Where has Electricity Demand Growth Gone in PJM and What are the Implications?

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Panel on Implications of a Zero/Low Electricity Demand Growth Scenario
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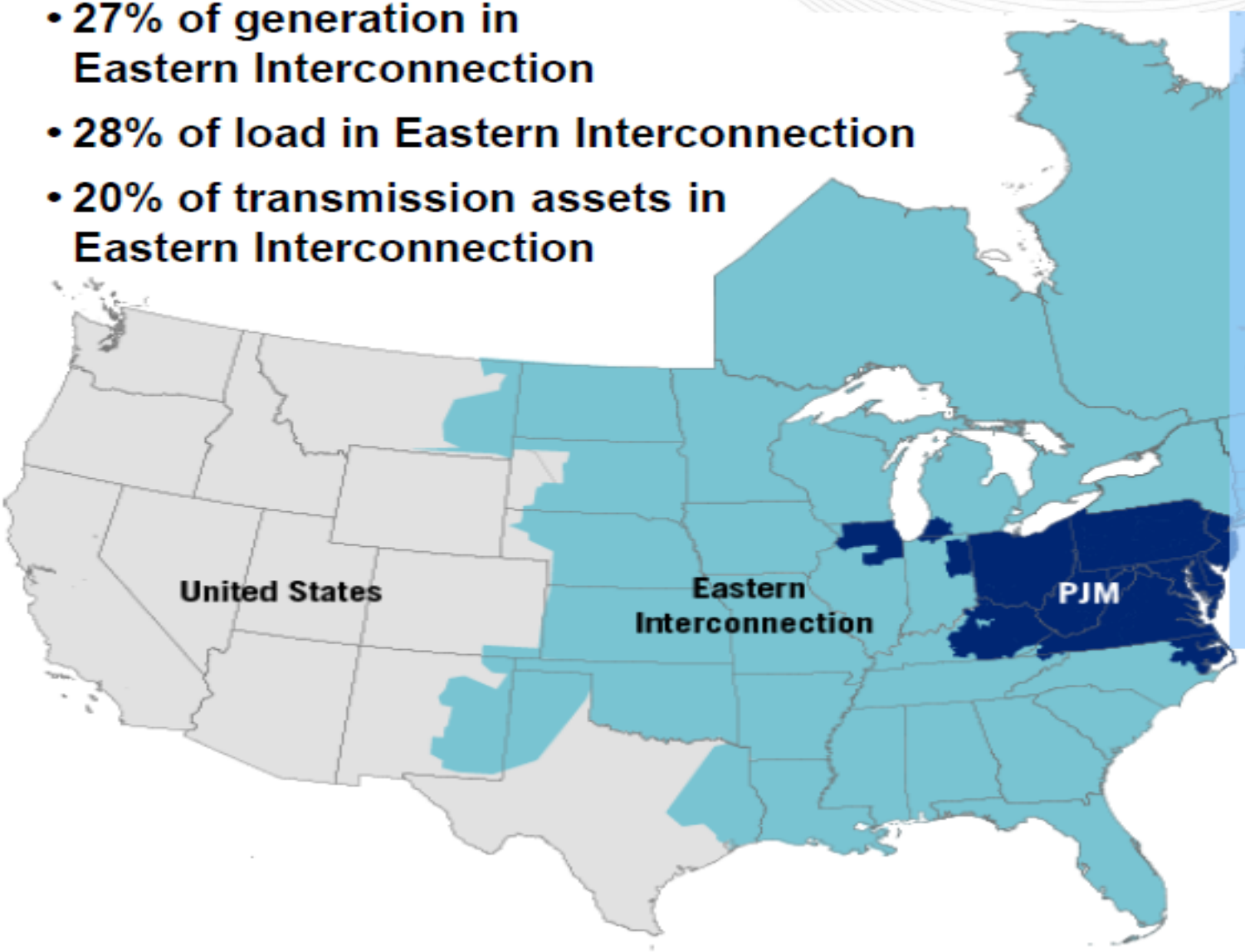
PJM as Part of the Eastern Interconnection

- **27% of generation in Eastern Interconnection**
- **28% of load in Eastern Interconnection**
- **20% of transmission assets in Eastern Interconnection**



KEY STATISTICS	
PJM member companies	850+
millions of people served	61
peak load in megawatts	165,492
MWs of generating capacity	185,600
miles of transmission lines	62,556
2013 GWh of annual energy	832,331
generation sources	1,365
square miles of territory	243,417
area served	13 states+DC
externally facing tie lines	191

21% of U.S. GDP produced in PJM

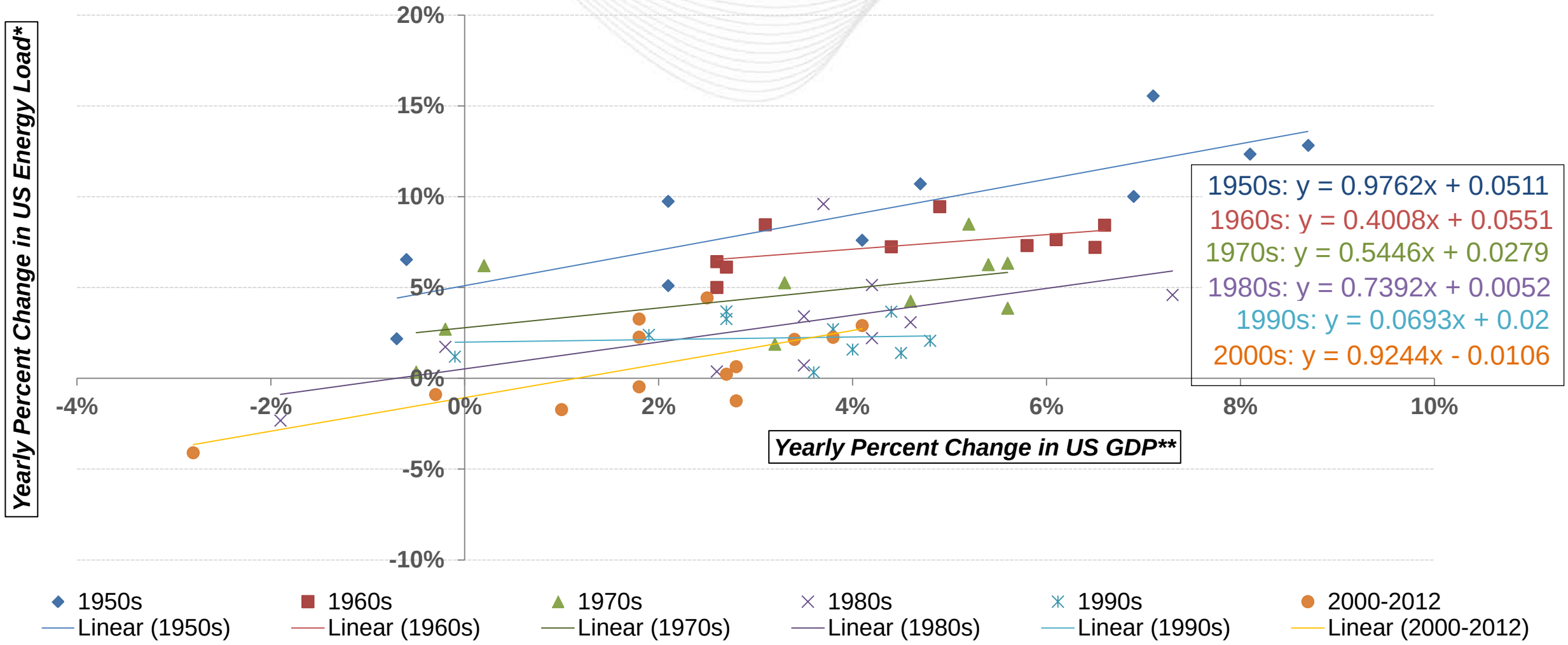
As of 1/1/2014

Why is it Important to Understand the Reasons For Flat to Declining Load Growth?

- The industry is facing an unprecedented turnover in generation capital stock
  - 26,000 MW of retirements since 2009 (nearly 14% of generation fleet) due to existing economic conditions and environmental rules
  - New entry of combined cycle gas and demand response resources…will there be incentives for continued new entry?
- Impending GHG regulations
  - How much reduction needs to be done and implications for the EE building block
- Load forecasts are key inputs into infrastructure planning and markets to maintain reliability
  - Transmission build outs and capacity markets

Trends in Load Growth

Regression of US Load Growth vs US GDP



*Based on EIA "Net Generation"
**Chained 2009 GDP

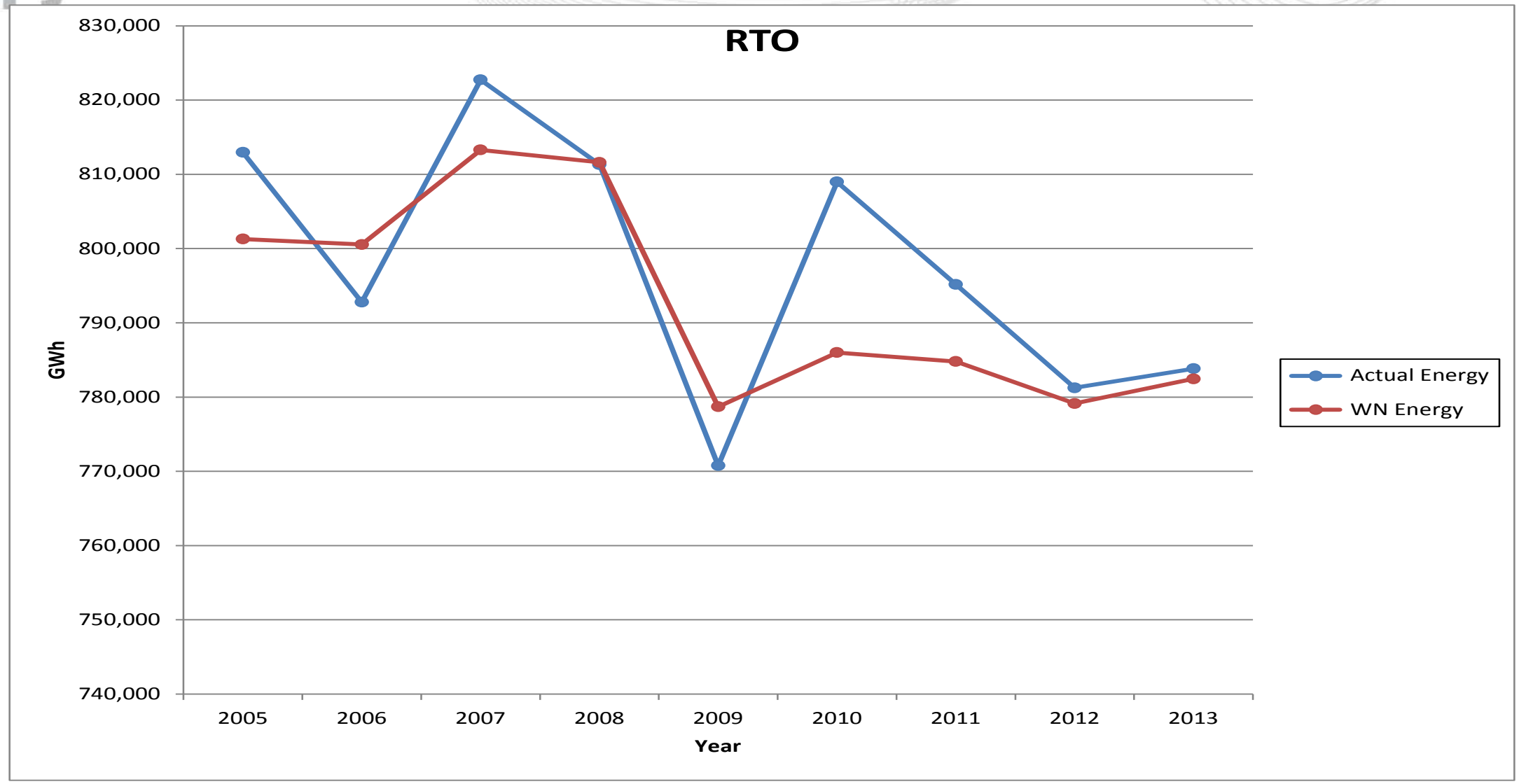
Load Growth and GDP by Decade in the US (from EIA data)

- The relationship between load growth and GDP growth has appeared to slowly eroding since the end of WW II.
  - Simple OLS of load growth vs. GDP growth shows slight downward trend in the effect of GDP growth on load growth
- But the intercept term may be capturing other things:
  - Income effects at the household level
  - Saturation of electrification of our lives over the decades
  - Technology diffusion and the turnover in building and appliance capital stock to more efficient capital stock over time

Load Growth and GDP by Decade in the US (from EIA data)

- The 1990s show almost no relationship between GDP growth and load growth
  - Clinton boom years
  - High Tech diffusion keeping growth fairly constant and captured in the intercept term
- The last 13 years (2000-2012) shows it takes more than 1% GDP growth to keep load flat
  - Income effects at the household level?
  - Contraction in household formation and employment?
  - Energy efficiency programs?
  - Distributed resources?

Total Energy Not Bouncing Back with Recovery

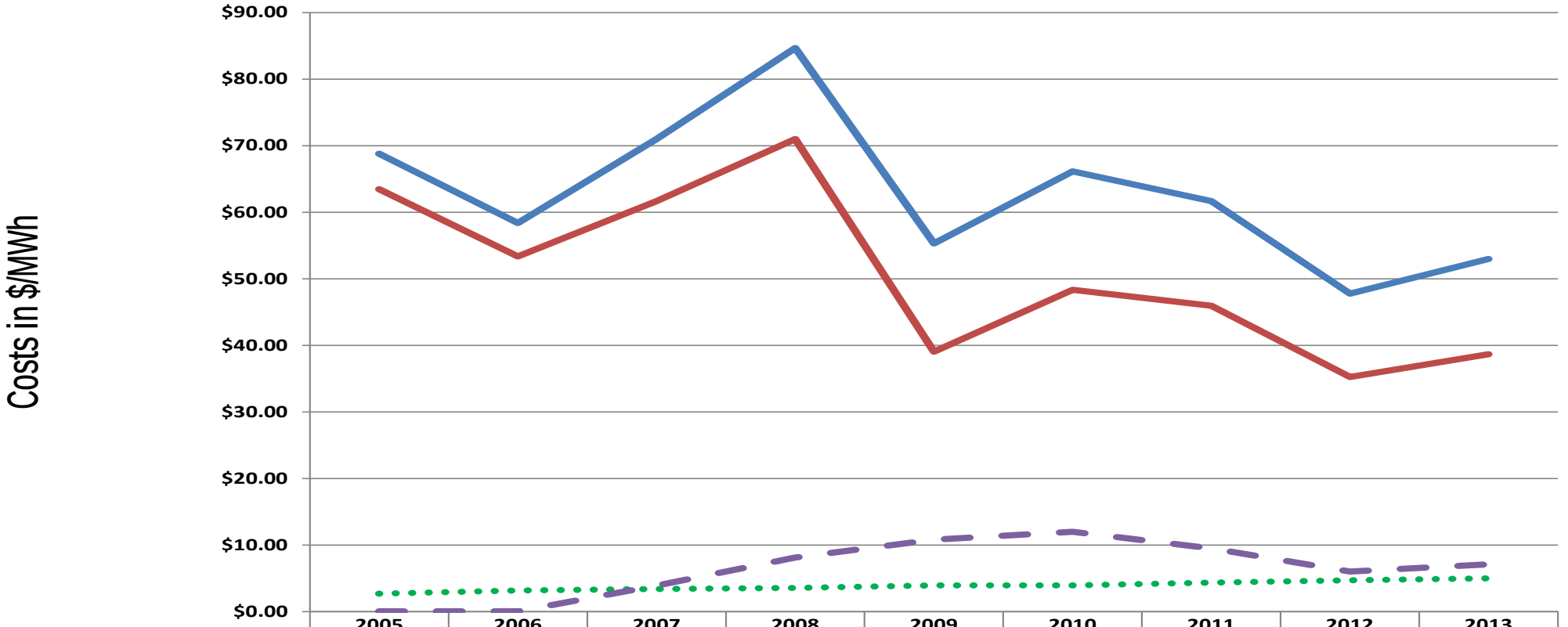


Total Energy Not Bouncing back with the Recovery

- In spite of GDP growth coming out of the trough of the recession, weather normalized total energy consumption is flat to falling…why?
  - Is it about declining median incomes?
  - Is it about the growth going to the top 1% and after a certain point, there is diminishing marginal utility to energy consumption?
  - Is it about the employment levels?
- We know it is not about energy prices which have fallen significantly since the peak when demand was highest
  - Does this point to an income effect story?
  - Is it energy efficiency measures?

Total Wholesale Power Costs

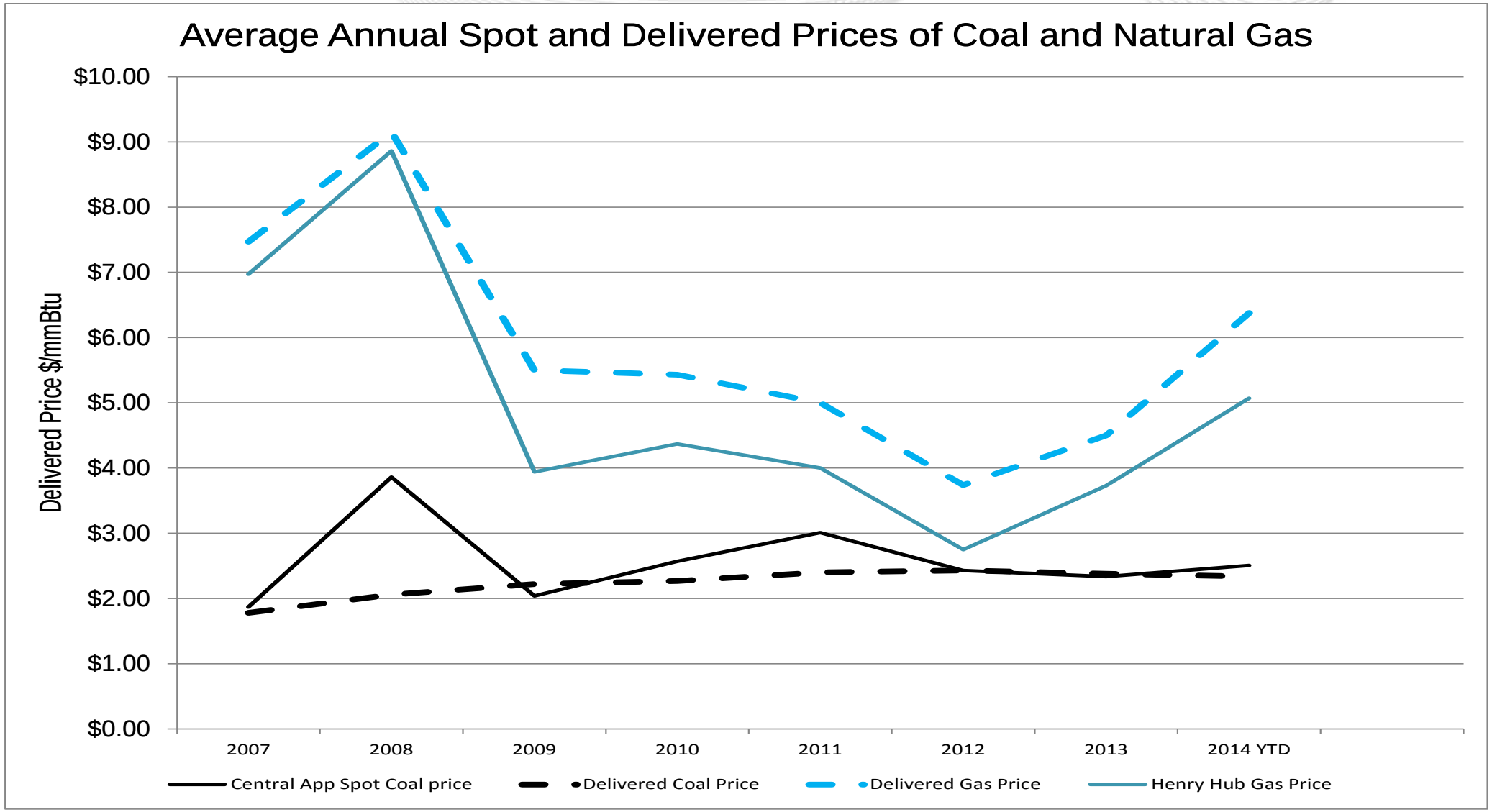
PJM Wholesale Power Costs ($/MWh): Total and Major Components 2005 - 2013



	2005	2006	2007	2008	2009	2010	2011	2012	2013
Wholesale Power Cost	$68.78	$58.38	$70.98	$84.66	$55.31	$66.15	$61.65	$47.77	$52.97
Energy	$63.46	$53.35	$61.66	$71.00	$39.05	$48.34	$45.94	$35.23	$38.67
Transmission	$2.69	$3.16	$3.39	$3.56	$3.94	$3.95	$4.34	$4.71	$5.00
Capacity	$0.03	$0.03	$3.91	$8.12	$10.79	$11.97	$9.49	$6.02	$7.10

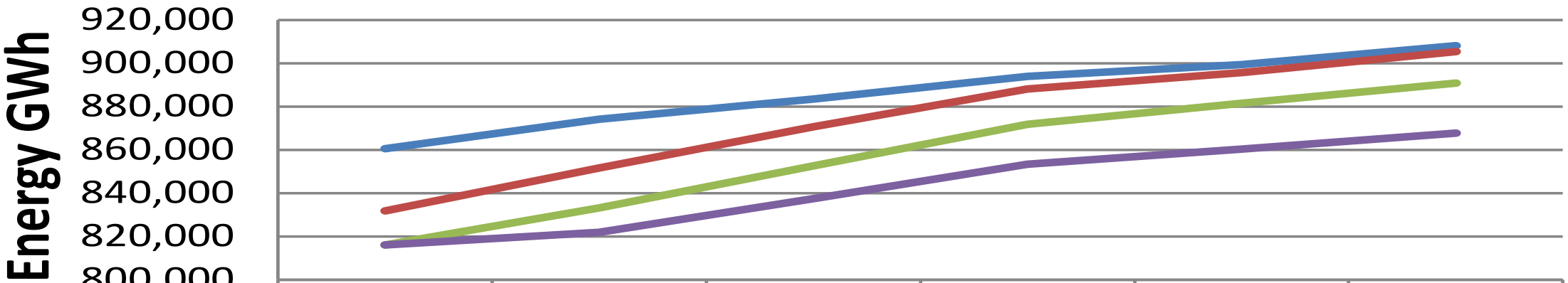
Wholesale Power Costs Falling since the Recession

- Natural gas prices have fallen and during peaks gas is the marginal fuel leading to lower peak prices
- Lower gas prices have implied more efficient combined cycle gas units have been dispatched ahead of coal units, but the cost of coal is not rising much
- Of course, lower prices are a result of lower overall demand, but if this were a price story, all else equal, we would see an increase in total energy…
  - Strong indicator it is likely an income effect at play
  - Strong indicator it could be energy efficiency…active policy or in the turnover of energy consuming capital stock is also at play


Average Annual Spot and Delivered Prices of Coal and Natural Gas
$10.00
$9.00
$8.00
$7.00
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
Delivered Price $/mmBtu
2007
2008
2009
2010
2011
2012
2013
2014 YTD
Central App Spot Coal price
Delivered Coal Price
Delivered Gas Price
Henry Hub Gas Price

Total Energy Forecasts Revised Downward

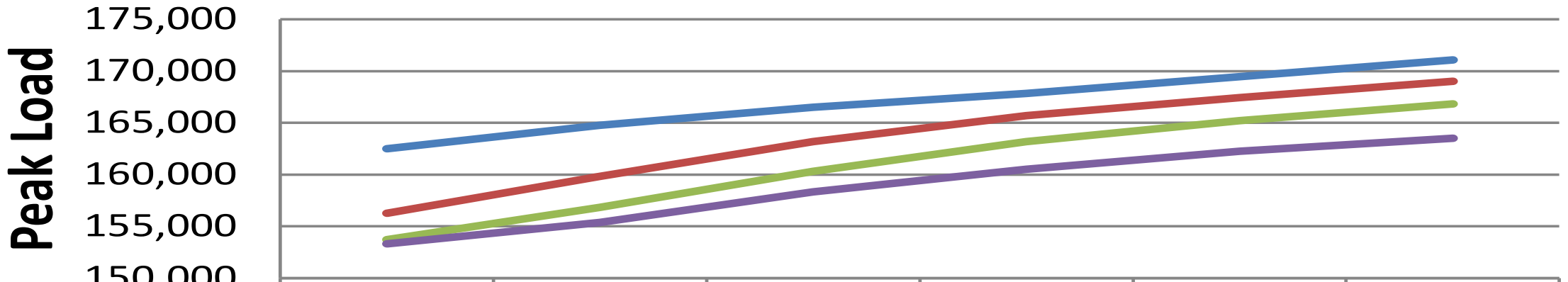
Changes in Forecast Energy (GWh) w/o EKPC



	2013	2014	2015	2016	2017	2018
2011	860,521	874,144	883,516	894,032	899,413	908,129
2012	831,898	851,726	870,636	888,097	895,748	905,401
2013	816,153	833,173	852,514	871,879	881,525	890,913
2014	816,153	821,985	837,421	853,355	860,433	867,760

Peak Load Forecasts Revised Downward

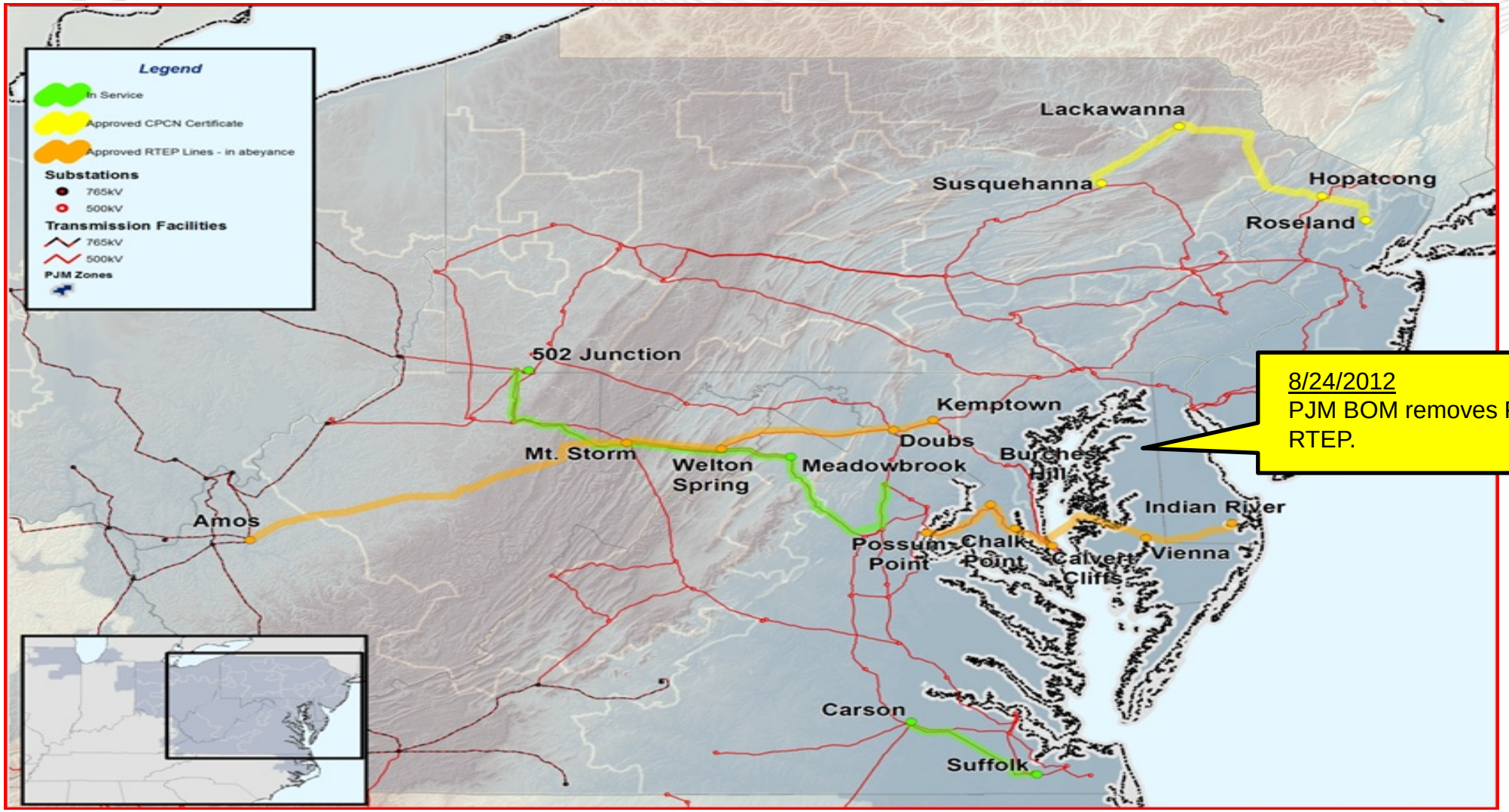
Changes in Forecast Peak Load w/o EKPC



	2013	2014	2015	2016	2017	2018
2011	162,489	164,772	166,506	167,847	169,443	171,067
2012	156,254	159,842	163,168	165,691	167,433	169,032
2013	153,716	156,813	160,321	163,176	165,226	166,810
2014	153,296	155,380	158,329	160,528	162,242	163,513

Implications of Lower Demand Growth for Transmission and Generation Capacity

PJM BOM-Approved Backbone Transmission Lines

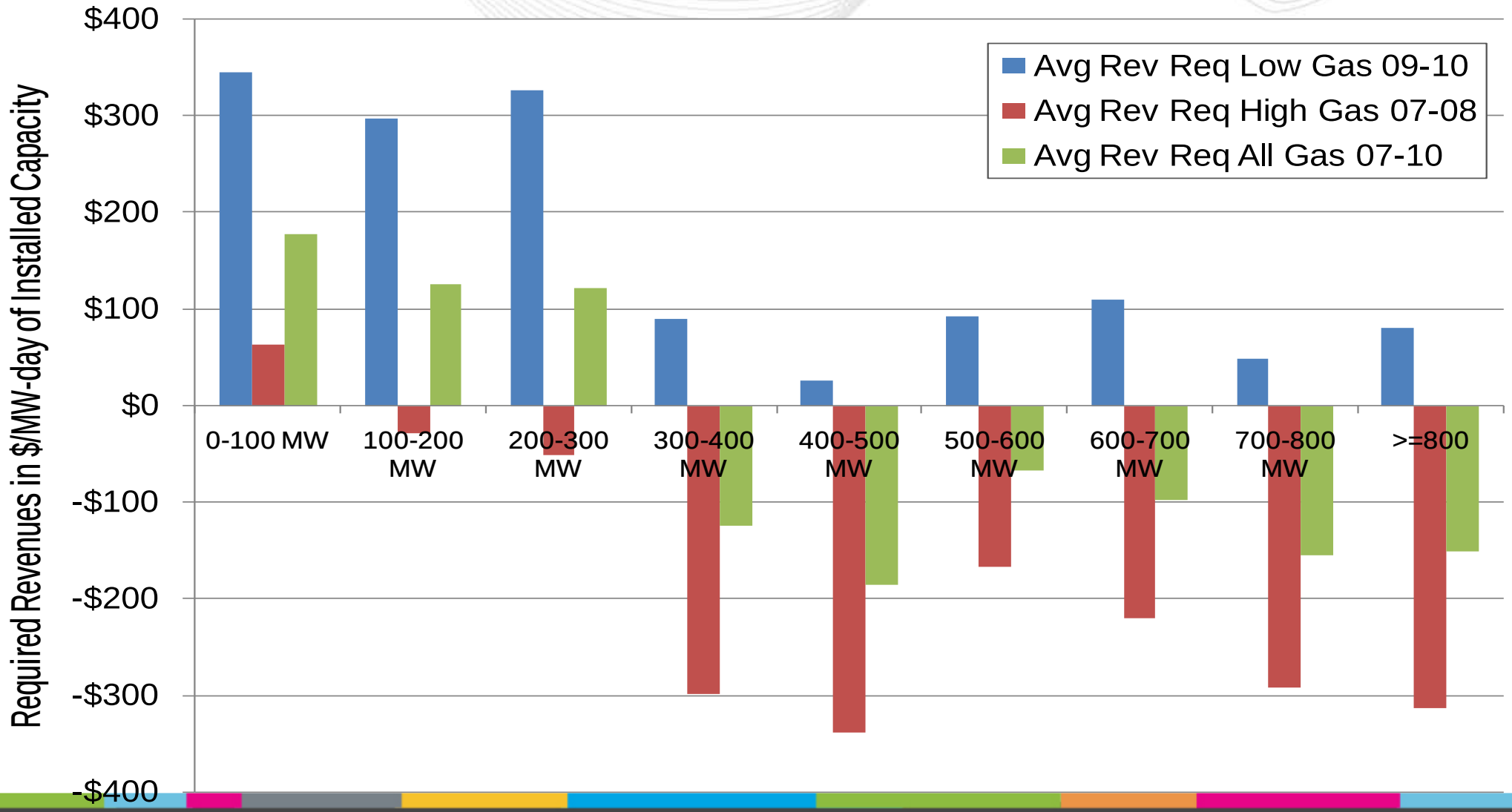


8/24/2012
PJM BOM removes PATH and MAPP from RTEP.

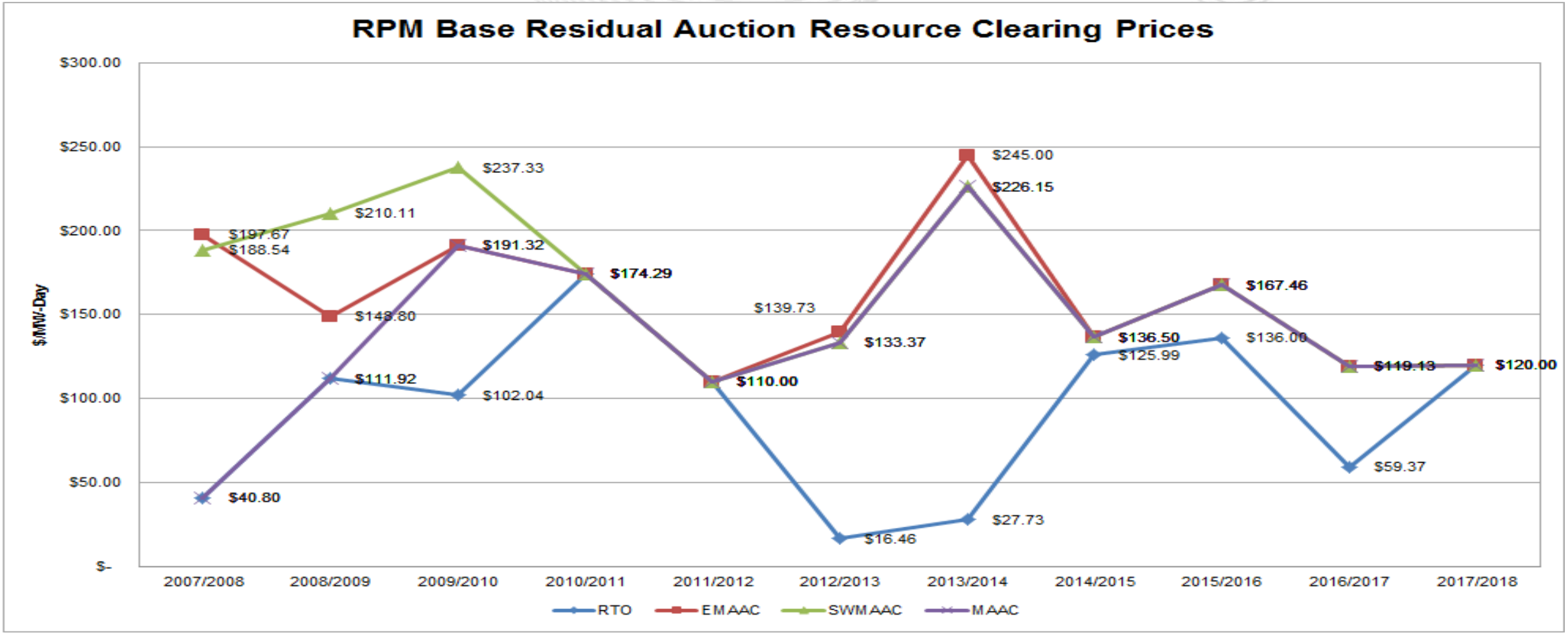
Load Growth Trends and Transmission

- Lower total energy (along with fuel cost changes) have led to lower congestion levels than have been the case historically
  - January and February 2014 being excepted
- Lower load growth was a contributor to the cancellation of some anticipated backbone transmission projects needed to solve identified reliability violations further into the future
  - MAPP and PATH

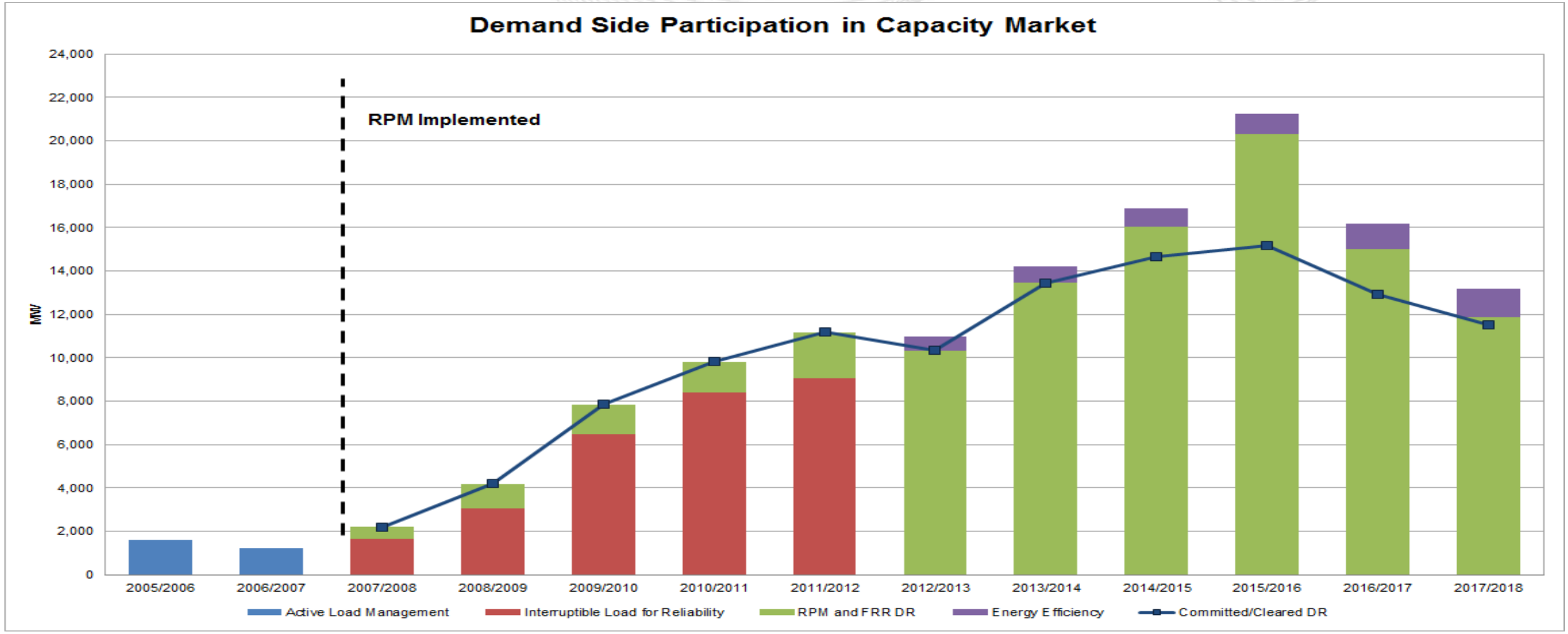
Necessary Revenue to Continue Operating under CSAPR and MATS Policies



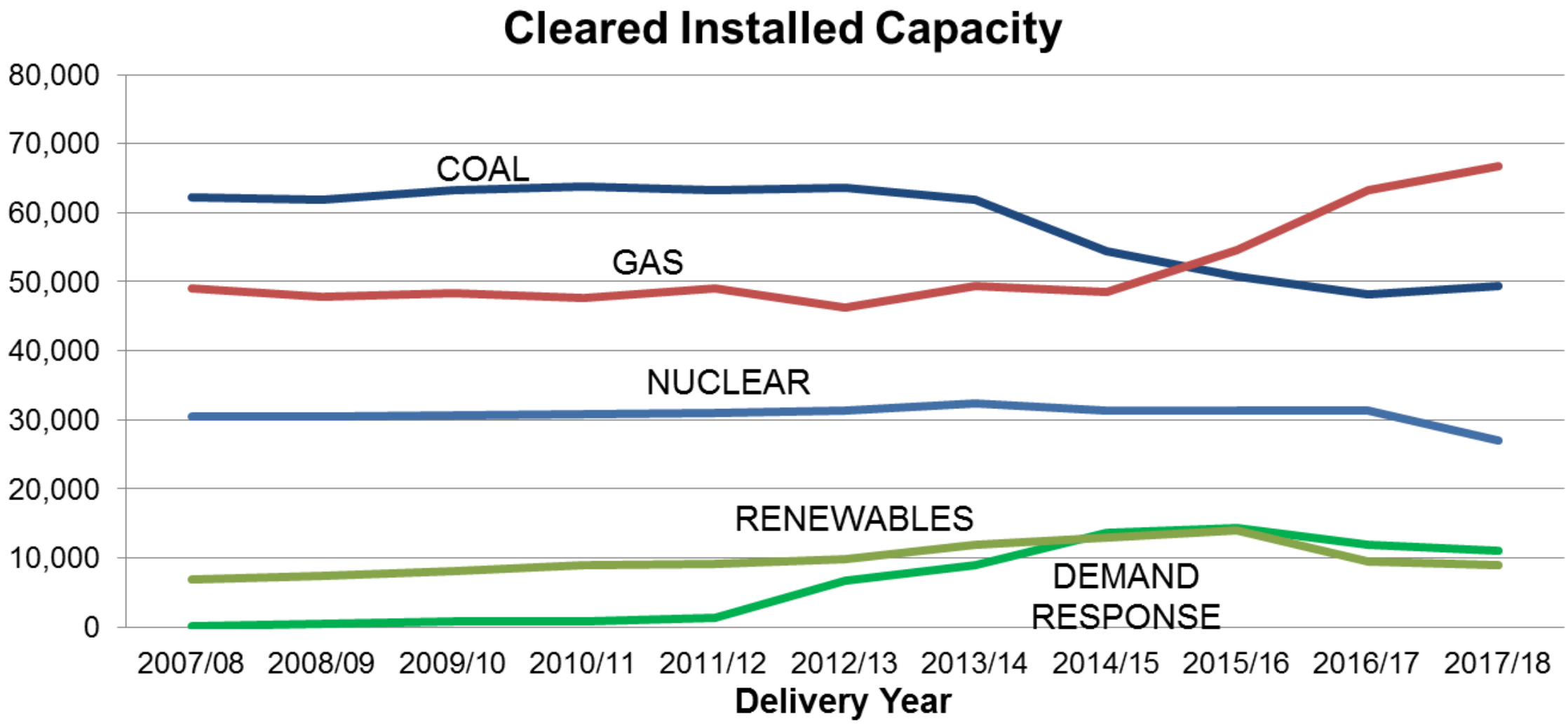
Evolution of Capacity Prices



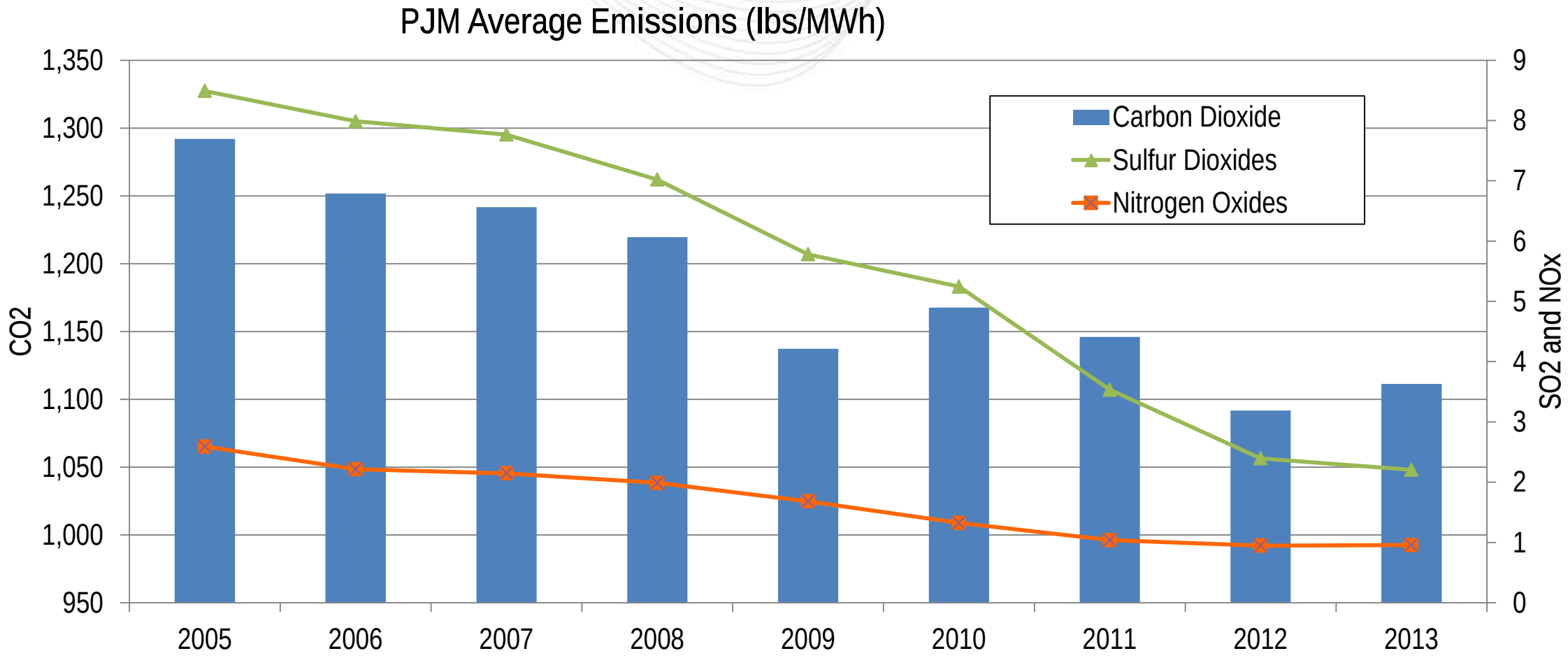
Demand is a Key Participant to Meet Resource Needs…



Evolving Resource Mix



Look Ahead to CAAA 111(d) GHG Compliance
PJM Market – Average Power Generation Emissions
Pounds Per MWh of Electricity Produced



PJM States System Emission Reduction Standards