

# What is the Future of Competitive Markets? Some Fundamental Preliminaries and View from Events in the PJM Market

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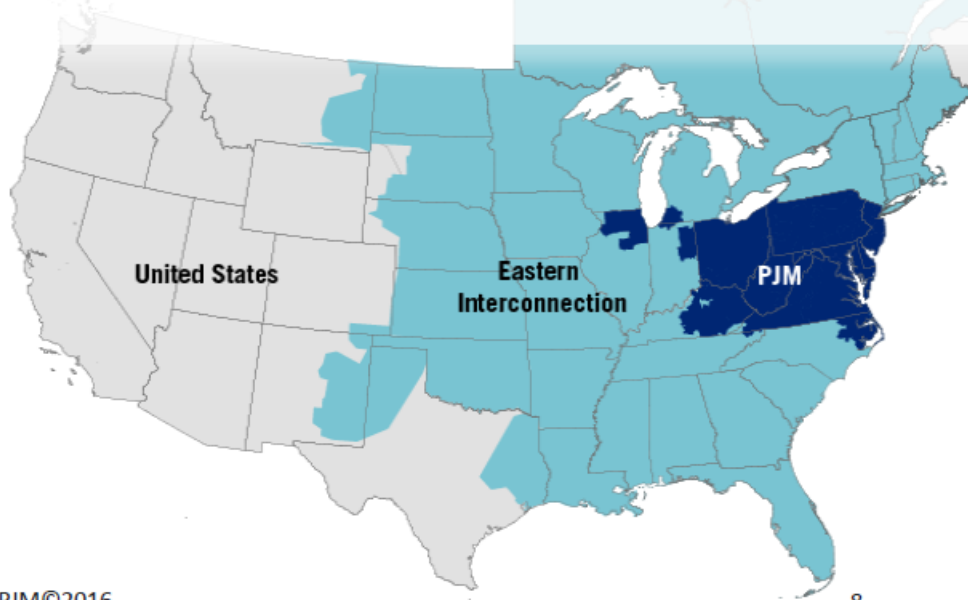
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# What are the ideal properties of competitive power markets??

- Neutral with respect to:
  - Age
  - Size
  - Technology
  - Fuel
- Encourage or take advantage of the following:
  - Cost reductions
  - Innovation
  - Incentives consistent with reliability needs
- Markets should be transparent and reflect underlying fundamentals

# PJM as Part of the Eastern Interconnection

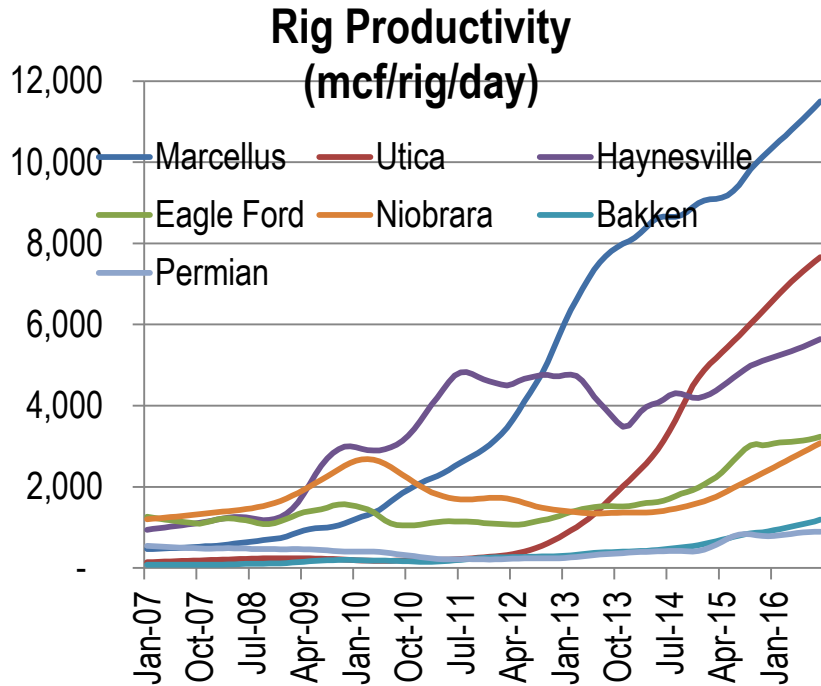
- 27% of generation in Eastern Interconnection
- 28% of load in Eastern Interconnection
- 20% of transmission assets in Eastern Interconnection



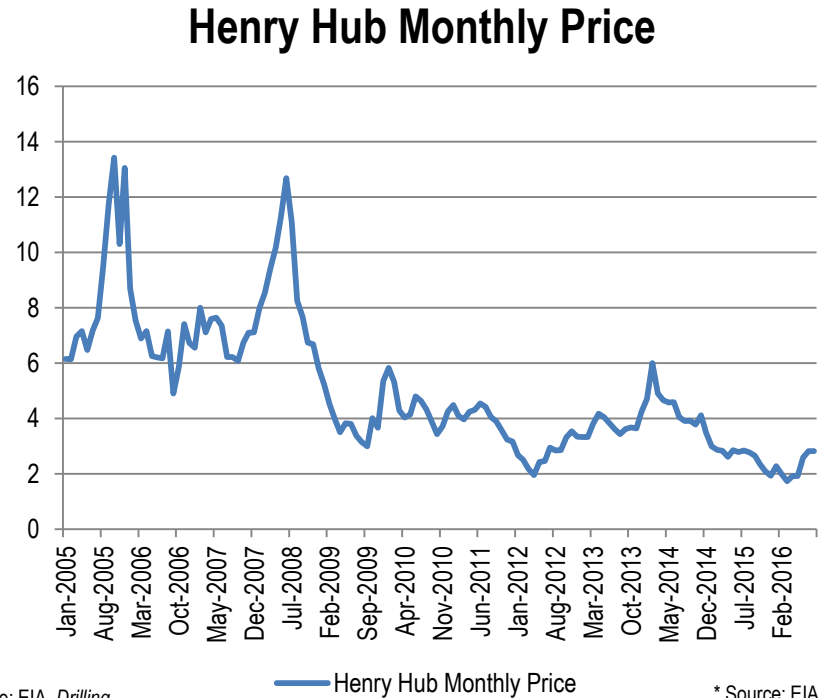
## Key Statistics

- PJM member companies 960+
- Millions of people served 61
- Peak load in megawatts 165,492
- MWs of generating capacity 171,648
- Miles of transmission lines 81,736
- 2014 GWh of annual energy 792,580
- Generation sources 1,304
- Square miles of territory 243,417
- Area served 13 states + DC
- Externally facing tie lines 191
- Share of US GDP Produced in PJM 21%

# Technology Part 1: Natural Gas Rig Productivity Rises and Prices Decline

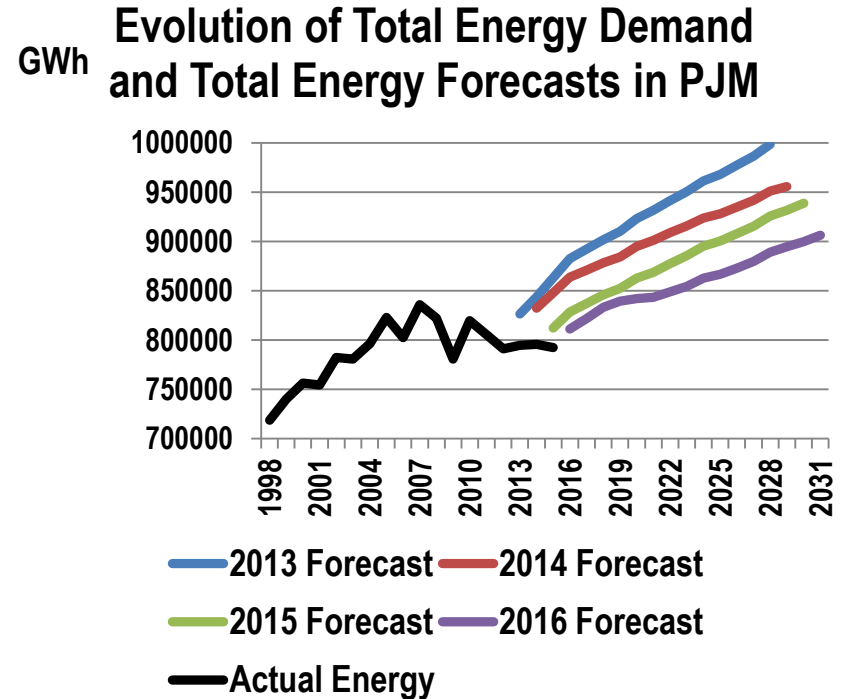
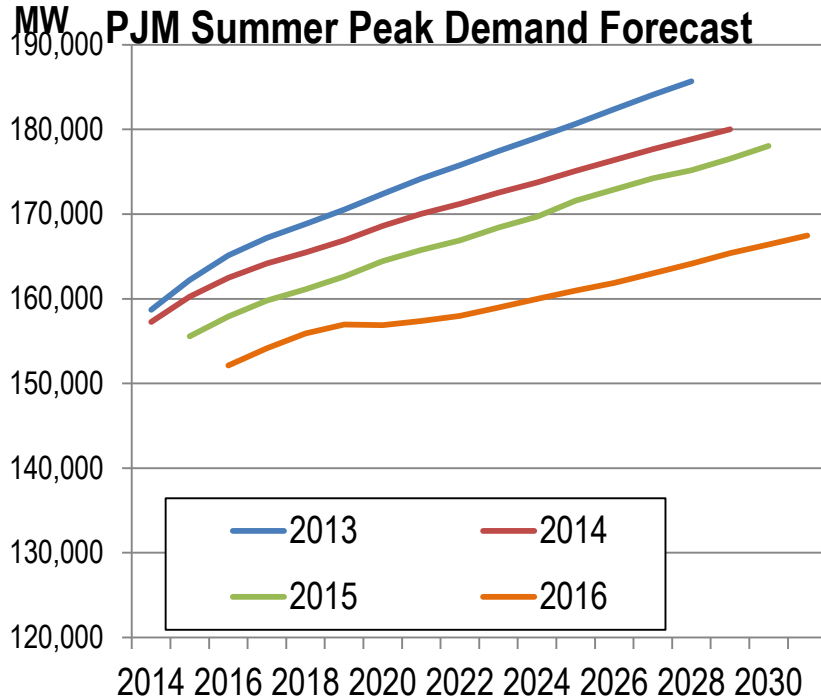


\* Source: EIA. *Drilling Productivity Report*. August 2016.

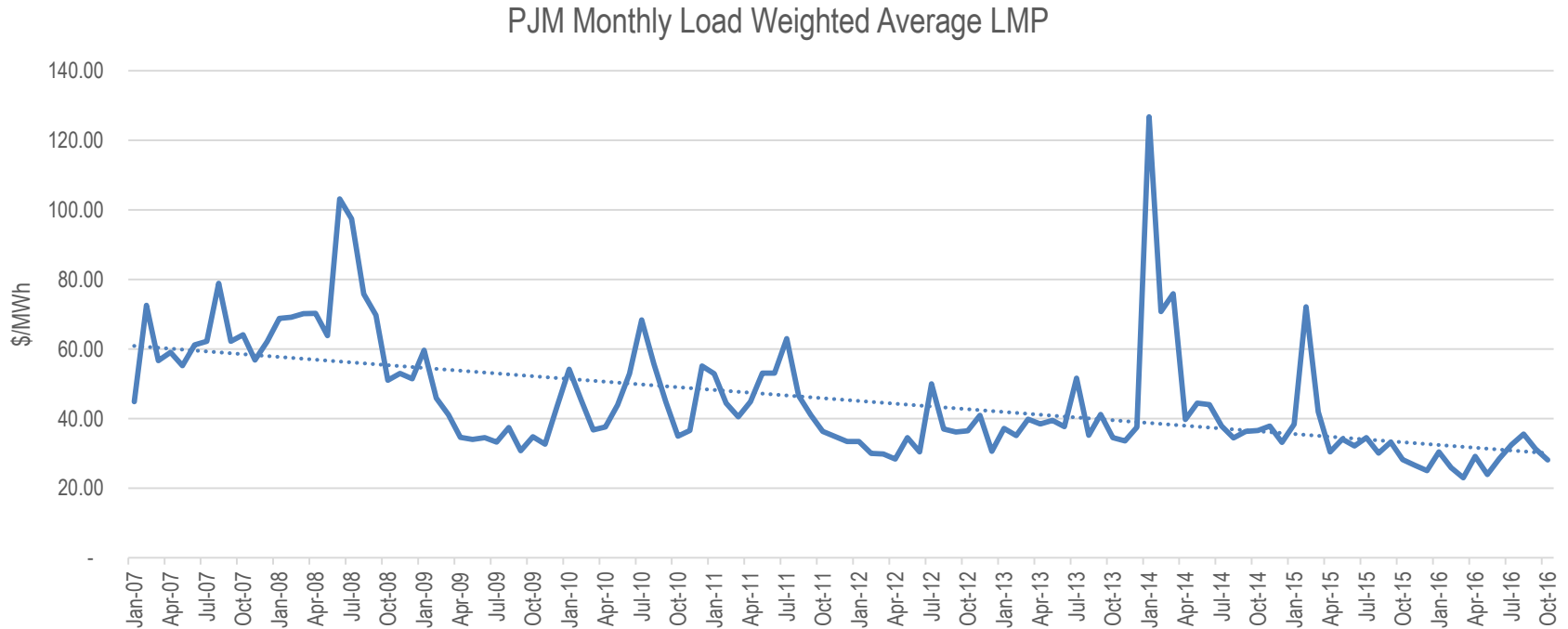


\* Source: EIA. *Henry Hub Monthly Spot Price Series* September 25, 2016.

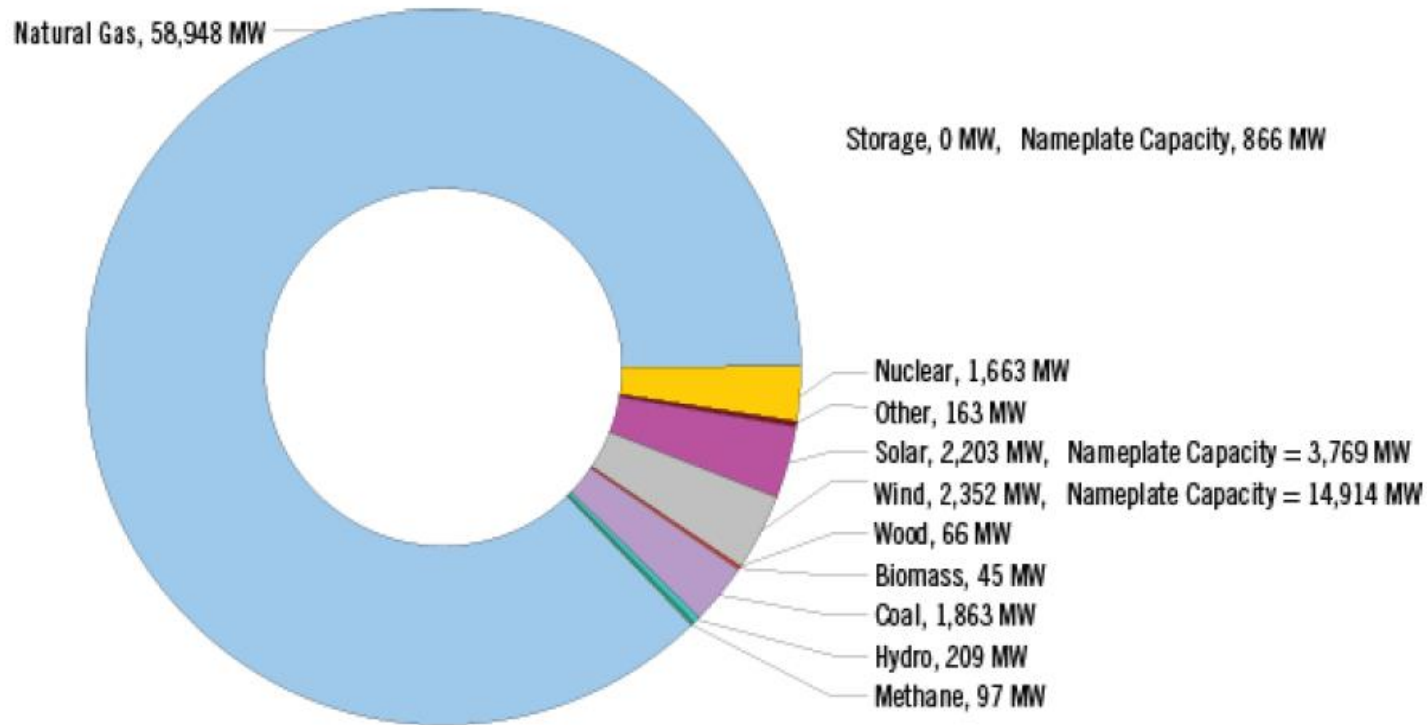
# The Big Shock: Where has Demand Growth Gone?



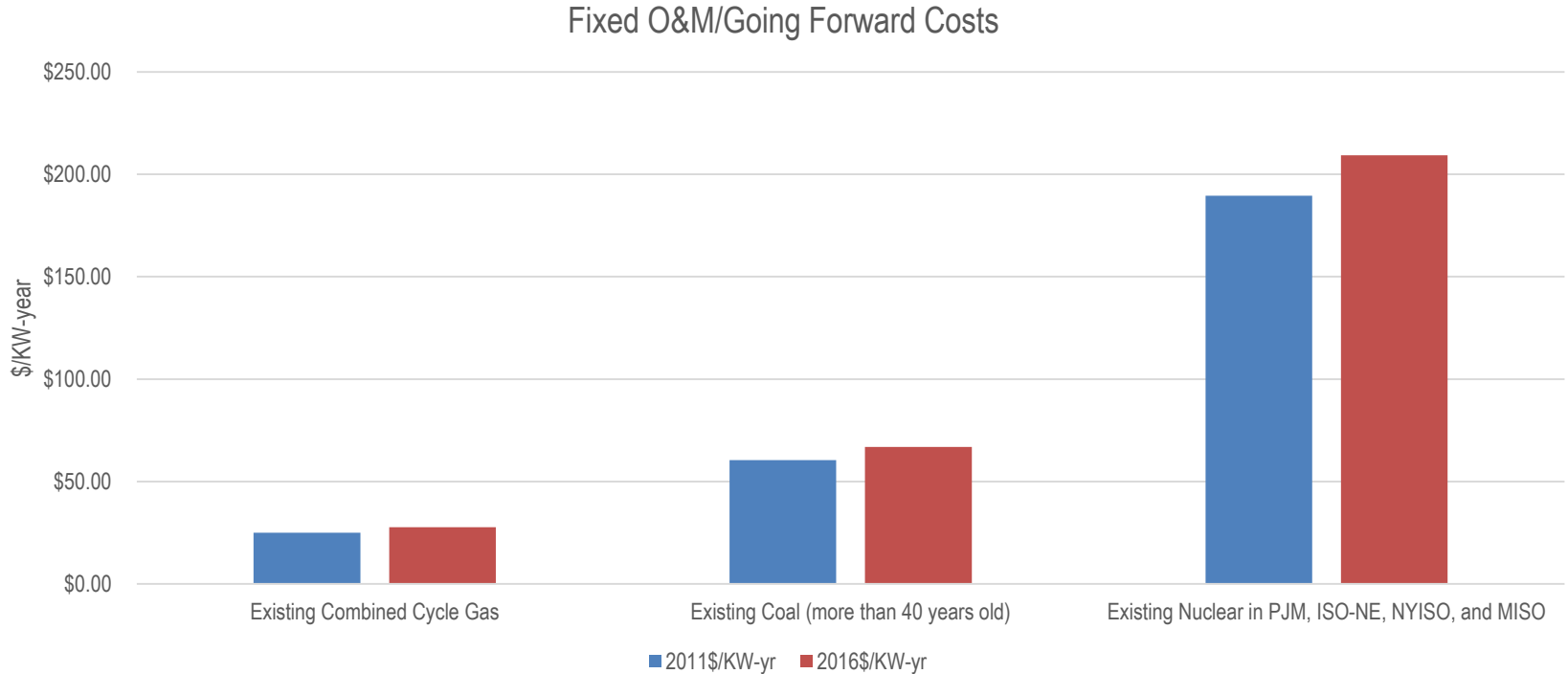
# And Energy Prices are Matching the Fuel and Demand Trends



# Technology Part 2: Gas Dominates Generation the Interconnection Queue



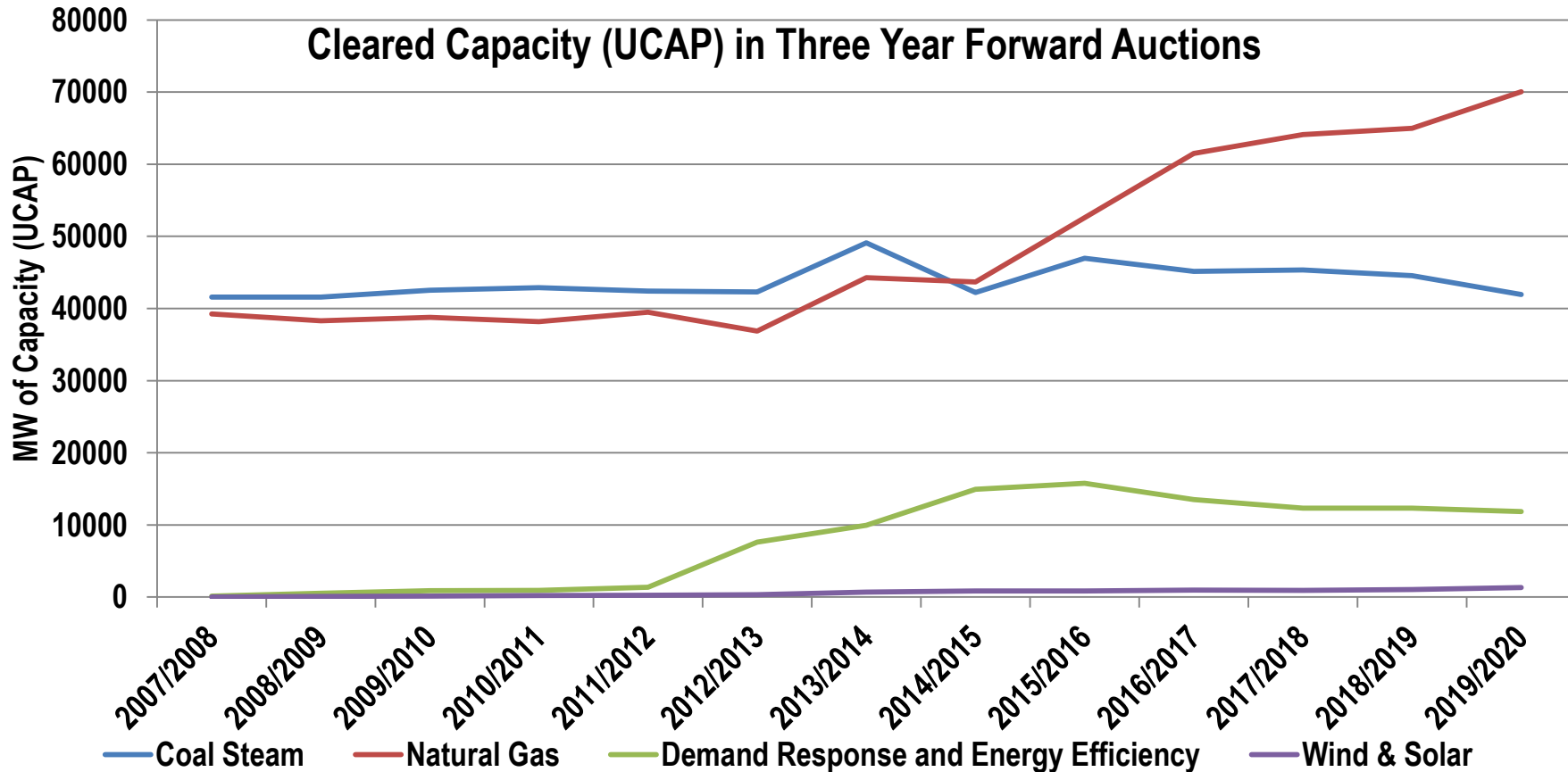
# Gas Dominates Going Forward Costs





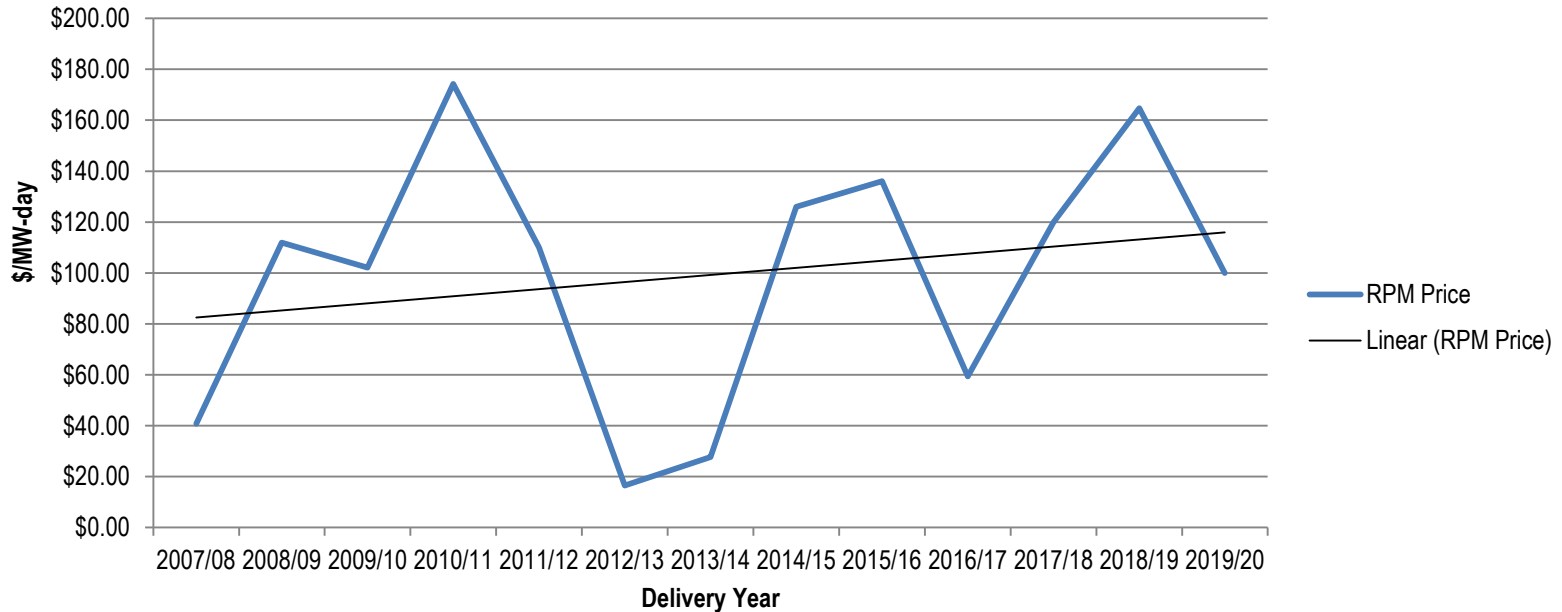
# Technology and Costs Part 2: Gas Capacity Surpassing Coal Capacity

## Cleared Capacity (UCAP) in Three Year Forward Auctions



# Capacity Prices: As Energy Market Prices Decline, Greater Need for Capacity Prices to Rise to Keep Resources in Service

## RPM Capacity Market Price in RTO LDA



To preserve competition in wholesale power markets, keep the following in mind...

- 1st Law of Infrastructure Financial Thermodynamics
  - All initial costs of bringing an asset into commercial operation are sunk once in operation
- 2nd Law of Infrastructure Financial Thermodynamics
  - Once built, the infrastructure asset must at least cover their going-forward costs such as fixed O&M, required forward looking incremental investment and other overhead costs to remain in commercial operation
- Law of Conservation of Risk
  - Risk can neither be created nor destroyed
  - Risk can be transferred from one party to another (willingly or unwillingly), hidden or made transparent
  - Risk can be transformed between physical/event risk into financial risk

# So, what are the challenges and consideration related to competition in power markets?

- Need for capacity markets in low energy price or energy market rent environments
  - See Alberta most recently
- Minimum Offer Price Rules
  - A market power mitigation measure...
  - ...being looked at as a price formation measure?
- State policy initiatives
  - Fairly easy to see who benefits
  - But who really pays? How transparent is it?
  - What are the price formation implications and is it market power or just inefficient?
  - RPS, CES, ZEC, M-O-U-S-E.....??