Regulation Up/Down Discussion

Zhenyu Fan
Real-Time Market Operations
Regulation Market Design Senior Task Force
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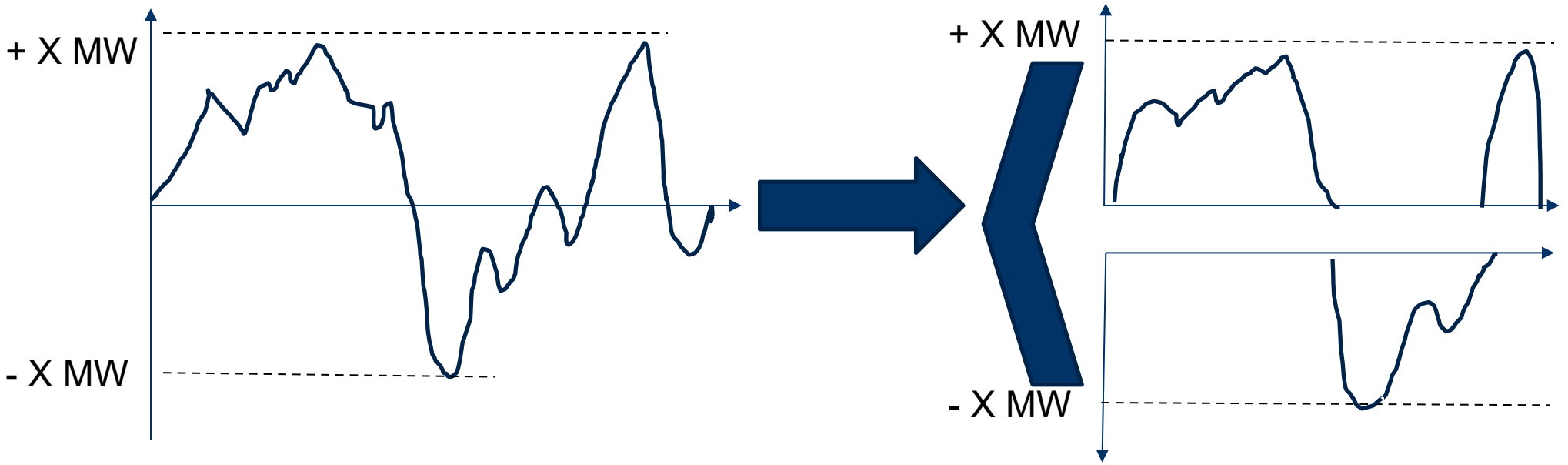
Regulation Up and Down Design

- Differentiate system needs – Different Up/Down Requirements
- Promote new entry / Remove or Lower the barrier
- Potential decrease on system production cost, LOC and clearing price
- Provide flexibility to meet future system needs while maintain least cost as possible

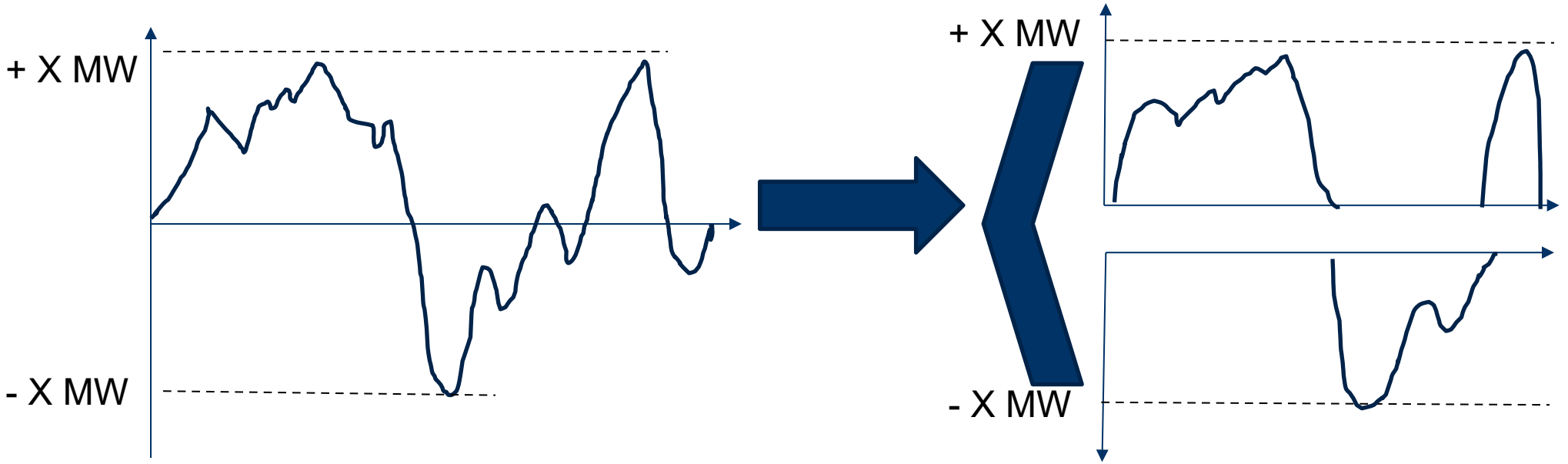
Capability Cost

- Capability Range
  - X MW (Bi-Directional) = X MW (RegUp) + X MW (RegDown)
- In general, cost ratio (Bi-Directional:RegUp/RegDown) ≅ 2:1



Performance Cost

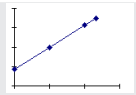
- Performance Cost (RegUp/RegDown) is also about half of the Status Quo.
  - Cost of unit in non-steady state is less since it only performs partially (up/down portion of the basepoint) if not half exactly



Lost Opportunity Cost (LOC)

- RMCP reflects any lost opportunity costs associated with keeping the resource capacity unloaded for Regulation instead of scheduling that capacity as Energy when the entire available capacity of a given resource is totally allocated among Energy and Regulation Awards.
- RT only Regulation Up/Down market
  - LOC is still going to contribute to clearing price
  - Two buckets →Up/Down
  - LOC Up or LOC Down if any, never both
  - LOC Up/Down (only one) = LOC (Bi-Directional), if any
  - LOC (Up/Down) <= LOC (Bi-Directional)

Examples (4 Units)

Unit	EcoMin (MW)	EcoMax (MW)	Price ($/MWh)	RegOffer (MW)	RegOffer ($/MW)
A	10	20	10	5	2
B	10	50		20	2
C	20	40	5	10	2
D	20	30	60	5	2

Assume RegUp/Down offer price is 50% of Status Quo

Unit	RegUp		RegDown	
	Offer $	Offer MW	Offer $	Offer MW
A	1	10	1	10
B	1	40	1	40
C	1	20	1	20
D	1	10	1	10

Scenarios

Scenarios	Load (MW)	Reg Requirement (MW)
1	70	10
2	80	10
3	110	10
4	130	10
5	130	5

Scenario 1: Load =70, Reg Req=10

Status Quo:

Unit	EcoMin (MW)	EcoMax (MW)	Initial Energy (MW)	Initial LMP ($/MWh)	Final Energy (MW)	Final LMP ($/MWh)	Reg (MW)	RMCP ($/MW)	Uplift /LOC
A	10	20	20	10	15	10	5	7	5
B	10	50	10	10	15	10	5	7	5
C	20	40	40	10	40	10			
D	20	30	0	0	0	0			

Production Cost : 70X10+2X5X7=770

Scenario 1: Load =70, Reg Req=10

RegUp/Down:

Unit	EcoMin (MW)	EcoMax (MW)	Initial Energy (MW)	Initial LMP ($/MWh)	Final Energy (MW)	Final LMP ($/MWh)	RegUp			RegDown		
							MW	$	LOC	MW	$	LOC
A	10	20	20	10	20	10						
B	10	50	10	10	10	10	10	1	0			
C	20	40	40	10	40	10				10	1	0
D	20	30	0	0	0	0						

Production Cost : 70X10+2X10X1=720

Scenario 2: Load =80, Reg Req=10

Status Quo:

Unit	EcoMin (MW)	EcoMax (MW)	Initial Energy (MW)	Initial LMP ($/MWh)	Reg (MW)	RMCP ($/MW)	Uplift/LOC
A	10	20	20	20	0		
B	10	50	20	20	10	2	0
C	20	40	40	20	0		
D	20	30	0	0	0		

Production Cost : 80X20+10X2=1620

Scenario 2: Load =80, Reg Req=10

RegUp/Down:

Unit	EcoMin (MW)	EcoMax (MW)	Initial Energy (MW)	Initial LMP ($/MWh)	RegUp			RegDown		
					MW	$	LOC	MW	$	LOC
A	10	20	20	20	0					
B	10	50	20	20	10	1	0	10	1	0
C	20	40	40	20	0					
D	20	30	0	0	0					

Production Cost : 80X20+10X(1+1)=1620

Scenario 3: Load =110, Reg Req=10

Status Quo:

Unit	EcoMin (MW)	EcoMax (MW)	Initial Energy (MW)	Initial LMP ($/MWh)	Final Energy (MW)	Final LMP ($/MWh)	Reg (MW)	RMCP ($/MW)	Uplift/ LOC
A	10	20	20	50	20	60	0		
B	10	50	50	50	30	60	10	22	20
C	20	40	40	50	40	60	0		
D	20	30	0	0	20	60	0		

Production Cost : 110X60+10X32=6920

Scenario 3: Load =110, Reg Req=10

RegUp/Down:

Unit	EcoMin (MW)	EcoMax (MW)	Initial Energy (MW)	Initial LMP ($/MWh)	Final Energy (MW)	Final LMP ($/MWh)	RegUp			RegDown		
							MW	$	LOC	MW	$	LOC
A	10	20	20	50	20	60	0					
B	10	50	50	50	30	60	10	31	30	10	1	0
C	20	40	40	50	40	60	0					
D	20	30	0	0	20	60	0					

Production Cost : 110X60+10X(31+1)=6920

Scenario 4: Load =130, Reg Req=10

Status Quo:

Unit	EcoMin (MW)	EcoMax (MW)	Initial Energy (MW)	Initial LMP ($/MWh)	Final Energy (MW)	Final LMP ($/MWh)	Reg (MW)	RMCP ($/MW)	Uplift/ LOC
A	10	20	20	60	20	60			
B	10	50	50	60	40	60	10	22	20
C	20	40	40	60	40	60			
D	20	30	20	60	30	60			

Production Cost : 130X60+10X22=8020

Scenario 4: Load =130, Reg Req=10

RegUp/Down:

Unit	EcoMin (MW)	EcoMax (MW)	Initial Energy (MW)	Initial LMP ($/MWh)	Final Energy (MW)	Final LMP ($/MWh)	RegUp			RegDown		
							MW	$	LOC	MW	$	LOC
A	10	20	20	60	20	60						
B	10	50	50	60	50	60				10	1	0
C	20	40	40	60	40	60						
D	20	30	20	60	20	60	10	1	0			

Production Cost : 130X60+10X(1+1)=7820

Scenario 5: Load =130, Reg Req=5

Status Quo:

Unit	EcoMin (MW)	EcoMax (MW)	Initial Energy (MW)	Initial LMP ($/MWh)	Final Energy (MW)	Final LMP ($/MWh)	Reg (MW)	RMCP ($/MW)	Uplift/ LOC
A	10	20	20	60	20	60			
B	10	50	50	60	45	60	5	17	15
C	20	40	40	60	40	60			
D	20	30	20	60	25	60			

Production Cost : 130X60+5X(15+2)=7885

Scenario 5: Load =130, Reg Req=5

RegUp/Down:

Unit	EcoMin (MW)	EcoMax (MW)	Initial Energy (MW)	Initial LMP ($/MWh)	Final Energy (MW)	Final LMP ($/MWh)	RegUp			RegDown		
							MW	$	LOC	MW	$	LOC
A	10	20	20	60	20	60	0					
B	10	50	50	60	50	60	0			5	1	0
C	20	40	40	60	40	60	0					
D	20	30	20	60	20	60	5	1	0			

Production Cost : 130X60+5X(1+1)=7810

Case Summary

Scenarios	Load (MW)	Reg Requirement (MW)	Production Cost $ (Status Quo)		Production Cost $ (RegUp/Down)
1	70	10	770 (Uplift)	>	720 (No Uplift)
2	80	10	1620 (No LOC)	=	1620 (No LOC)
3	110	10	6920 (LOC)	=	6920 (LOC)
4	130	10	8020 (LOC)	>	7820 (No LOC)
5	130	5	7885 (LOC)	>	7810 (No LOC)

Observations/Conclusions

- Total system production cost, clearing price and LOCs in RegUp/Down design are less or equal to those in bidirectional design.
- RMCP(status quo) and RMCPs(RegUp/RegDown)
  - No straight/linear relationship
  - Benefits(flexibility, performance) other than clearing prices
- The clearing price for each product will be determined by the Supply(Offers)/Demand(Reqs.), Offer Prices/Costs, and LOCs.
- Regulation Commitment and Real Time Condition
- Efficient Market Design → Incentives → Respond → "Positive" Feedback → Sustainability on Market and Operation

Contact

Facilitator:
Mike Herman, Michael.Herman@pjm.com

Secretary:
Wenzheng Qiu, Wenzheng.Qiu@pjm.com

SME/Presenter:
Zhenyu Fan, Zhenyu.Fan@pjm.com

Regulation Market Design Senior Task Force

Member Hotline

(610) 666 – 8980

(866) 400 – 8980

custsvc@pjm.com