

Capacity Auction Clearing with Resource Specific FRR

Markets & Reliability Committee
Special Session: PJM Response
to FERC on Capacity Market
Reforms Meeting
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Monitoring Analytics

Overview

- **Resource specific FRR results in price suppression if the subsidized resource would not clear in the auction without FRR**
- **Resource specific FRR may have an impact on prices if the entire subsidized resource would clear in the auction without FRR**
- **With resource specific FRR, load will pay more in the longer term due to the resulting inefficient fleet of resources**
- **With resource specific FRR, clearing prices will not provide efficient entry and exit signals**

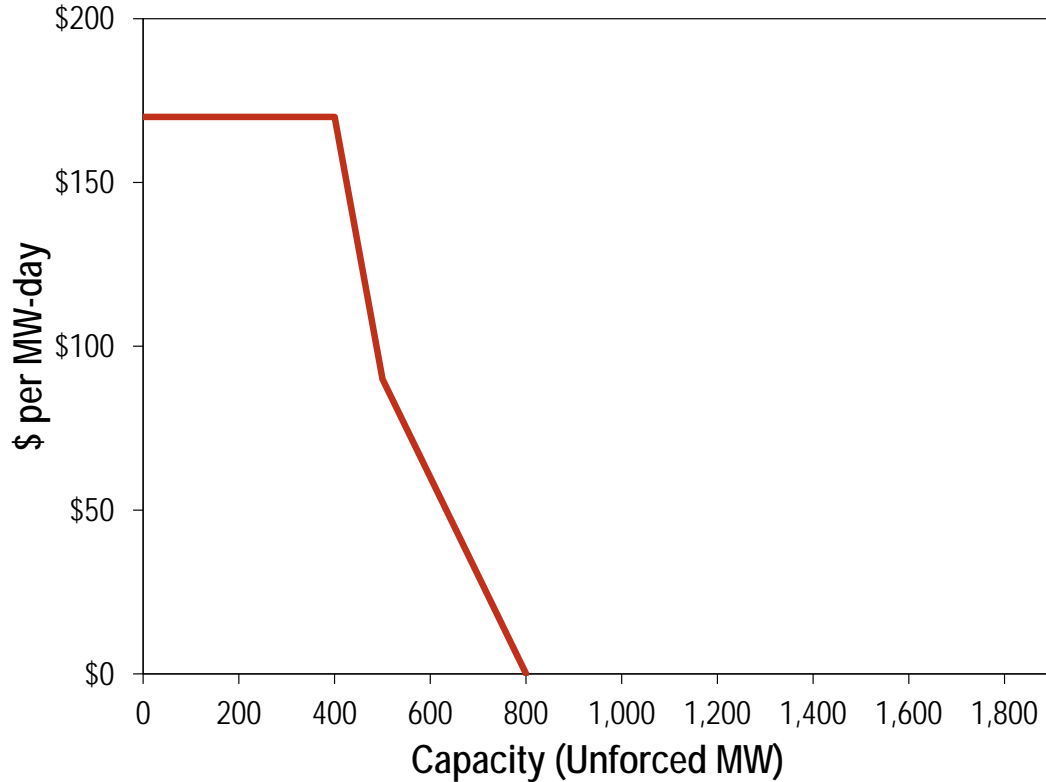
Auction Clearing

- **Subsidized resources are removed from the supply curve**
- **The reliability requirement of the LDA where the subsidized resources are located is reduced by the total unforced capacity of the subsidized resources**
- **The new VRR curve (derived from the reduced LDA reliability requirement and Installed Reserve Margin) is shifted to the left**
- **Auction cleared with residual supply and shifted VRR curve**

Example Auction Clearing

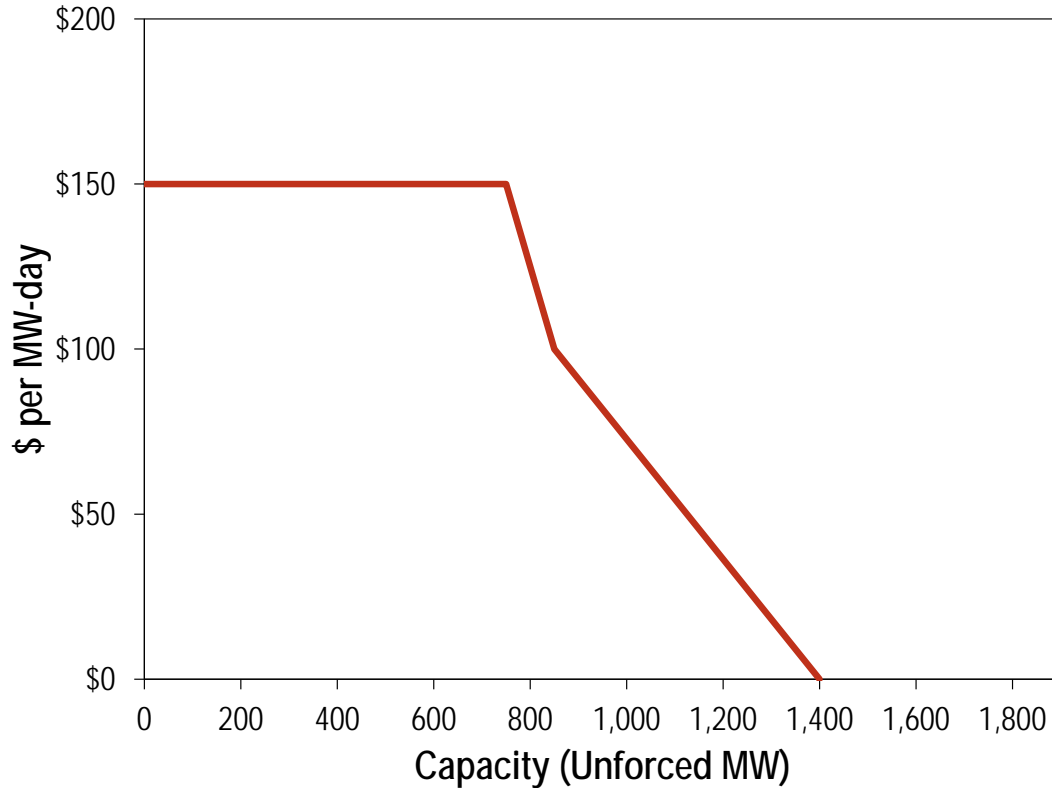
- **Simple example with two LDAs**
- **Extra marginal resource of 200 MW UCAP located in the child LDA received subsidy.**
- **Reliability requirements for both child and parent LDAs were reduced by 200 MW.**
- **The VRR curve parameters for both parent and child LDAs were derived from the reduced reliability requirement and Installed Reserve Margin.**
- **The shifted VRR curve does not have the same slope as that of the original VRR curve.**
- **Auction cleared with residual supply curve and shifted VRR curve**

Example: Child LDA



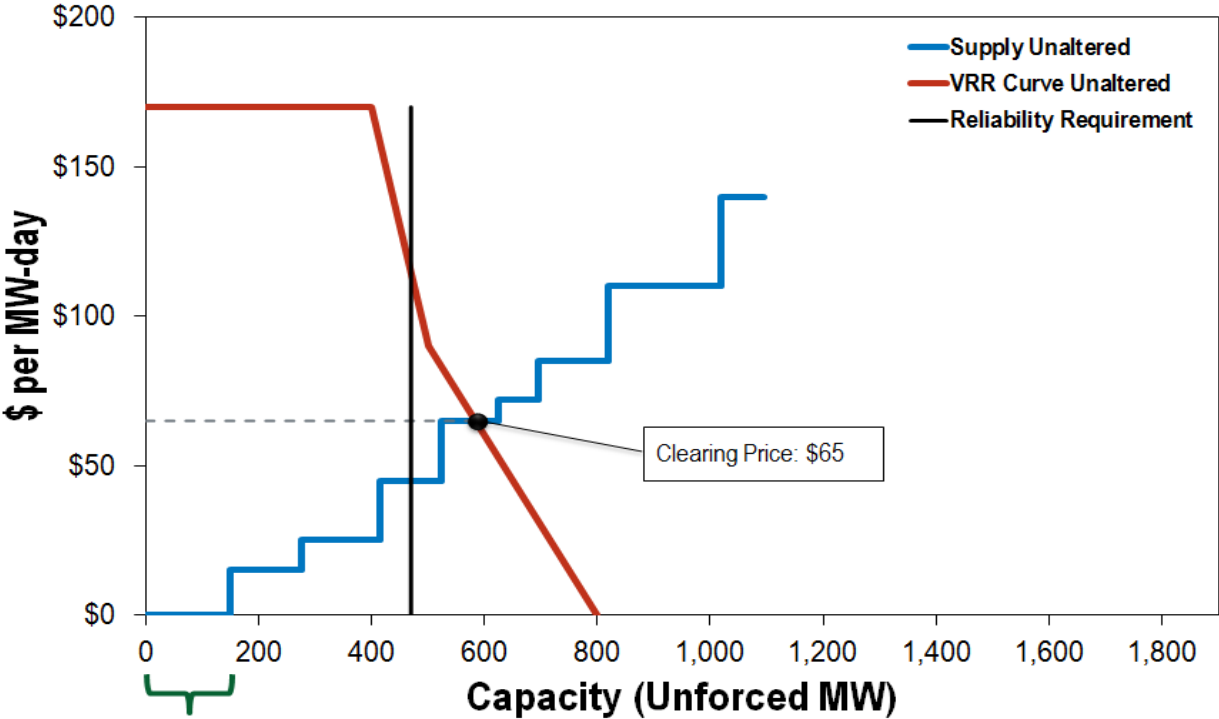
	Capacity (Unforced MW)	Offer (\$/MW-day)
Res C1	125.0	\$15.00
Res C2	140.0	\$25.00
Res C3	110.0	\$45.00
Res C4	100.0	\$65.00
Res C5	70.0	\$72.00
Res C6	125.0	\$85.00
Res C7	200.0	\$110.00
Res C8	75.0	\$140.00

Example: Parent LDA



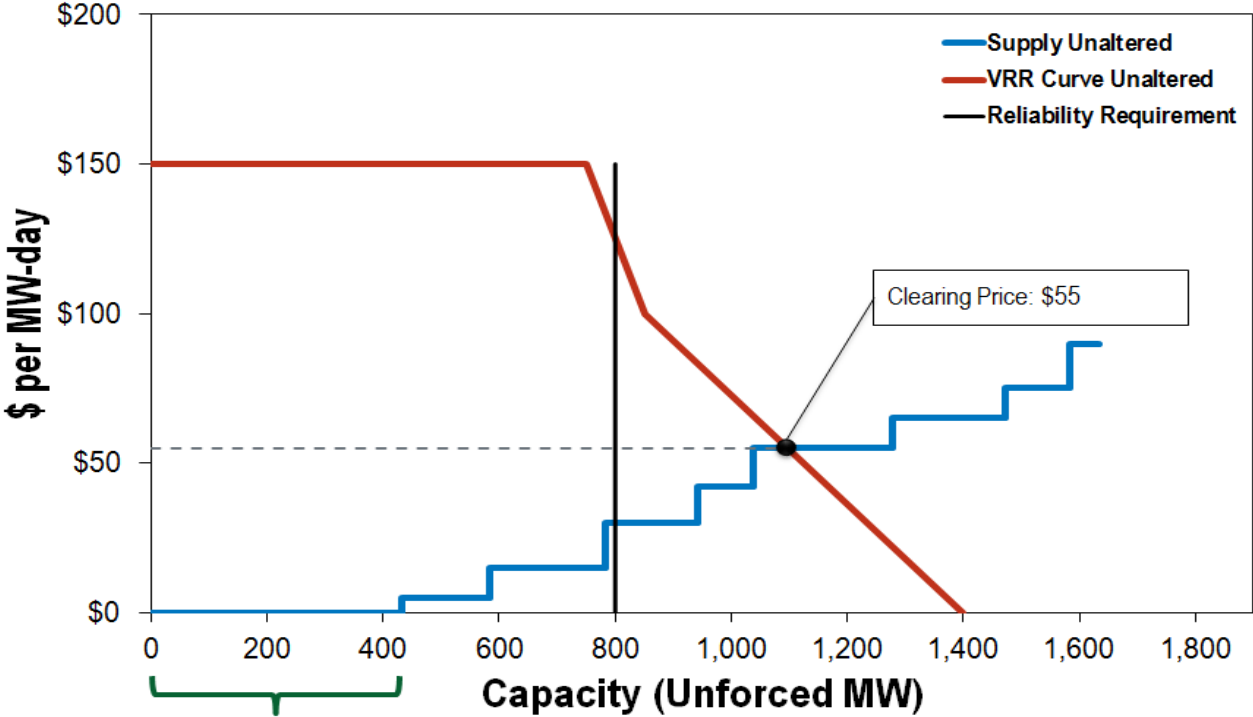
	Capacity (Unforced MW)	Offer (\$/MW-day)
Res P1	150.0	\$5.00
Res P2	200.0	\$15.00
Res P3	160.0	\$30.00
Res P4	95.0	\$42.00
Res P5	240.0	\$55.00
Res P6	195.0	\$65.00
Res P7	110.0	\$75.00
Res P8	50.0	\$90.00

Base Case Child LDA



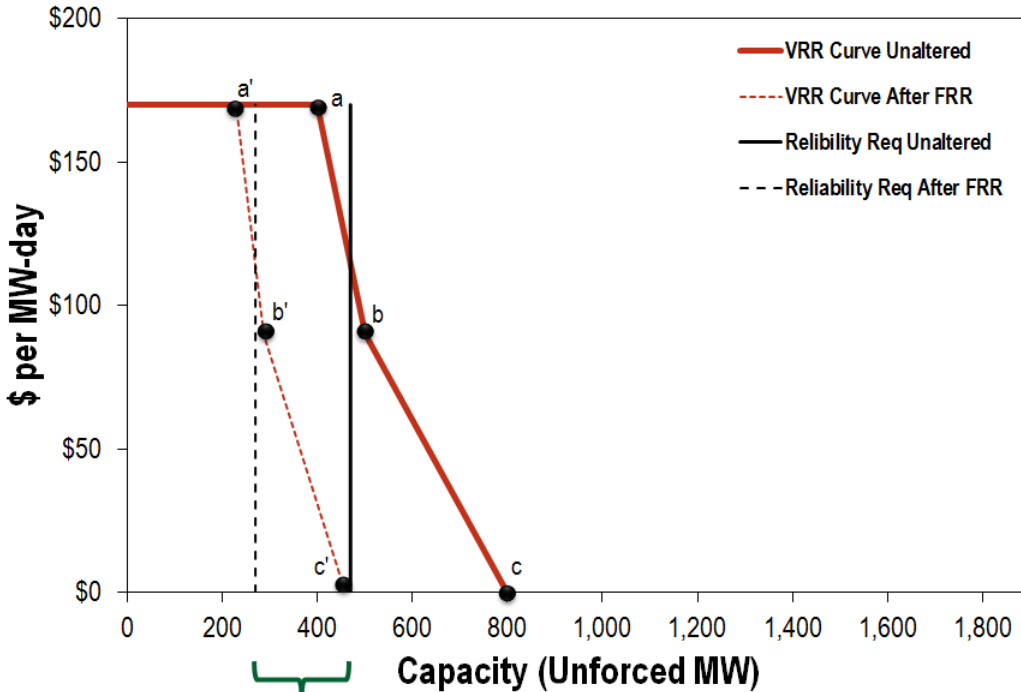
Imports from parent LDA
(150 MW out of available 150 MW CETL)

Base Case Parent LDA



(Child LDA's cleared VRR, net of imports: 433.3 MW)

Shift in VRR Curve



Reduction in Reliability Requirement: 200 MW

X coordinate of point *a* of VRR curve:

$$X_a = \text{Reliability Req} \times \left(\frac{1 + \text{IRM} + F_a}{1 + \text{IRM}} \right)$$

where

IRM: Installed Reserve Margin (percentage)

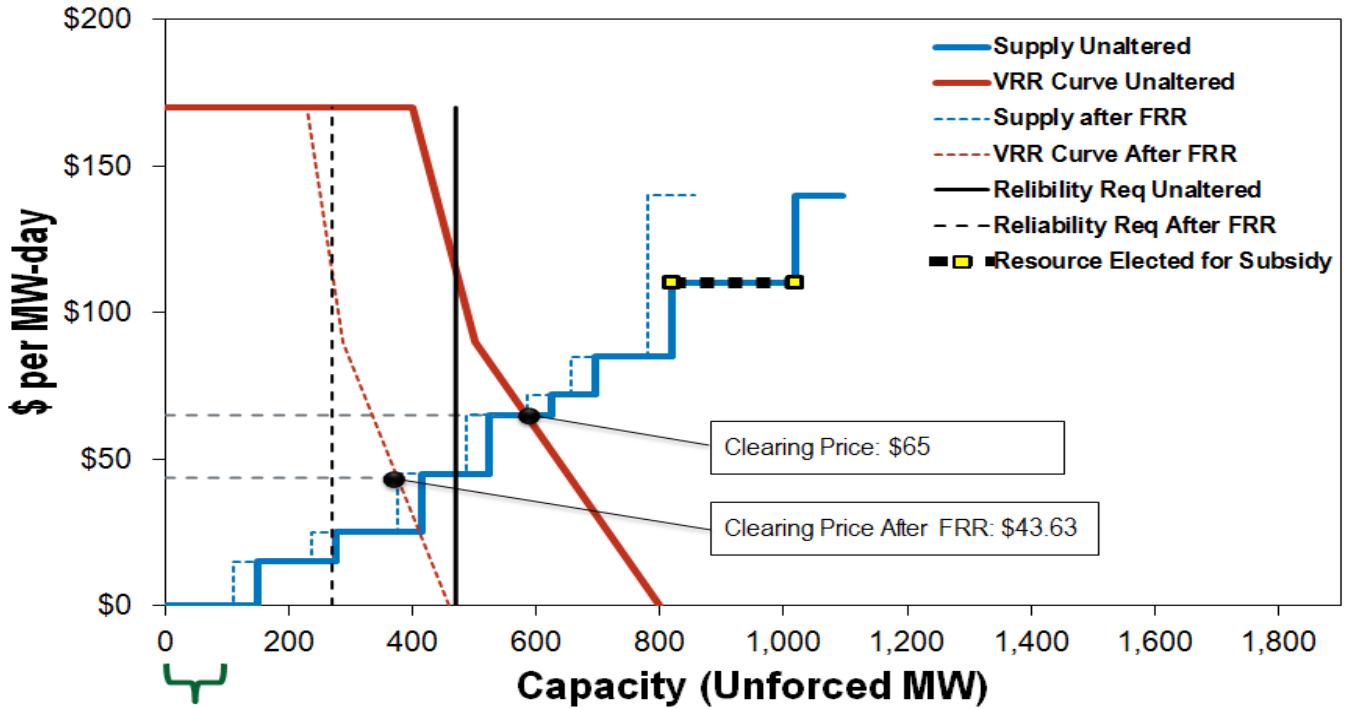
F_a : Factor (percentage)

Installed Reserve Margin	15.0%
Reliability Requirement Unaltered	470.0
Reliability Requirement After FRR	270.0

Factor*	X coordinate			
	VRR Curve Unaltered		VRR Curve After FRR	
<i>F_a</i> -17.1%	a	400.0	a'	229.8
<i>F_b</i> 7.3%	b	500.0	b'	287.2
<i>F_c</i> 80.7%	c	800.0	c'	459.6

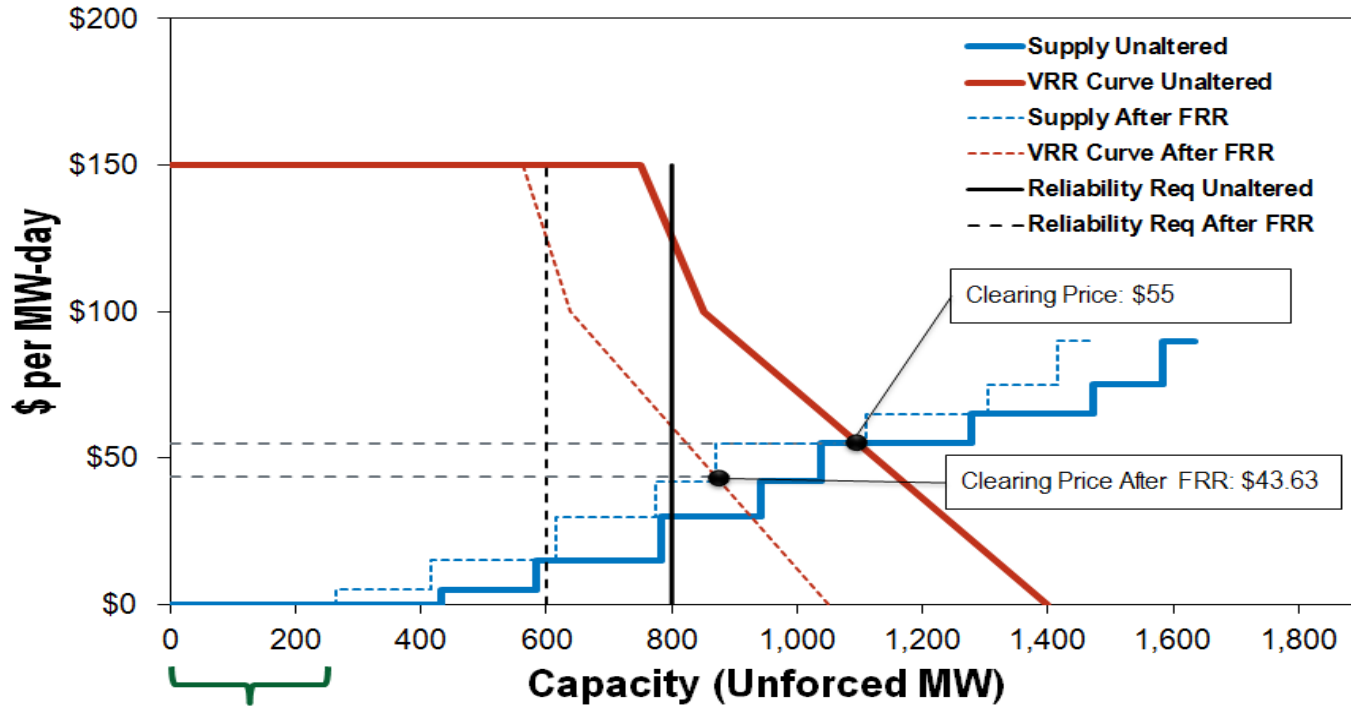
* The factors used in the example are not same as the factors used by PJM in the BRA.

Example : FRR for Extramarginal Resource Child LDA



Imports from parent LDA
(111 MW out of available 150 MW CETL)

Example : FRR for Extramarginal Resource Parent LDA



(Child LDA's cleared VRR, net of imports: 265 MW)

Sensitivity Analyses

- **Offers and auction parameters from the 2021/2022 RPM Base Residual Auction were used to assess the impact of Resource Specific FRR under select scenarios.**
- **The auction was cleared with residual supply and the shifted VRR curve reflecting a reduction in the reliability requirement.**
- **Minimum Internal Resource Requirements are applied to existing non-resource specific FRR only, consistent with actual 2021/2022 BRA clearing.**
- **The reliability requirement reduction is equal to the total unforced capacity of resources eligible for the resource specific FRR option within the LDA.**

FRR for All Cost of Service Units

LDA	Base Residual Auction Clearing Price (\$ per MW-Day)	FRR for Cost of Service Units Clearing Price (\$ per MW-Day)	Change (\$ per MW-Day)
RTO	\$140.00	\$84.77	(\$55.23)
ATSI	\$171.33	\$164.01	(\$7.32)
ComEd	\$195.55	\$189.01	(\$6.54)
EMAAC	\$165.73	\$165.00	(\$0.73)
BGE	\$200.30	\$200.20	(\$0.10)
PSEG	\$204.29	\$204.16	(\$0.13)
DEOK	\$140.00	\$128.47	(\$11.53)

FRR for Units at Risk of Retirement

LDA	Base Residual Auction	FRR for Units at Risk of Retirement	
	Clearing Price (\$ per MW-Day)	Clearing Price (\$ per MW-Day)	Change (\$ per MW-Day)
RTO	\$140.00	\$70.00	(\$70.00)
ATSI	\$171.33	\$70.00	(\$101.33)
ComEd	\$195.55	\$189.02	(\$6.53)
EMAAC	\$165.73	\$165.47	(\$0.26)
BGE	\$200.30	\$70.00	(\$130.30)
PSEG	\$204.29	\$203.53	(\$0.76)
DEOK	\$140.00	\$128.47	(\$11.53)

FRR for 25 Percent of Coal and Nuclear Units

LDA	Base Residual Auction	FRR for 25 percent of Coal and Nuclear Resources		
	Clearing Price (\$ per MW-Day)	Clearing Price (\$ per MW-Day)	Change (\$ per MW-Day)	
RTO	\$140.00	\$100.21		(\$39.79)
ATSI	\$171.33	\$145.68		(\$25.65)
ComEd	\$195.55	\$164.22		(\$31.33)
EMAAC	\$165.73	\$165.73		\$0.00
BGE	\$200.30	\$160.77		(\$39.53)
PSEG	\$204.29	\$204.29		\$0.00
DEOK	\$140.00	\$117.25		(\$22.75)

FRR for 50 Percent of Coal and Nuclear Units

LDA	Base Residual Auction	FRR for 50 percent of Coal and Nuclear Resources		
	Clearing Price (\$ per MW-Day)	Clearing Price (\$ per MW-Day)	Change (\$ per MW-Day)	
RTO	\$140.00	\$69.96	(\$70.04)	
ATSI	\$171.33	\$69.96	(\$101.37)	
ComEd	\$195.55	\$78.69	(\$116.86)	
EMAAC	\$165.73	\$149.92	(\$15.81)	
BGE	\$200.30	\$159.77	(\$40.53)	
PSEG	\$204.29	\$204.29	\$0.00	
DEOK	\$140.00	\$85.99	(\$54.01)	

FRR for 100 percent of Coal and Nuclear Units

LDA	Base Residual Auction Clearing Price (\$ per MW-Day)	FRR for 100 percent of Coal and Nuclear Resources Clearing Price (\$ per MW-Day)	Change (\$ per MW-Day)
RTO	\$140.00	\$25.00	(\$115.00)
ATSI	\$171.33	\$25.00	(\$146.33)
ComEd	\$195.55	\$43.93	(\$151.62)
EMAAC	\$165.73	\$150.92	(\$14.81)
BGE	\$200.30	\$150.92	(\$49.38)
PSEG	\$204.29	\$202.18	(\$2.11)
DEOK	\$140.00	\$25.00	(\$115.00)

FRR for Annual Wind and Solar Units

LDA	Base Residual Auction	FRR for Annual Wind and Solar Units		
	Clearing Price (\$ per MW-Day)	Clearing Price (\$ per MW-Day)	Change (\$ per MW-Day)	
RTO	\$140.00	\$140.00	\$0.00	
ATSI	\$171.33	\$171.33	\$0.00	
ComEd	\$195.55	\$193.05	(\$2.50)	
EMAAC	\$165.73	\$165.73	\$0.00	
BGE	\$200.30	\$200.30	\$0.00	
PSEG	\$204.29	\$203.89	(\$0.40)	
DEOK	\$140.00	\$140.00	\$0.00	

PJM's Proposed Method

- **PJM proposed that subsidized resources “will be self scheduled in the auction and no adjustments will be made to the demand curve.”**
- **PJM's proposed method for auction clearing results in different outcomes than the auction clearing method with residual supply and shifted VRR curve.**

FRR for Units at Risk of Retirement: PJM method

LDA	Base Residual Auction	Residual Supply and Shifted VRR Curve		PJM's Proposed Method	
	Clearing Price (\$ per MW-Day)	Clearing Price (\$ per MW-Day)	Change (\$ per MW-Day)	Clearing Price (\$ per MW-Day)	Change (\$ per MW-Day)
RTO	\$140.00	\$70.00	(\$70.00)	\$79.98	(\$60.02)
ATSI	\$171.33	\$70.00	(\$101.33)	\$79.98	(\$91.35)
ComEd	\$195.55	\$189.02	(\$6.53)	\$192.00	(\$3.55)
EMAAC	\$165.73	\$165.47	(\$0.26)	\$165.47	(\$0.26)
BGE	\$200.30	\$70.00	(\$130.30)	\$79.98	(\$120.32)
PSEG	\$204.29	\$203.53	(\$0.76)	\$204.29	\$0.00
DEOK	\$140.00	\$128.47	(\$11.53)	\$128.47	(\$11.53)

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