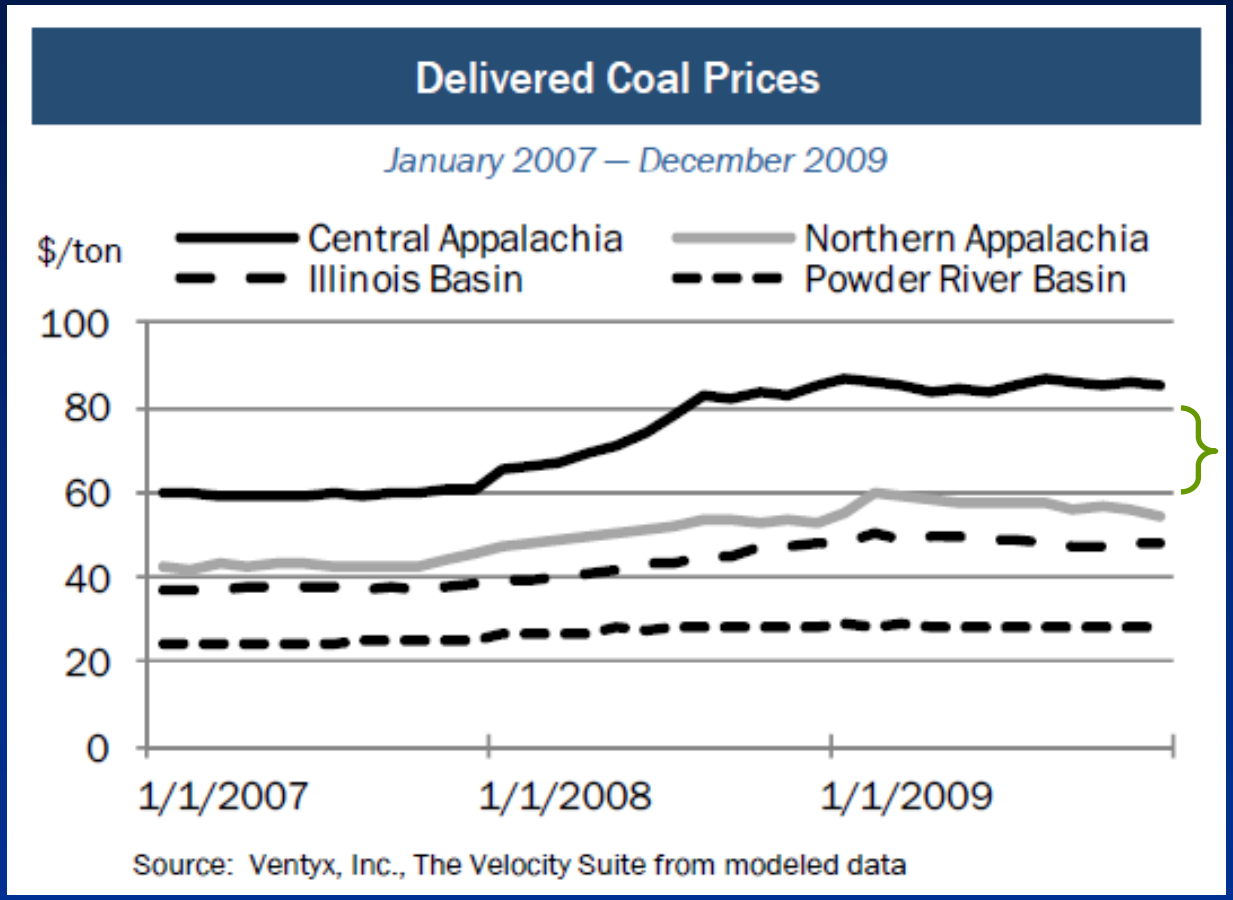
Historical Volatility in Coal Prices



Coal prices are rebounding more quickly than assumed in original VCERC report

Source: Edison Electric Institute: Q2 2010 Financial Update: Fuel (www.eei.org/whatwedo/DataAnalysis/IndusFinanAnalysis/Documents/2010_Q2_Fuel_Final.pdf)

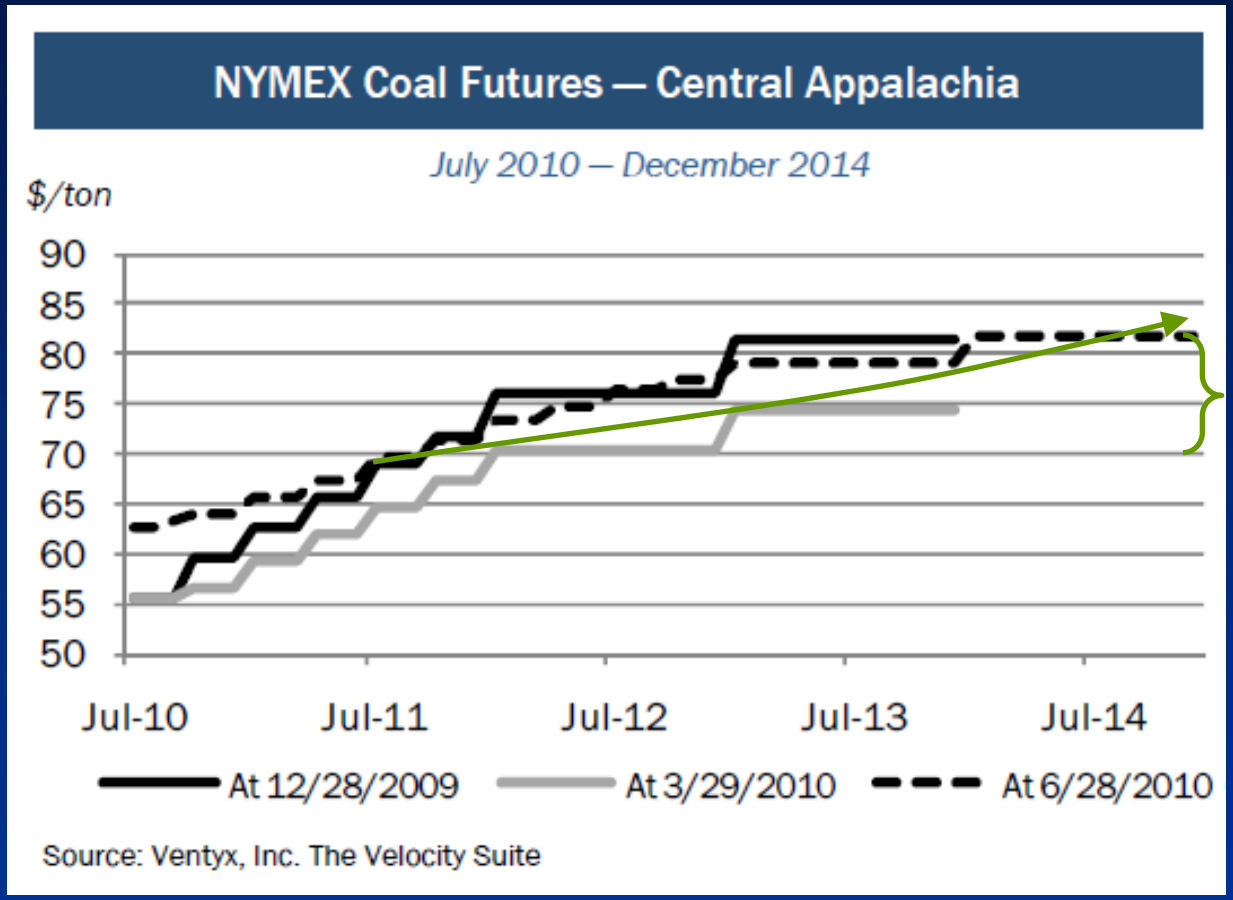
Recent Delivered Coal Prices



Assumed price range in first year (2012)

Source: Edison Electric Institute: Q2 2010 Financial Update: Fuel (www.eei.org/whatwedo/DataAnalysis/IndusFinanAnalysis/Documents/2010_Q2_Fuel_Final.pdf)

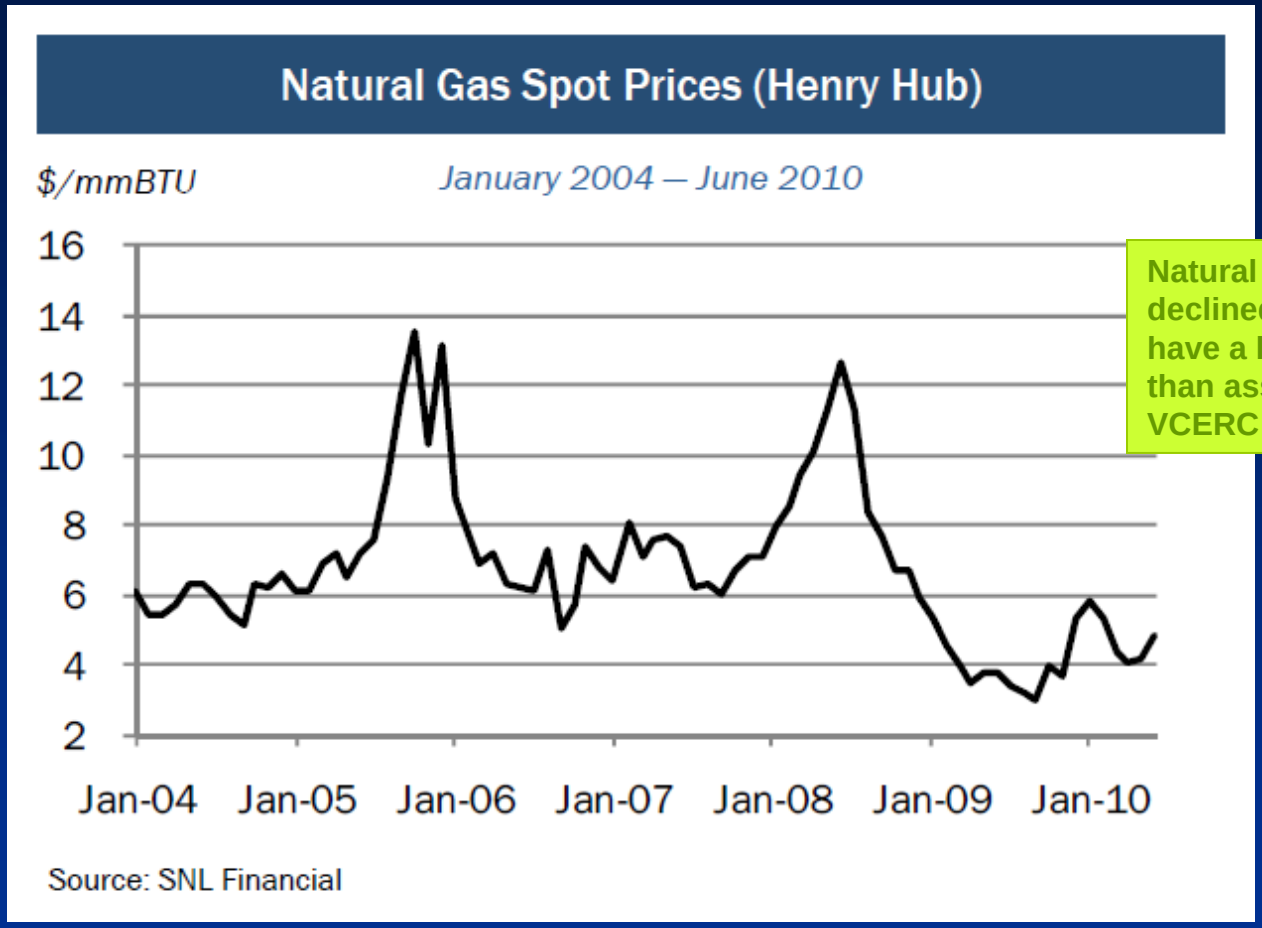
Near-Term Forecast of Central Appalachian Coal Spot Market Prices



6% nominal annual escalation rate

Source: Edison Electric Institute: Q2 2010 Financial Update: Fuel (www.eei.org/whatwedo/DataAnalysis/IndusFinanAnalysis/Documents/2010_Q2_Fuel_Final.pdf)

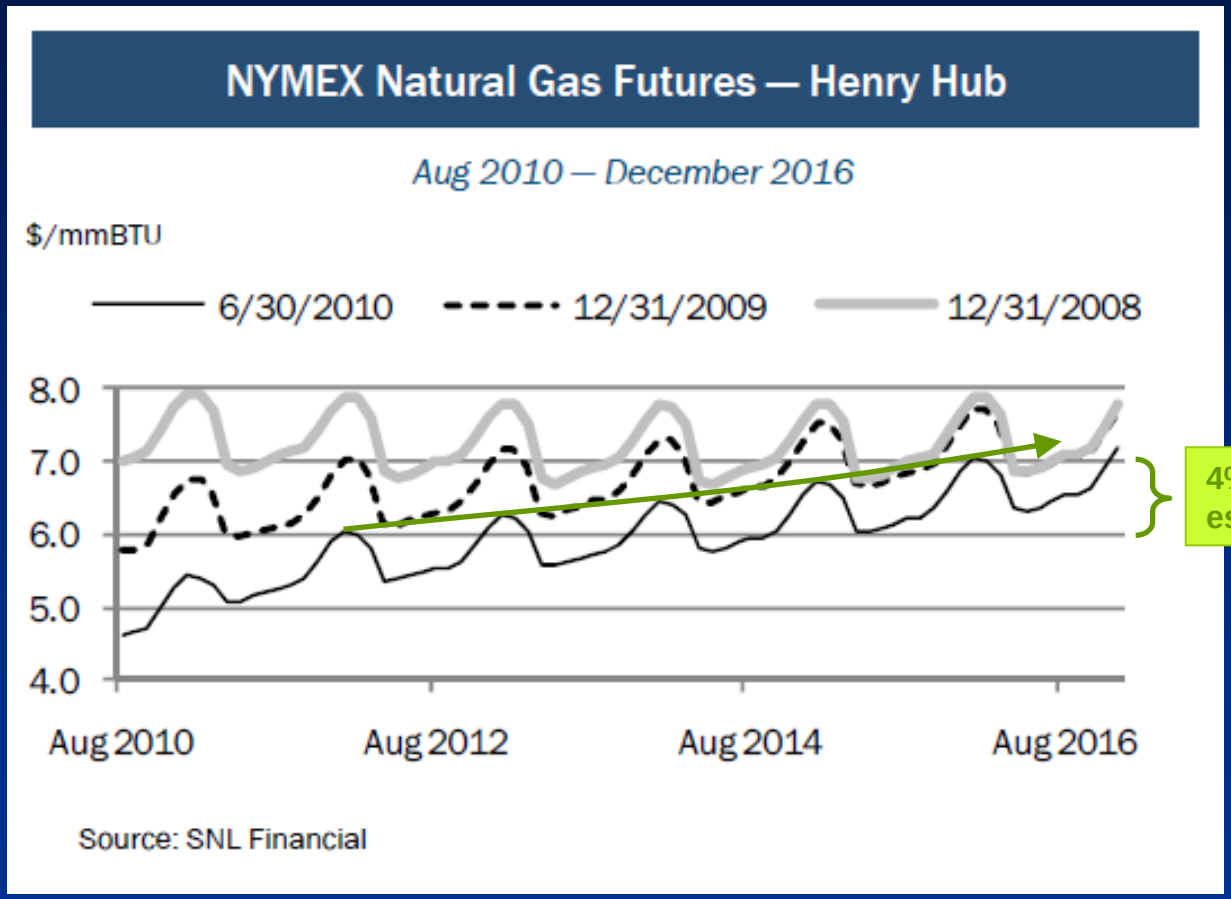
Historical Volatility in Natural Gas Prices



Natural gas prices have declined and are likely to have a lower 2012 price than assumed in original VCERC report

Source: Edison Electric Institute: Q2 2010 Financial Update: Fuel (www.eei.org/whatwedo/DataAnalysis/IndusFinanAnalysis/Documents/2010_Q2_Fuel_Final.pdf)

Near-Term Forecast of Henry Hub Natural Gas Spot Market Prices



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