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BLACK & VEATCH



Houston Renewable Energy Network

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November 11, 2009

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Topics for Today

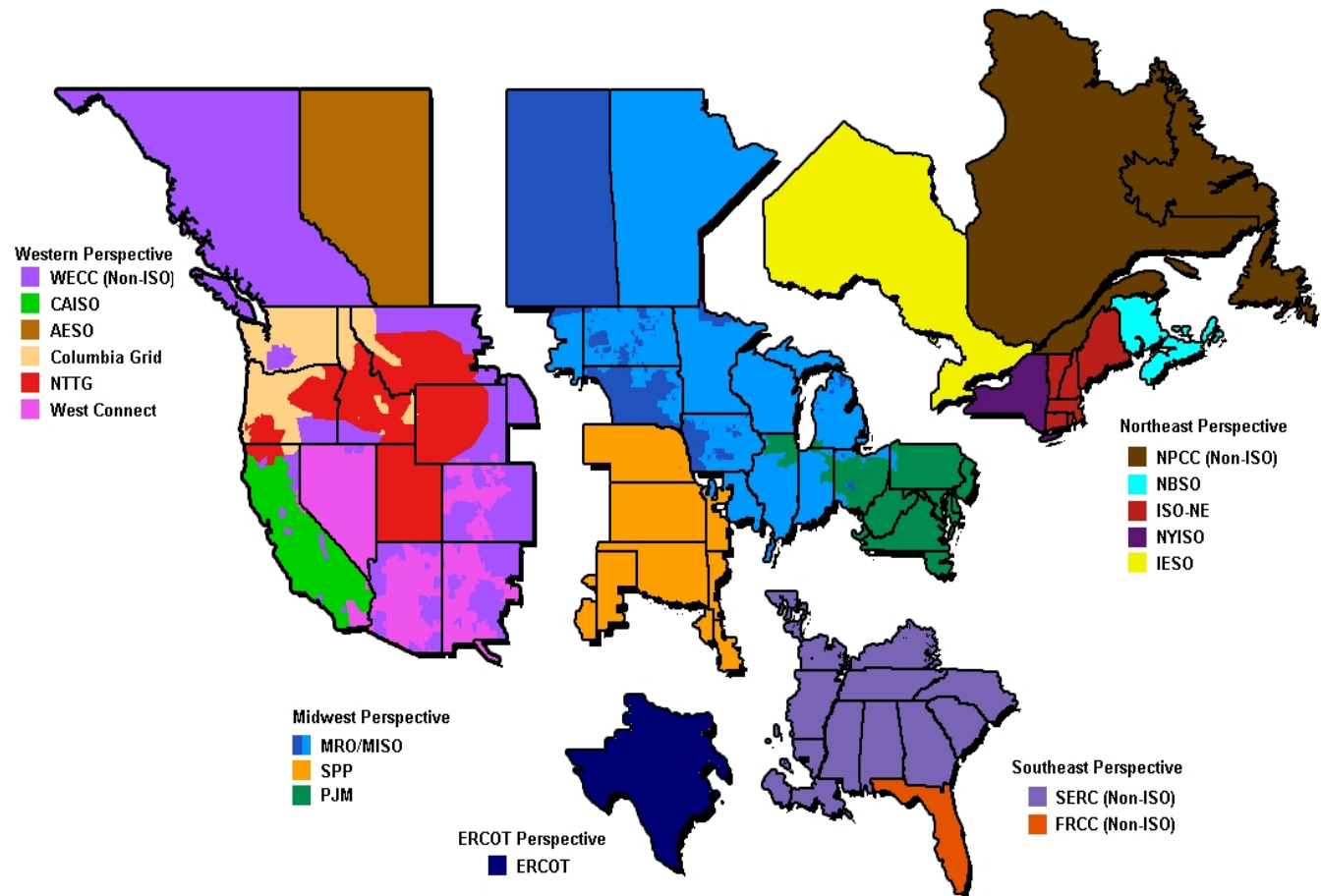
- BV Power Industry View – *Energy Market Perspective*
- Cost of Renewable Generation Technologies
- Recent ERCOT Patterns
- ERCOT Forecasting Examples
- Hand-off to Shell for WREZ/RETI discussion

Energy Market Perspective: Finding the “New Normal”

About the Energy Market Perspective

EMP North American Market Coverage

The Black & Veatch **Energy Market Perspective** is prepared every six months to provide B&V clients with a fresh and insightful assessment of the current state of North American energy markets, and a Base Case long term view of how those markets may function.



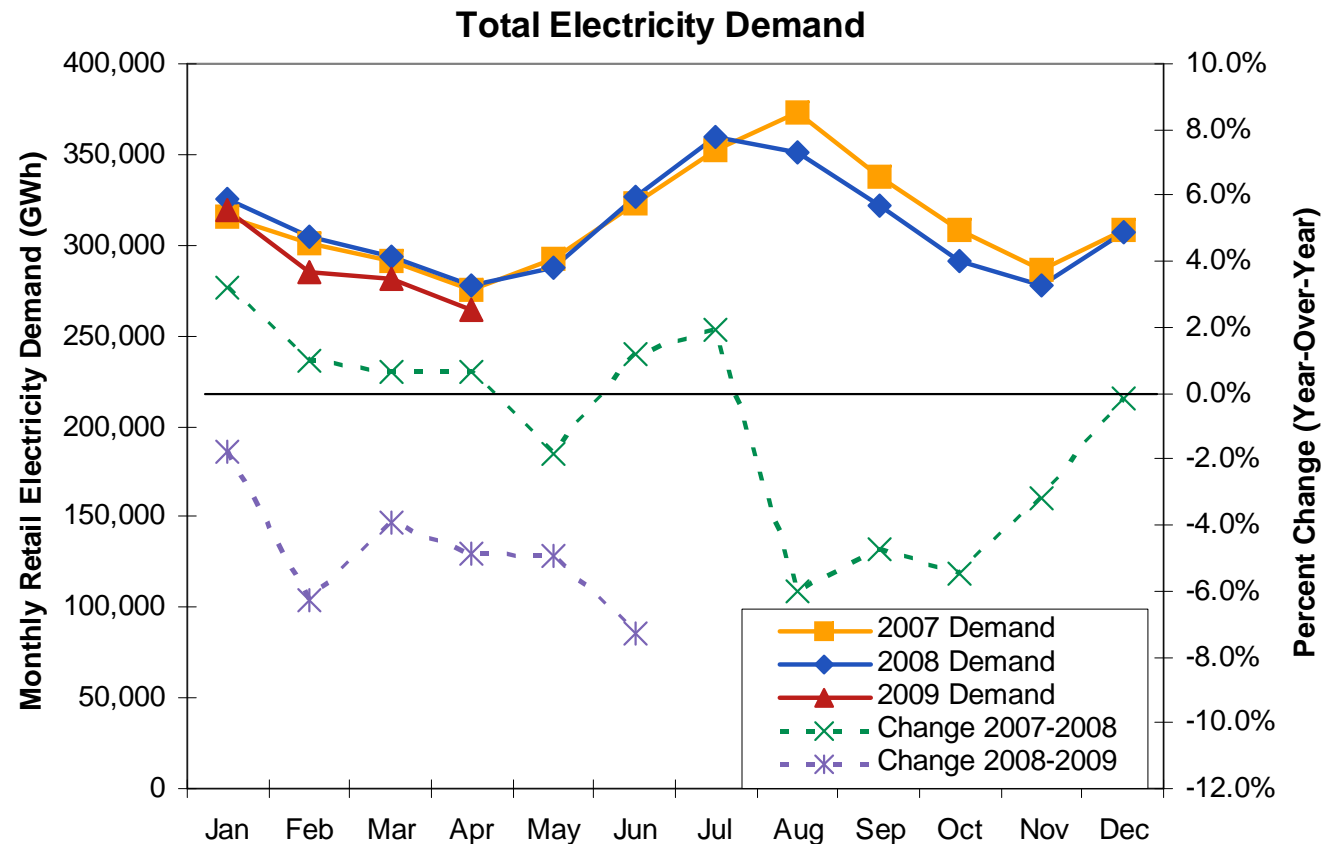
The B&V Energy Market Perspective is available as a National Service or as one or more Regional Services: Western, Texas (ERCOT), Northeast, Midwest and Southeast.

Finding the “New Normal” For Energy

- The world has changed in many ways, and has re-set its expectations in response to the worst recession since WWII.
- Major Impacts
 - Electricity Demand Growth
 - Future Natural Gas Prices
 - New Generation Asset Choices
 - Carbon Compliance

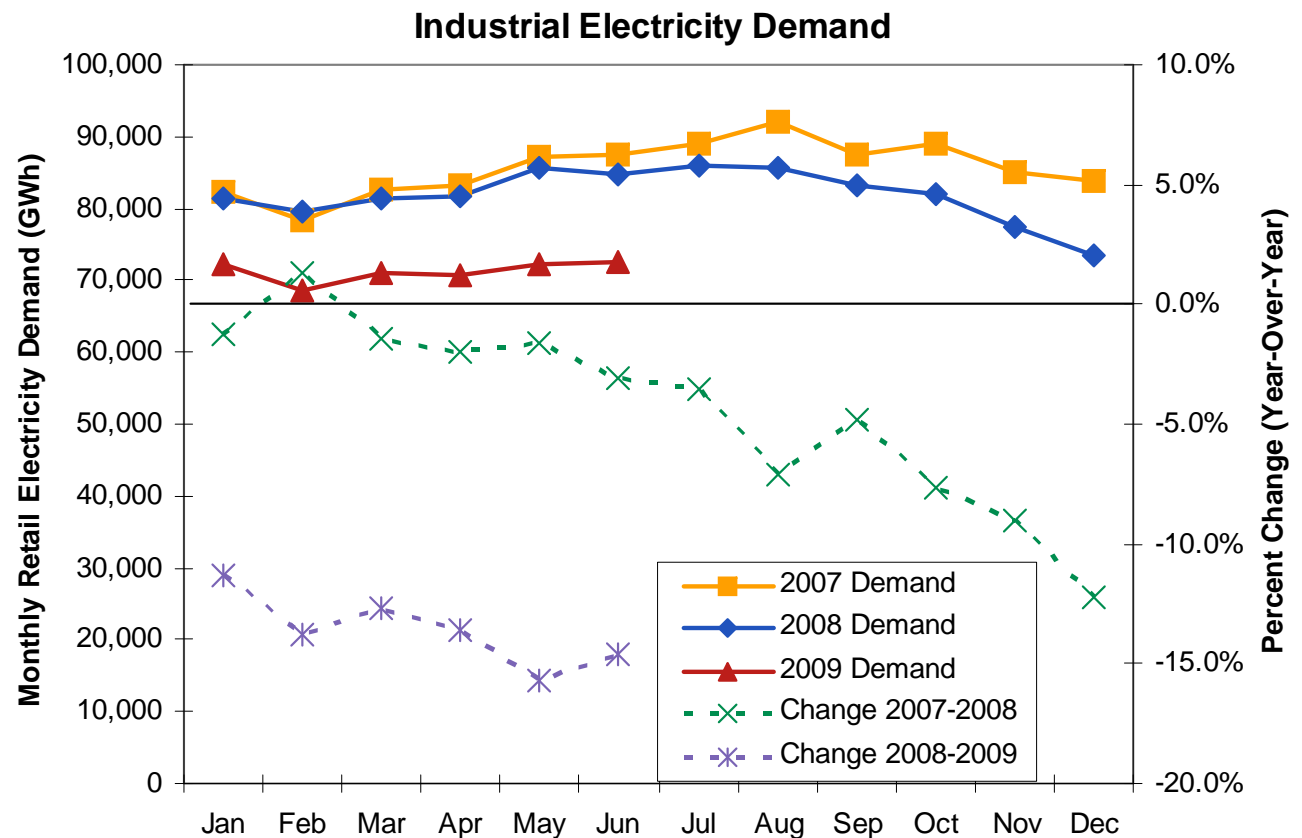
Recent Decrease in Electricity Demand

- A direct result of the recession has been a drop in US electricity demand that began in August 2008.
- Year over year average growth rates:
 - Jan-Jul 08 = +1.0%
 - Aug-Dec 08 = -3.9%
 - Jan-Jun 09 = -4.9%
- Combined with increased account delinquencies and defaults, this has constrained revenue and earnings for most electric utilities.



Industrial Electricity Demand is Getting Hit Hardest

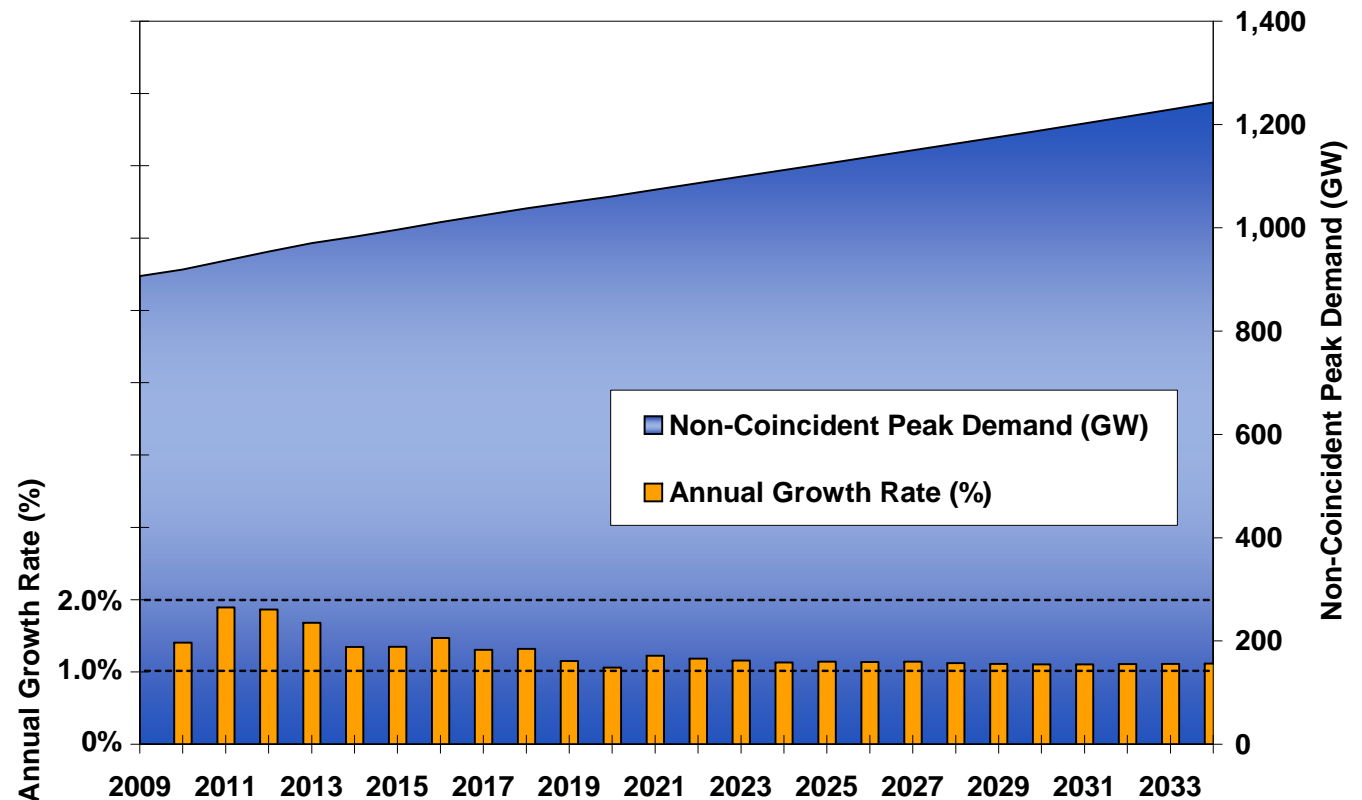
- The residential and commercial sectors have seen significant hits, but the biggest decrease has been in the industrial sector.
- Industrial year over year average growth rates:
 - Jan-Jul 08 = -1.7%
 - Aug-Dec 08 = -8.2%
 - Jan-Jun 09 = -13.6%
- The industrial sector decline started earlier and has been deeper. Utilities dependent upon industrial revenue have been hit the hardest.



Forecast for Power Demand

- Black & Veatch’s analysis of regional long term forecasts reveals a large amount of regional variation in recovery expectations on all measures: timing, magnitude and long term trend.
- Regional variations captured in the EMP analysis.
- Expectation is a moderate economic rebound in 2010-2013 with “1990’s style” growth before reverting to a long term growth trend of about 1.1% per year.

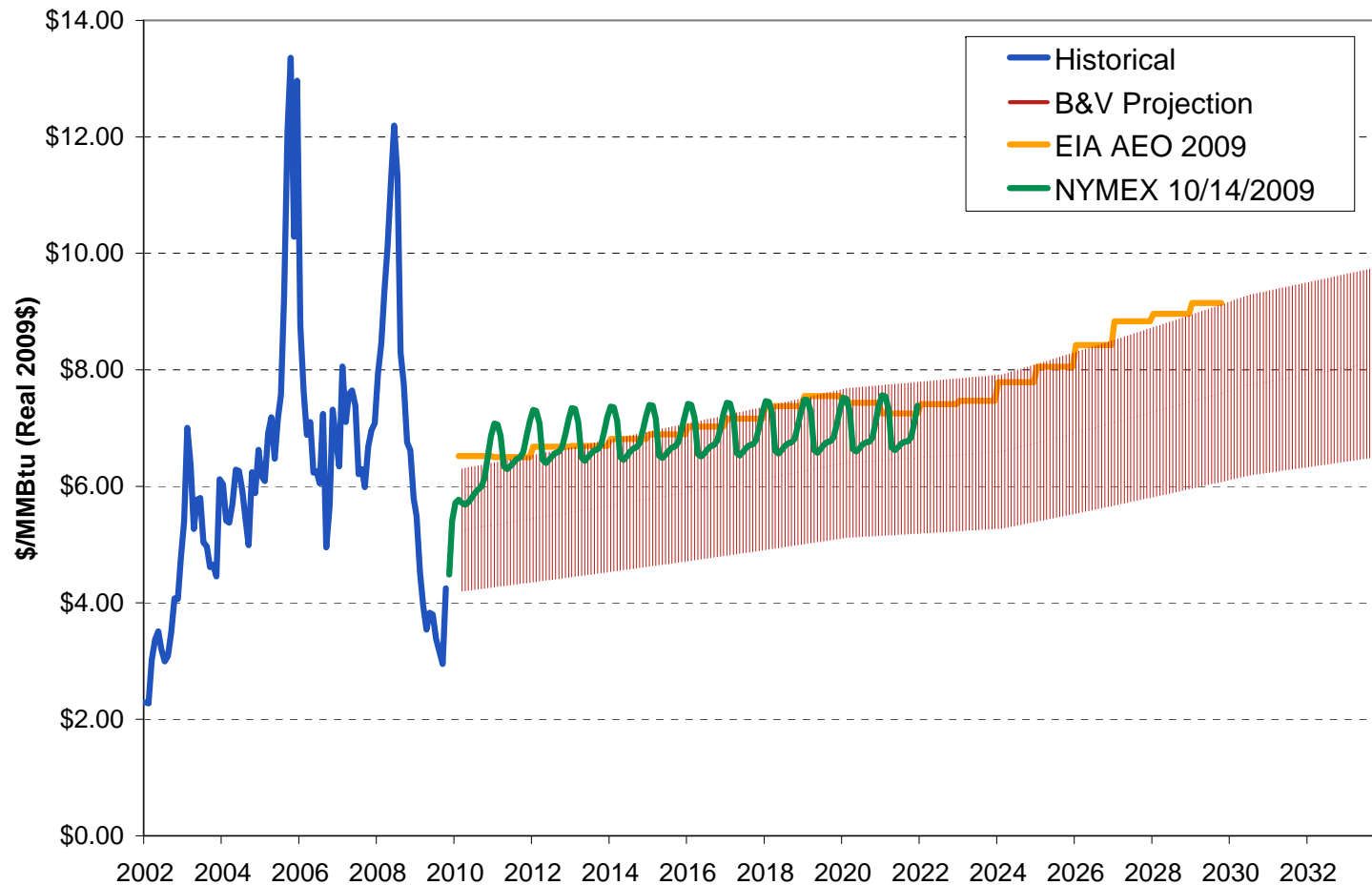
Forecasted Peak Demand-North America



Source: B&V Analysis

Natural Gas Prices Are Projected to Rise Moderately With Demand Growth and New Higher Cost Supplies

Historical and Projected Henry Hub Natural Gas Prices

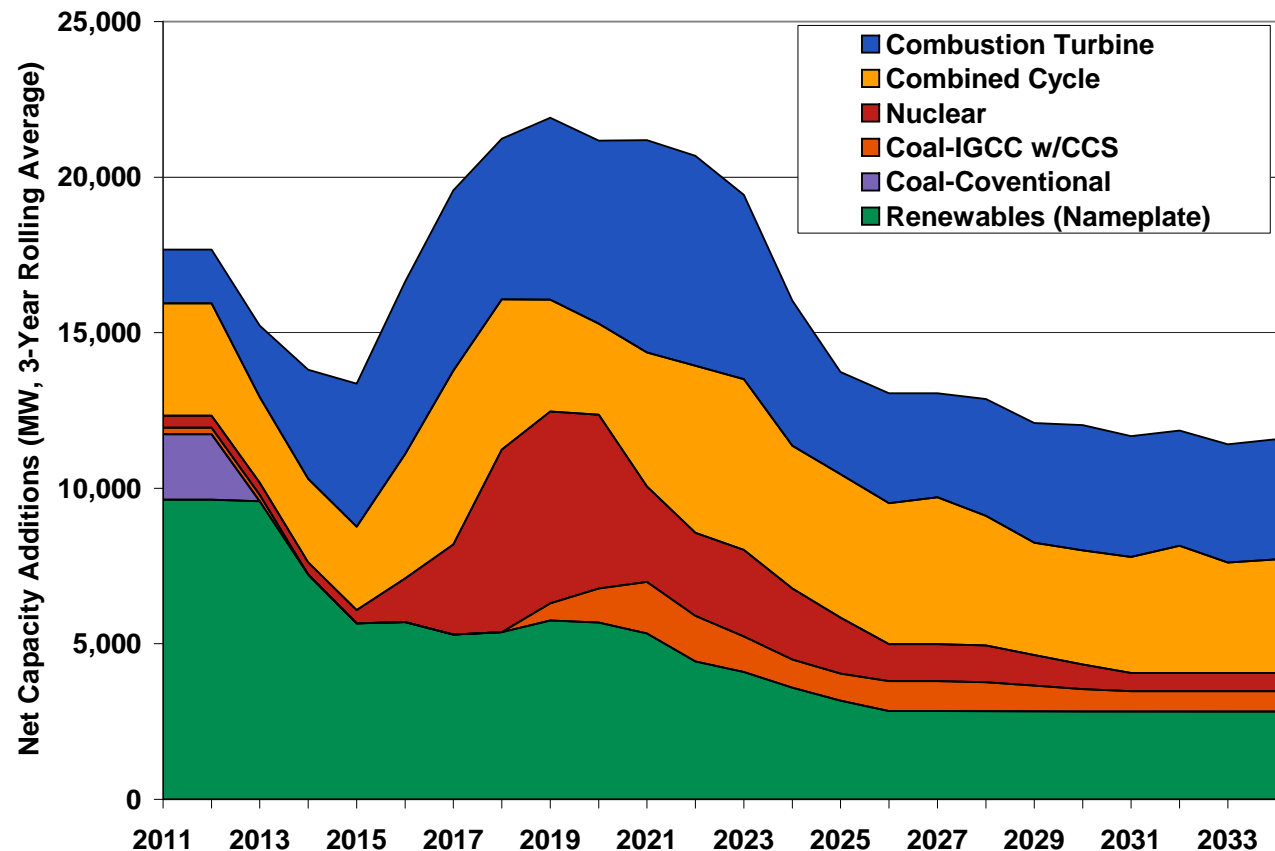


Source: EIA, B&V Analysis, NYMEX.com

Resource Implications of the Energy Market Perspective

- Near-term resource additions are dominated by renewable energy and natural gas resources.
- Wind resource additions decline over time as many state RPS standards and guidelines are largely met.
- Longer-term resource needs are met by natural gas resources, with growing role for nuclear and possibly IGCC w/ CCS for meeting base load growth.

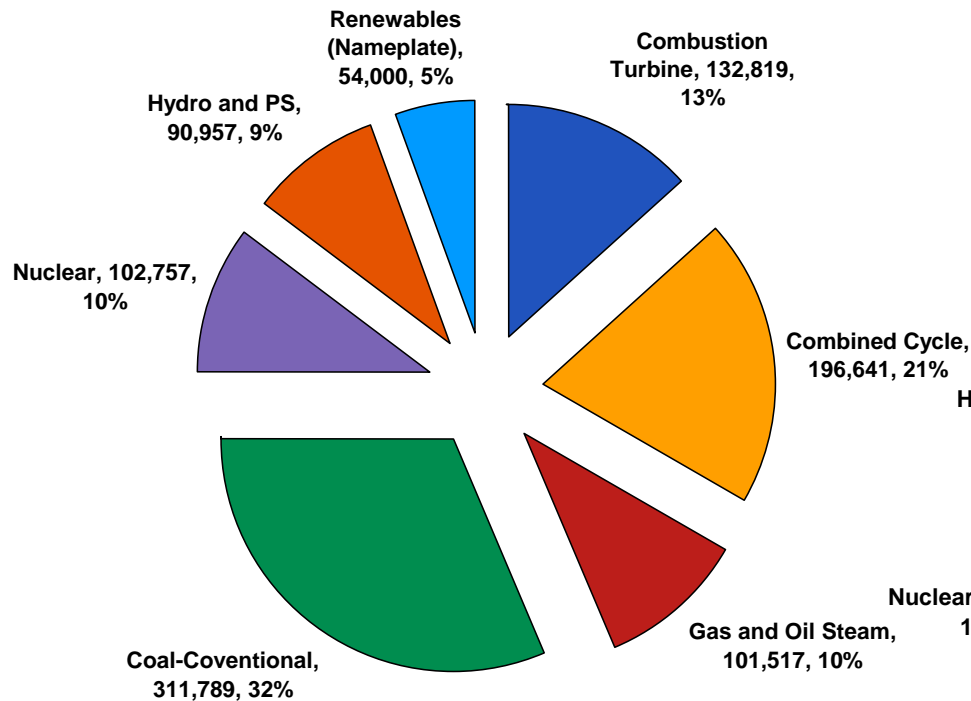
Annual Resource Additions, Trended (MW)



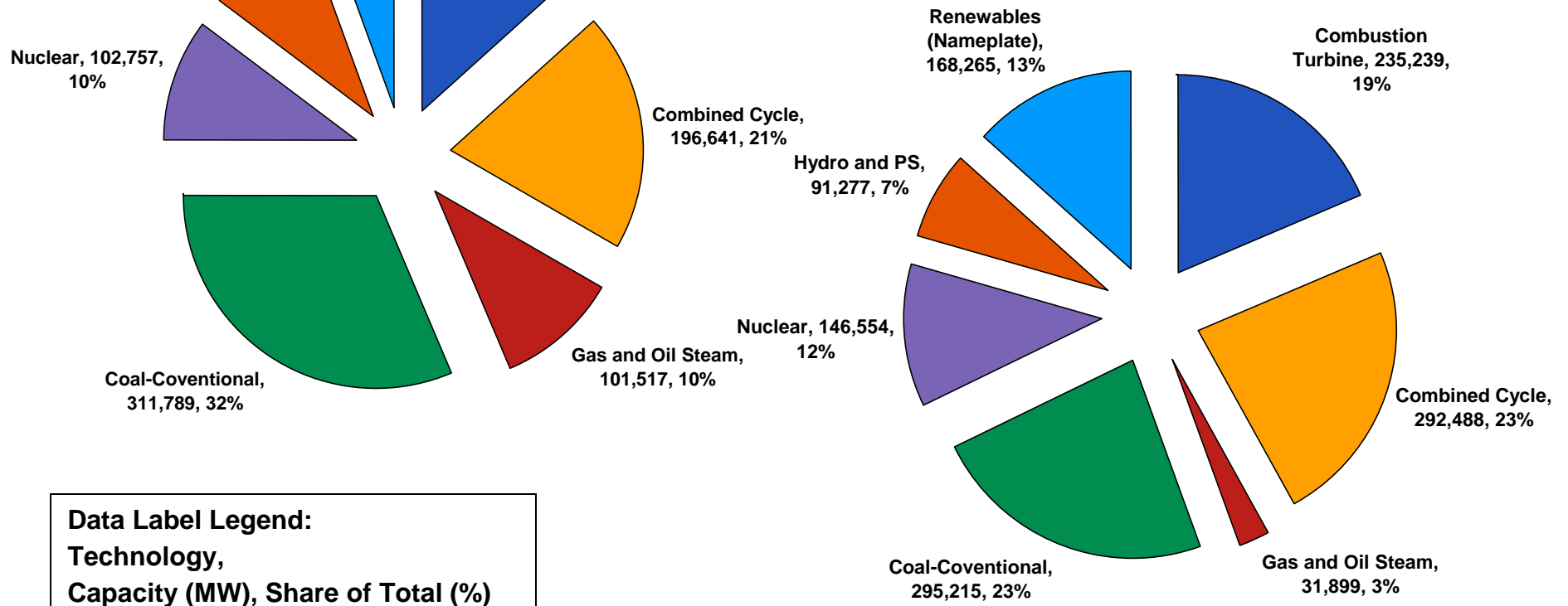
Source: B&V Analysis

The Changing Resource Mix-US

Resource Mix—2010



Resource Mix—2034



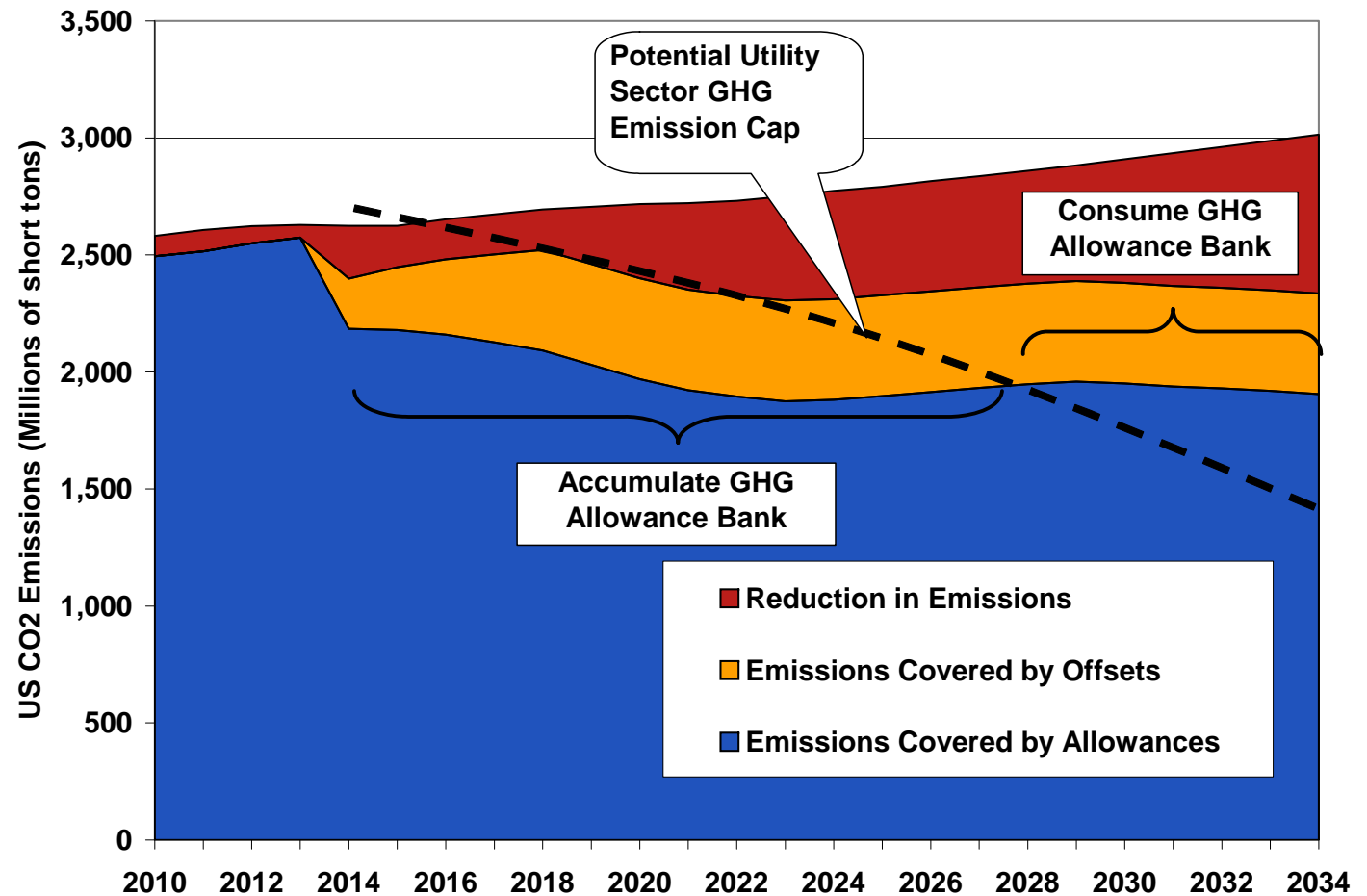
Data Label Legend:
Technology,
Capacity (MW), Share of Total (%)

Source: B&V Analysis

Compliance with a CO2 Emission Cap

Power Sector CO2 Compliance Profile

- Offsets are crucial for successful compliance.
- Assuming use of only half of its pro rata share of the 2 billion tpy of offsets, the electric power sector can bank offsets through the late 2020's and consume that bank well into the late 2030's.

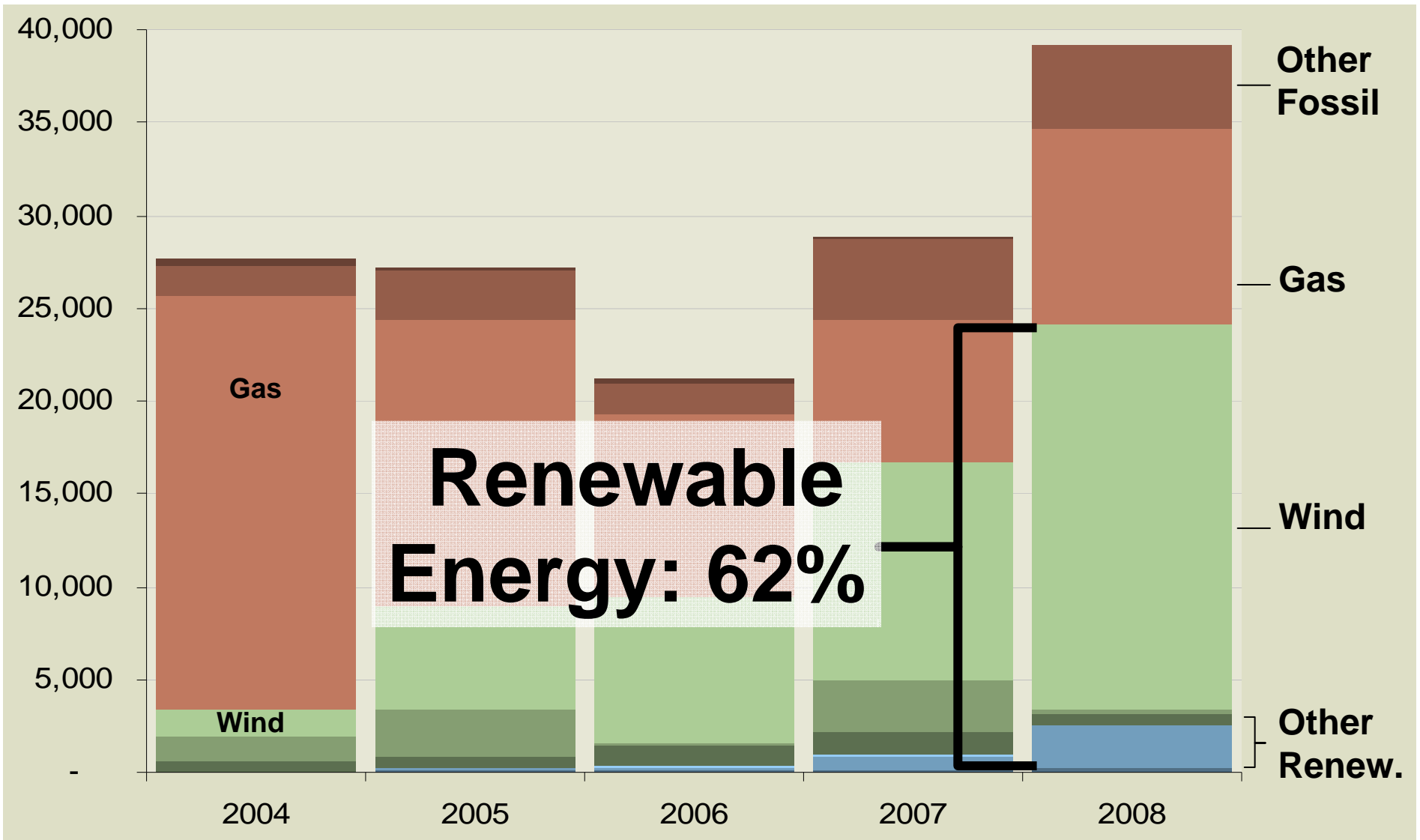


Source: B&V Analysis

Renewable Energy Costs

Cost of Annual North American Capacity Additions

\$ Millions

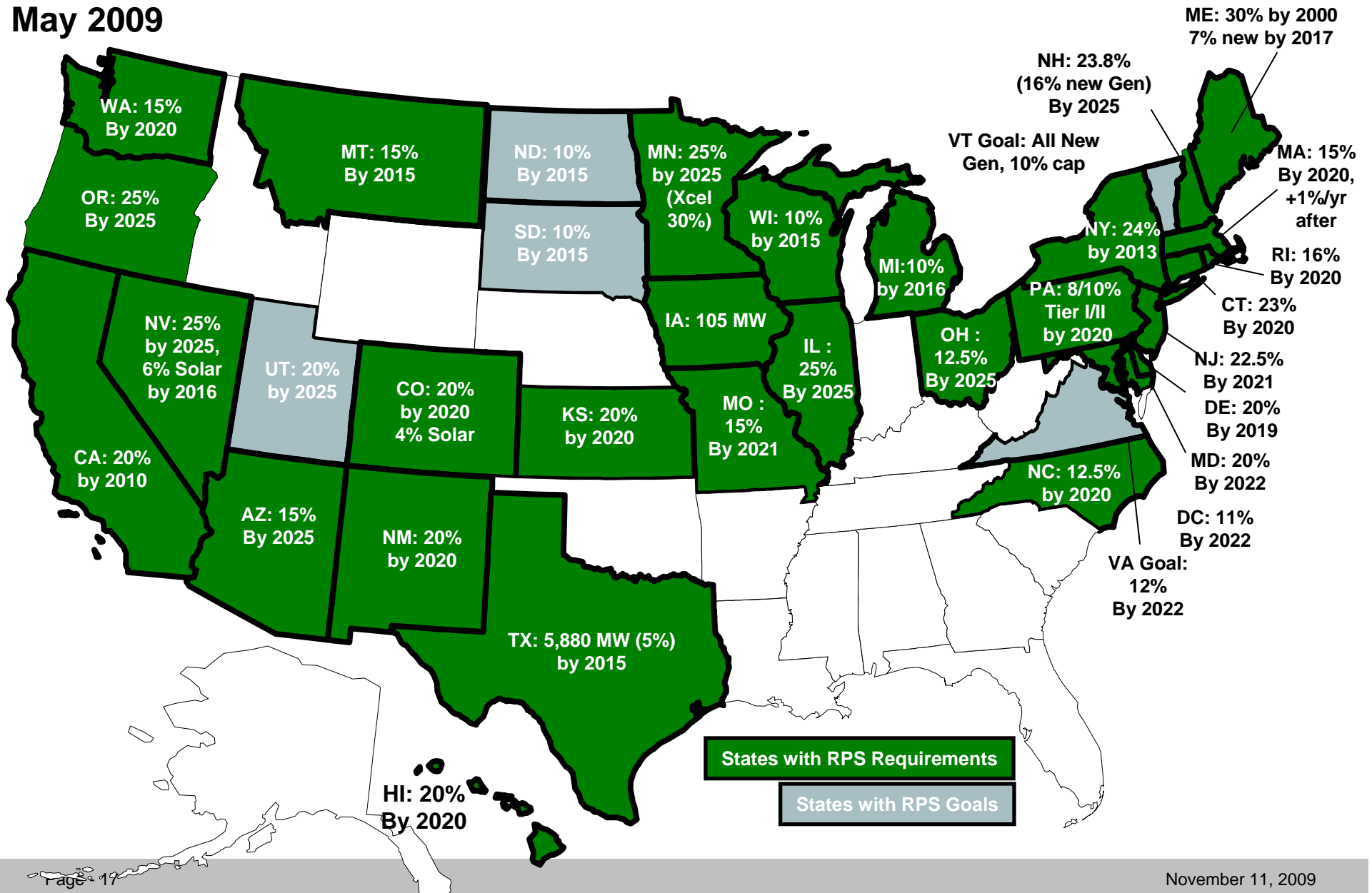


Major Issues Affecting Renewables in the US

- Expanded State Initiatives (RPS)
- Tax Credit Extension and Changes
- Financial Crisis
- Greenhouse Gas Legislation
- Changing Resource Economics – Renewables competitive?
- Transmission Constraints

State Renewable Portfolio Standards

May 2009



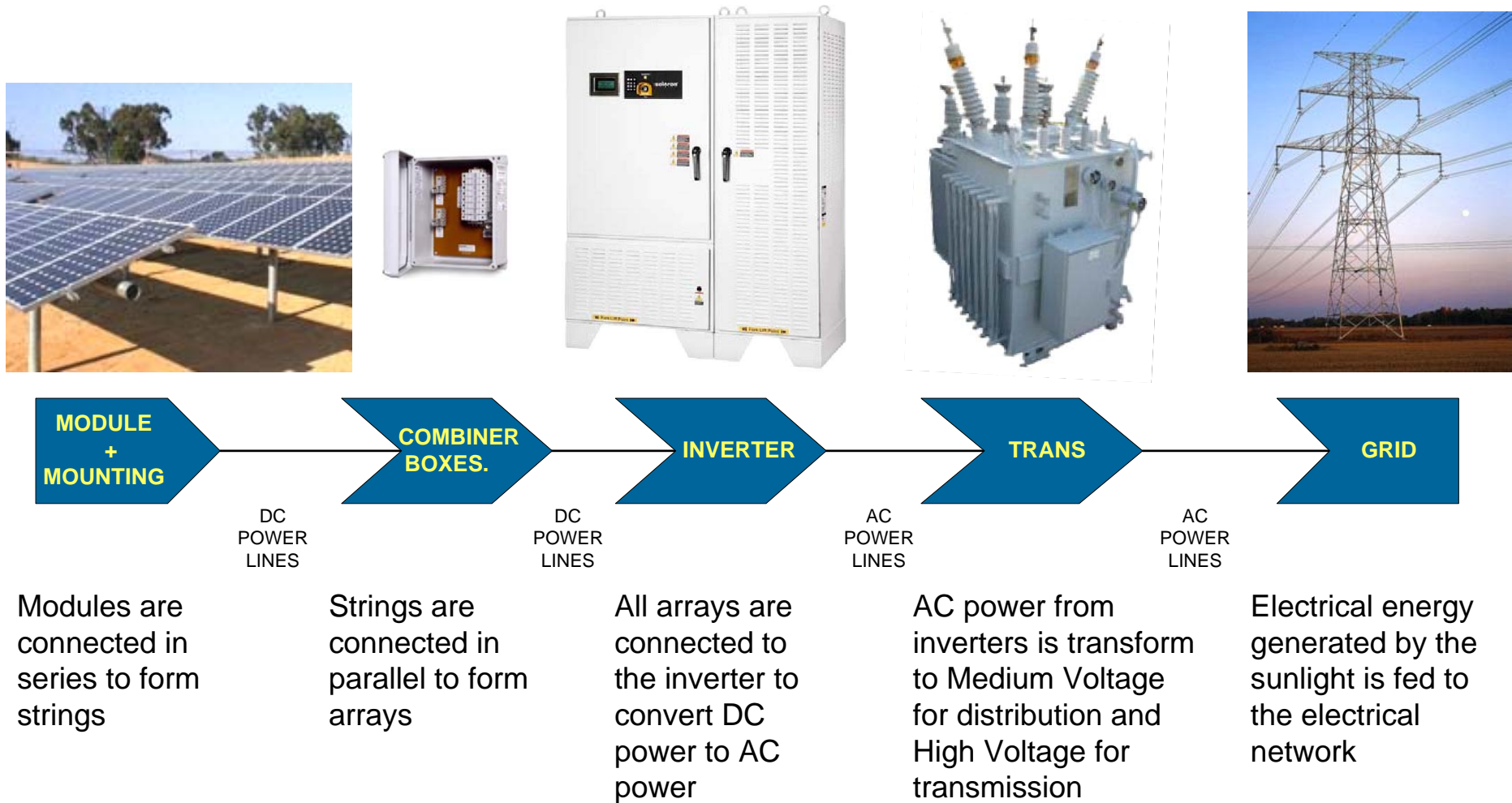
US Market Drivers: Solar

- 30% Federal Investment Tax Credit extended to 2016 as part of bailout bill
- Solar mandates in several state RPS
 - NV, AZ, CO, NJ, PA, OH
- California Solar Initiative
 - 3,000 MW, 10-year program started Jan 2007
- Larger utility scale projects becoming more common

Characterized Renewable Technologies

- Solar photovoltaic
 - thin film (utility scale)
 - crystalline tracking (utility scale)
 - thin film (commercial rooftop)
 - crystalline (commercial rooftop)
 - concentrating (utility scale)
- Solar thermal
 - parabolic trough
 - power tower
- Wind
- Geothermal
- Biomass direct fired
- Biomass cofiring

From the Sun to the Electrical Network



STRING	ARRAY	INVERTER	MV & SWITCHGEAR	INTERCONNECTION
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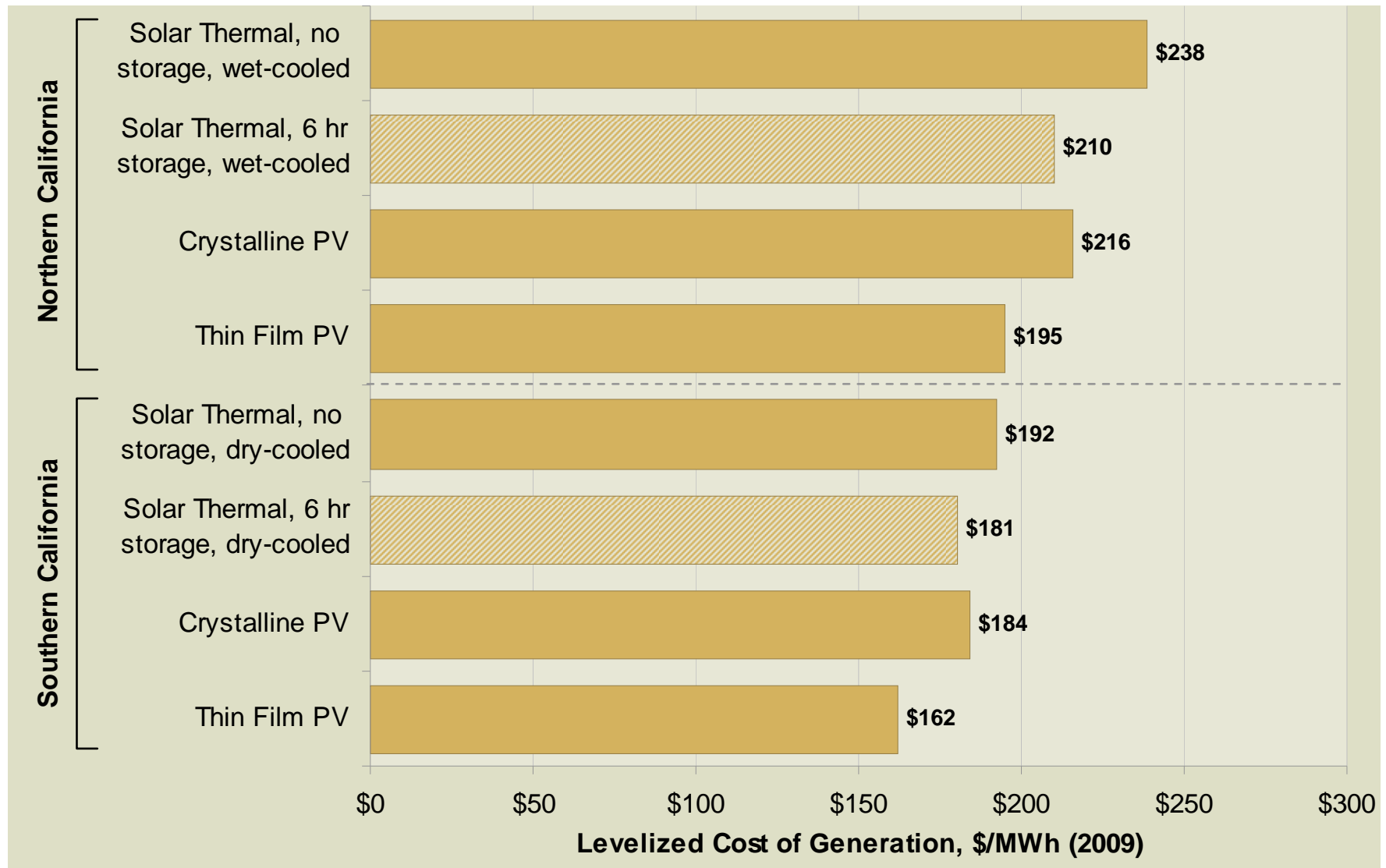
Representative PV Construction Schedule

- Tradeoff between labor and time
- To date, typical construction was 1 MW/month
- First Solar:
 - 2008: 3 MW/month
 - 2009: 7 MW/month
 - 2010: 10 MW/month

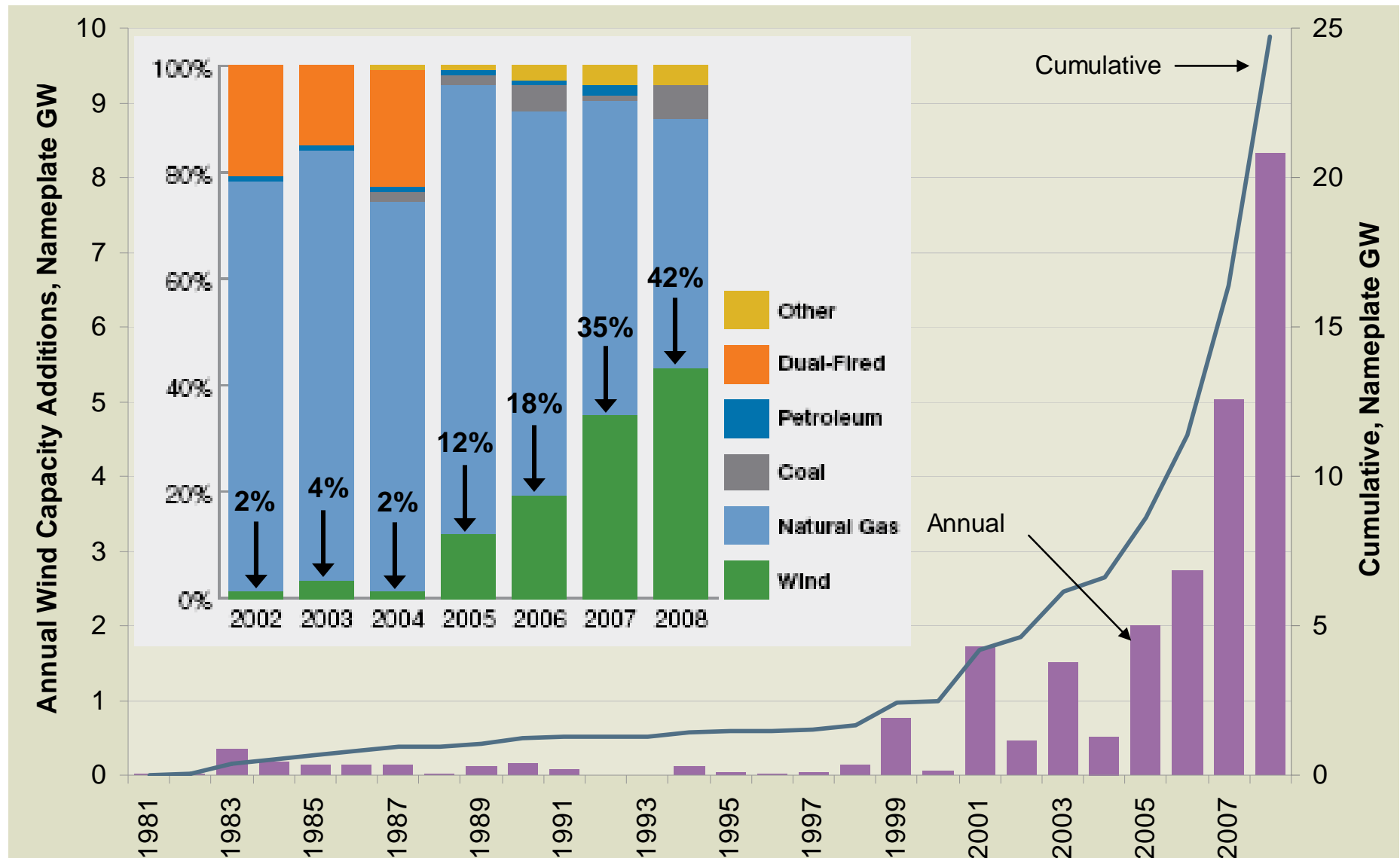
Performance and warranty issues

- Limited, if any, EPC firms in the photovoltaic market
 - Three largest developers leverage in-house construction
- Module power warranties are *not* production warranties
 - Inverter warranties are short
- Limited “EPC” wrap or performance guarantees available

Example Solar Cost Comparisons



Wind is ~1% of U.S. Electricity, But Growing Fast

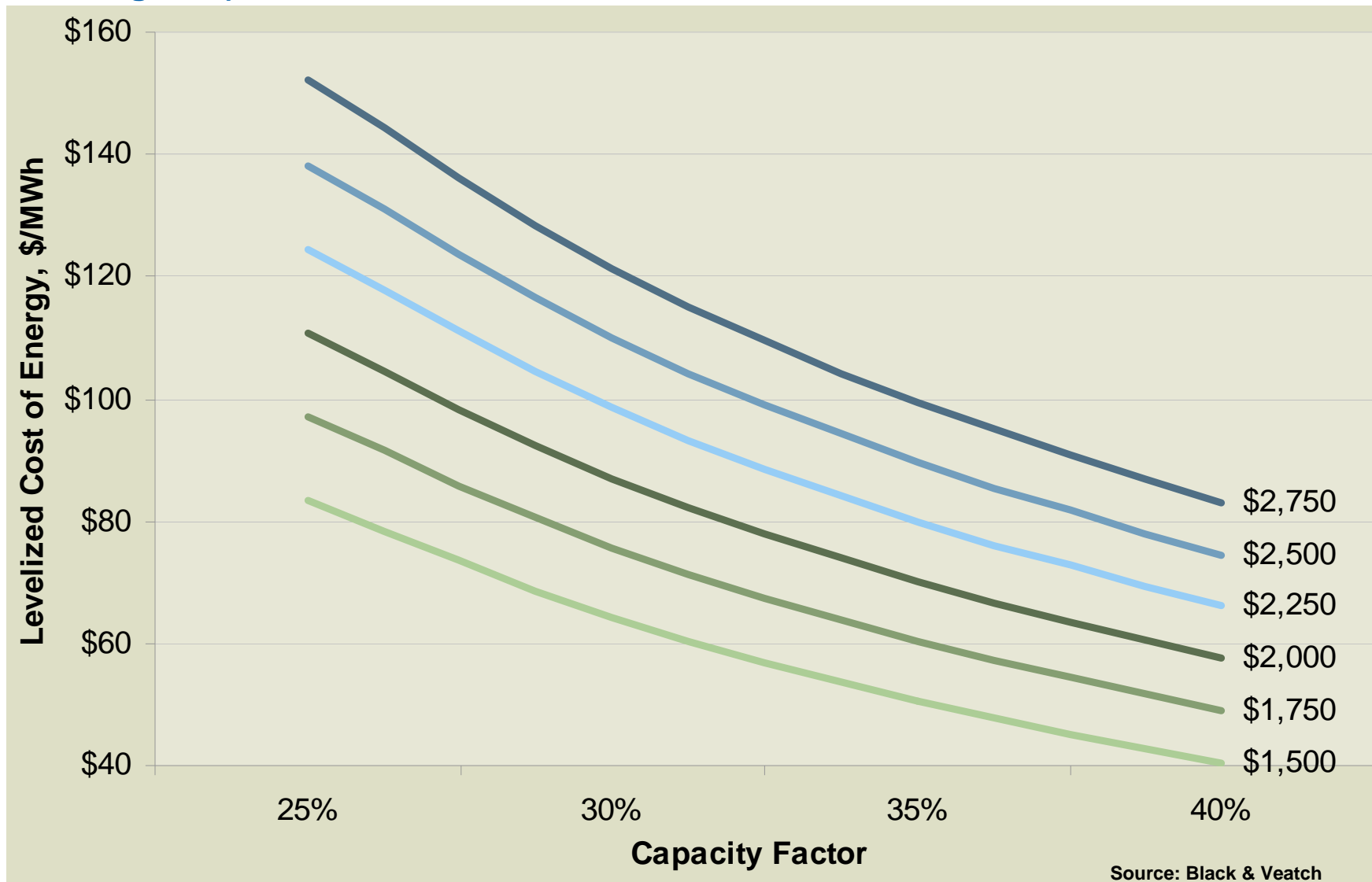


Recent Wind Project Cost Increases

- Costs have risen from ~\$1,200/kW to ~\$2,400/kW
- Cost increases are due to several factors:
 - Euro/Dollar exchange rate, as most wind turbines are manufactured in Europe
 - Supply/Demand imbalance
 - Steel/Concrete/Copper price increases
 - Transportation Costs (Oil)
 - General increases in construction costs
- Some evidence of recent pullback in prices

Cost of Energy vs. Capital Cost and Capacity Factor

(Including PTC)

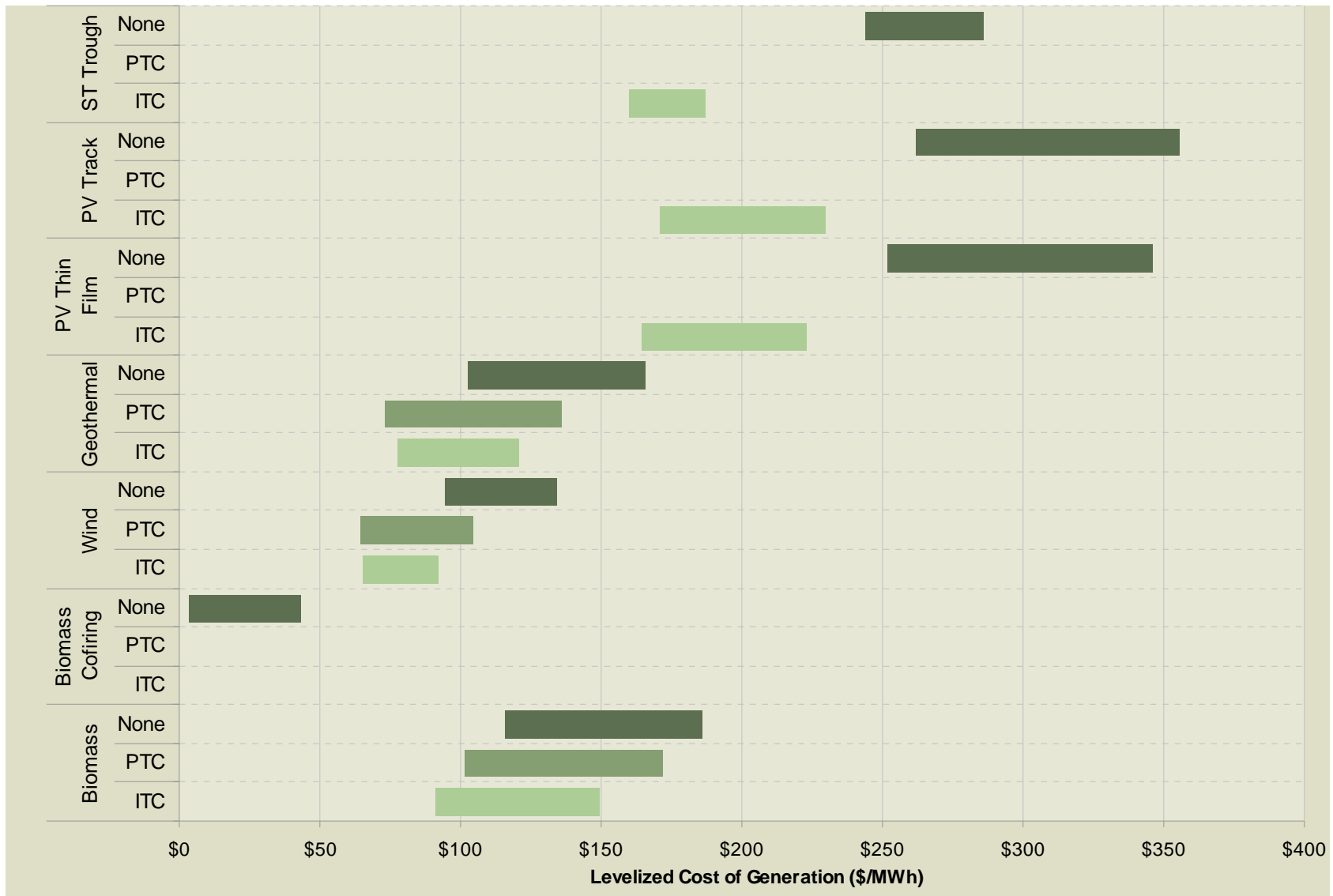


Source: Black & Veatch

On-shore wind vs. Off-shore wind

	On-Shore	Off-Shore
Typical Capacity, MW	100	100
Capital Cost, \$/kW	2,000-2,400	3,500-4,500
Capacity Factor	30% - 40%	35% - 45%
O&M, \$/kW-yr	50	75
Total Development, months	24 - 36	???
NTP to COD, months	12	24
LCOE, \$/MWh	65-100	120-160+

Comparison of Costs with and without Subsidies for Renewables



Recent ERCOT Patterns

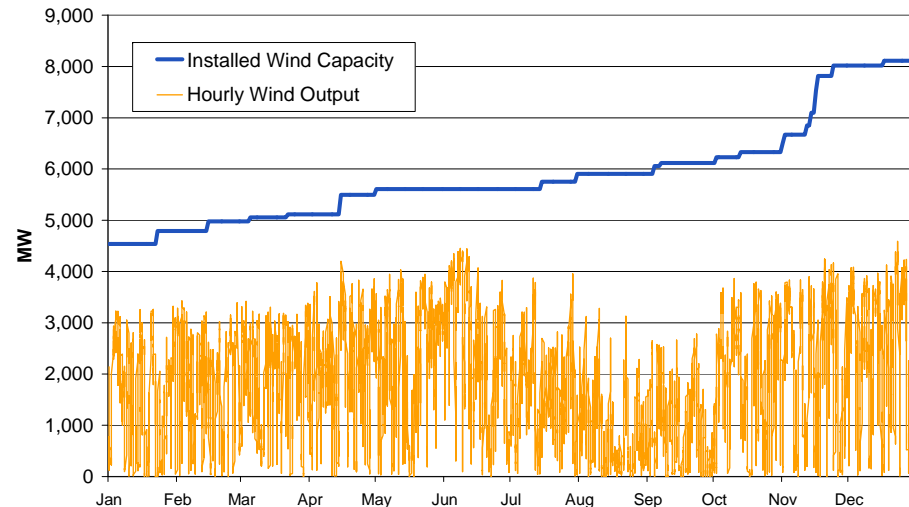
ERCOT Industry Structure – Focus on Wind

- Wind capacity factors at 25-40%
- West Zone prices drop to negative levels, particularly during the shoulder months, off peak
- Incidence of negative West zone prices are in general decreasing over time and will continue to do so with transmission improvements.

Occurrences of Negative West Zonal Energy Price, by Number of Hours

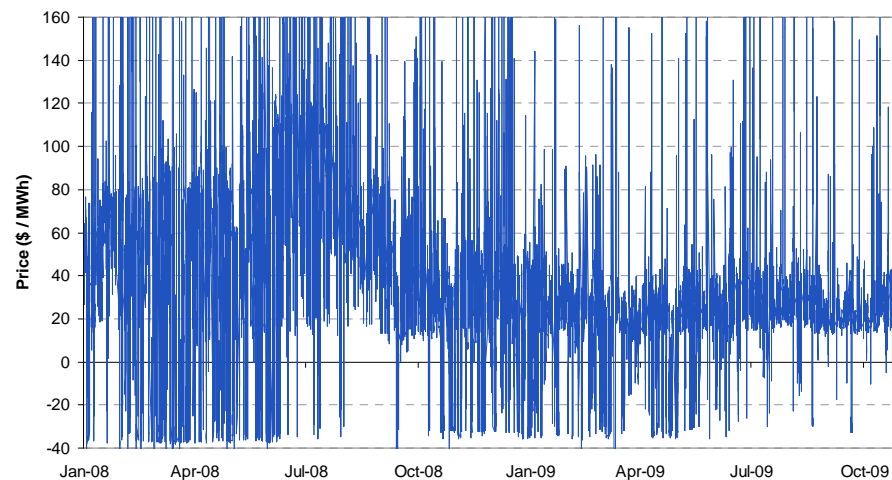
	2008	2009
Jan	54	91
Feb	121	78
Mar	239	115
Apr	144	158
May	132	83
Jun	104	45
Jul	17	13
Aug	1	28
Sep	12	19
Oct	65	15
Nov	100	
Dec	162	

2008 Wind Hourly Output



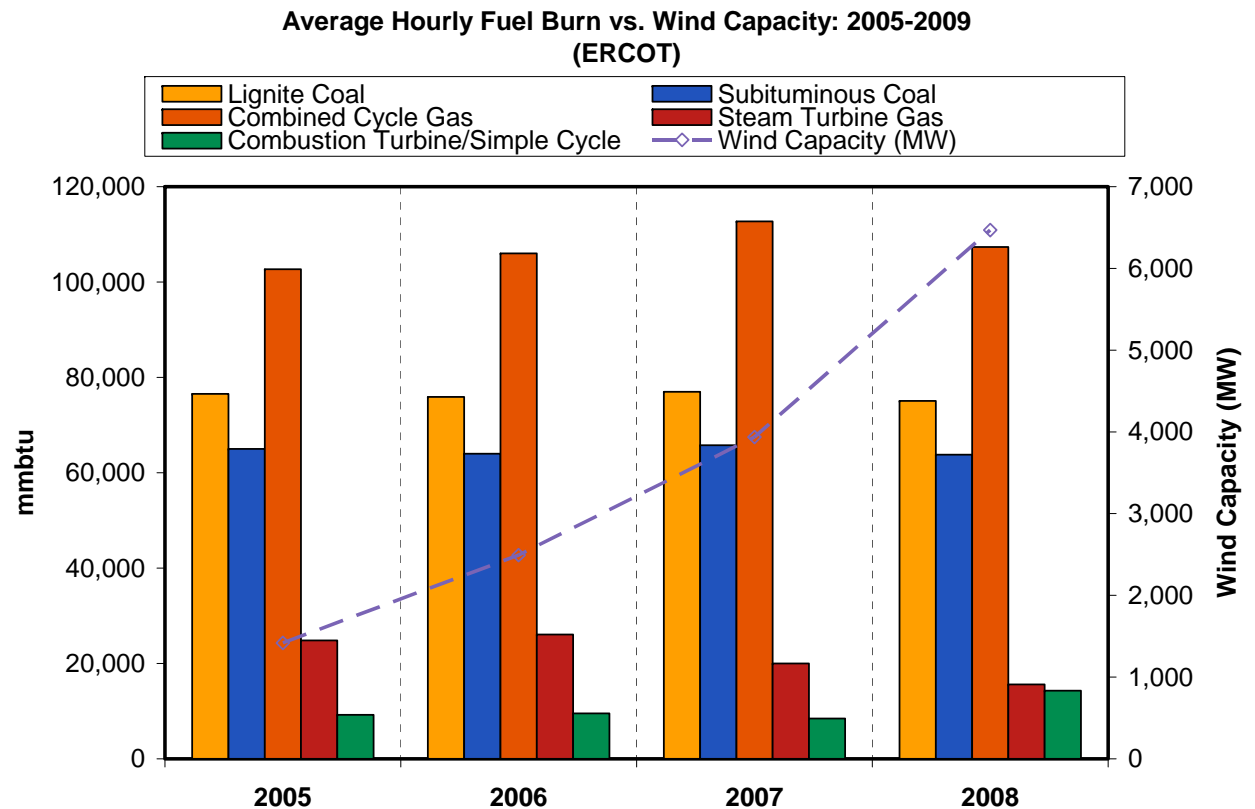
Source: B&V
Analysis of
ERCOT data

West LMP



Tracking the Effects of Increased Wind Capacity

- Changing levels of peaking technologies with increasing wind
- Wind substitution: Average decrease of 0.5% per year in fossil fuel generation or 0.1% decrease in all generation including nuclear, with average 1.5% annual demand growth

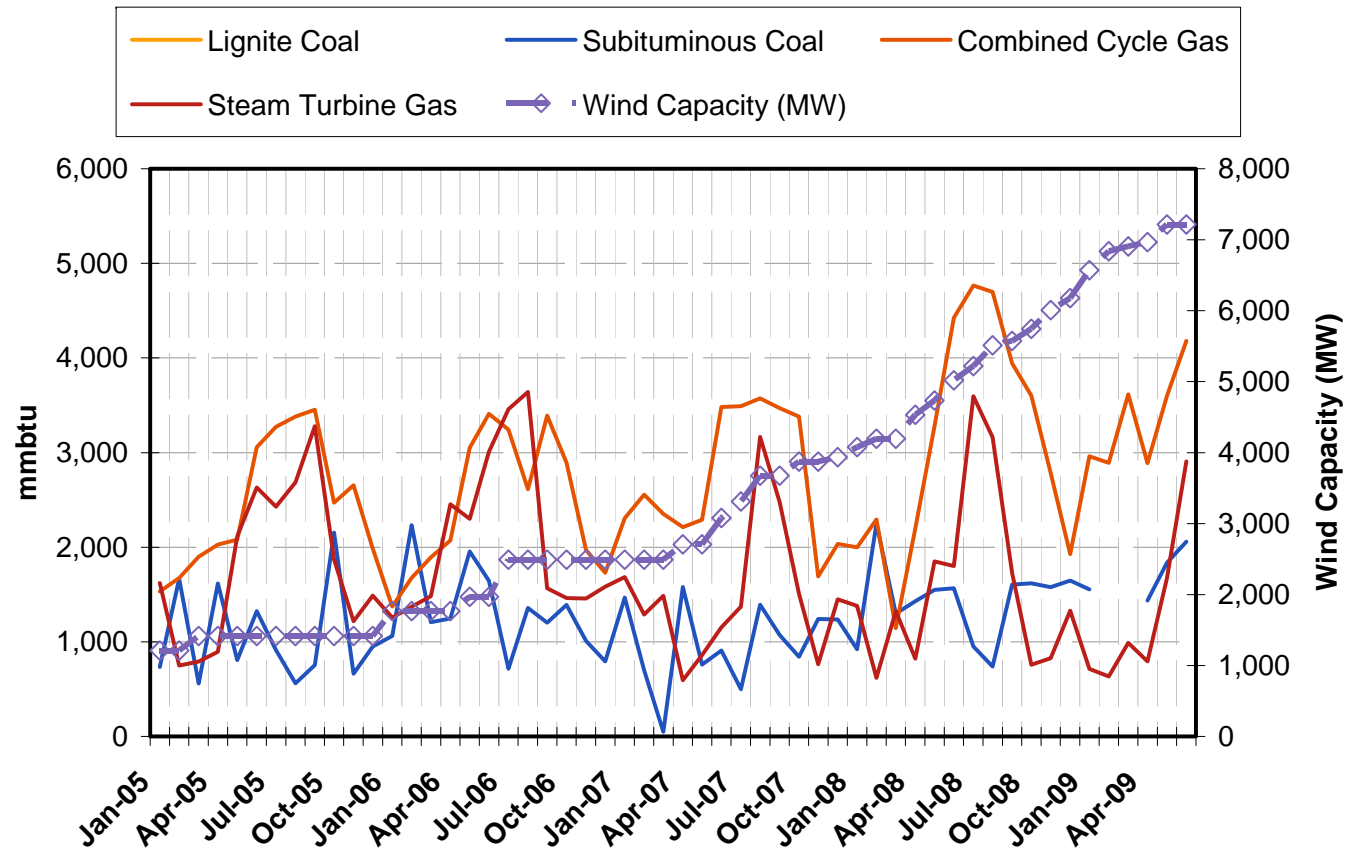


Source: Energy Velocity-compiled CEMS data

Tracking the Effects of Increased Wind Capacity

- Additional West zone wind capacity causing increased variability in combined cycle generation
- Some new combined cycle generation

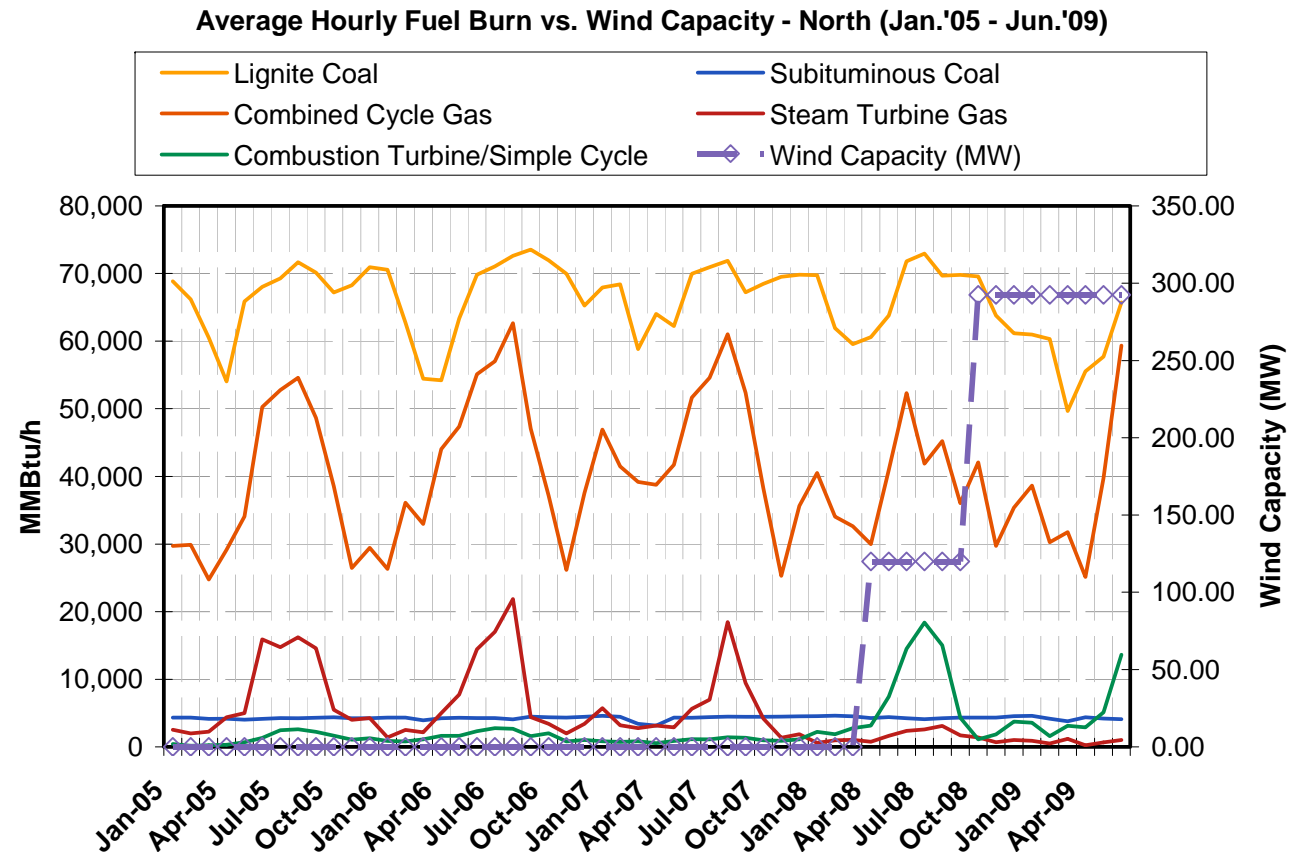
St. Dev of Fuel Burn vs. Wind Capacity - West (Jan.'05 - Jun.'09)



Source: Energy Velocity-compiled CEMS data

Tracking the Effects of Increased Wind Capacity

- North zone generation showing decreased and more varied combined cycle operations
- Simple cycle CTs filling traditional role of ST-Gas
- Primary drivers for this are increased West zone wind capacity and generation, with more complex operations along the West-North interface.

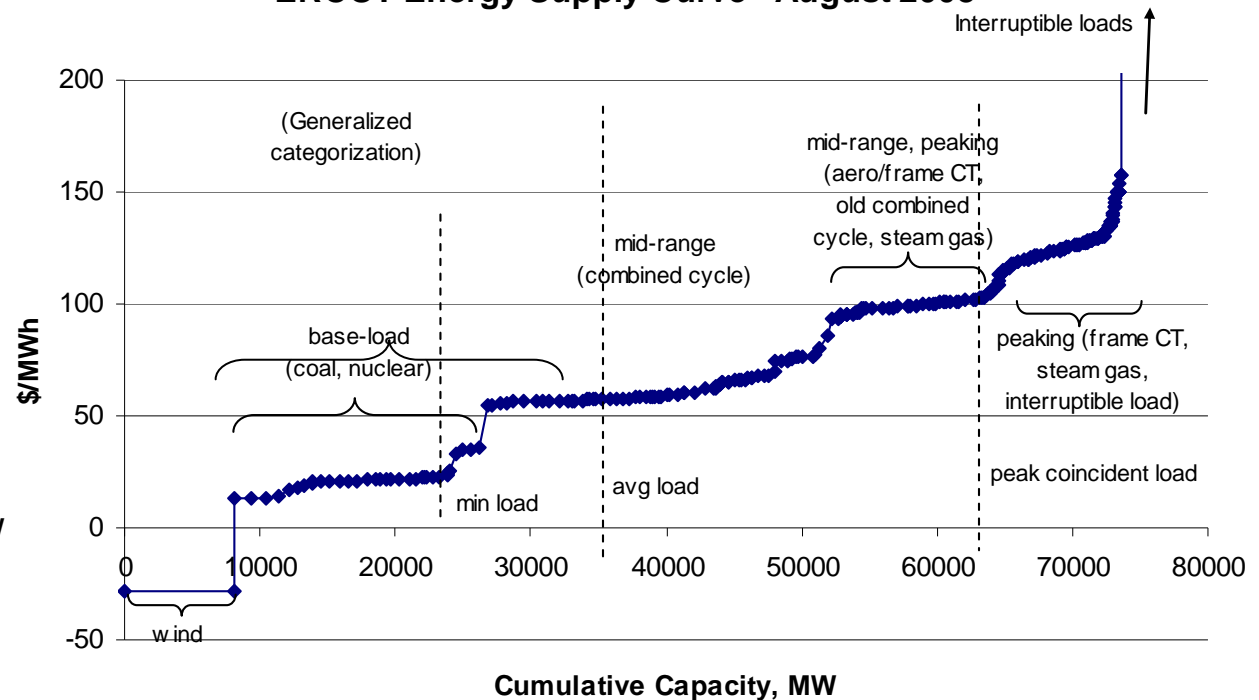


Source: Energy Velocity-compiled CEMS data

ERCOT Cost Structure

- Four basic groupings of generation that is typically available for dispatch:
 - Wind and miscellaneous small sources through ~9,000 MW
 - Nuclear and coal from ~9,000 to 27,000 MW
 - Combined-cycle from 27,000 to 51,000 MW
 - Mid-range (older combined cycle, efficient CT and steam gas) from 51,000 to 65,000 MW
 - Peaking (CT and steam gas only) and interruptible loads > 65,000 MW

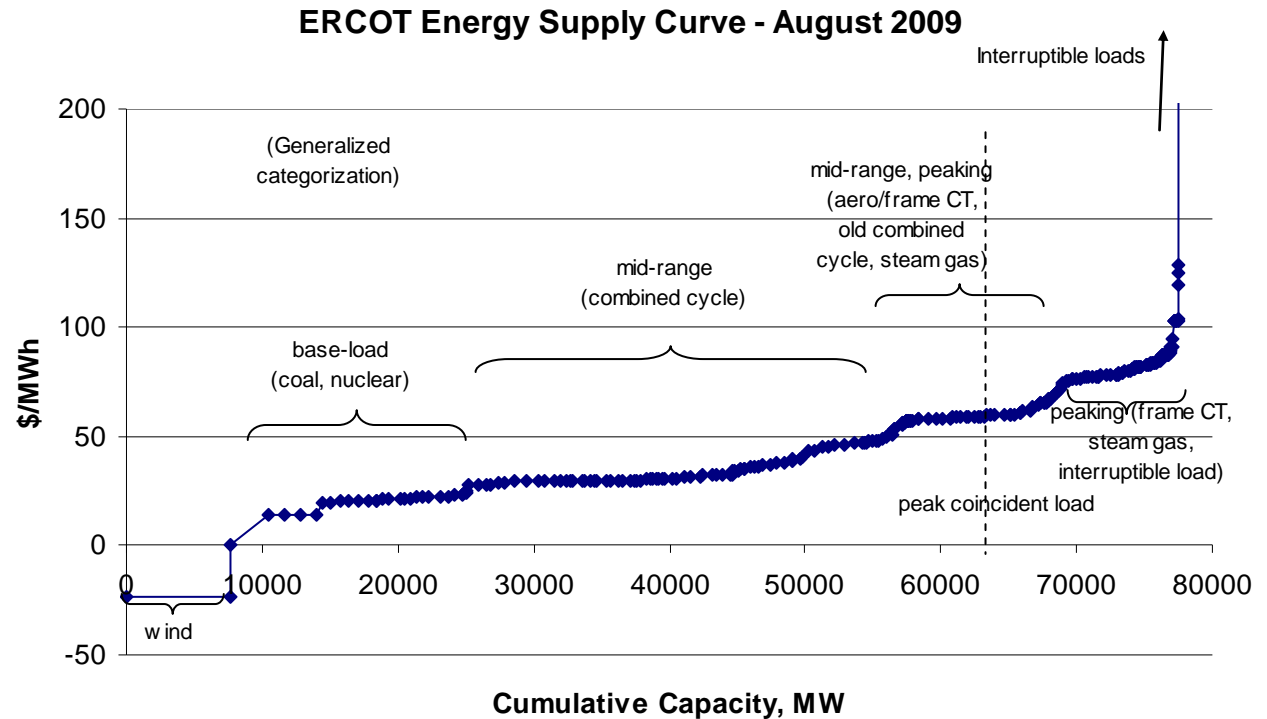
ERCOT Energy Supply Curve - August 2008



Source: B&V Analysis

ERCOT Cost Structure

- 2009 brought lower gas prices, which diminished dramatic differences in the supply curve “plateaus” observed in Aug 2008.
- Part of the key to understanding ERCOT “volatility” is appreciating not only the volatility of gas price, but the exacerbation of “latent discontinuities” in the supply curve caused by *higher* gas prices drawing out differences in generator heat rates.

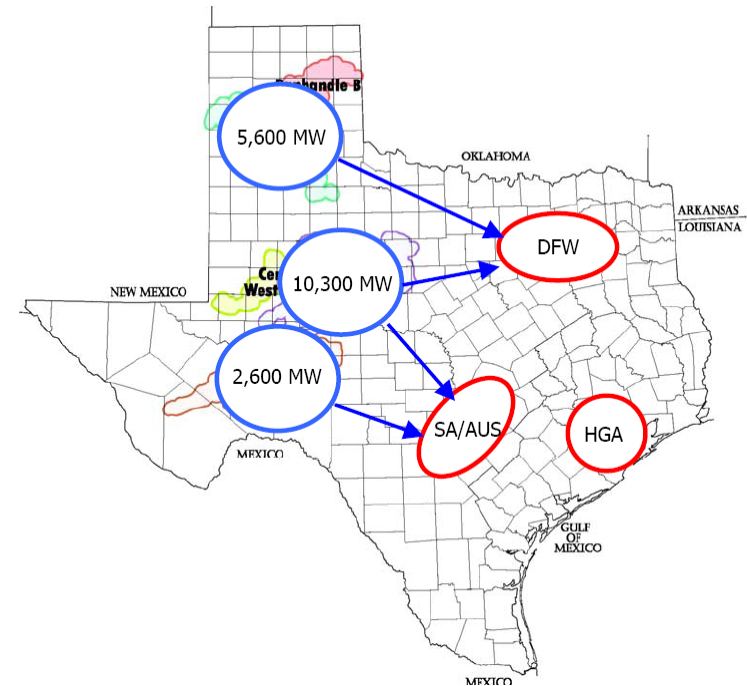


Source: B&V Analysis

ERCOT Forecasting Example

ERCOT Industry Structure - CREZ

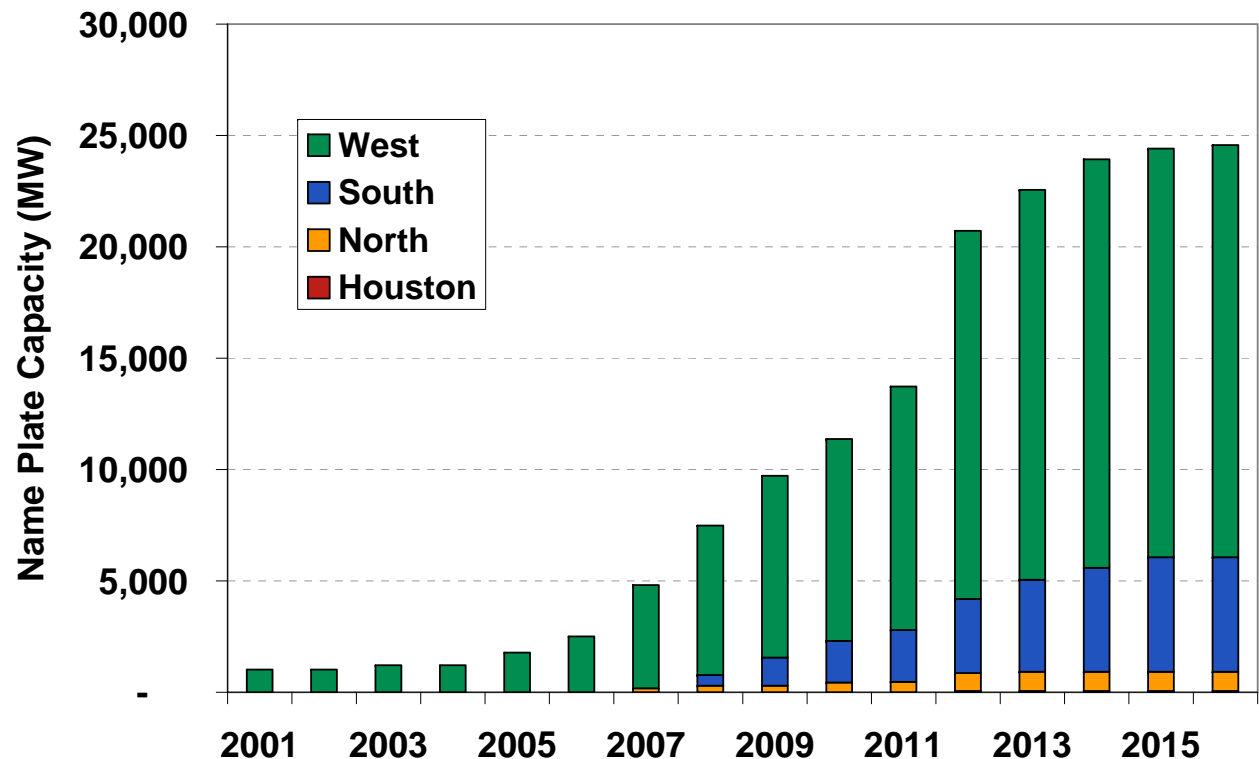
- CREZ Scenario 2 has been selected by Texas PUC; involves 2,376 miles of new ROW with a backbone consisting of double ckt 345kV lines, estimated to cost \$4.93 bn, and is based on transmission needs for 18.5 GW of wind capacity in the West zone.
- Most CREZ “Default” and “Priority” projects are already underway or have Certificate of Convenience and Necessity (CCN) filed.
- PUCT has developed a sequencing order for processing remaining Transmission Service Provider (TSP) applications for CCNs from March-July 2010. B&V assumes buildout occurs over 2010-2014.
- Significant regulatory activity in determining financial commitment of generators needed for CCN. In general, southern CREZ regions have limited requirements, but initial Panhandle developers likely to face collateral requirements with TSPs (between \$10-15.35/kW). Collateral required for first 1595.5MW in PHA, 1196.5MW in PHB.
- Wind owner NextEra energized a privately-constructed transmission line in late October.



Source:
ERCOT

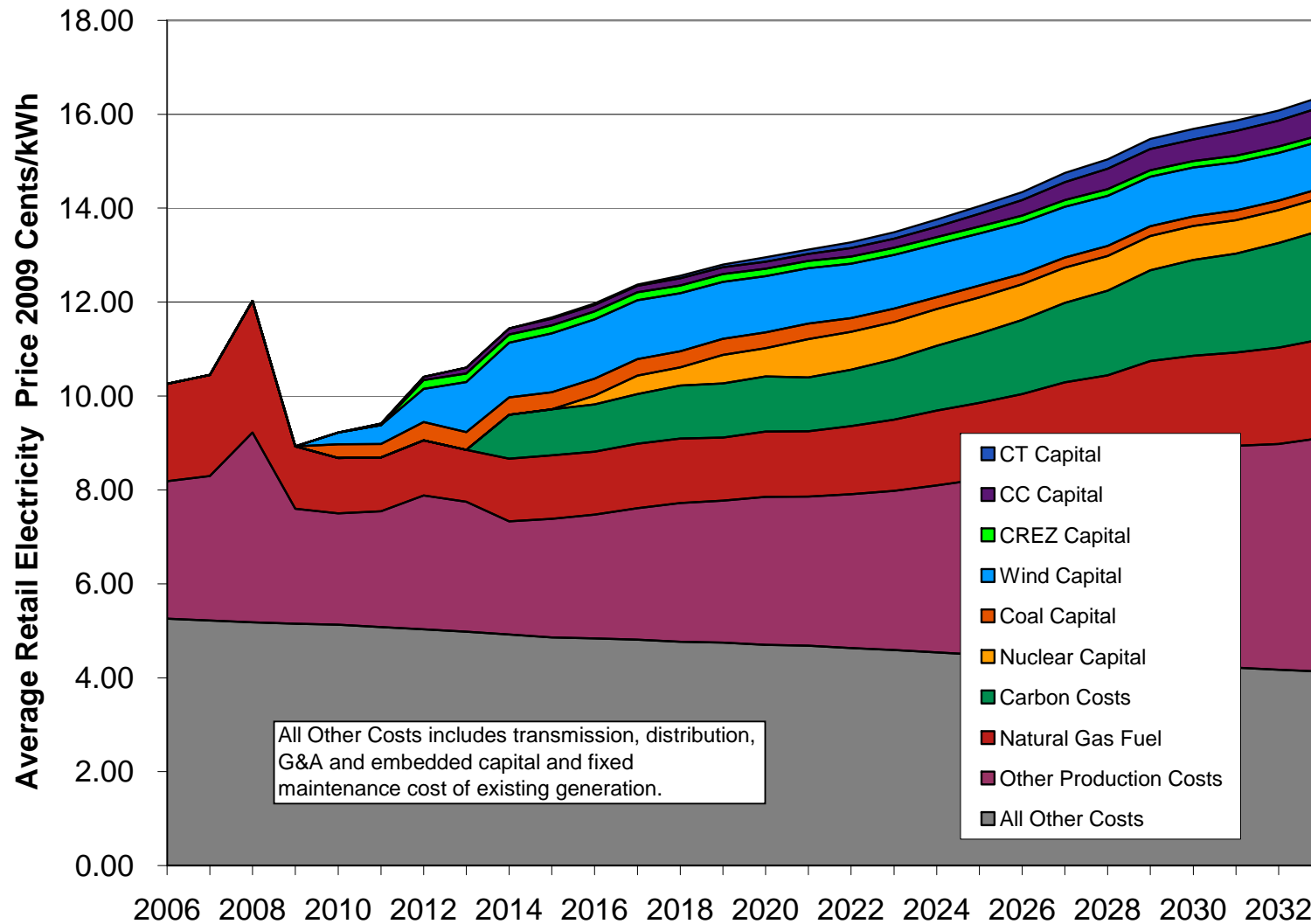
ERCOT – Cumulative Wind Scenario

- Wind additions slowed in 2009, as developers tend to wait for CREZ, investors regroup with or without tax equity, and economy slowing.
- This assumes wind development to accelerate as PUCT approves CCNs and investors eye Dec 2011 ARRA ITC/grant deadline



Source: B&V Analysis

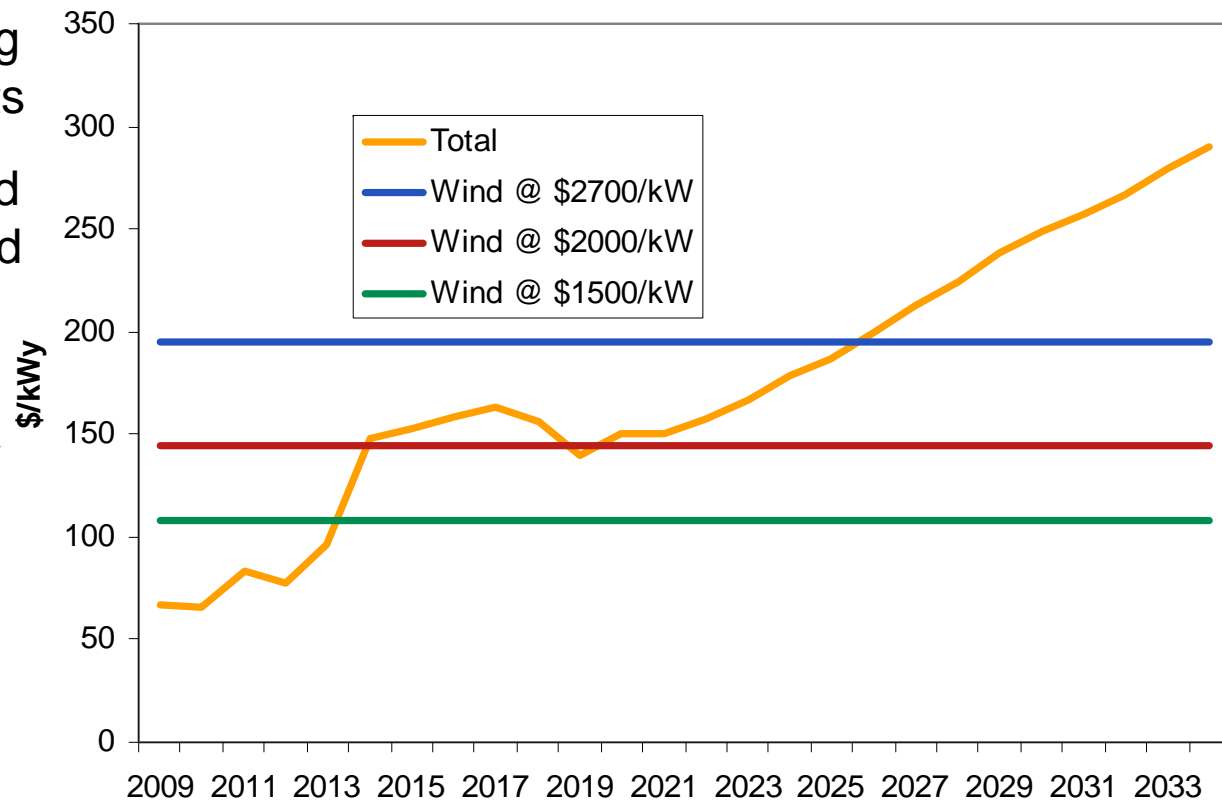
Elements of Retail Price



Perspectives on wind plant profitability

- Rough estimate of profits net of operating costs vs carrying costs
- Carrying costs defined as EPC \$/kW, lowered by 30%, times 10.3% fixed-charge rate
- Generator profitability depends on evolution of overall industry structure

Estimated profit \$/kW-year vs carrying cost of new wind



Black & Veatch Services

Black & Veatch

Global Renewable Energy Group

- Multidisciplinary group of more than 150 staff across company
- Services from R&D to turnkey EPC projects
- Experienced in all energy sources – no favorites
 - Wind
 - Hydro
 - Solar Thermal
 - Biomass
 - Landfill Gas
 - Anaerobic Digestion
 - Ocean
 - Solar Photovoltaic
 - Geothermal
 - Ethanol / Biodiesel
- Key renewables offices
 - Kansas City, MO
 - London, UK
 - Sacramento, CA
 - Denver, CO
 - Washington DC
 - Raleigh, NC
 - Ann Arbor, MI
 - San Francisco, CA

National Solar Thermal Test Facility



Black & Veatch

Global Renewable Energy Group

- Independent Engineering
- Development Support
- Owners Engineer
- Construction Management
- Technology Due Diligence

Black & Veatch Environmental Services for Energy (Power Delivery-related)

- Routing studies
- Environmental research and permit assessments
- Consultation with permitting agencies
- Wetland delineations & threatened/endangered species assessments
- Permit application development
- Public meeting participation and public testimony

Black & Veatch Enterprise Management Solutions

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