"Meet the New Market, Same as the Old Market" – the Risks to Coal Plants in the Next Four Years

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These are Troubled Times for the Coal Industry

- Coal's share of the U.S. electricity mix fell to 30.4% in 2016, down from 49% in 2006.
- Some 250 coal plants have been retired or have announced that they will be retired in coming years.
- Total installed wind capacity increased to 82,183 MW at the end of 2016, up from 11,450 MW in 2006.
- Total U.S. utility-scale solar rose over 20,000 MW in 2016, with another 17,503 MW in various stages of development.
- Yet the new administration and its allies in Congress and some states claim coal will be " Great Again"

New Administration, Congress and Some States Pushing Measures to Reverse Decline in Coal

- Eliminate EPA regulations.
- Reduce funding for EPA and NOAA.
- Roll back rooftop solar incentive programs in the states. (e.g. MN and UT)
- Two-year ban on wind development in ND proposed but not adopted – reason for ban was wind farms are contributing to coal retirements.
- OK Gov. Fallin has proposed new tax on energy generated from wind turbines.
- Ohio legislators again targeting the state's renewable energy mandate.

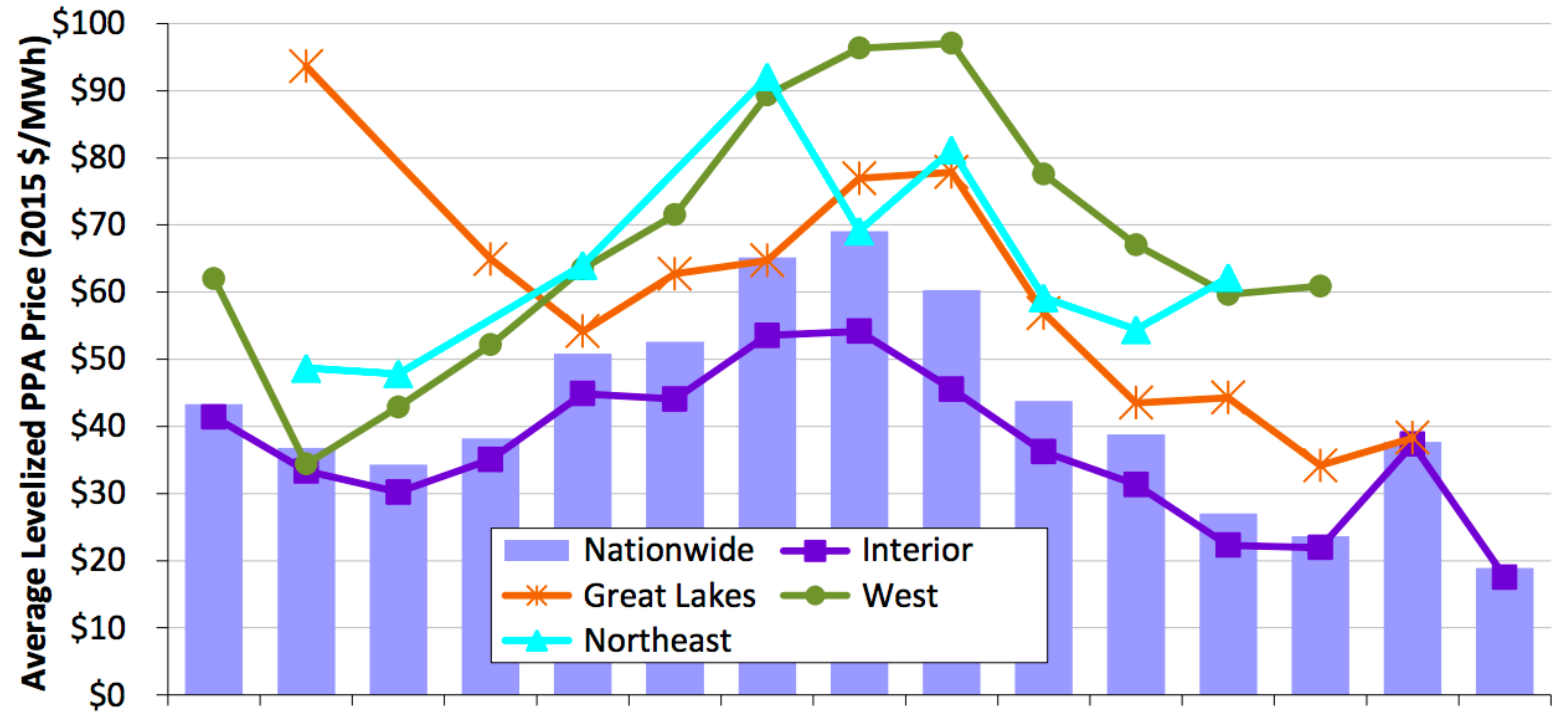
Coal-Fired Generators Continue to Face Same Market Risks as Before January 2017

- Low natural gas and energy market prices.
- Growing competition from wind & solar.
- Low gas prices and increased competition from renewables means less generation from coal-fired plants and lower revenues from sales.
- Flat or nearly flat peak demands (MW) and energy loads (MWh) – *means increased competition to serve same sized loads.*
- Low and/or volatile capacity market prices.
- An aging coal fleet.
- Environmental Regulations.

Solar and Wind Also Pose Serious Threats to Financial Viability of Coal Plants

- Solar and wind installation costs and power purchase agreement (PPA) prices have been declining dramatically in recent years.
- With no fuel costs, utility-scale solar and wind facilities are dispatched first in the competitive markets, displacing energy from coal- and gas-fired generators.
- Solar generation keeps energy market prices low during periods of peak demands. Wind generation does the same in both peak and off-peak hours.
- Distributed rooftop solar photovoltaic resources reduce loads on the electric grid and, therefore, reduce the need for generation from coal (and natural gas) plants.

Substantial Declines in Wind PPA Prices



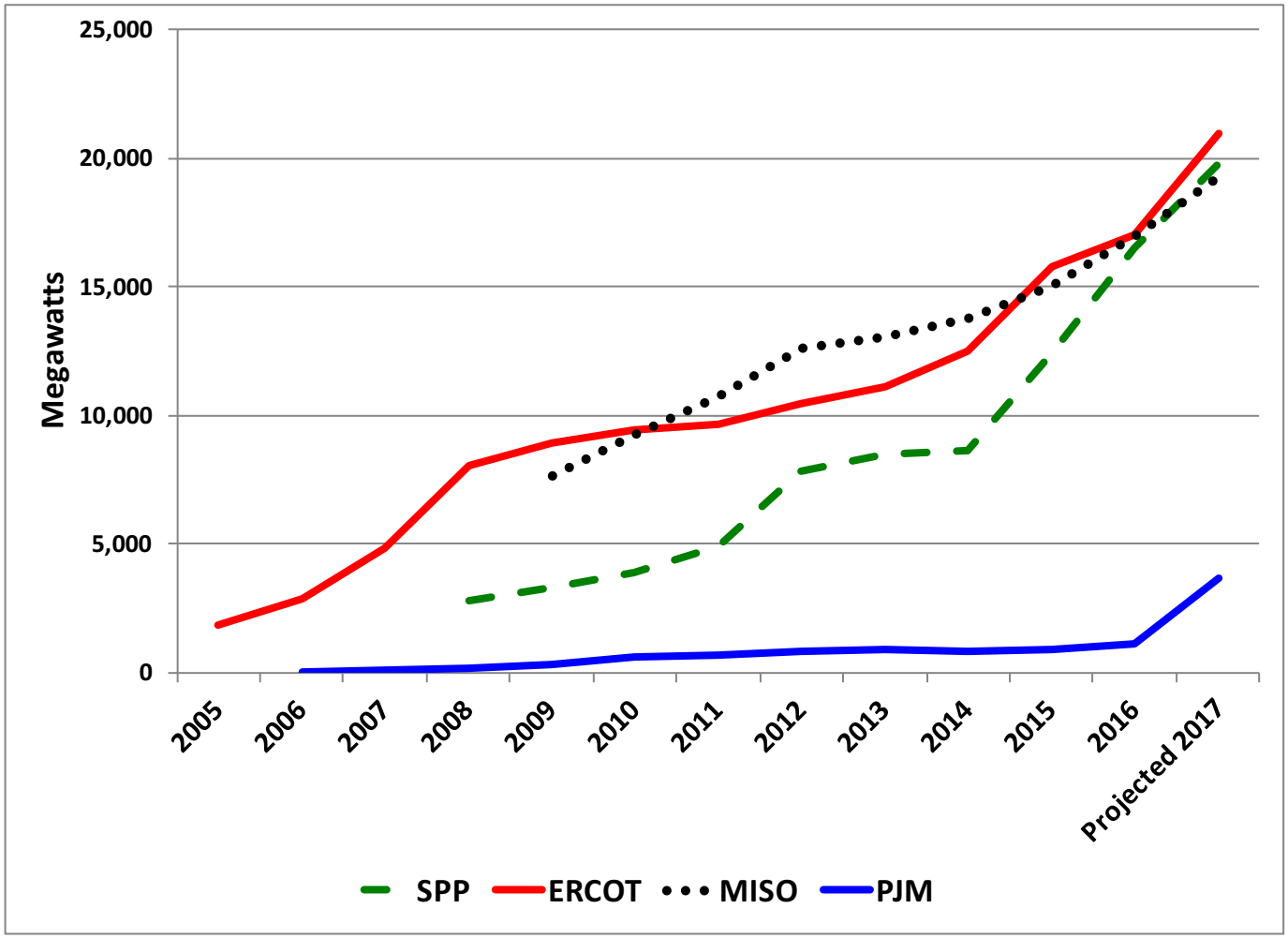
PPA Year:	96-99	00-01	02-03	04-05	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Contracts:	10	17	24	30	31	26	39	49	49	43	13	32	16	6	2
MW:	553	1,249	1,382	2,190	2,436	1,781	3,465	4,048	4,790	4,727	970	4,374	1,985	401	207

Source: Berkeley Lab

Figure 48. Generation-weighted average levelized wind PPA prices by PPA execution date and region

[Lawrence Berkeley National Lab – 2015 Wind Technologies Market Report]

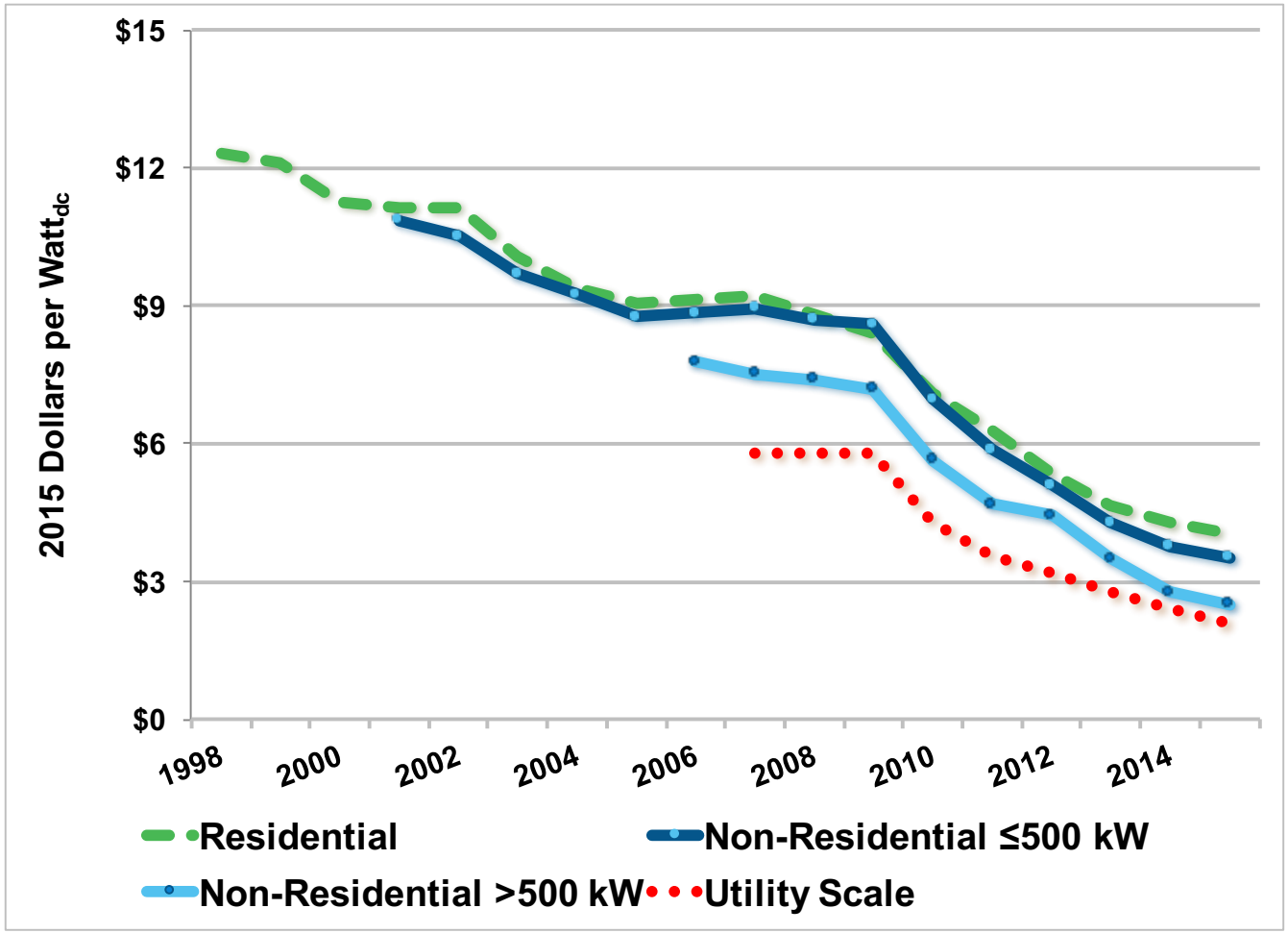
Increases in Installed Wind Capacity in Coal-Heavy Competitive Markets (but not PJM)



Wind Highlights

- MISO expects a total of 25 GW of new wind will be added, presumably within the next decade – 14 GW of new wind is in its Definitive Planning Queue.
- SPP studies reveal it has the potential to serve 75% of its load with wind – it has 32 GW of new wind in its interconnection queue. SPP's manager of operations analysis and support is quoted saying "Maybe not all that 32 [GW] will be installed, but we know we'll have more than 16."
- SPP served over 50% of its load with wind-generated electricity for several hours on February 12, 2017.
- Eight states generated more than 15% of their electricity in 2016 with wind. Five of those states generated more than 20%. IA generated 36.6% from wind, followed by SD (30.3%), KS (29.6%), OK (30.3%) & ND (21.5%)

Declining Solar Installation Prices



[LBNL – *Utility-Scale Solar 2015: An Empirical Analysis of Project Cost, Performance and Pricing Trends in the United States*]

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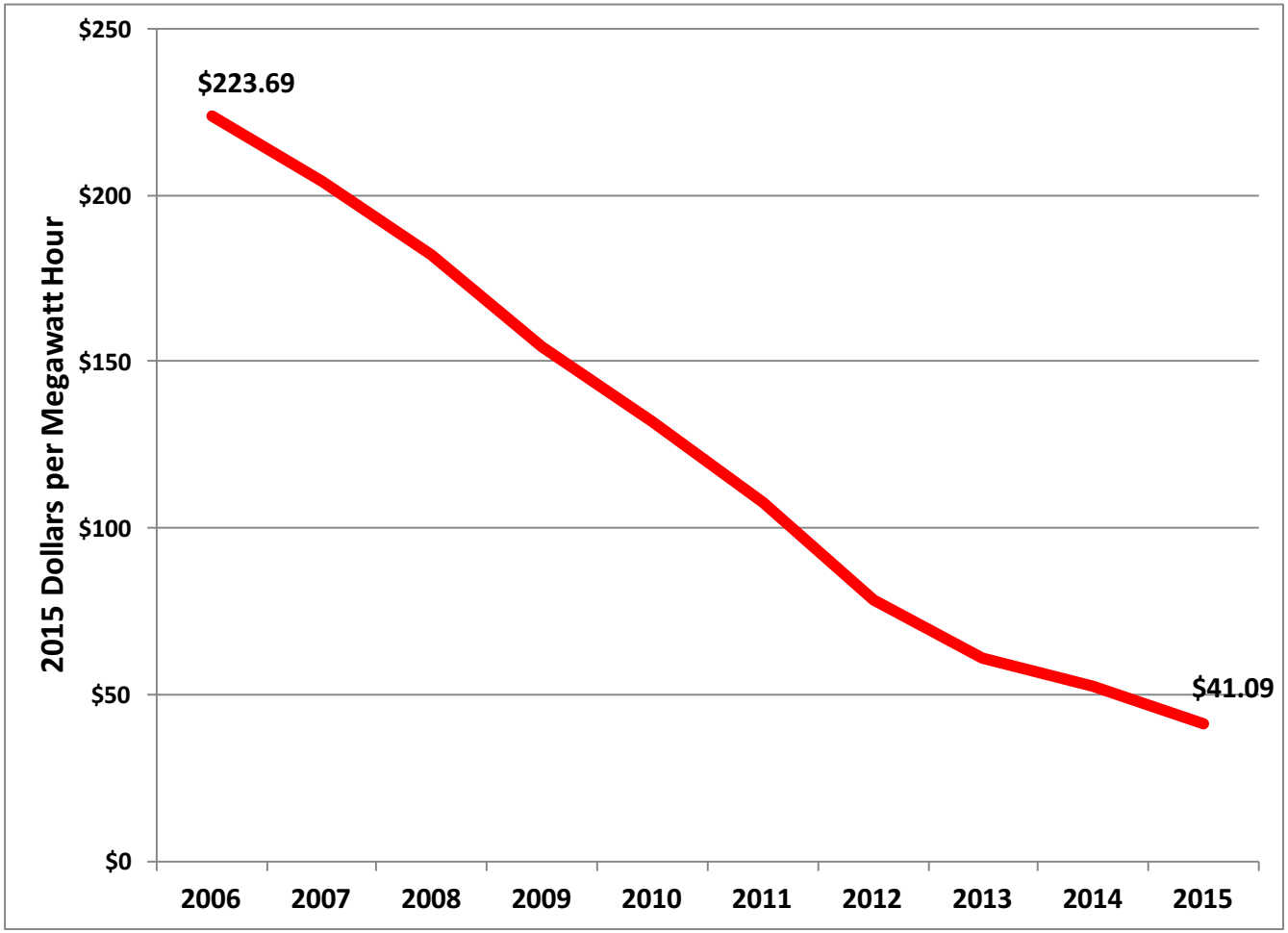
Solar PPA Prices "Dropping Like They're Hot"



[LBNL – *Utility-Scale Solar 2015: An Empirical Analysis of Project Cost, Performance and Pricing Trends in the United States*]

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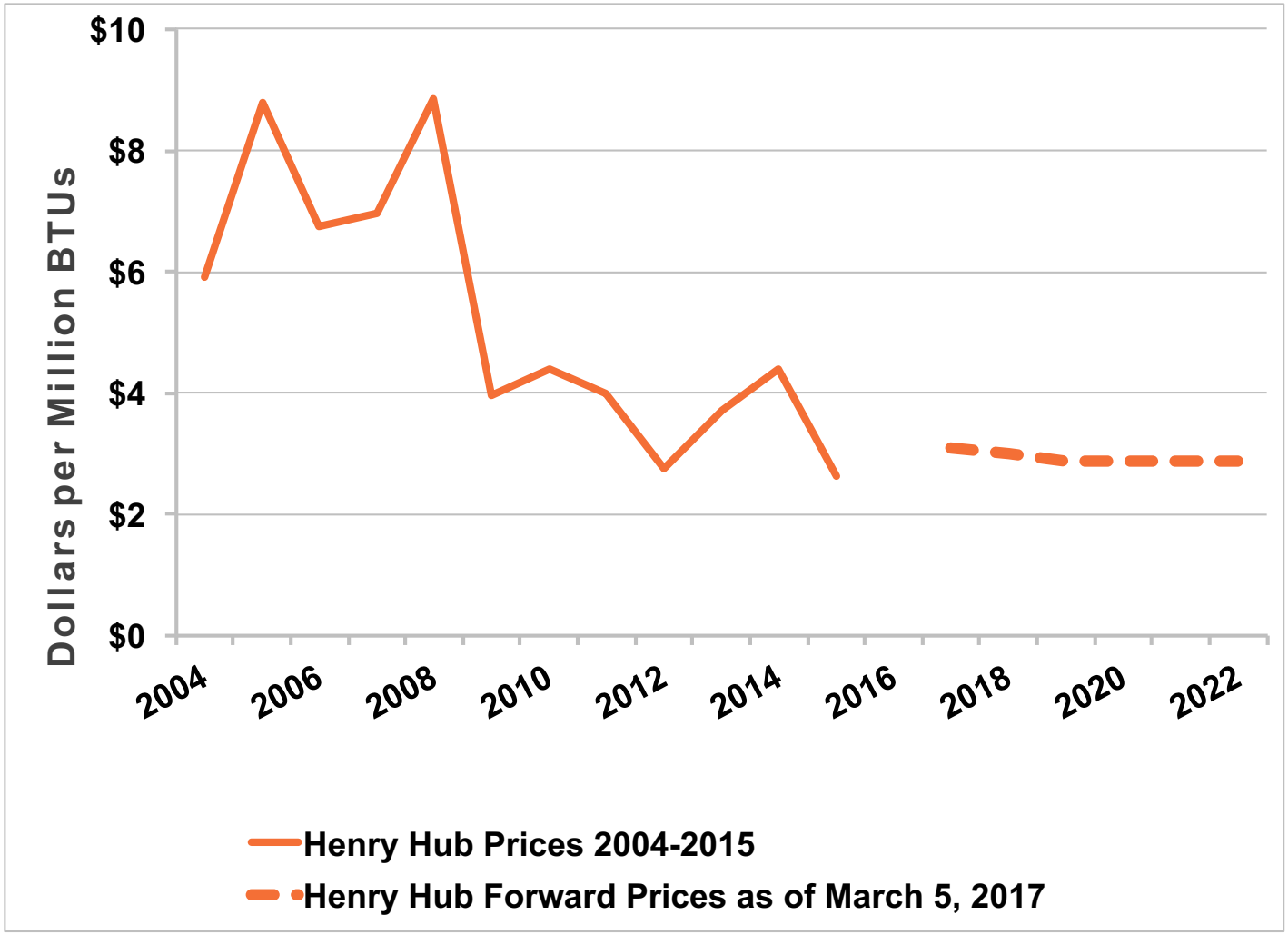
Natural Gas Prices Have Declined Since 2008 and Are Expected to Remain Low in Coming Years



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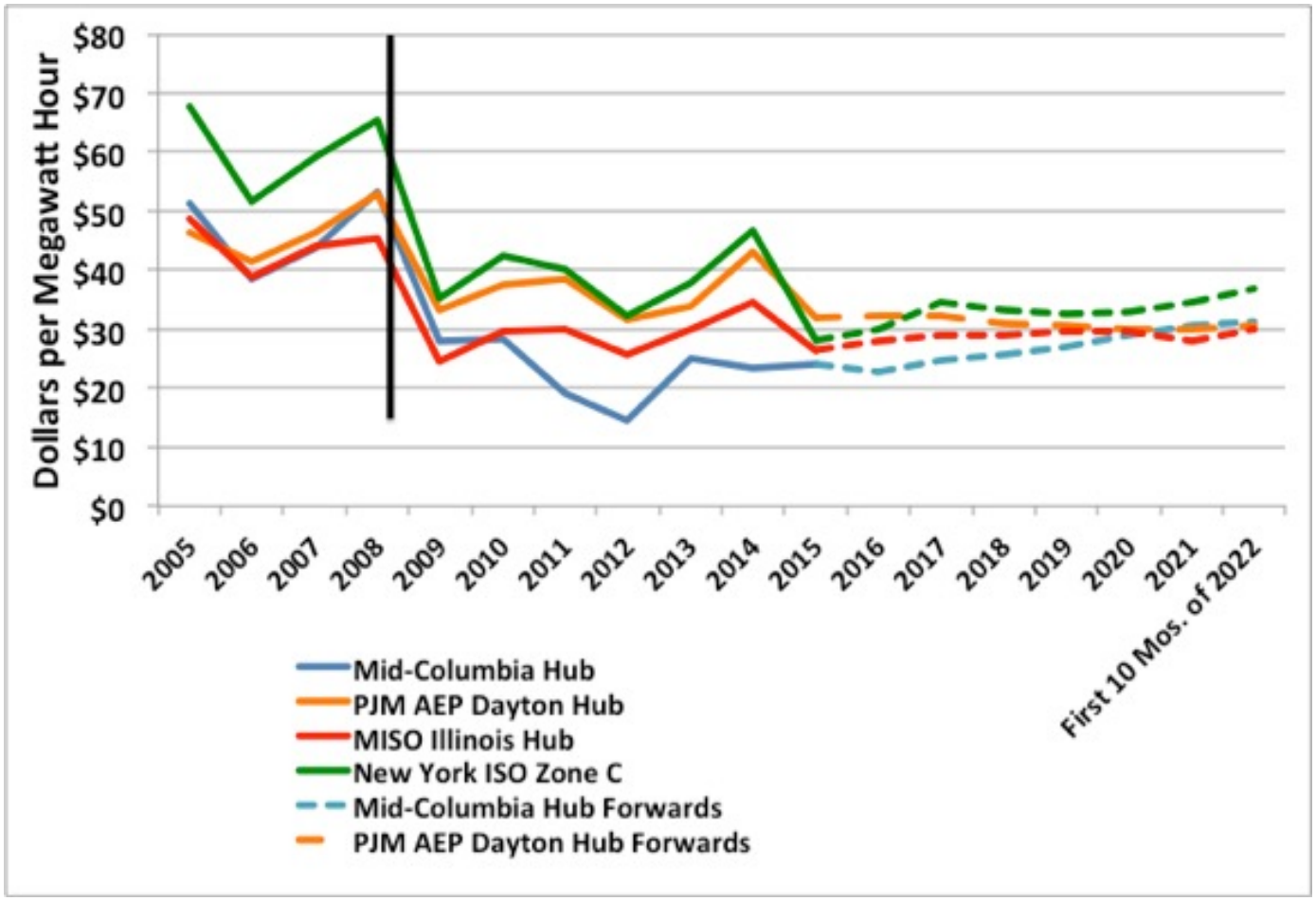
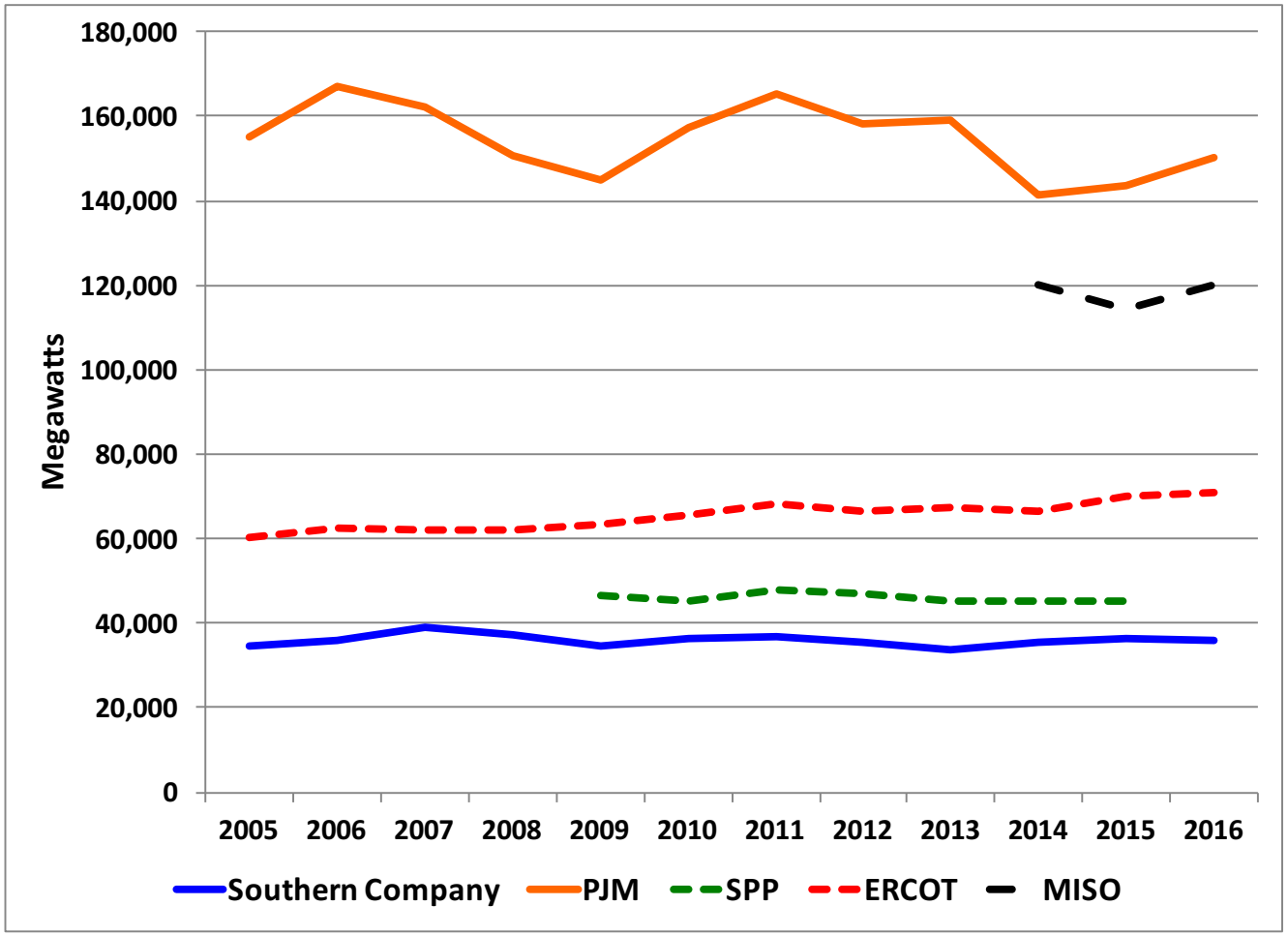
Low Gas Prices Lead to Lower Energy Prices in Competitive Wholesale Markets



More Gas-Fired Capacity is On the Way

- 19 GW of new gas-fired capacity is scheduled to be added to the grid in 2017.
- According to SNL, Financial, 71 GW of new combined-cycle gas plants may come online in the next four years.
- Even if only a small % of this gas-fired capacity is built it will provide further competition for coal-fired generators, especially on top of all of the new wind and solar resources expected to be added to the grid.

Little-to-No Growth in Peak Demands in Last Decade



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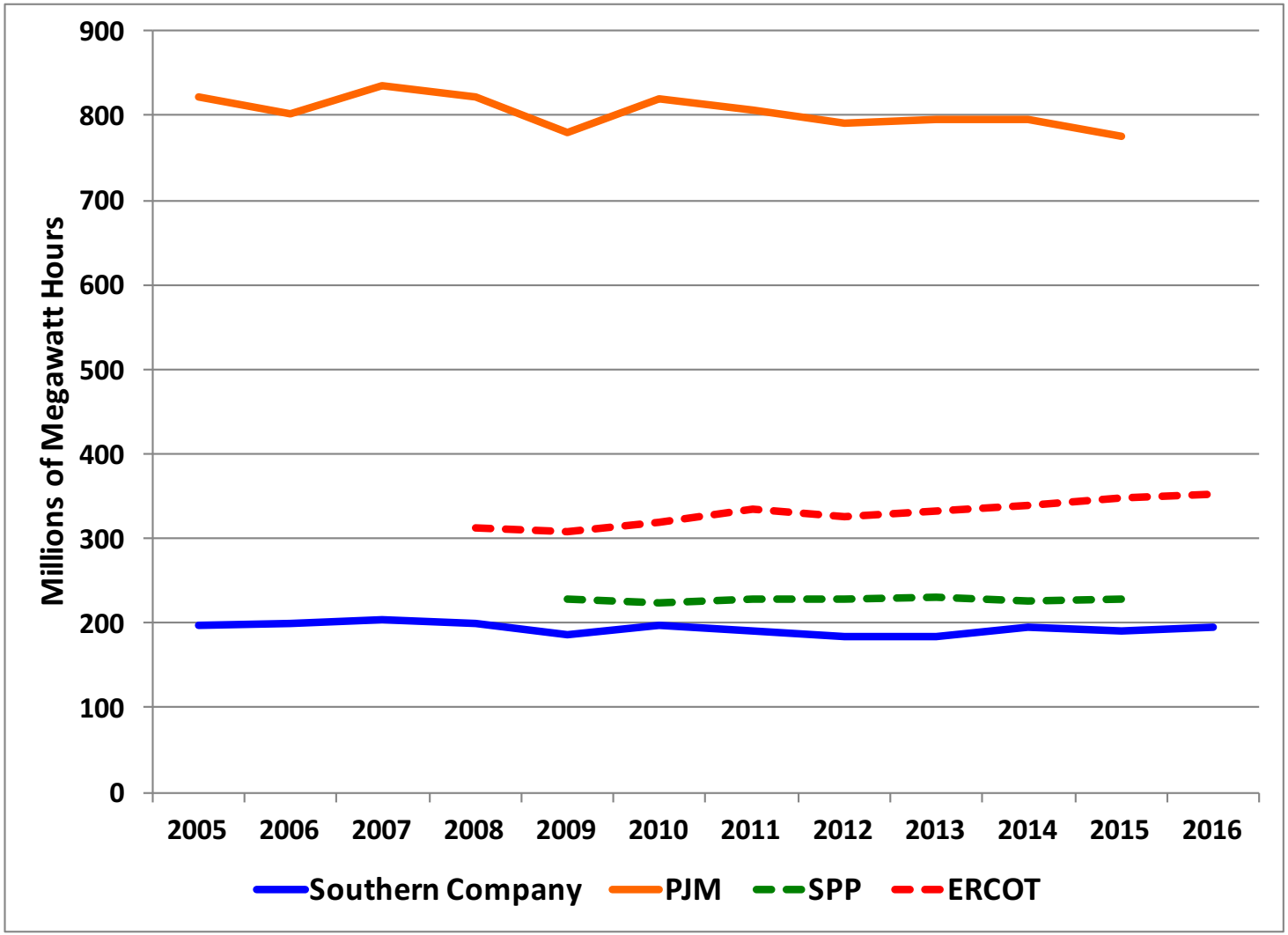
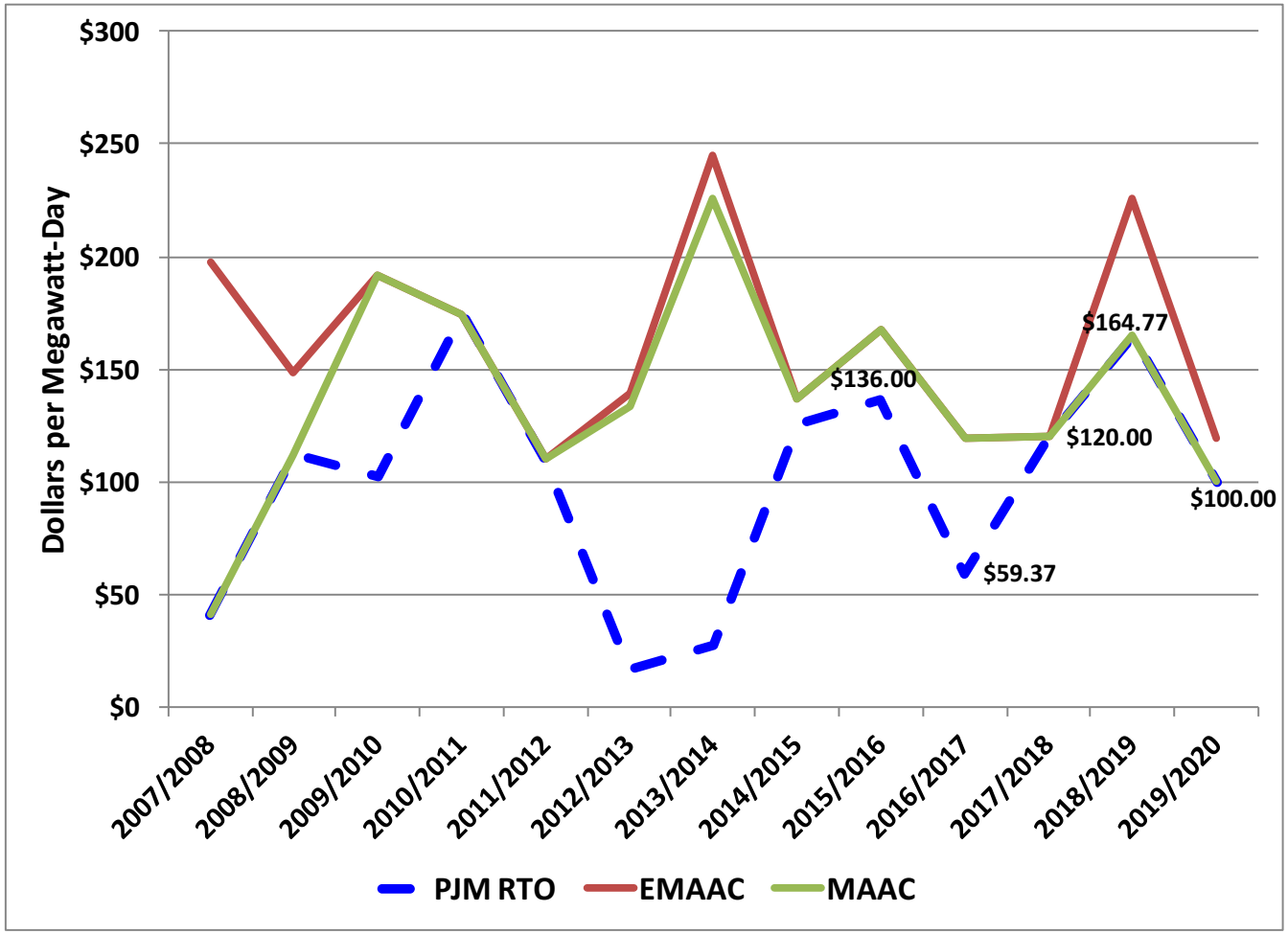
Also Little-to-No Growth in Energy Sales



Why Are the Loads So Flat

- Impact of formal energy efficiency investments and increased interest from consumers in saving energy.
- Increased generation from distributed “rooftop” solar PV.
- GDP growth has outpaced increases in electricity consumption as a result of strategies by industrials and large utilities to better manage their power use and load + changing residential consumption habits.
- All of these likely to continue to dampen future growth.
- Recovery from Great Recession.

Capacity Markets Do Bailout Coal-Fired Plants But Prices Too Volatile to Provide Financial Assurance



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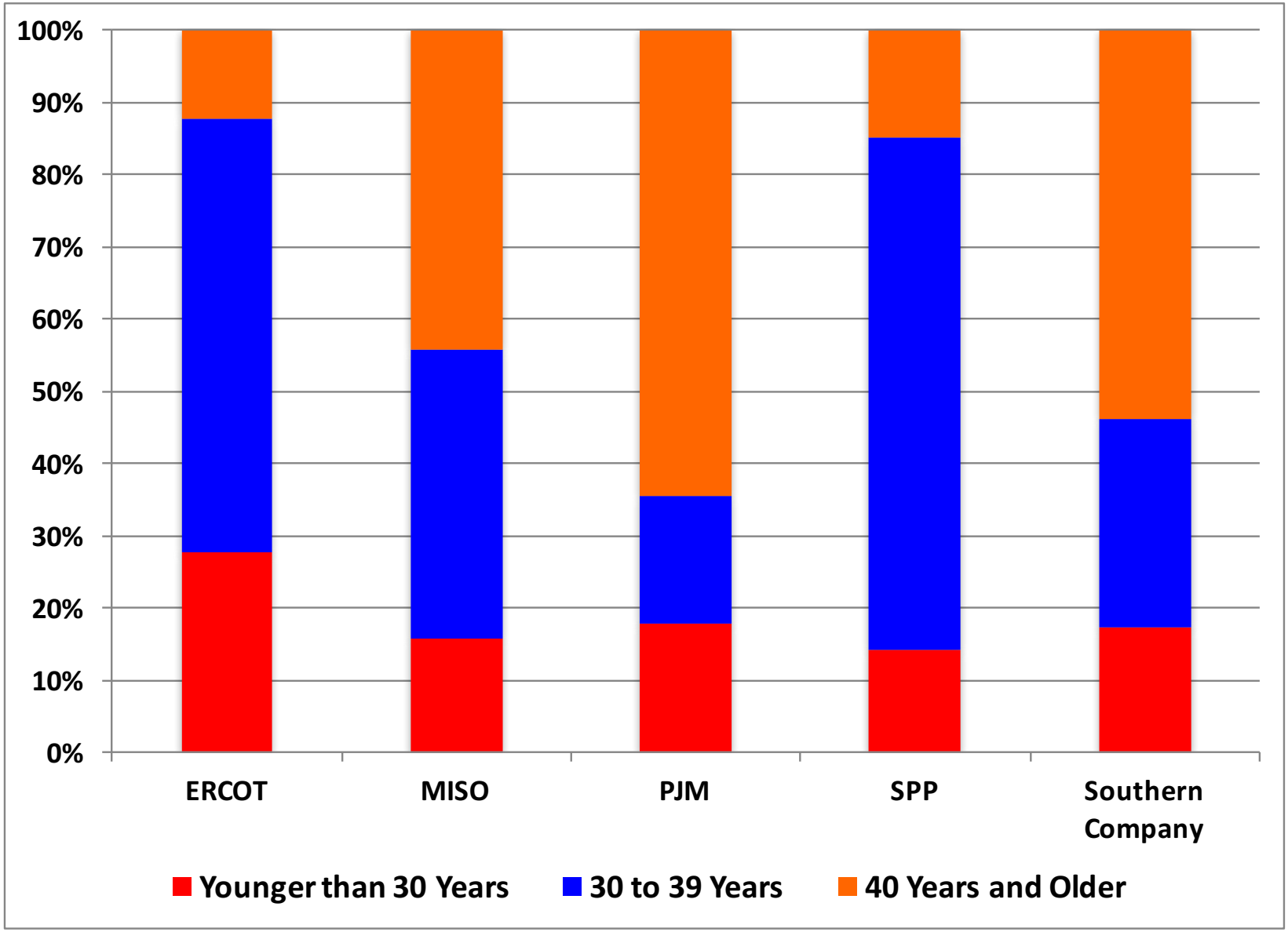
U.S. Coal Fleet is Aging



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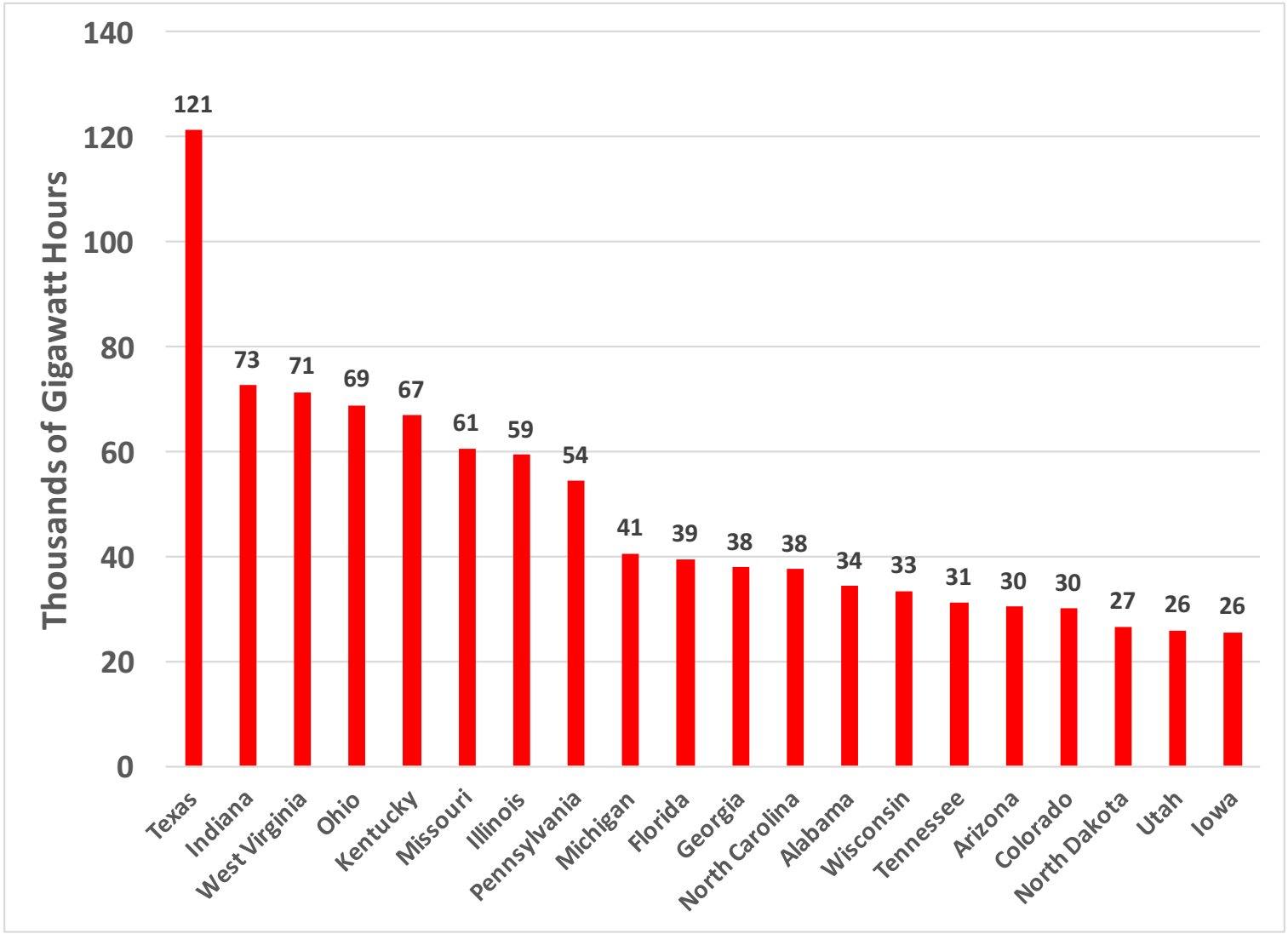
20 Biggest Coal Generating States in 2016



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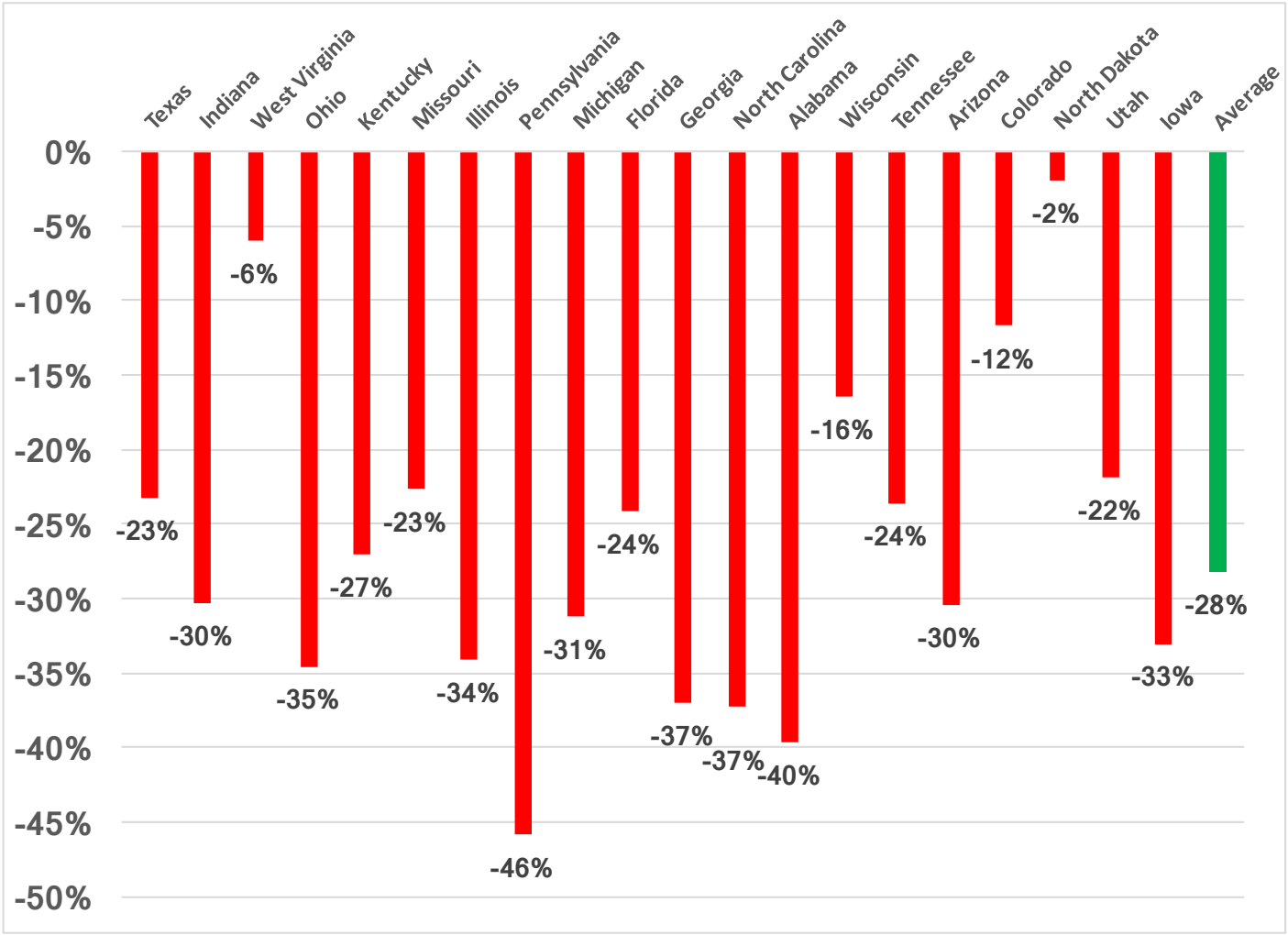
Declining Coal-Fired Generation in 20 Biggest Coal States from 2011 to 2016



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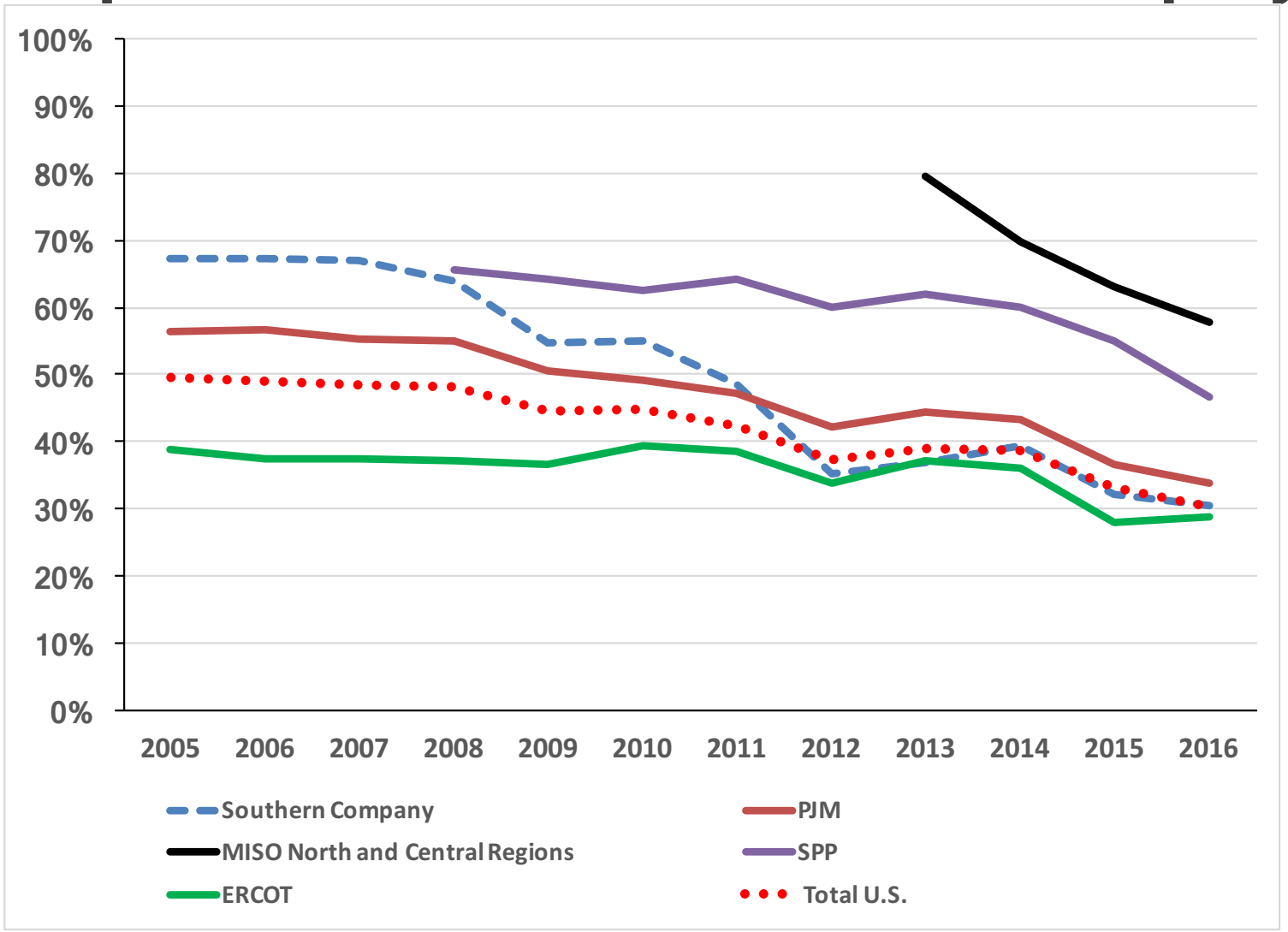
Summary -- Coal's Declining Market Share in Competitive Markets and Southern Company



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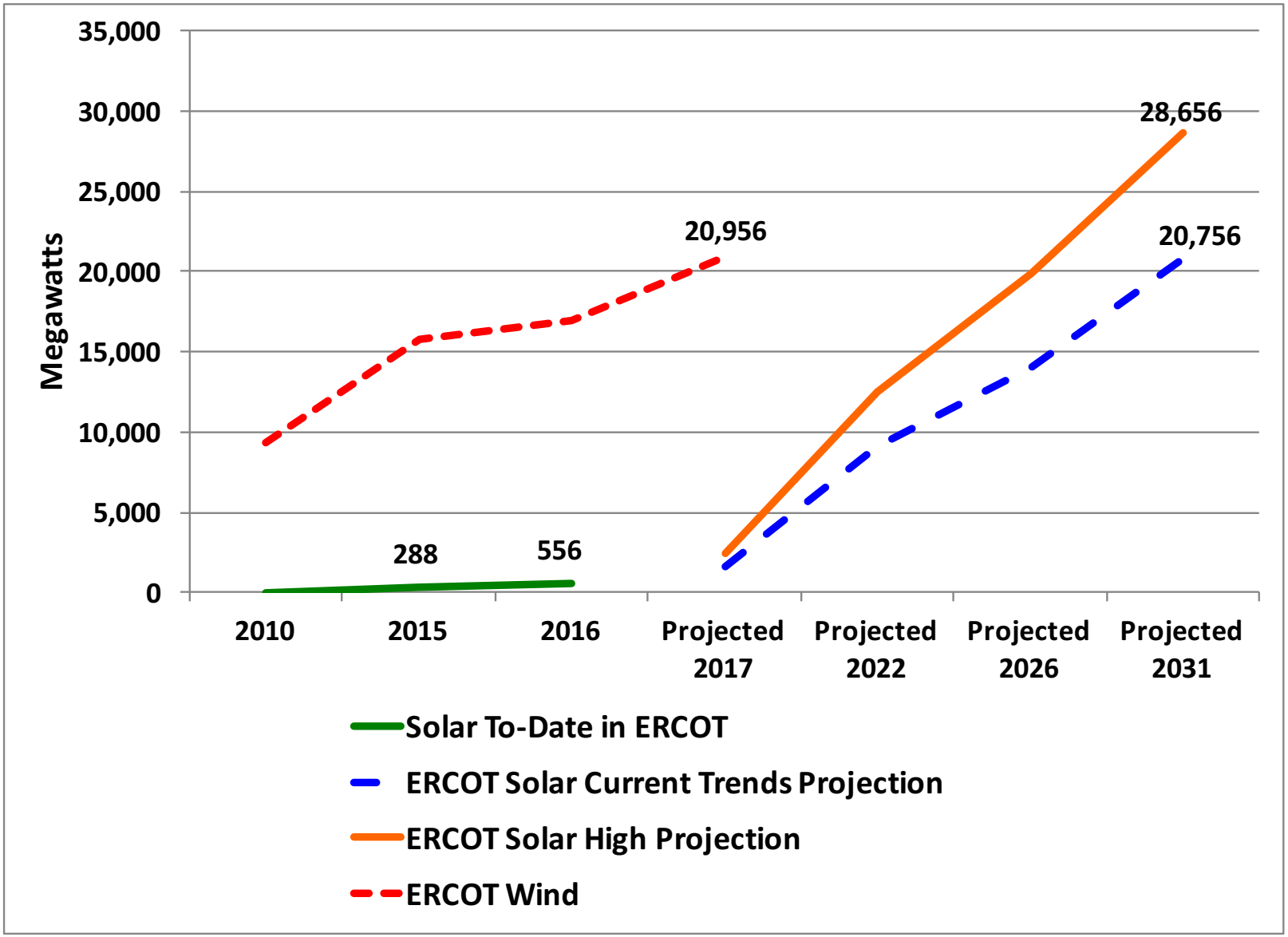
Alberta Electric System Operator
Ontario Independent Electric System Operator
ISO New England
New York ISO
Midcontinent ISO
PJM Interconnection
California ISO
Southwest Power Pool
Electric Reliability Council of Texas

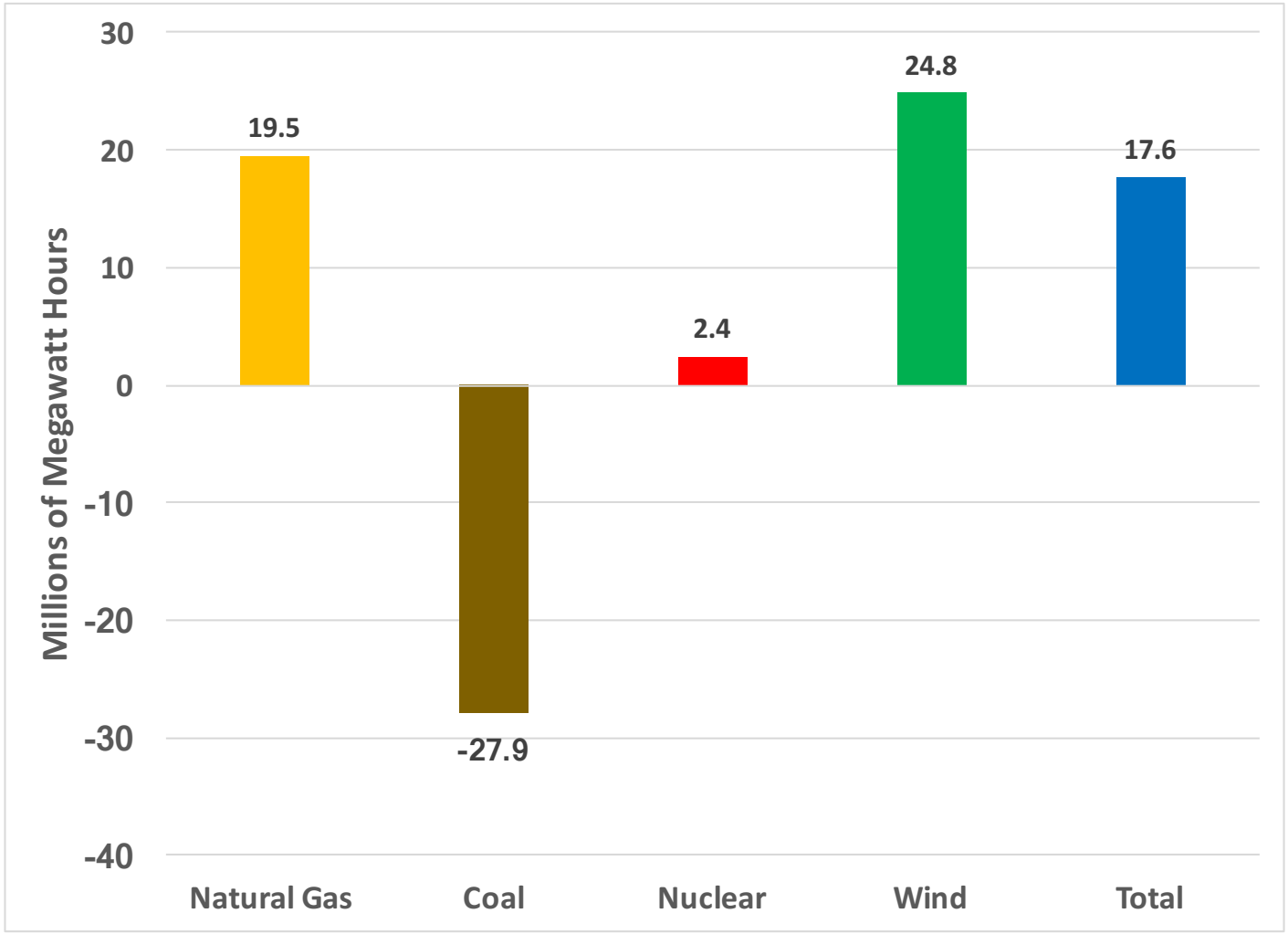
ERCOT

- Coal generation declined by 22% from 2011 to 2016.
- Wind generation increased by 88% in the same period.
- More wind is on the way. Between 14.5 and 28 GW of solar also is projected to be added to the grid by 2031. SNL refers to “solar as far as the eye can see.” This will be bad news for coal.
- Some wind produces max output during off-peak hours, some during peak-periods, depending on the location of the wind turbines. Solar produces max power during peak pricing periods. Combination of wind and solar will displace more generation from coal and keep energy market prices low.

Wind and Solar in ERCOT



Change in ERCOT's Generation Mix 2011 to 2016



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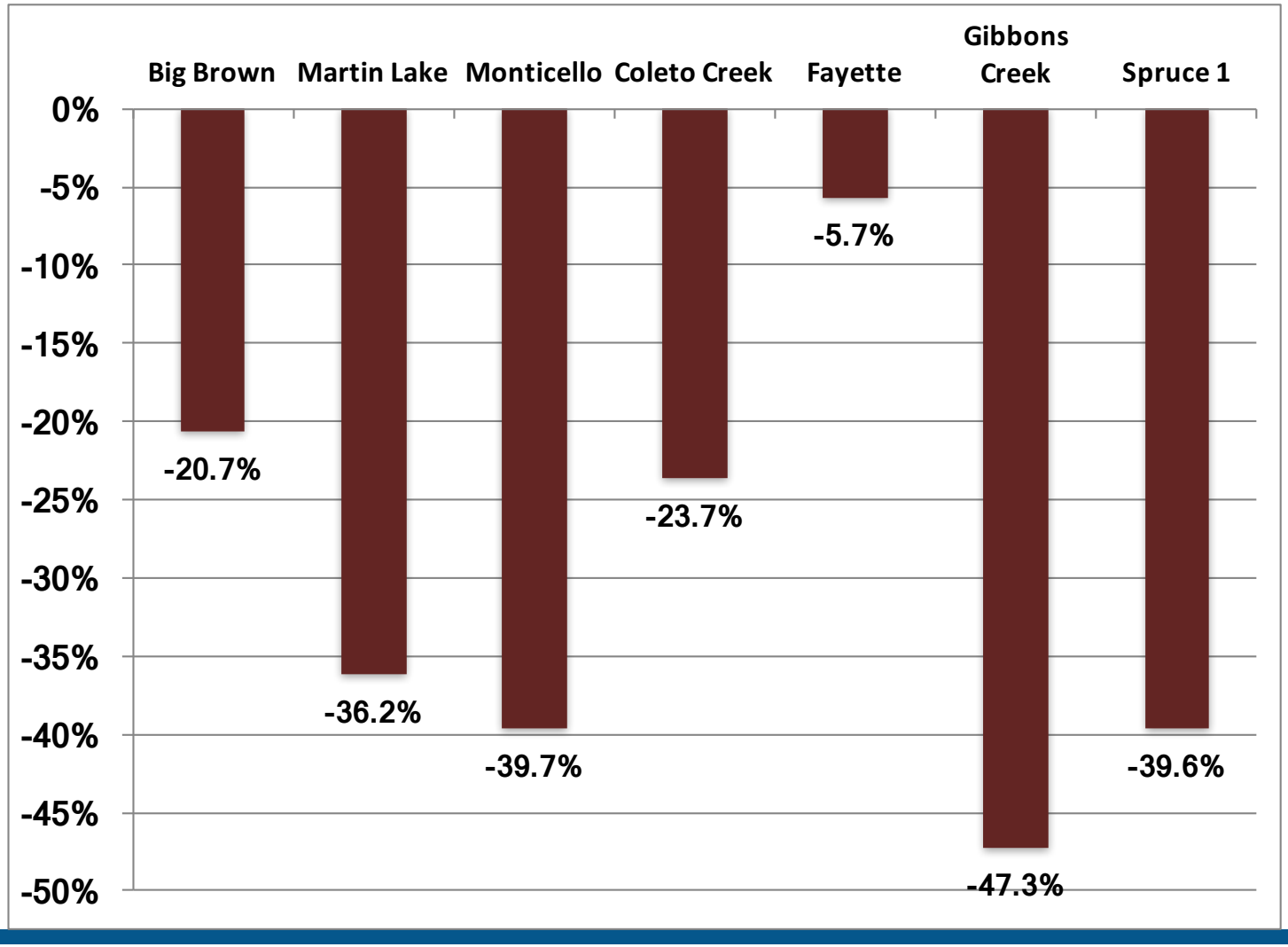
Declines in Generation at Texas Coal-Fired Generators Between 2011 and 2016



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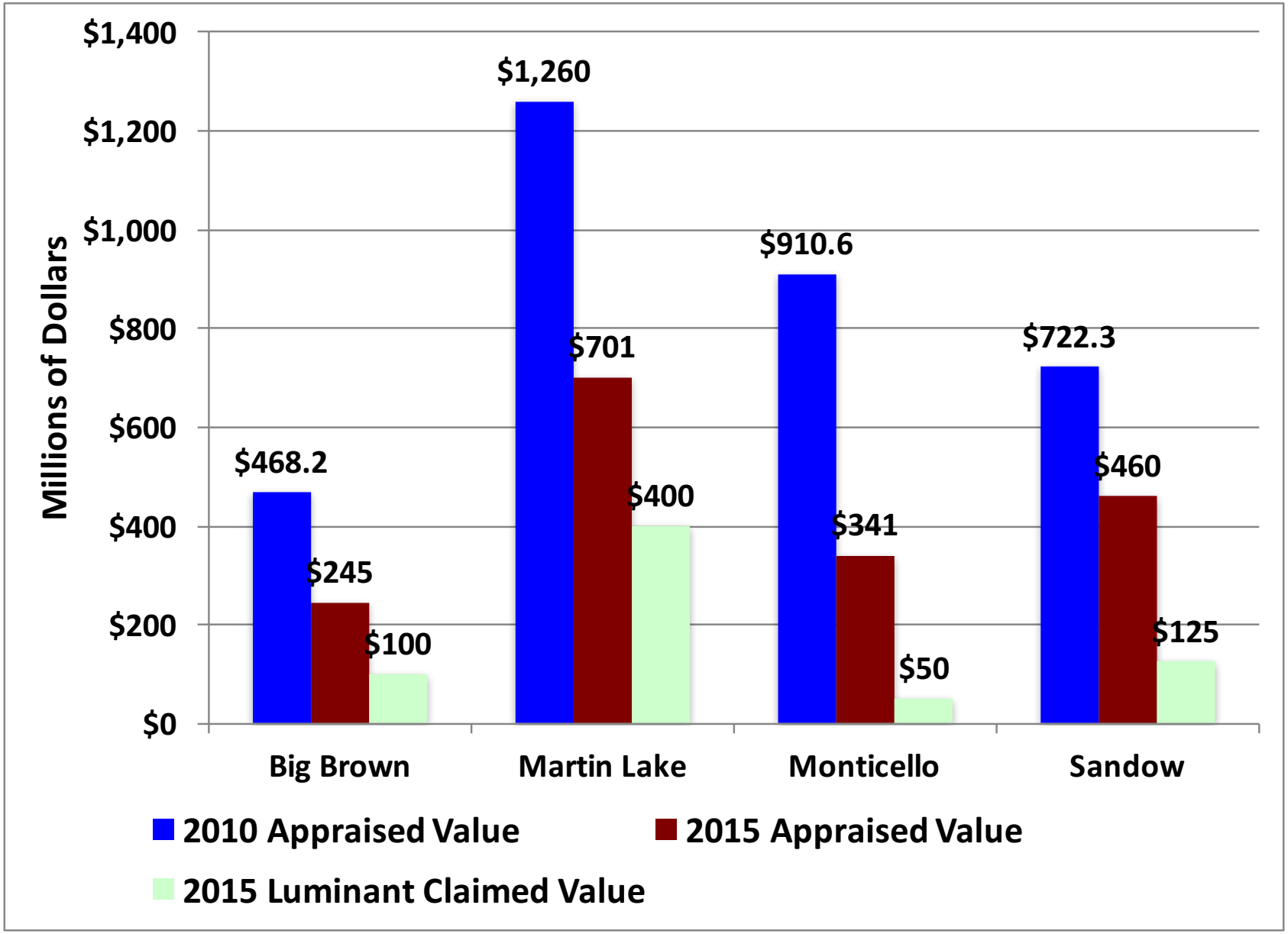
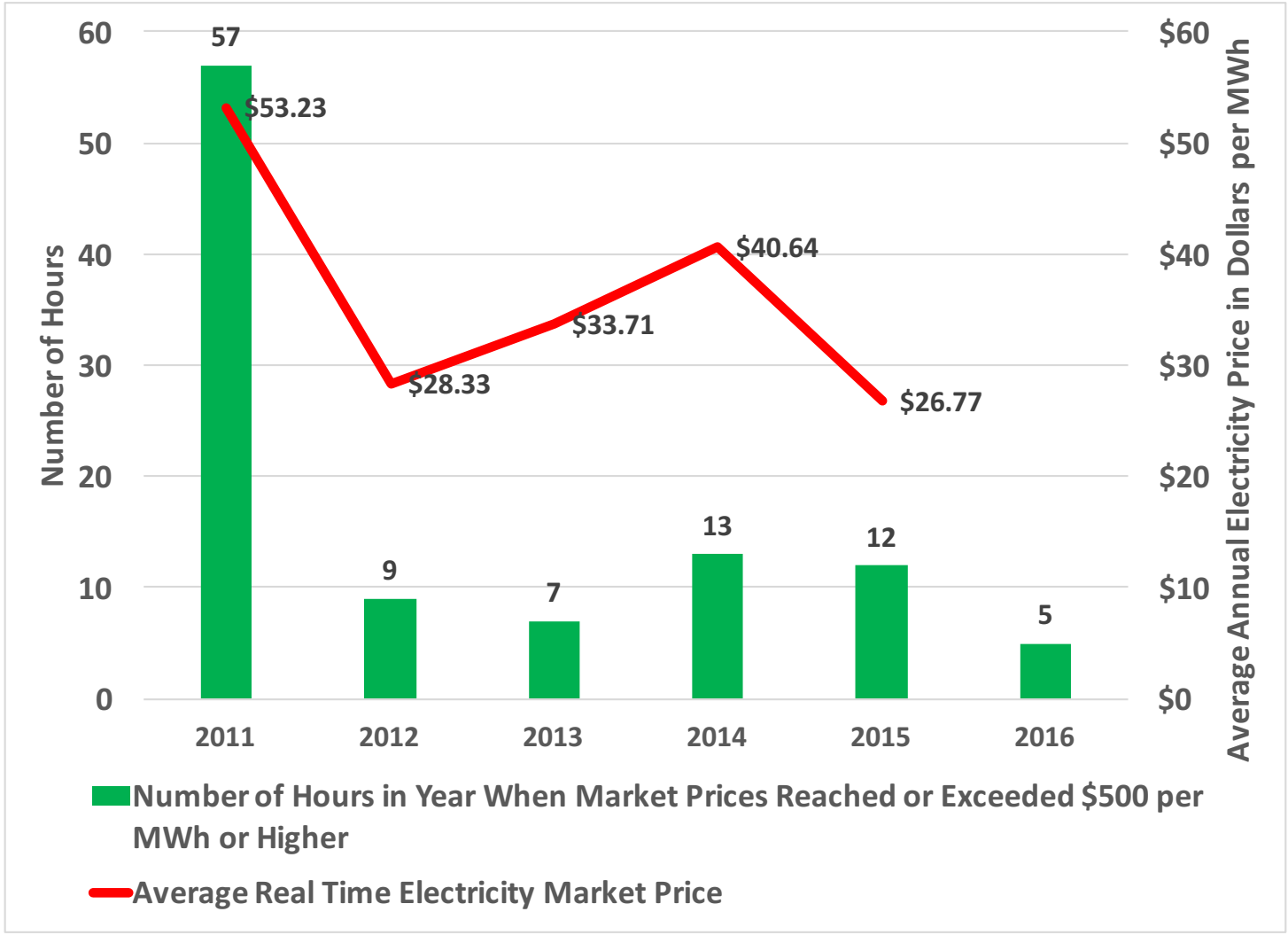
Decline in Tax Values of Luminant's Coal-Fired Generators in Texas



Declining Prices and Fewer Price Spikes as ERCOT Has Transitioned Away from Coal



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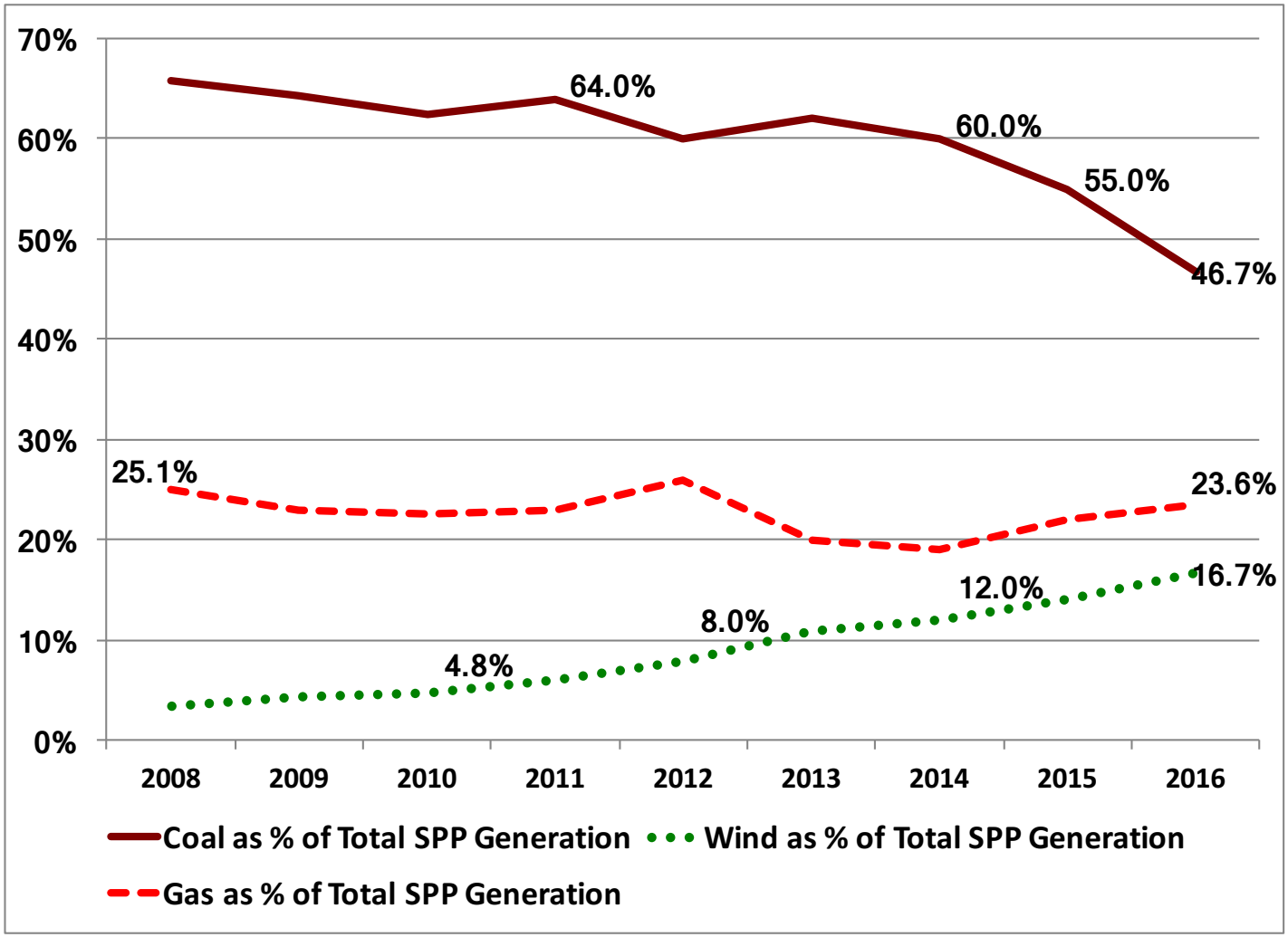
Southwest Power Pool

- Wind resources and generation continue to increase, reaching nearly 17% of SPP fuel mix in 2016 – 20% in the fall.
- More wind capacity is being added. Some solar is on the way too. SPP believes it can achieve a 75% wind penetration level.
- Coal's share of SPP fuel mix declined to below 47% in 2016 despite rising natural gas and energy market prices.
- Very high reserve margins in SPP mean lots of excess capacity.

Wind + Gas Displacing Coal in the Southwest Power Pool



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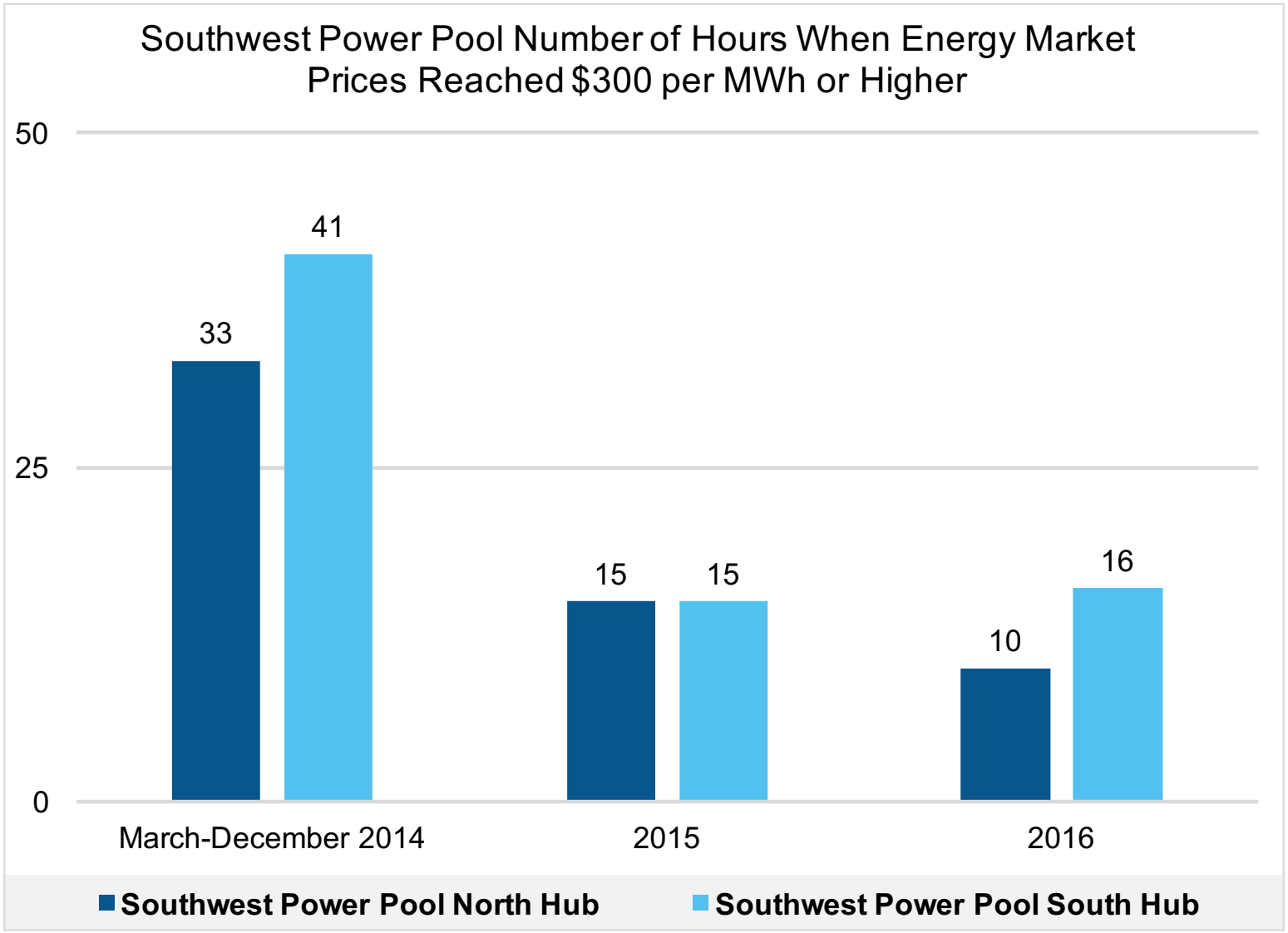
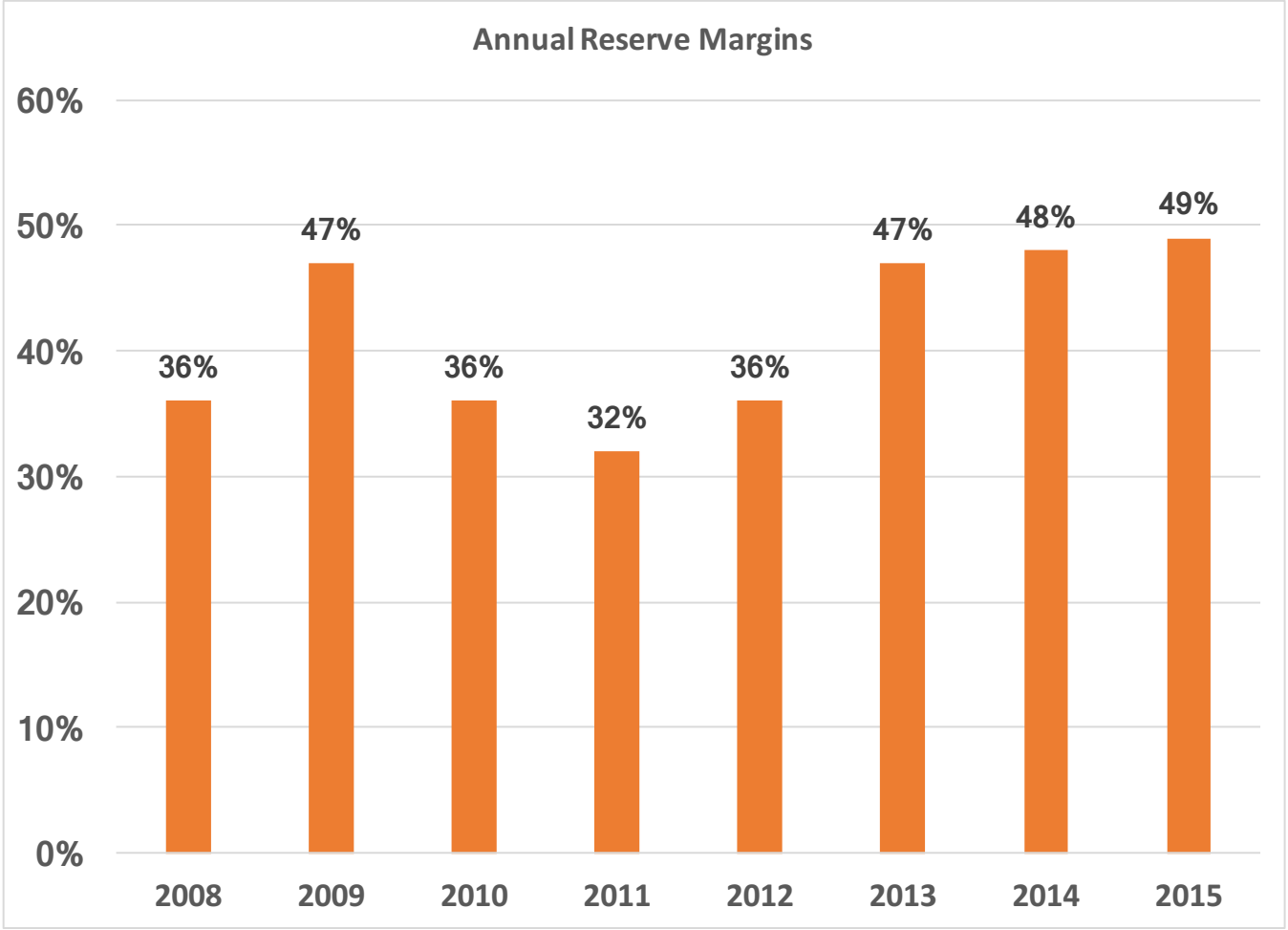
Transition from Coal is Not Causing Price Spikes



Excess Capacity in SPP Reduces Reliability Risks from Retiring Coal-Fired Generators



SPP only assumes a 5% capacity credit for wind.
Typical reserve margins for reliability are 15-20%

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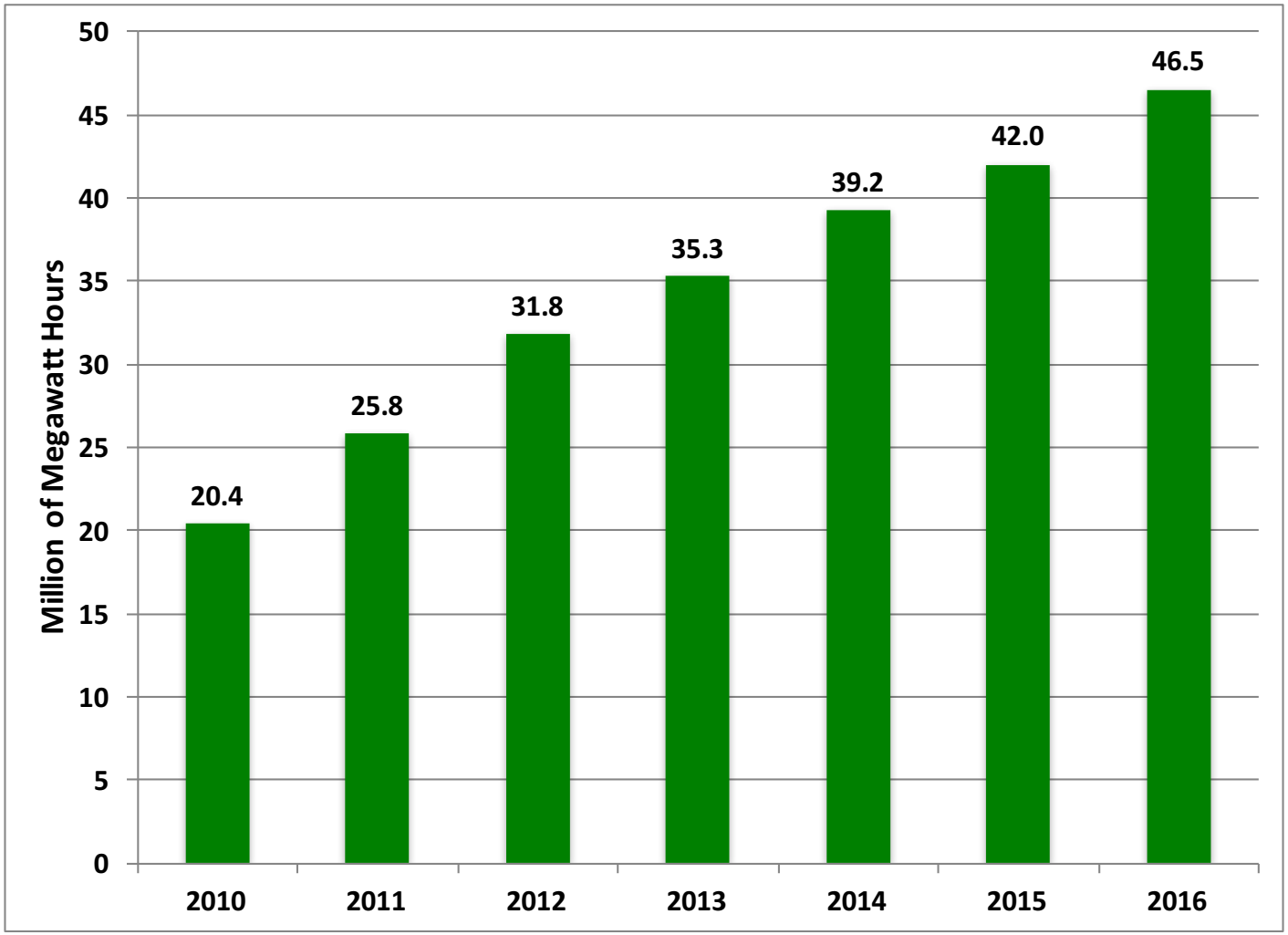
MISO

- Annual wind generation in MISO increased by 32% in just two years. Wind provided 28% of the energy in MISO's North region in the 15 month period September 2015 through November 2016, with a high of over 42% of the energy in April 2016.
- Wind capacity factors also are improving. For example, the average capacity factor for 15,029 MW of wind in MISO was 40.9% in February 2016.
- Another 14 GW of new wind capacity is in MISO's Definitive Planning Queue.
- Large coal-fired generators in northern regions of MISO are being cycled due to flat loads and low natural gas prices. Plus lots of wind generation.

Annual Wind Generation in MISO (North and Central) Has More than Doubled Since 2010



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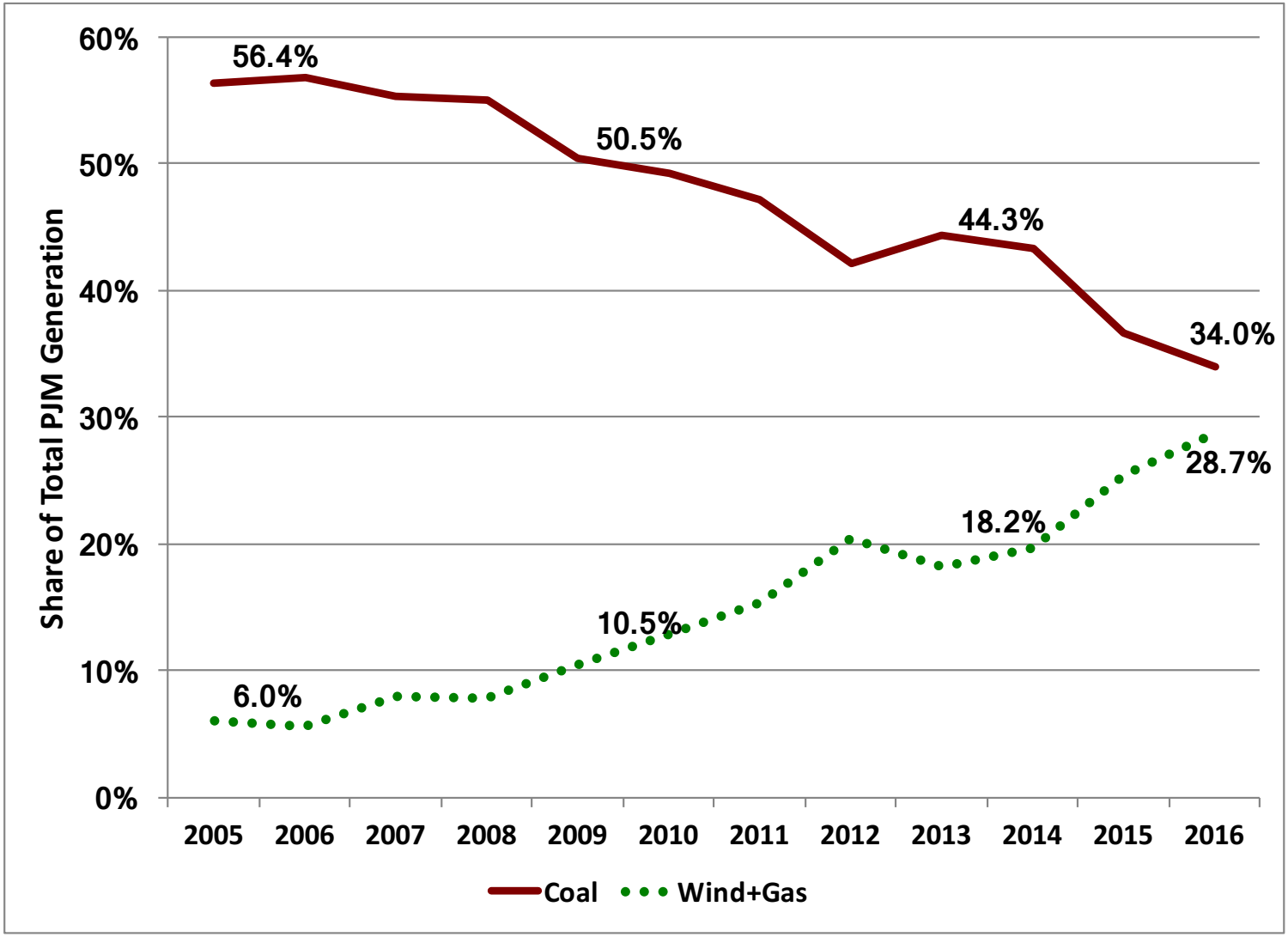
PJM (1)

- For the second straight year, PJM's annual Load Forecast Report significantly lowered projected future system demands and energy.
- In 2015 Load Forecast, PJM projected that the peak demand in 2016 would be 157.9 GW. In the 2017 Forecast, PJM now projects this load won't be experienced until 2032. As a result, 2030 peak is now forecast to be almost 12% below what was projected to be in PJM's 2015 forecast.
- PJM's 2017 Load Forecast also now projects that its annual energy consumption in 2030 will over 10% below what PJM projected in its 2015 forecast.
- Reduced loads the result of (a) modeling corrections, (b) new economic data and (c) more distributed solar.

PJM (2)

- At the same time PJM faces stagnant loads and low energy market prices, it is expected to add a net 8.5 GW of capacity in 2017. 3.4 GW of the new capacity will be renewable and 6.4 GW will be gas-fired.
- The combination of flat loads and more renewable and gas-fired capacity will mean continued low energy market prices and, most likely, low capacity auction prices.
- Also reinstatement of the RPS in Ohio and passage of the nuclear bailout bill in Illinois will mean more renewables.
- These developments are bad news for coal-fired generators.

Gas and Wind Are Displacing Coal in PJM



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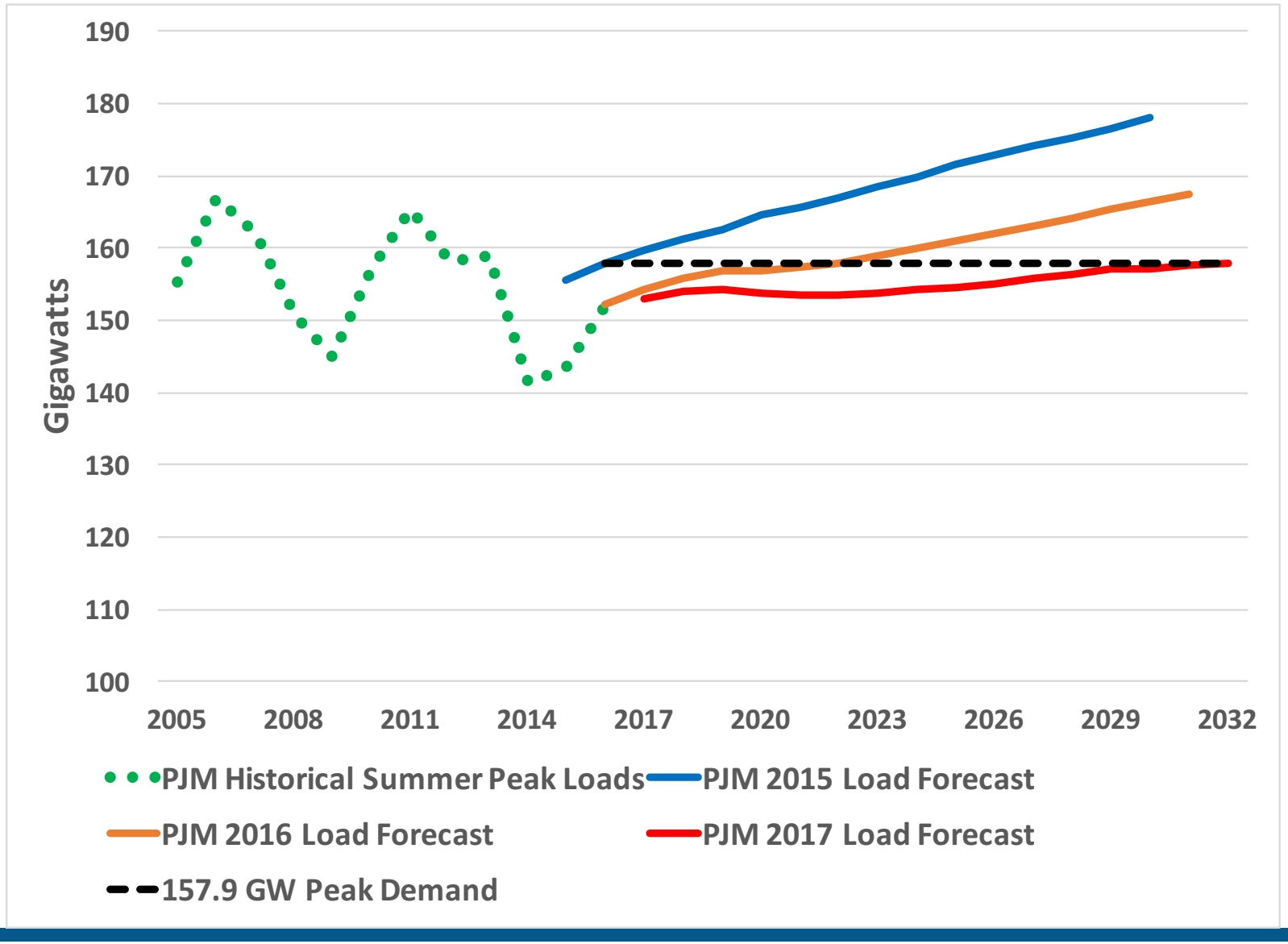
Declining PJM Peak Demand Forecasts



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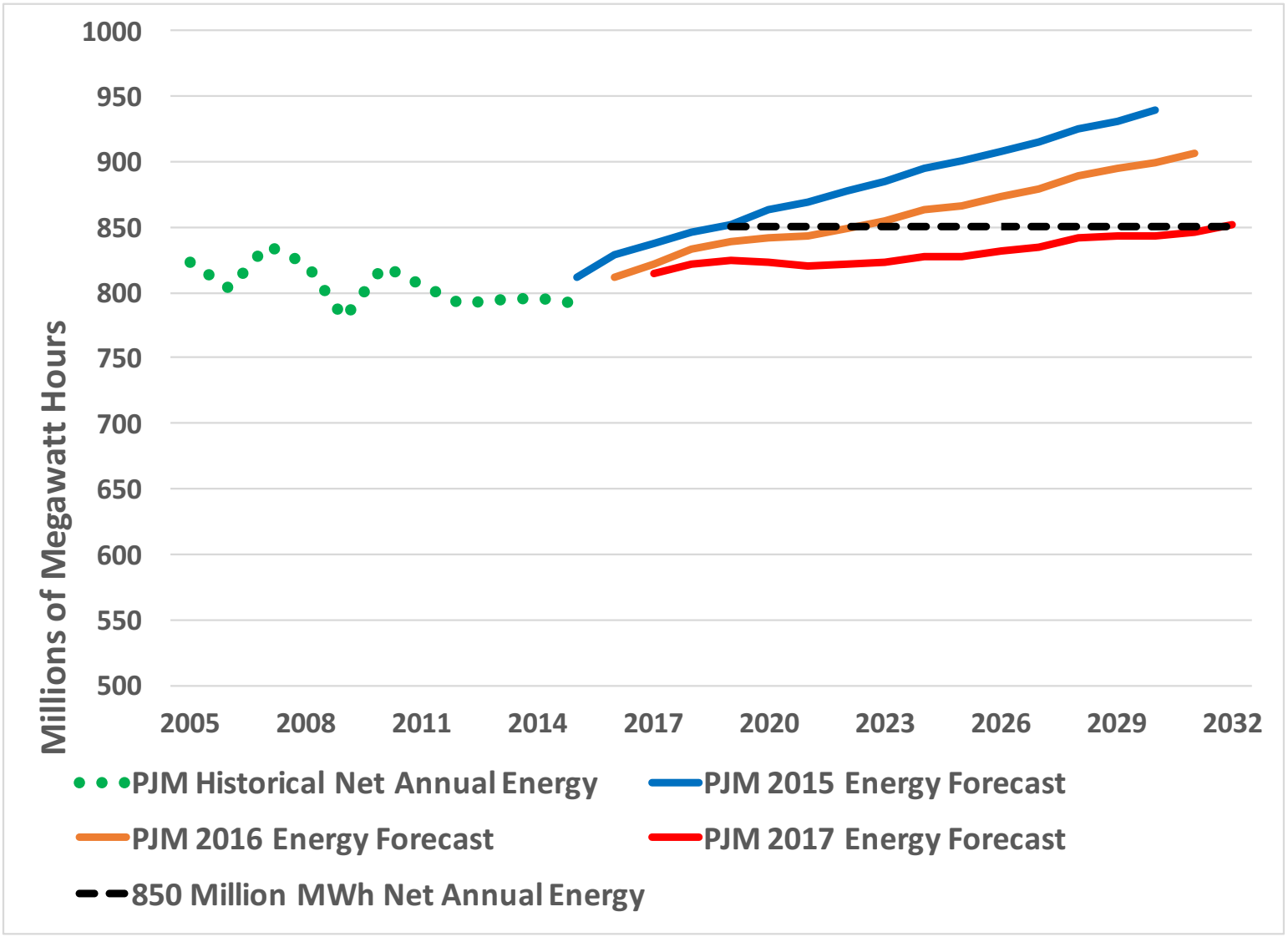
Declining PJM Energy Forecasts



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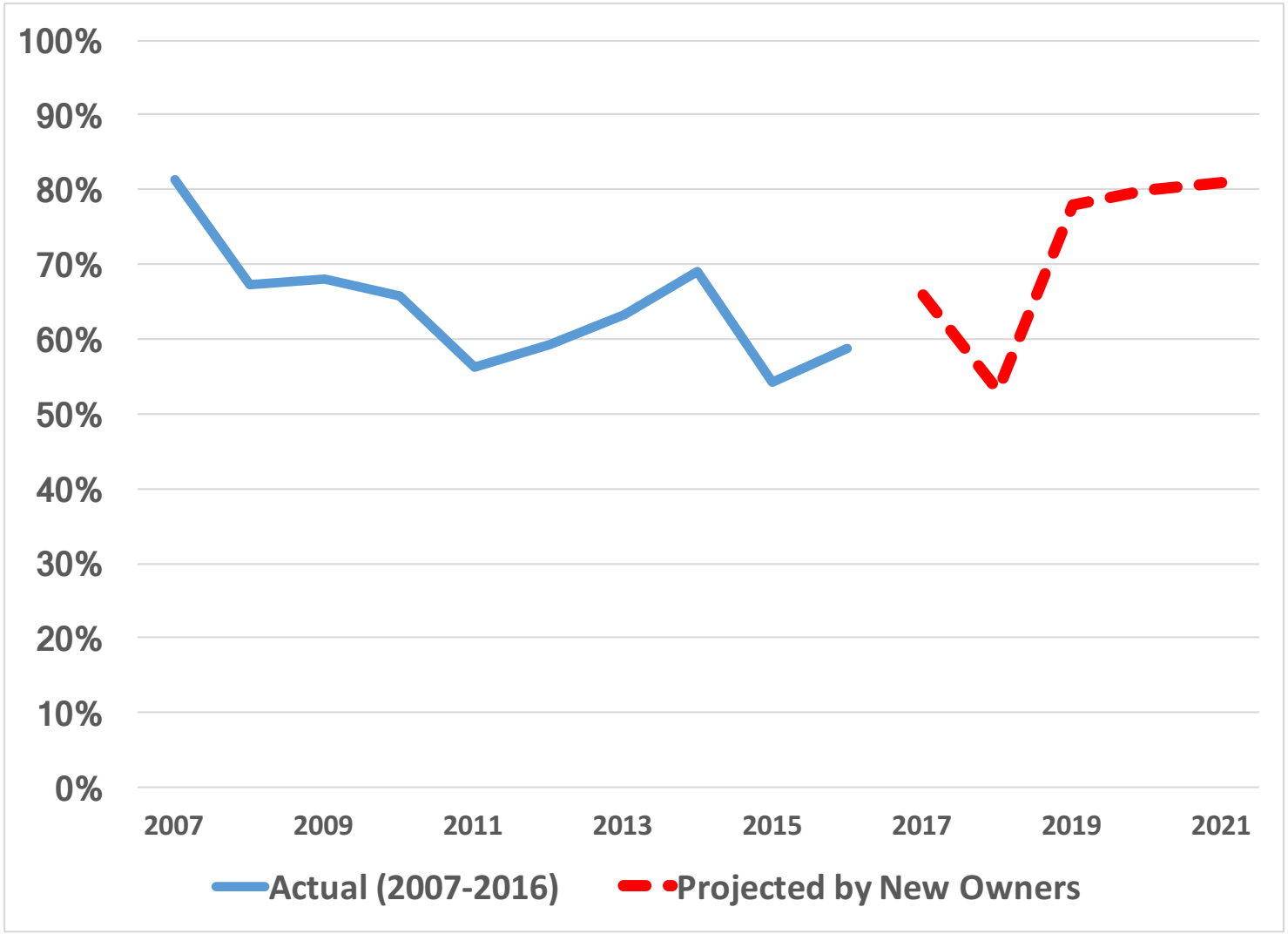
Result – Coal Plants Are Caught in Death Spiral (Or At Least Near-Death Experience)

- Many coal-fired plants generating much less power than before and/or not operating as base load generators.
- Plus, because energy market prices are so low, owners getting less for each MWh of power their plants generate.
- This means significantly lower revenues from power sales.
- But production costs at many plants are increasing. Capex, some expensive, also necessary.
- Generating at high cost and selling at low cost is never good!
- Coal is in serious trouble even without the EPA!

Four Recent Examples of the Impact of Market Forces on Coal-Fired Generators (1)

- Homer City - 48 year-old, 1884 MW merchant coal plant in Pennsylvania.
- Now going through bankruptcy for the second time since mid-2012. The plant made no profit for the years 2013-2016 after it emerged from bankruptcy the first time. Couldn't afford to pay interest on debt in 2016.
- New owners claim that the future will be much brighter than recent past – plant's generation, market prices and capacity market revenues all will be higher.
- However the plant is unlikely to be financially viable going forward as future PJM markets probably will not be significantly more favorable to coal + Homer City's owners plan to spend between $382 and $472 million on capex next five years.

Homer City's Recent and Projected Generation



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Four Recent Examples of the Impact of Market Forces on Coal-Fired Generators (2)

- Coal Creek - 37 year-old, 1141 MW coal plant in North Dakota.
- Owned by Great River Energy, (GRE) a co-op.
- Averaged an 88 percent capacity factor during 2012-2016.
- GRE, has decided to return Coal Creek to its cycling roots because it is no longer needed to operate at full load around the clock (i.e., as a baseload generator). Instead, it will cycle up and down, generating more power when market prices are higher. Among the reasons for this change are the massive increase in wind generation in upper Midwest and low growth in the demand for power.

Four Recent Examples of the Impact of Market Forces on Coal-Fired Generators (3)

- Pleasant Prairie - 37 year-old, 1190 MW plant in Wisconsin.
- Plant's generation has decreased by over 20% in just the 3 years from 2013 to 2016.
- The owner has decided that the plant will be placed in economic storage for six months of the year (March-May and September-November) due to flat loads and low natural gas prices.
- Thus the plant will generate only during the winter and summer periods when market prices are higher.

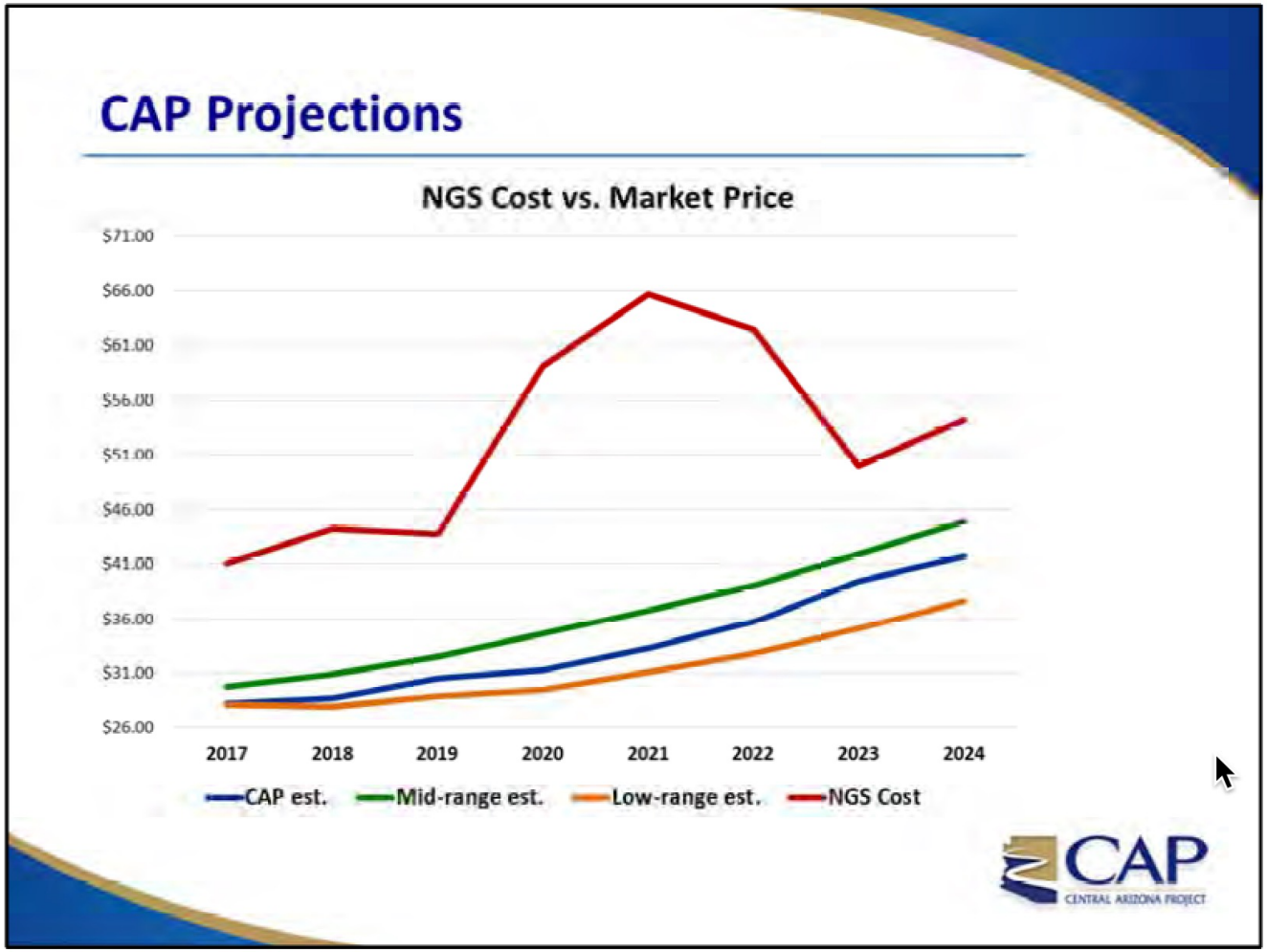
Four Recent Examples of the Impact of Market Forces on Coal-Fired Generators (4)

- Navajo - 43 year-old, 2250 MW plant in Arizona.
- Plant's generation declined by over 30% in just the 2 years from 2014 to 2016.
- Owners have decided to retire the plant in 2019 in the face of low natural gas and energy market prices.
- For example, peak prices at the trading hub closest to Navajo averaged around $32 per MWh in 2015. According to a study from NREL, the all-in cost of power from Navajo averaged about $38 per MWh.

Four Recent Examples of the Impact of Market Forces on Coal-Fired Generators

- The Central Arizona Project (CAP) is a major customer for the power from Navajo.
- CAP paid $81.2 million in 2016 for pumping energy from Navajo. According to a CAP analysis, the cost of purchasing the same energy from the market would have been only $42.7 million.
- CAP expects that Navajo's economics are going to get worse in coming years.

CAP Assessment of Future Economics of Buying Power from Navajo



Key Takeaways

- Market forces working against coal are inexorable – the coal industry and its allies *maybe* can slow down but cannot reverse industry's long-term decline.
- Increases in renewable resources also can't be stopped. – costs have declined too much for that.
- Vital to oppose attempts to bailout fossil-fuel industry.
- Natural gas prices likely to remain low.
- It is important to continue to stress to decision-makers that individual (and groups of) coal plants remain exposed to significant economic and financial risks. Therefore, it is prudent to plan for a transition away from coal.

For More Information

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