MA Scarcity Pricing Proposal: Price Targets and Related Issues

SPWG

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Monitoring Analytics

Proposed Scarcity Pricing Approach

- **Concept: Add reserve constraints to the optimization model**
- **LMP is the incremental cost to serve incremental load at a location while controlling for *all* related constraints**
- **Reserves are additional constraints to the optimization**
- **LMP = Energy + Marginal Losses + Congestion + "Scarcity Adder"**
- **"Scarcity Adder" is an administrative contribution to marginal bus LMP(s) when short reserves**

Defining the Reserve Requirement "LMP Target"

- **Purpose is to signal scarcity and attract resources**
- **Purpose is to attract resources not committed via the capacity market**
- **Setting the resulting energy price too high will result in a wealth transfer, rather than meaningful increase in resources availability**
- **Determines the opportunity cost for reserves during scarcity**

Synchronized Reserve Target

- **Synchronized Reserve Target**

- **If system runs short of reserves:**
  - **LMP at the marginal unit buses set equal to $1,000.**
  - **Resulting opportunity costs determined relative to LMP**
  - **Max opportunity cost for reserves = $1,000**
  - **Hour ahead market for reserves incorporates opportunity cost in clearing price**

Two approaches, same concept

- **Use of Operating Reserve Penalty Factor Curve to drive within hour dispatch and optimization**
  - **PJM**
    - **Cumulative fixed $850 penalty factors that drive dispatch**
    - **Penalty factor(s) applied to marginal bus LMP (max price $2,700) during reserve scarcity**
  - **MA**
    - **$1,000 penalty factor(s) that drive dispatch**
    - **Defined LMP targets (max price $1,000) on marginal buses during reserve scarcity**
    - **Adder to marginal bus endogenously determined**
    - **Maintains indifference between LMP and opportunity cost for reserves**

Issues for discussion

- **Operating Reserve Penalty Factor Curves**
  - **10 minutes reserve target(s)—Synchronized Reserve (S.R.) vs. Primary and S.R.**
  - **Scarcity price targets ($1,000 vs. $2,700)**
  - **False Positive**
    - **Morning pickup/min gen events**
  - **Structure of Tier 2 market**
    - **Hour ahead structure vs. 5 minute optimization**

“MA Approach” vs. “PJM Approach”

Gen	MC	Max Gen	Max Reserves
A	$20	400	50
B	$60	400	50
C	Q+$100	400	50

Reserve Requirement = 100 MW

MA: LMP goes to $1000 when scarce, Max Price for Reserves = $1000

PJM: Penalty Factor = $850

MA Approach

	"Market Prices" (Non RPM resources price)							Dispatch					
Total Load/Energy	System Reserve	Energy Price (LMP)	Opportunity Cost	"Scarcity Adder"	MU	"Scarcity Adder"	MU	Energy A	Reserves A	Energy B	Reserves B	Energy C	Reserves C
400	100	$ 20	$ -		A		A	400	0	0	50	0	50
500	100	$ 60	$ -		B		B	400	0	100	50	0	50
700	100	$ 60	$ -		B		B	400	0	300	50	0	50
750	100	$ 60	$ -		B		B	400	0	350	50	0	50
800	100	$ 150	$ 90		C		C	400	0	350	50	50	50
850	100	$ 200	$ 140		C		C	400	0	350	50	100	50
900	100	$ 250	$ 190		C		C	400	0	350	50	150	50
950	100	$ 300	$ 240		C		C	400	0	350	50	200	50
1000	100	$ 350	$ 290		C		C	400	0	350	50	250	50
1050	100	$ 400	$ 340		C		C	400	0	350	50	300	50
1100	100	$ 450	$ 390		C		C	400	0	350	50	350	50
1110	90	$1,000	$ 940	$ 940	B	$ 550	C	400	0	360	40	350	50
1140	60	$1,000	$ 940	$ 940	B	$ 550	C	400	0	390	10	350	50
1170	30	$1,000	$ 530	$ 530	C	$ 530	C	400	0	400	0	370	30

PJM Approach

Total Load/ Energy	"Market Prices" (Non RPM resources price)									Dispatch					
	System Reserve		Energy Price (LMP)		Opportunity Cost	"Scarcity Adder"	MU	"Scarcity Adder"	MU	Energy A	Reserves A	Energy B	Reserves B	Energy C	Reserves C
400	100	$	20	$	-		A		A	400	0	0	50	0	50
500	100	$	60	$	-		B		B	400	0	100	50	0	50
700	100	$	60	$	-		B		B	400	0	300	50	0	50
750	100	$	60	$	-		B		B	400	0	350	50	0	50
800	100	$	150	$	90		C		C	400	0	350	50	50	50
850	100	$	200	$	140		C		C	400	0	350	50	100	50
900	100	$	250	$	190		C		C	400	0	350	50	150	50
950	100	$	300	$	240		C		C	400	0	350	50	200	50
1000	100	$	350	$	290		C		C	400	0	350	50	250	50
1050	100	$	400	$	340		C		C	400	0	350	50	300	50
1100	100	$	450	$	390		C		C	400	0	350	50	350	50
1110	90	$	1,000	$	850	$ 850	B	$ 460	C	400	0	360	40	350	50
1140	60	$	1,000	$	850	$ 850	B	$ 460	C	400	0	390	10	350	50
1170	30	$	1,000	$	850	$ 850	C	$ 850	C	400	0	400	0	370	30

LMP Target vs. Penalty Factor Additions to LMP

- **Using the same reserve targets, the unit specific operational dispatch signals are identical**
  - **Using different targets will cause different potential outcomes**
- **Both mechanisms would move PJM from manual within hour dispatch for reserves to automated within dispatch for reserves**
- ***Both* represent a *change* from current operations**
- **Both would result in a change in what is considered to be "optimal" dispatch**

Pricing Under Scarcity: $2,700 vs. $1,000

- **No evidence that the scarcity signal in the energy market need exceed $1,000 in order to maintain reliability**
- **Resources have responded below $1,000 in the past**
- **Last and "only" scarcity event reached $1,000 due to administrative process, not by the value of the most expensive *marginal* resource**

Pricing Under Scarcity: $2,700 vs. $1,000

- **Capping the market price at $1,000**
  - **Makes it possible to arbitrage between DA and RT**
  - **Not possible to arbitrage between DA and RT at $2,700.**
  - **Allows participants to better manage risks in DA market**
    - **Missed load prediction**
    - **Tripped unit**

Pricing Under Scarcity: $2,700 vs. $1,000

- **Capping the market price at $1,000**
  - **Would set LMP consistently with current resource offer caps**
  - **Would ensure full resource stack is dispatched**

Issues for discussion

- **Structure of the Tier 2 Market: Hour ahead scheduling vs. “full 5 minute optimization”**
  - **Cycling of unit assignments**
  - **Location specific opportunity costs**
  - **Participation of DR**
  - **Effects on generation participation and incentives**

Concerns with PJM's Approach

- **System control issues with PJM's proposal**
  - **PJM proposes to largely eliminate hour ahead scheduling of Tier 2 Synchronized Reserve (S.R.)**
  - **PJM proposal, as presented, will reduce reserves and sources of reserves**
    - **Cycling within hour assignments**
    - **Participation of DR eliminated or reduced**
  - **May affect frequency of events**
  - **Affects on generation participation and incentives**

Synchronized Reserve Optimization: MA concerns with PJM proposal

- **Concerns with elimination of hour ahead tier 2 market):**
  - **Fewer reserves could be made available if hour ahead scheduling is lost:**
    - **DR may need hour ahead notification to participate**
      - Significant source of Tier 2 S.R. under current structure
    - **Generation may have less reserves available on "5 minute" basis**
      - 10 minute ramp vs. 5 minute assignment
      - May have more available from predetermined set points (from hour ahead assignment)
      - Incentives under hourly integrated prices
      - Questionable transparency improvement with hourly integrated prices

Cycling within hour assignments

Area A Generation			
Gen	MC	Max Gen	Reserves
B	$60	850	50
C	Q + $100	400	50
Area B Generation			
Gen	MC	Max Gen	Reserves
D	$600	100	50

Reserve Requirement = 100 MW

Cycling within hour assignment

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
											Energy area A								Energy Area B					Unit D		
Row	Total Greater System Demand	Greater System Demand (Area A)	Transmission from A to B	Local Demand for area B	Net Demand for area B	Reserves	Area A LMP	Opportunity Cost	MU Area A	MU Area B	B Energy	B Reserves	MC	"Local" Opportunity Cost	C Energy	C Reserves	MC	"Local" Opportunity Cost	Area B LMP	D Energy	D Reserves	MC	"Local" Opportunity Cost	Margin on energy	Margin on Reserves	Row
1	450	400	50	50	0	150	$ 60	0	B	B	450	50	$ 60		0	50	$ -		$ 60	0	50	$ -				1
2	550	500	50	50	0	150	$ 60	0	B	B	550	50	$ 60	$ -	0	50	$ -		$ 60	0	50	$ -				2
3	750	700	50	50	0	150	$ 60	0	B	B	750	50	$ 60	$ -	0	50	$ -		$ 60	0	50	$ -				3
4	800	750	50	50	0	150	$ 60	0	B	B	800	50	$ 60	$ -	0	50	$ -		$ 60	0	50	$ -				4
5	850	800	50	50	0	100	$ 60	0	B	B	850	0	$ 60	$ -	0	50	$ -		$ 60	0	50	$ -				5
6	950	850	50	100	50	100	$ 150	$ 90	C	D	850	0	$ 60	$ 90	50	50	$ 150	$ -	$ 600	50	50	$ 600	$-	$ -		6
7	1020	900	50	120	70	100	$ 220	$ 160	C	D	830	20	$ 60	$ 160	120	50	$ 220	$ -	$ 600	70	30	$ 600	$-	$ -		7
8	1080	950	50	130	80	100	$ 250	$ 190	C	D	820	30	$ 60	$ 190	150	50	$ 250	$ -	$ 600	80	20	$ 600	$-	$ -		8
9	1130	1000	50	130	80	100	$ 330	$ 270	C	D	820	30	$ 60	$ 270	230	50	$ 330	$ -	$ 600	80	20	$ 600	$-	$ -		9
10	1190	1050	50	140	90	100	$ 390	$ 330	C	D	810	40	$ 60	$ 330	290	50	$ 390	$ -	$ 600	90	10	$ 600	$-	$ -		10
11	1240	1100	50	140	90	100	$ 440	$ 380	C	D	810	40	$ 60	$ 380	340	50	$ 440	$ -	$ 600	90	10	$ 600	$-	$ -		11
12	1250	1110	50	140	90	100	$ 450	$ 390	C	D	810	40	$ 60	$ 390	350	50	$ 450	$ -	$ 600	90	10	$ 600	$-	$ -		12
13	1270	1130	50	140	90	80	$ 910	$ 850	B	D	830	20	$ 60	$ 850	350	50	$ 450	$ 460	$ 1,450	90	10	$ 600	$850	$ 850	$ 850	13
14	1290	1150	50	140	90	60	$ 910	$ 850	B	D	850	0	$ 60	$ 850	350	50	$ 450	$ 460	$ 1,450	90	10	$ 600	$850	$ 850	$ 850	14
15	1320	1180	50	140	90	30	$1,330	$ 850	C	D	850	0	$ 60	$1,270	380	20	$ 480	$ 850	$ 1,450	90	10	$ 600	$850	$ 850	$ 850	15

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Cycling within hour assignment

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
											Energy area A								Energy Area B					Unit D		
Row	Total Greater System Demand	Greater System Demand (Area A)	Transmission from A to B	Local Demand for area B	Net Demand for area B	Reserves	Area A LMP	Opportunity Cost	MU Area A	MU Area B	B Energy	B Reserves	MC	"Local" Opportunity Cost	C Energy	C Reserves	MC	"Local" Opportunity Cost	Area B LMP	D Energy	D Reserves	MC	"Local" Opportunity Cost	Margin on energy	Margin on Reserves	Row
1	450	400	50	50	0	150	$ 60	0	B	B	450	50	$ 60		0	50	$ -		$ 60	0	50	$ -				1
2	550	500	50	50	0	150	$ 60	0	B	B	550	50	$ 60	$ -	0	50	$ -		$ 60	0	50	$ -				2
3	750	700	50	50	0	150	$ 60	0	B	B	750	50	$ 60	$ -	0	50	$ -		$ 60	0	50	$ -				3
4	800	750	50	50	0	150	$ 60	0	B	B	800	50	$ 60	$ -	0	50	$ -		$ 60	0	50	$ -				4
5	850	800	50	50	0	100	$ 60	0	B	B	850	0	$ 60	$ -	0	50	$ -		$ 60	0	50	$ -				5
6	950	850	50	100	50	100	$ 150	$ 90	C	D	850	0	$ 60	$ 90	50	50	$ 150	$ -	$ 600	50	50	$ 600	$-	$ -	$ -	6
7	1020	900	50	120	70	100	$ 220	$ 160	C	D	830	20	$ 60	$ 160	120	50	$ 220	$ -	$ 600	70	30	$ 600	$-	$ -	$ -	7
8	1080	950	50	130	80	100	$ 250	$ 190	C	D	820	30	$ 60	$ 190	150	50	$ 250	$ -	$ 600	80	20	$ 600	$-	$ -	$ -	8
9	1130	1000	50	130	80	100	$ 330	$ 270	C	D	820	30	$ 60	$ 270	230	50	$ 330	$ -	$ 600	80	20	$ 600	$-	$ -	$ -	9
10	1190	1050	50	140	90	100	$ 390	$ 330	C	D	810	40	$ 60	$ 330	290	50	$ 390	$ -	$ 600	90	10	$ 600	$-	$ -	$ -	10
11	1240	1100	50	140	90	100	$ 440	$ 380	C	D	810	40	$ 60	$ 380	340	50	$ 440	$ -	$ 600	90	10	$ 600	$-	$ -	$ -	11
12	1250	1110	50	140	90	100	$ 450	$ 390	C	D	810	40	$ 60	$ 390	350	50	$ 450	$ -	$ 600	90	10	$ 600	$-	$ -	$ -	12
13	1270	1130	50	140	90	80	$1,000	$ 940	B	D	830	20	$ 60	$ 940	350	50	$ 450	$ 550	$1,000	90	10	$ 600	$400	$ 400	$ 400	13
14	1290	1150	50	140	90	60	$1,000	$ 550	B	D	850	0	$ 60	$ 940	350	50	$ 450	$ 550	$1,000	90	10	$ 600	$400	$ 400	$ 400	14
15	1320	1180	50	140	90	30	$1,000	$ 520	C	D	850	0	$ 60	$ 940	380	20	$ 480	$ 520	$1,000	90	10	$ 600	$400	$ 400	$ 400	15

MA S.R. Proposal: Enhance Current Market Structure

- **MA proposes that PJM keep hour ahead Tier 2 Sync Market, market definitions and associated assignments**
  - **Tier 2 S.R. hour ahead assignments should be based on expectations of next hour system conditions and prices**
  - **Hour ahead Tier 2 S.R. assignments should continue to be taken as a "given" going into within hour optimization**
  - **As today, within hour adjustments (additions) to Tier 2 S.R. made in real time**
    - **Enhance within hour adjustments (additions) via use of reserves modeled as a constraint**

MA Synchronized Reserve Proposal: Advantages

- Consistent with current market structures
  - "Known" methodology and still improves within hour dispatch
  - Better at dealing with resource limitations that may otherwise limit reserve availability
  - More consistent with reserve requirements (90 minutes to rebuild)
- Will avoid issues of 5 minute "cycling"
  - Should provide for and encourage availability of more reserve resources
  - Allows continued participation by less flexible units
  - Allows continued participation by DR
  - May allow a means to properly recognize scarcity and avoid false positives (morning ramp)

Frequency Issue: Morning Pickup and Scarcity

- **There needs to be a way for the mechanism(s) to differentiate between the morning pickup situation and a scarcity event.**
  - **Supply stack is not "exhausted"**
- **Objective should be to develop a tool that internalizes the decision making process used by operations**
- **Morning pick up is normal. Not an emergency event.**
- **Repeated morning pick "emergencies" would indicate faulty mechanism and/or scheduling problem**

Morning Pickup and Scarcity

- **Mechanism needs to differentiate between a reserve draw down when it is not an issue and when it is an issue**
- **Operations knows that generation is on the way**
  - **Experience and DA schedules**
  - **Not an emergency**
- **Should look at ways to incorporate DA scheduling information to differentiate scarcity from non scarcity events**
  - **Look ahead capability (hour ahead mechanism, etc)**