Valuing Inflexibility Undermines Energy Price Formation

PJM Energy Policy Roundtable

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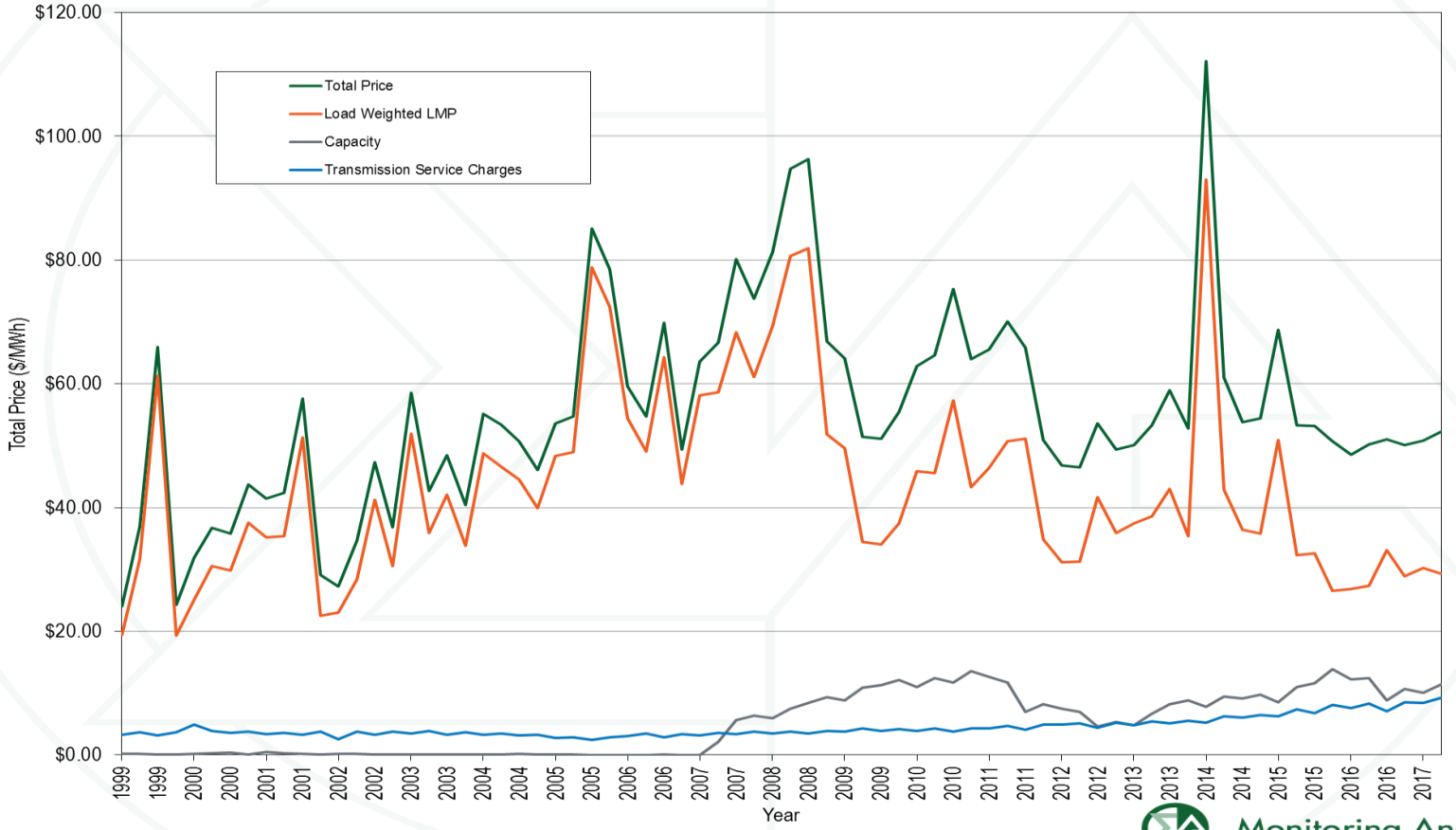
Reasons Cited by PJM

- Need to recognize contribution of baseload
- Negative offers have pernicious effects on baseload retirement
- Falling energy net revenues for baseload
- Desire to shift revenue from capacity to energy
- Flattening supply curve decreases net revenue
- Reducing uplift

- PJM's reasons amount to administratively picking winners and losers in the market.

PJM All In Price



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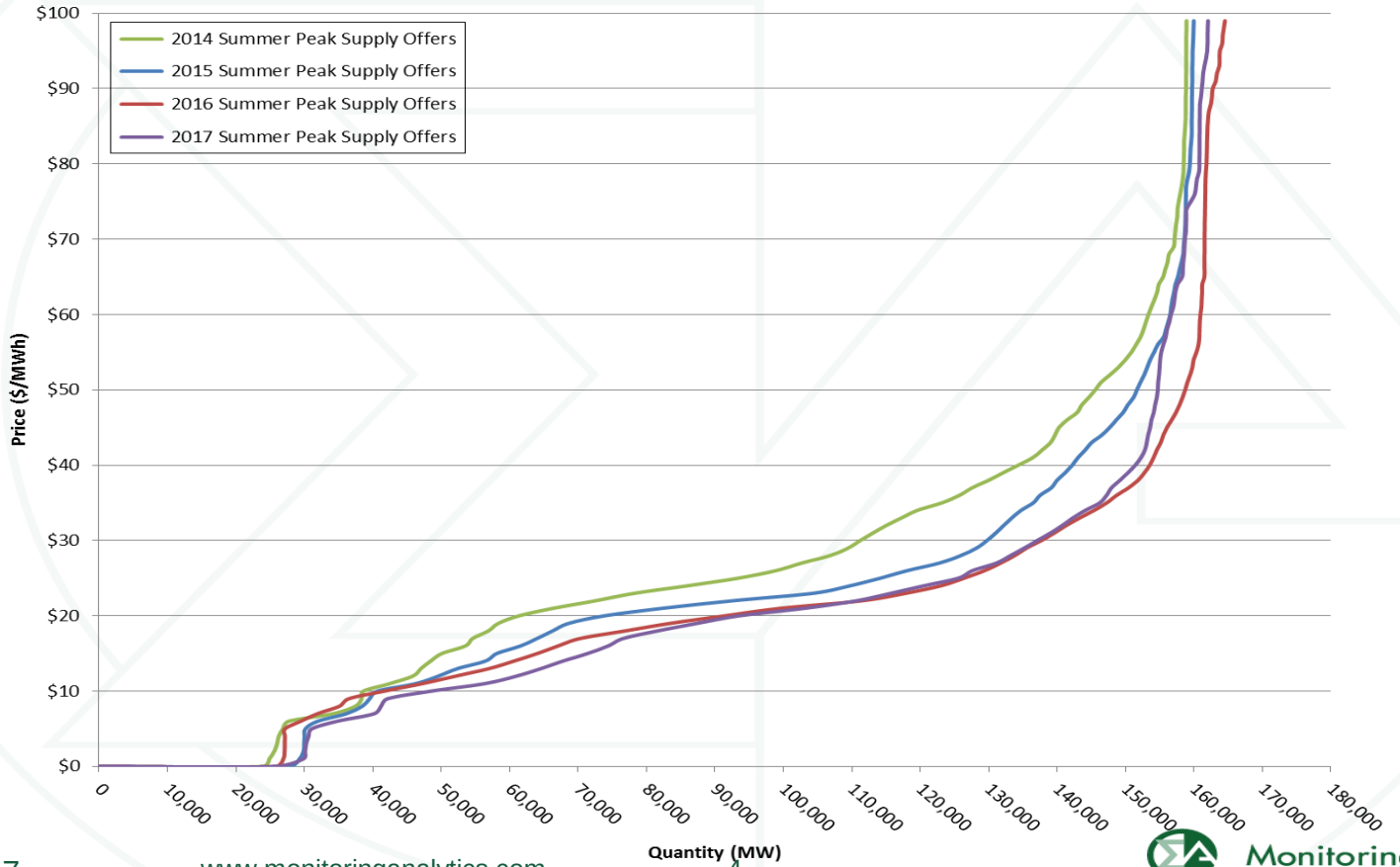
PJM Supply Curve



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Nuclear Avoidable Cost Recovery

Technology	Total Installed Capacity (ICAP)	Recovery of avoidable costs from energy and ancillary net revenue			Recovery of avoidable costs from all markets		
		First quartile	Median	Third quartile	First quartile	Median	Third quartile
Nuclear (2016)	31,661	61%	88%	105%	91%	119%	135%
Nuclear (July 2016 through June 2017)	31,661	81%	95%	113%	104%	126%	143%

- **Negative LMPs reduced nuclear net revenues by an average of 0.3 percent and a maximum of 2.6 percent in 2016.**

PJM Price Formation Proposal

- **Allow all inflexible units to set the energy price**
  - **Extending concept to must run baseload units**
- **Inflexible units are not marginal in the efficient market solution.**
- **The design would require two market solutions:**
  1. **Efficient dispatch solution**
  2. **Pricing solution**
- **Uplift required for the true (dispatch solution) marginal units to follow dispatch instructions.**

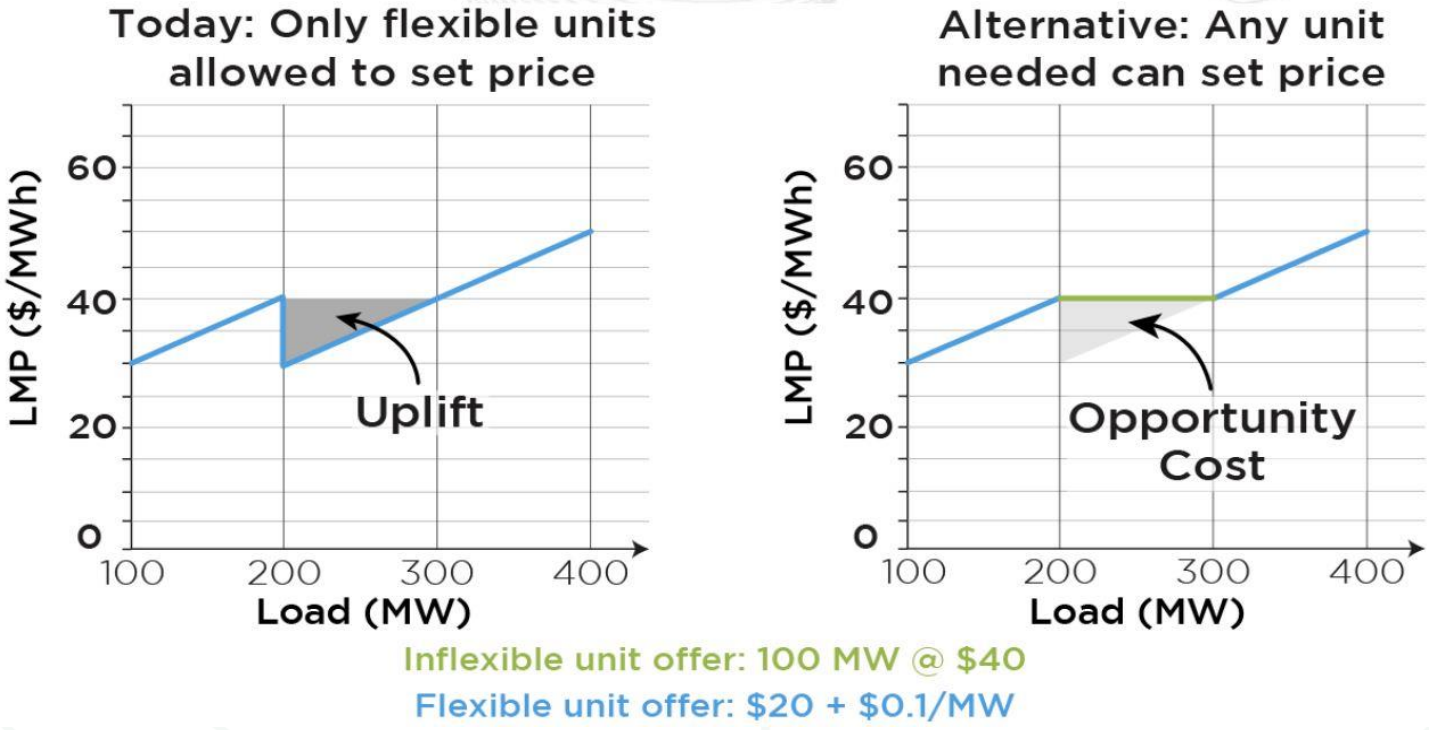
Theoretical Points

- **Valuing inflexibility is at odds with valuing flexibility.**
- **A direct increase in consumer costs results from PJM's proposal to have inflexible units set price.**
- **LMP based on short run marginal cost minimizes production cost, including uplift. The design is appropriate and supported by economic theory.**
- **Pricing nonconvex offers as if they were convex is not necessary for market efficiency.**

Theoretical Points

- **When demand does not justify committing a unit's first MW, whether flexible or not, the unit should not set price and will rely on uplift.**
- **PJM's proposal will not eliminate uplift. It creates new uplift and increases total costs to load.**

PJM Uplift Graphs



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Behavioral Implications

- **PJM proposes 1) higher energy prices and 2) uplift to true marginal units.**
  - **Both payment changes increase the incentive to self schedule and enter the market.**
- **Uplift payments to the true marginal units can create incentives for less flexible ramp rates to keep the units in a marginal position.**
- **Significant resulting changes (up and down) in congestion costs would impact UTC and FTR behavior.**

Generation Commitment Status 2016

Energy Market	Self Scheduled (Must Run)	Self Scheduled (Dispatchable)	Pool Scheduled (Block Loaded)	Pool Scheduled (Dispatchable)	No Defined Status
Day Ahead	32.5%	29.3%	3.4%	34.8%	0.0%
Real Time	35.7%	24.9%	4.9%	34.2%	0.3%

Improving Energy Price Formation

- **Pricing transmission scarcity**
  - **Replace constraint relaxation and transmission constraint penalty factors**
  - **Use transmission constraint demand curves**
- **Improve scarcity pricing**
  - **Evaluate levels vs. probability of load shedding**
  - **Sloped demand curve**

Improving Energy Price Formation

- **Evaluation of reserve products**
  - **Should work together with scarcity pricing**
  - **Unpriced operator reliability commitments**
- **Reduce uplift payments**
  - **Pay inflexible units based on flexible parameters**

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Distribution of MW for self scheduled and dispatchable unit offer prices: 2016

	Self Scheduled		Self Scheduled and Dispatchable (Range)							
Unit Type	Must Run	Emergency	($200) - $0	$0 - $200	$200 - $400	$400 - $600	$600 - $800	$800 - $1,000	Emergency	Total
CC	2.9%	0.9%	0.3%	10.1%	0.0%	0.0%	0.0%	0.0%	0.8%	15.0%
CT	0.5%	0.1%	0.0%	1.1%	0.0%	0.0%	0.0%	0.0%	0.1%	1.8%
Diesel	20.0%	0.9%	2.7%	1.5%	0.0%	0.0%	0.0%	0.0%	1.1%	26.3%
Fuel Cell	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Nuclear	86.4%	1.1%	4.5%	2.5%	0.0%	0.0%	0.0%	0.0%	0.1%	94.6%
Pumped Storage	17.9%	9.3%	3.5%	0.0%	0.0%	0.0%	0.0%	0.0%	4.2%	34.8%
Run of River	60.0%	13.7%	0.3%	20.8%	0.0%	0.0%	0.0%	0.4%	4.7%	99.8%
Solar	39.0%	14.4%	2.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	55.9%
Steam	4.6%	1.5%	0.1%	36.8%	0.0%	0.0%	0.0%	0.0%	2.6%	45.7%
Transaction	76.2%	23.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Wind	4.9%	4.0%	22.8%	3.1%	0.0%	0.0%	0.0%	0.0%	3.5%	38.5%
All Self-Scheduled Offers	20.9%	1.4%	1.5%	16.6%	0.0%	0.0%	0.0%	0.0%	1.4%	41.9%

Energy uplift credits by unit type: 2016

Unit Type	Day-Ahead Generator	Balancing Generator	Canceled Resources	Local Constraints Control	Lost Opportunity Cost	Reactive Services	Synchronous Condensing	Black Start Services
Combined Cycle	13.0%	10.1%	0.0%	0.0%	3.4%	29.3%	0.0%	11.8%
Combustion Turbine	3.5%	72.5%	35.7%	71.1%	75.6%	11.2%	100.0%	88.2%
Diesel	0.0%	0.6%	0.0%	0.0%	1.2%	1.0%	0.0%	0.0%
Hydro	0.0%	0.0%	64.3%	0.0%	0.0%	0.0%	0.0%	0.0%
Nuclear	0.0%	0.0%	0.0%	0.0%	6.3%	0.0%	0.0%	0.0%
Steam - Coal	80.9%	13.3%	0.0%	27.0%	4.3%	56.1%	0.0%	0.0%
Steam - Others	2.6%	3.4%	0.0%	0.0%	0.2%	2.4%	0.0%	0.0%
Wind	0.0%	0.1%	0.0%	1.9%	9.0%	0.0%	0.0%	0.0%
Total (Millions)	$57.3	$57.7	$0.1	$0.4	$18.6	$2.5	$0.0	$0.3