BOSTON ENERGY
Trading and Marketing

Price Formation and Uplifts

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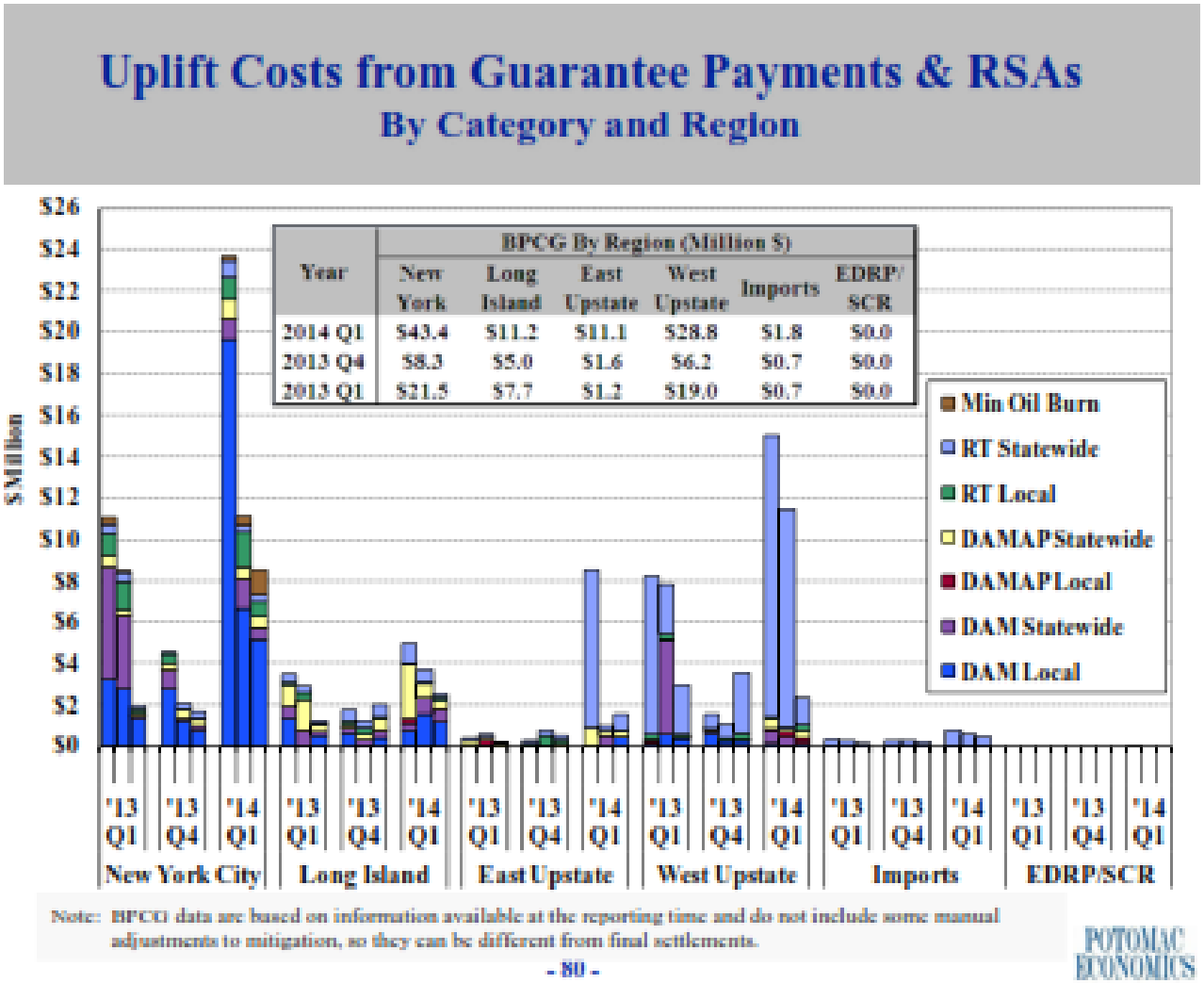
Price Formation Uplift in RTO Markets

Agenda

- Polar vortex uplift performance.
- Uplift allocation issues.
- What do the markets need to do better in order to reduce uplifts?

NY Uplift

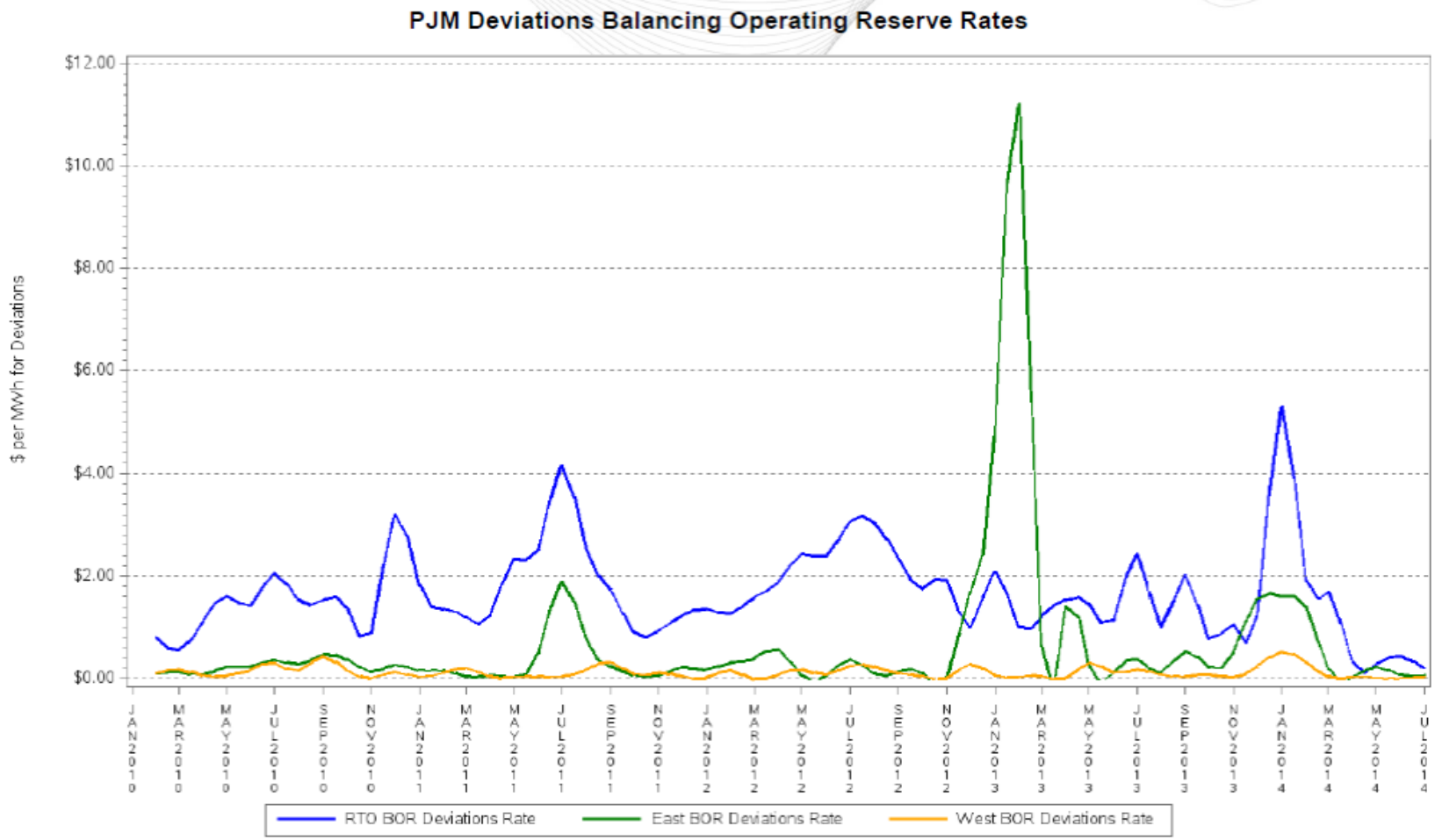


Year	BPCG By Region (Million $)					
	New York	Long Island	East Upstate	West Upstate	Imports	EDRP/ SCR
2014 Q1	$43.4	$11.2	$11.1	$28.8	$1.8	$0.0
2013 Q4	$8.3	$5.0	$1.6	$6.2	$0.7	$0.0
2013 Q1	$21.5	$7.7	$1.2	$19.0	$0.7	$0.0

Source: Quarterly Report on the New York ISO Electricity Markets First Quarter 2014: Potomac Economics

PJM Uplift

PJM BOR Deviations Rates



Source: PJM Report

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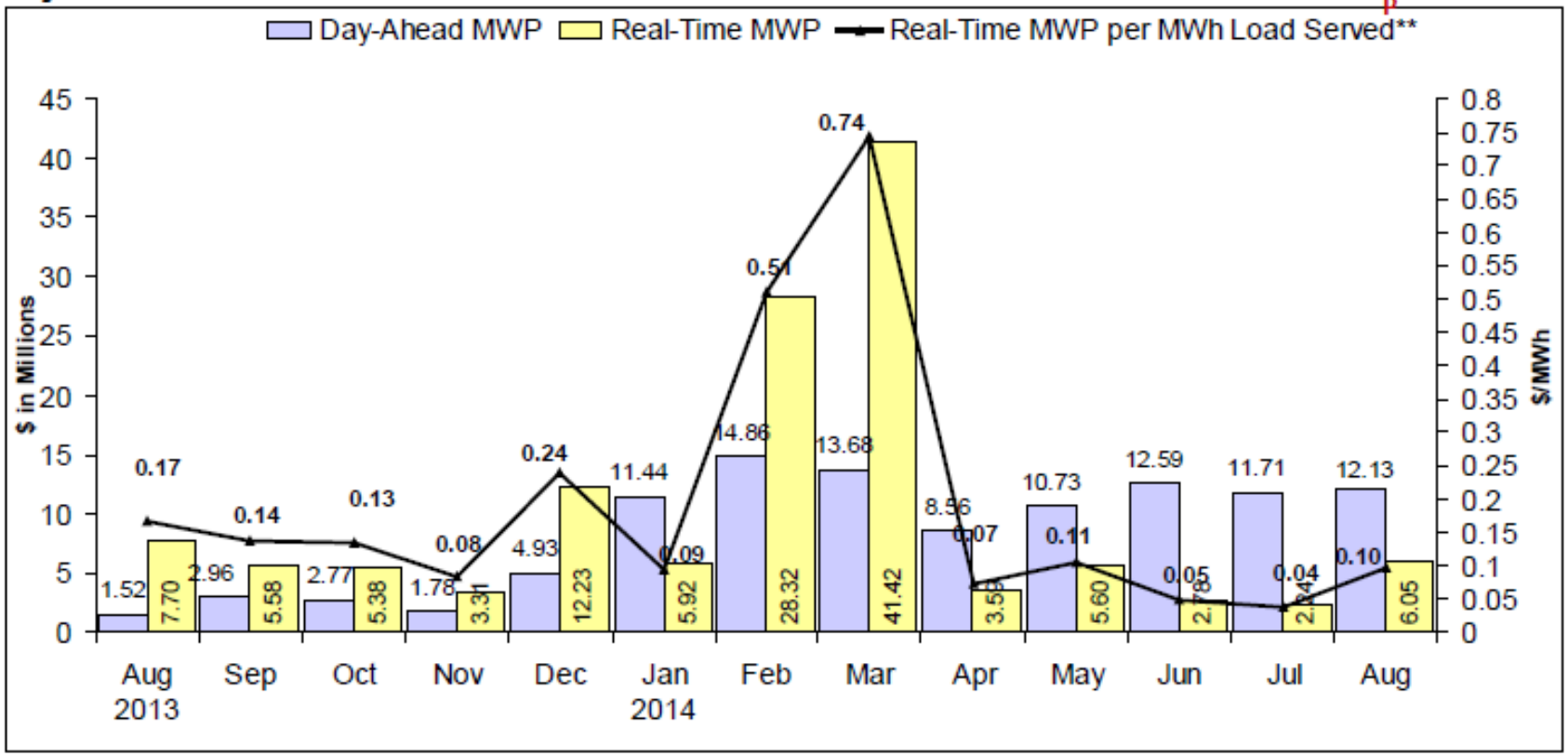
MISO Uplift

Revenue Sufficiency Guarantee Day-Ahead and Real-Time



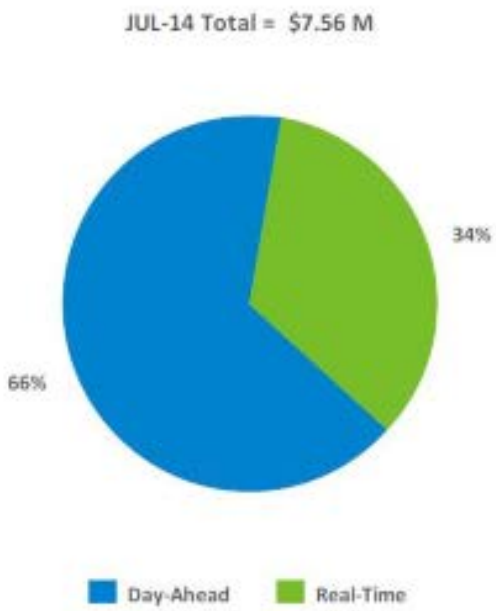
Date of Extraction: September 07, 2014. Values may change due to resettlement.

Source: MISO report

New England Uplift

Uplift Costs – 2014

DA and RT NCPC Charges

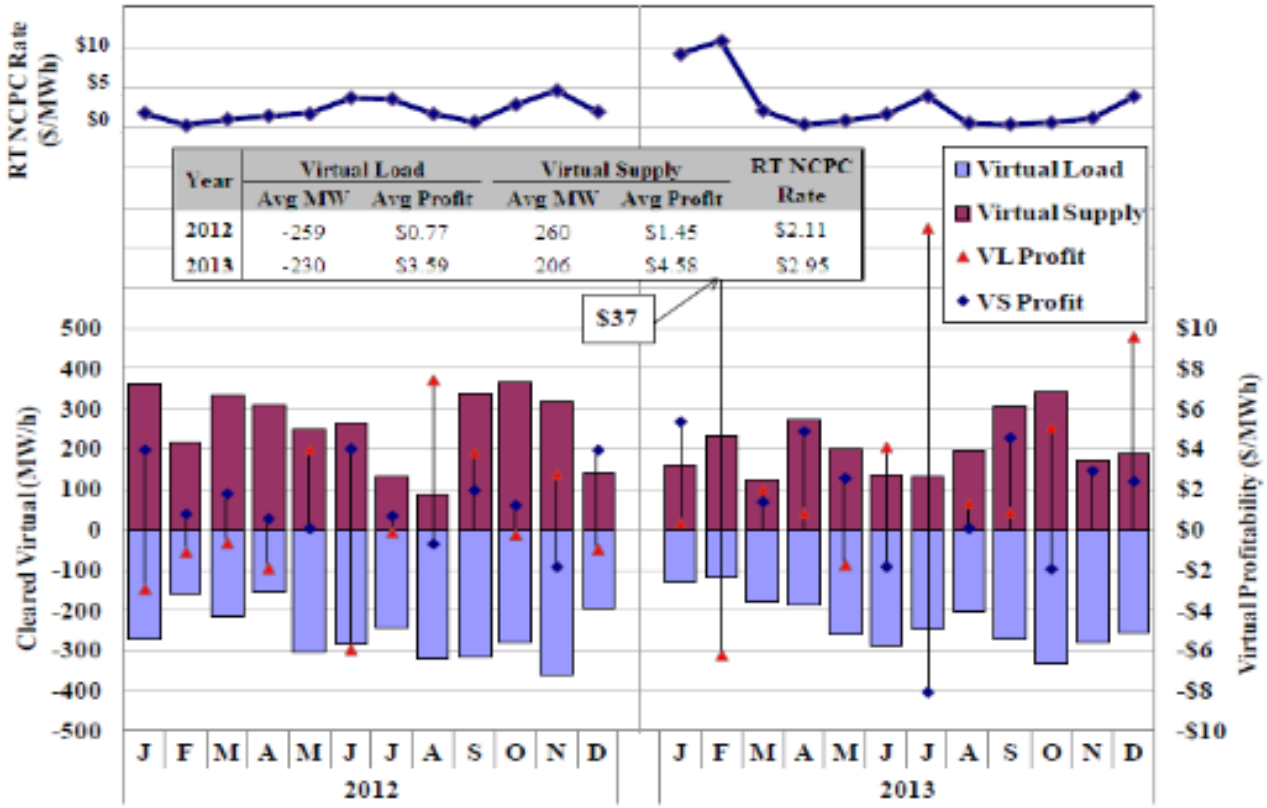


Source:Uplift Issues in New England – Ron Coutu 9/11/2014 – PJM Conference Call

New England Uplift

Problem with Allocating Uplift to Virtuals

Figure 6: Virtual Transaction Volumes and Profitability
By Month and By Location, 2012 – 2013



Year	Virtual Load		Virtual Supply		RT NCPC Rate
	Avg MW	Avg Profit	Avg MW	Avg Profit	
2012	-259	$0.77	260	$1.45	$2.11
2013	-230	$3.59	206	$4.58	$2.95

Source: Uplift Issues in New England – Ron Coutu 9/11/2014 – PJM Conference Call

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Problems/Answers?

- We are spending all our time talking about who should be paying uplifts
  - Deviations? – if the RT prices were right they would already be paying.
  - Peanut butter to load? – IF RT prices were right the average charge to load would be very small.
  - Virtual bids vs UTCs? – PJM UTCs will now go the way of PJM virtual bids, limited participation, limited liquidity and more volatile RT results from both and absolute and congestion pricing.
  - RSG proceedings went on for how many years, 4, 5? – and we're still waiting for a very watered down "ELMP" to be implemented.
  - PJM's hidden uplift – FTR underfunding caused by RT congestion imbalances.

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Problems/Answers?

- We aren't spending nearly enough time on how to reduce the uplift charges to the point that they are no longer a big issue:
  - Peaking unit commitment and pricing;
  - Real time reserve co-optimization with reserve shortage demand curves;
  - Scarcity event pricing;
  - Emergency demand response programs;
  - Matching RT prices to operator actions;
  - Consistency of DA and RT market models;
  - Ability to reflect actual costs in DA and RT markets;
  - Coordination of gas and power markets.

Peaking Unit Commitment and Pricing

This is the single biggest issue in the uplift discussion:

- The early days of the NYISO market were punctuated by OOM peaking units ineligible to set price
  - Actions taken by the operators to ensure reliability were not being reflected in the market prices.
  - Hybrid and dual dispatch allows online and offline peaking resources to be dispatched anywhere between 0 MW and their upper operating limit.
  - Multi-interval commitment and dispatch optimization (MIO) is a critical part of ensuring that the dispatch price when the unit is committed is high enough to address the minimum run time of the resource.
  - The commitment lagrangian is reflected in the first period energy price and uplift is $0.

$200 Resource Not Yet Committed

	Period 1	Period 2	Period 3	Period 4	Period 5	Average Price
Price at Location ($/MWh)	$ 640.00	$ 120.00	$ 100.00	$ 80.00	$ 60.00	$ 200.00
Return at Location ($/MWh)	$ 440.00	$ (80.00)	$ (100.00)	$ (120.00)	$ (140.00)	$ -

Peaking Unit Commitment and Pricing

This is the single biggest issue in the uplift discussion:

- MISO RSG issues were caused by the lack of peaking units setting prices which led to development of ELMP.
- The full convex hull ELMP solution originally envisioned was incredibly elegant but also a major software change that was just a bridge too far.
- The "ELMP" that is being implemented achieves much of what the complex hull would have achieved in the energy market by allowing peakers to be dispatched anywhere between 0 and their upper operating limit:
  - Dr Patton has correctly determined that the current proposal has flaws.
  - The flaws are a function of the lack of a multi-period optimization, and therefore an inability to reflect the minimum run time costs that must be covered to warrant starting an offline resource. Otherwise the additional units tend to just suppress prices and create additional uplift.
  - The most important of his solutions is to amortize the startup cost over a shorter time period i.e., to increase the first period dispatch cost of the offline units, artificially achieving a similar result to the MIO.
  - This allows the commitment lagrangian associated with starting the unit to be reflected in the first period price of the energy market

The Real ELMP

This originally hypothesized ELMP was a huge step forward in controlling the presence of uplifts across all the energy and ancillary services markets:

- Its central component was the ability to capture the langrangians associated unit commitment decisions and ensure that the prices for products or constraints that were causing resources to get committed were
- If a unit needed to be committed to meet the regulation requirement in a particular hour, the uplift costs, net cycle cost etc would be allocated into the regulation price of that hour or hours where the resource would not other wise have been started

The inability of any of the existing market software or pricing methodologies to capture the commitment langrangian associated with lumpy unit commitment decisions, reserve requirements, reliability rules, operator actions, demand response activations may ultimately make the uplift problem even worse.

- Once the decision is made to start a resource, how is it dispatched and how does its dispatch affect prices for other products and uplifts?

Peaking Unit Commitment and Pricing

This is the single biggest issue in the uplift discussion:

- PJM's balancing operating reserves are high enough and unpredictable enough to stifle their virtual bidding markets:
  - Only 10% of a peaking resource is eligible to set price.
  - If operators commit a 200 MW bank of peakers, 180MW of that is treated like a minimum generation block so more than 180 MW of that resource must be necessary to solve the problem before they will set price even in the first dispatch interval.
  - This impacts both congestion and overall load driven scenarios.
  - There is a similar parameter for the pricing of emergency demand response programs that tends to send PJM prices the wrong way on high load days.

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Extreme Days

On extreme days real-time co-optimization, scarcity pricing mechanisms and demand response programs all need to work together to ensure real-time dispatch prices match the operator actions and reliability concerns:

- Will the court case impact existing EDRP pricing rules in the wholesale markets?
- A gradual increase in prices is important as load rises – the real-time reserve demand curves and the ERCOT B+ models achieve this well.
- PJM's new scarcity pricing mechanisms were untested through the non-summer of 2014. Their demand response pricing in 2013 failed to set reasonable prices in PSEG and BGE where thousands of MW of demand response were called. They were able to use closed interfaces in the RT market to get prices right in Cleveland but did so at the expense of FTR funding as the constraint used in RT was not modeled in the DAM.

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Extreme Days

Demand Response is particularly difficult to model and price:

- What is the incremental cost of a MW when all generation is running or providing reserves and then thousands of load are removed from the system for extended periods of time?
  - Administrative pricing?
    - Price will be $x for as long as the demand response is called or for as long as total reserves are below some threshhold.
  - “But for” dispatch?
    - Return the load back into the dispatch.
    - Add a proxy generator to reflect the load reduction at some bid in or administrative price.
    - Allow the demand response to “set price” if necessary to meet load or maintain operating reserves.
- These days are not just critical from an uplift standpoint but also from the standpoint of ensuring that the short-term price signals incenting new generation are present

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Other Issues Affecting Uplift

Consistency of DA and RT modeling:

- Same constraint set;
- Same transmission outages;
- Spread virtual bidding (MISO trying will NY ever?);

Reflecting actual costs in DA and RT markets:

- Timing of NY market means that generator offers must be submitted prior to the gas market opening;
- Mitigation plans need to cope with volatile and potentially extreme gas prices. Failure to do so leads to leads to market dislocation and uplifts.
- Inability of PJM generators to change offer curves by hour or between the DA and RT markets if their cost change.

5-Minute Settlement in PJM:

- Generator uplifts are increased in ramping periods as the hourly average price and hourly average volume pay the generators less than the 5-minute prices and volumes.

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The Next Uplift Problem

I believe the next uplift problems that we will face (or are already facing) will be a result of the need for system operators to acquire ramping capability:

- Ramping capability required to meet wind generation uncertainty both up and down
- Ramping capability required to meet beginning and end of day solar generation ramping
- Some markets have already talked about the need to have additional regulation, or reserves, or load following or all three

The commitment of additional resources to provide this ramp capability without an ability to capture the commitment lagrangians and get them priced in to the correct ”product” clearing price

- Without any change, energy prices and any other associated products that the resource may be able to provide at low cost, once committed, will fall and uplifts will increase
- How to value energy storage?

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