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

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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%

Source: PJM Interconnection, LLC
07/20/2016
Technology Part 1: Natural Gas Rig Productivity Rises and Prices Decline

**Rig Productivity (mcf/rig/day)**

- Marcellus
- Utica
- Haynesville
- Eagle Ford
- Niobrara
- Bakken
- Permian

**Henry Hub Monthly Price**

- January 2005 to February 2016


The Big Shock: Where has Demand Growth Gone?

**PJM Summer Peak Demand Forecast**

- 2013
- 2014
- 2015
- 2016

**Evolution of Total Energy Demand and Total Energy Forecasts in PJM**

- 2013 Forecast
- 2014 Forecast
- 2015 Forecast
- 2016 Forecast
- Actual Energy

Source: PJM Interconnection, LLC
And Energy Prices are Matching the Fuel and Demand Trends

PJM Monthly Load Weighted Average LMP

Source: PJM Interconnection, LLC
Technology Part 2: Gas Dominates Generation the Interconnection Queue

Source: PJM Interconnection, LLC
Gas Dominates Going Forward Costs

Fixed O&M/Going Forward Costs

$0.00 - $250.00

Existing Combined Cycle Gas
Existing Coal (more than 40 years old)
Existing Nuclear in PJM, ISO-NE, NYISO, and MISO

2011$/KW-yr
2016$/KW-yr

E-Cubed Policy Associates, LLC

Source: EPA IPM Modeling Base Case v.5.13 Documentation
Technology and Costs

Part 2: Gas Capacity Surpassing Coal Capacity

Cleared Capacity (UCAP) in Three Year Forward Auctions

- **Coal Steam**
- **Natural Gas**
- **Demand Response and Energy Efficiency**
- **Wind & Solar**

Source: PJM Interconnection, LLC
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

Source: PJM Interconnection, LLC
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.....??