

CARIS Phase II

Action Items from Oct. 11, 2012

(Revised to add supporting spreadsheets)

Dana Walters

*Director, Reliability & Economic Planning
New York Independent System Operator*

Electric System Planning Working Group

11/5/2012

Rensselaer, N.Y.

Action Items from October 11, 2012

- ◆ **Provide references which support installing wind as the first step for generic additions in the CARIS Phase II process**
- ◆ **Run 2022 with wind that would have otherwise been added in 2023 and 2024**
- ◆ **Run 2024 & 2032 with 250MW CC units in the vicinity of the wind**
- ◆ **Document the difference between the base case and the \$5/ton CO₂ for 2024 & 2032**
- ◆ **Discuss the process for how we derived prices for the 3 gas regions**

Wind as Generic Addition

- ♦ **CARIS Manual Section 1.2.6 V. A. c.**

“A representative generic combination of peakers and combined cycle units will be added as needed to maintain target ICL. Appropriate adjustments will be made in areas with a demonstrated favorability for renewable resources.”

- ♦ **Oct. 15, 2010 ESPWG Presentation by Bill Lamanna**

“Add wind MWs from Queue to satisfy RPS and then add generic combined cycle (250 MW block) or peaker (100 MW block) to maintain a representative system measured against target reserve proxies ...”

Sensitivities^{*}

♦ 2022

- *All Wind In-Service in 2022*

♦ 2024

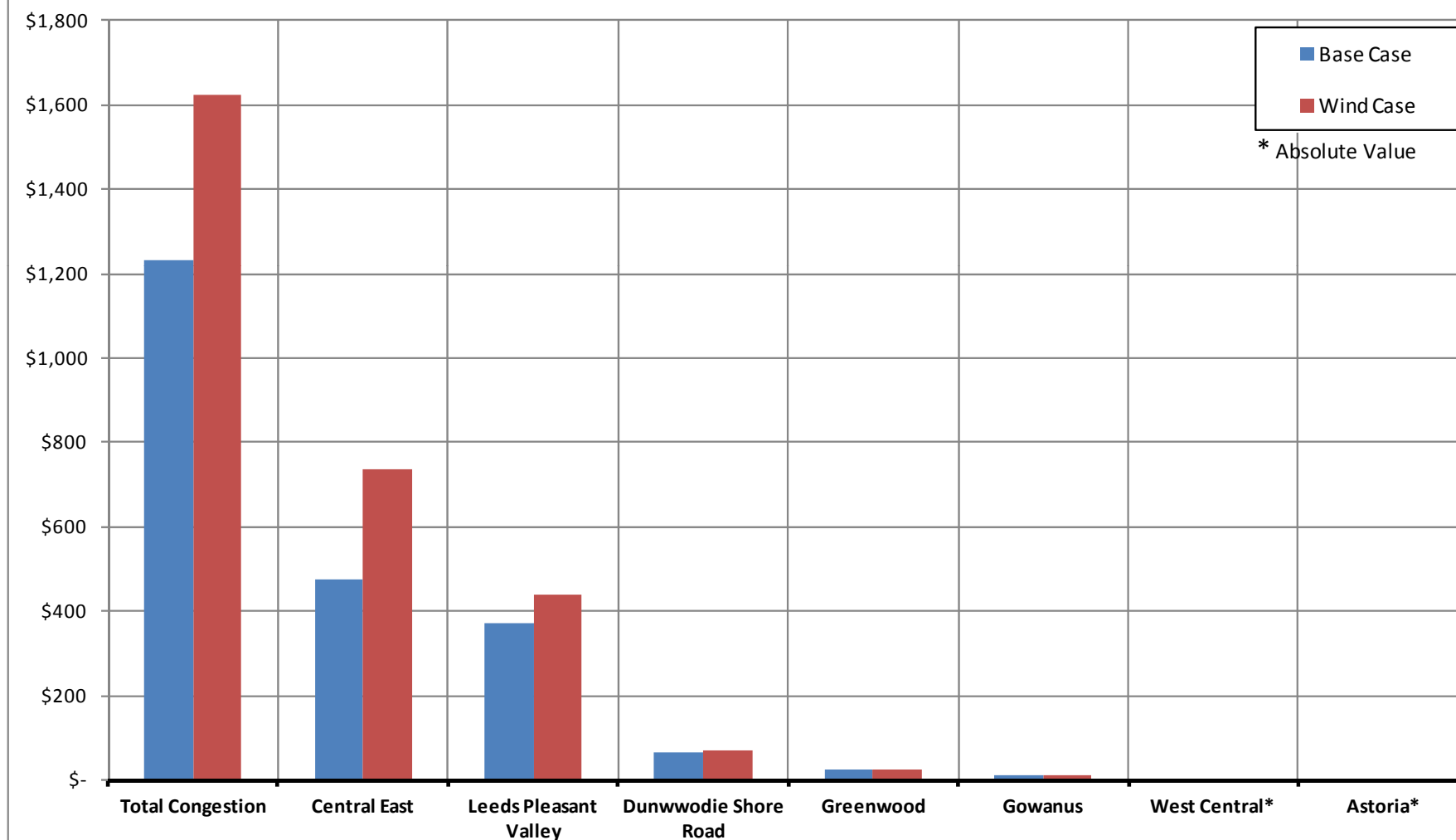
- *No Wind No Replacement: Informational – not a representative system*
- *1 Generic CC – Capacity Replacement: Replace 235.7 MW DMNC (2,357 MW Nameplate) with a 250 MW Combined Cycle*
- *4 Generic CC – Energy Replacement: Replace ~7 TWh of Wind Energy with ~6 TWh of Energy from four 250 MW Combined Cycles*

♦ 2032

- *1 Generic CC – Capacity Replacement*
- *4 Generic CC – Energy Replacement*

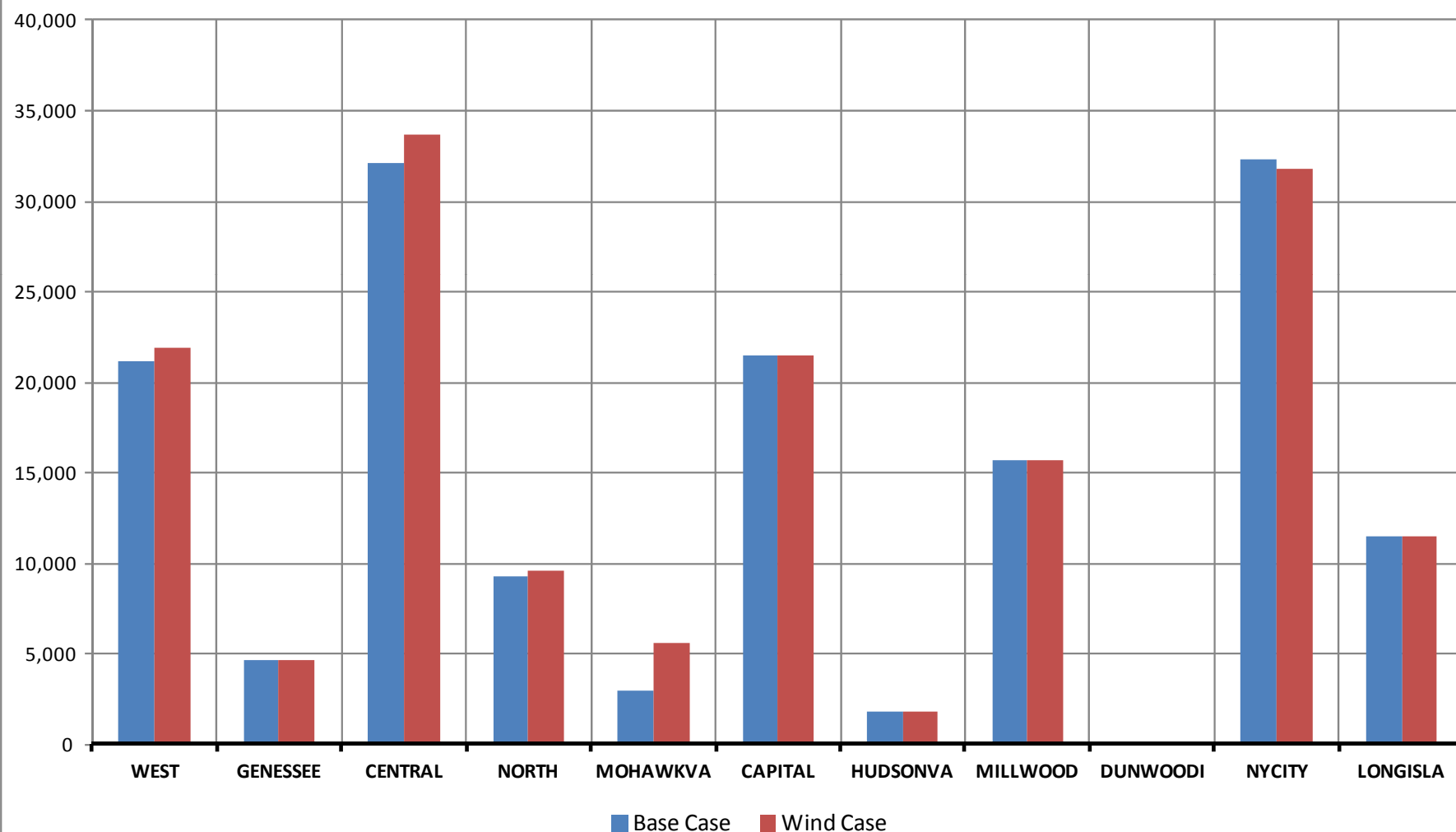
*** Base Case includes 2,357 MW Nameplate wind in 2023 and 2024**

2022 Demand Congestion (Million \$)

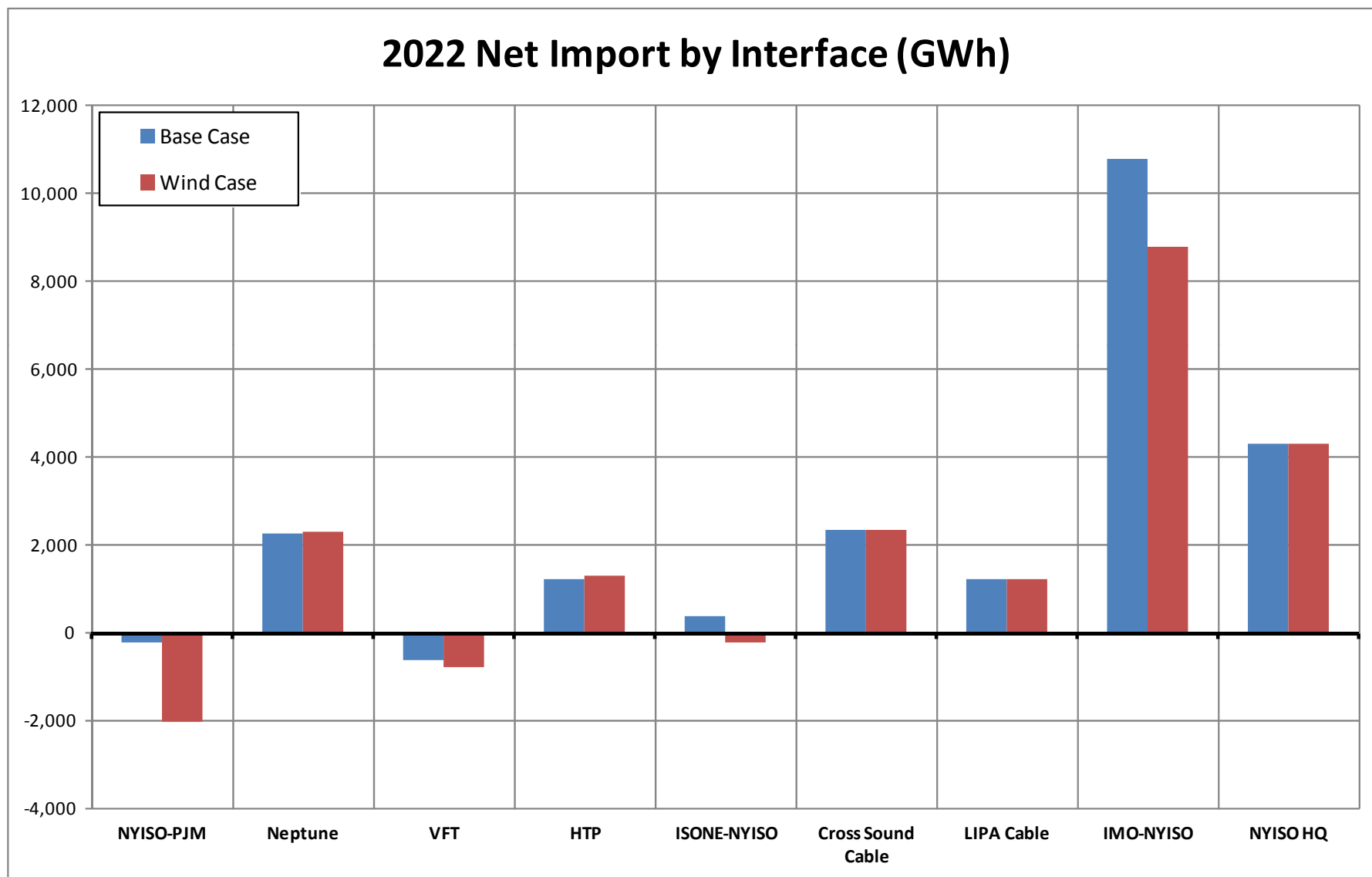


2022 Demand Congestion (Million \$)		
	Base Case	Wind Case
Total Congestion	\$ 1,231	\$ 1,626
Central East	\$ 474	\$ 739
Leeds Pleasant Valley	\$ 370	\$ 439
Dunwwodie Shore Road	\$ 66	\$ 71
Greenwood	\$ 25	\$ 25
Gowanus	\$ 9	\$ 10
West Central*	\$ 2	\$ 1
Astoria*	\$ 1	\$ 1

2022 Zonal Generation (GWh)

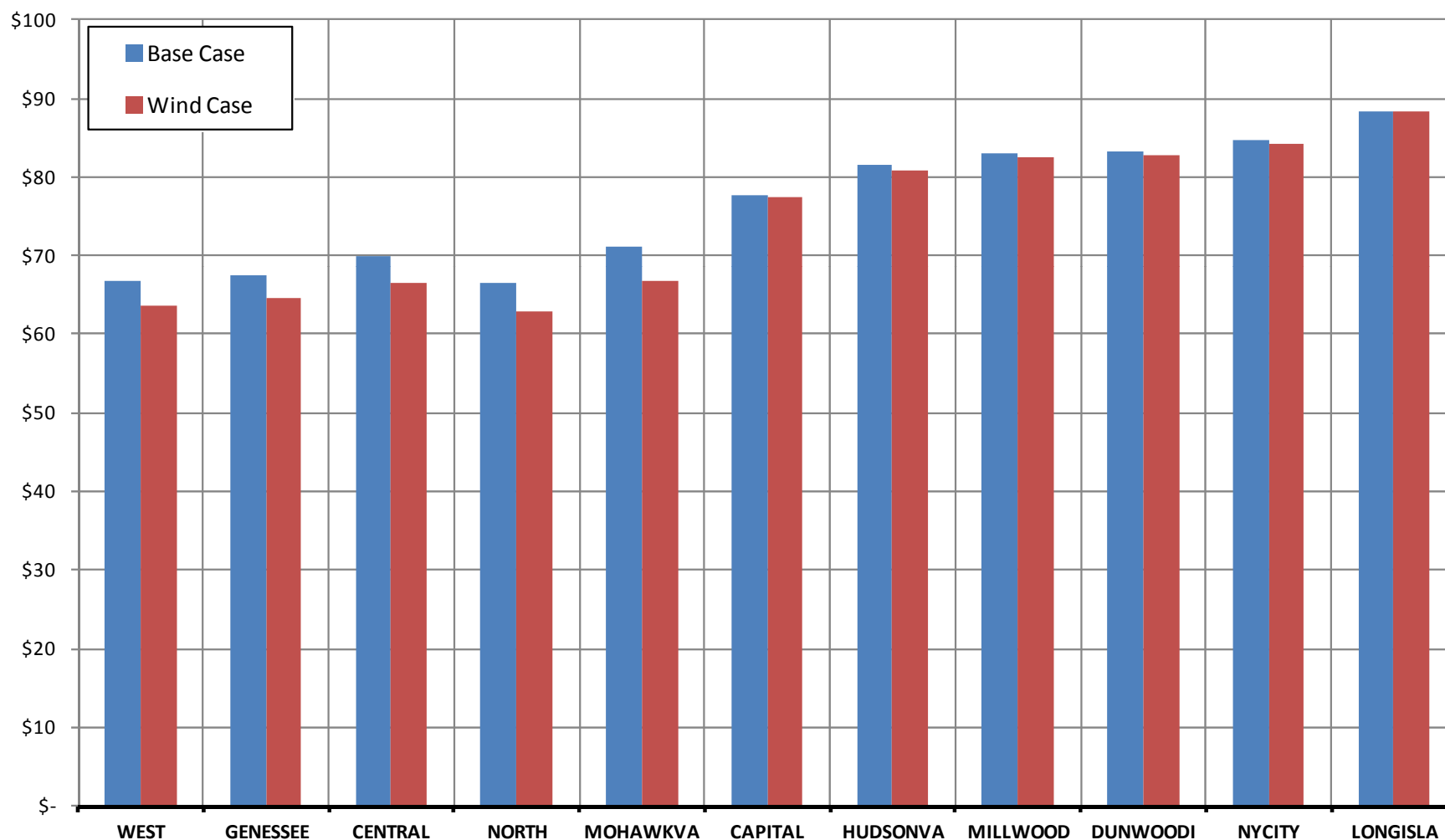


2022 Generation Metric (GWh)		
	Base Case	Wind Case
WEST	21,193	21,940
GENESSEE	4,628	4,620
CENTRAL	32,142	33,658
NORTH	9,341	9,616
MOHAWKVA	3,036	5,659
CAPITAL	21,452	21,508
HUDSONVA	1,815	1,808
MILLWOOD	15,763	15,763
DUNWOODI	6	6
NYCITY	32,340	31,770
LONGISLA	11,491	11,458
Total NYCA (GWh)	153,206	157,806



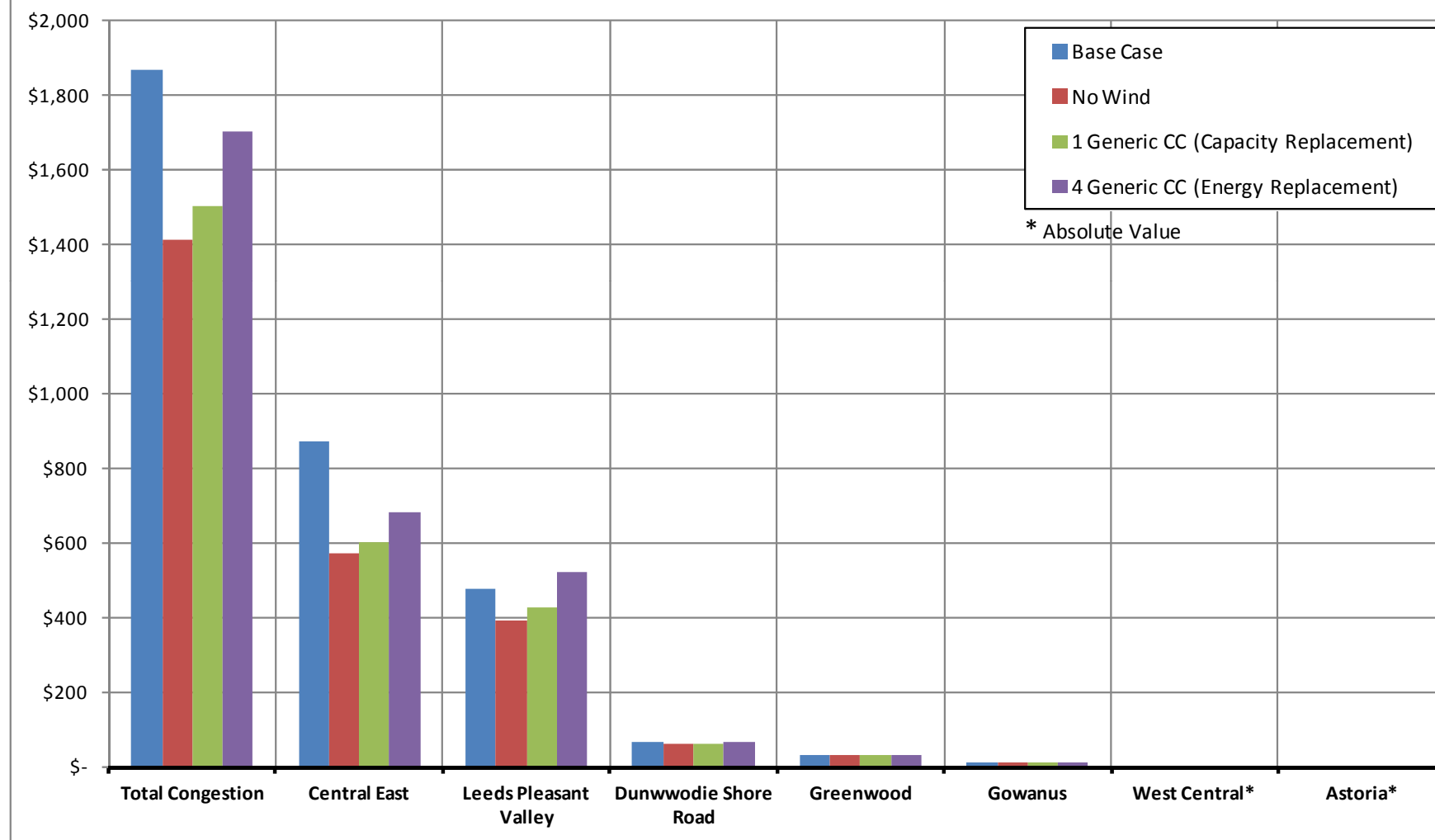
Net Imports Metric (GWh)		
	Base Case	Wind Case
NYISO-PJM	-195	-2,018
Neptune	2,278	2,320
VFT	-605	-779
HTP	1,244	1,297
ISONE-NYISO	391	-199
Cross Sound <input type="checkbox"/> Cable	2,361	2,352
LIPA Cable	1,221	1,214
IMO-NYISO	10,784	8,798
NYISO HQ	4,330	4,330
NYISO-HQ CHAT	4,141	4,141
NYISO-HQ CEDAR	189	189
Total Net Imports	21,809	17,316

2022 Zonal Spot Price (\$/MWh)



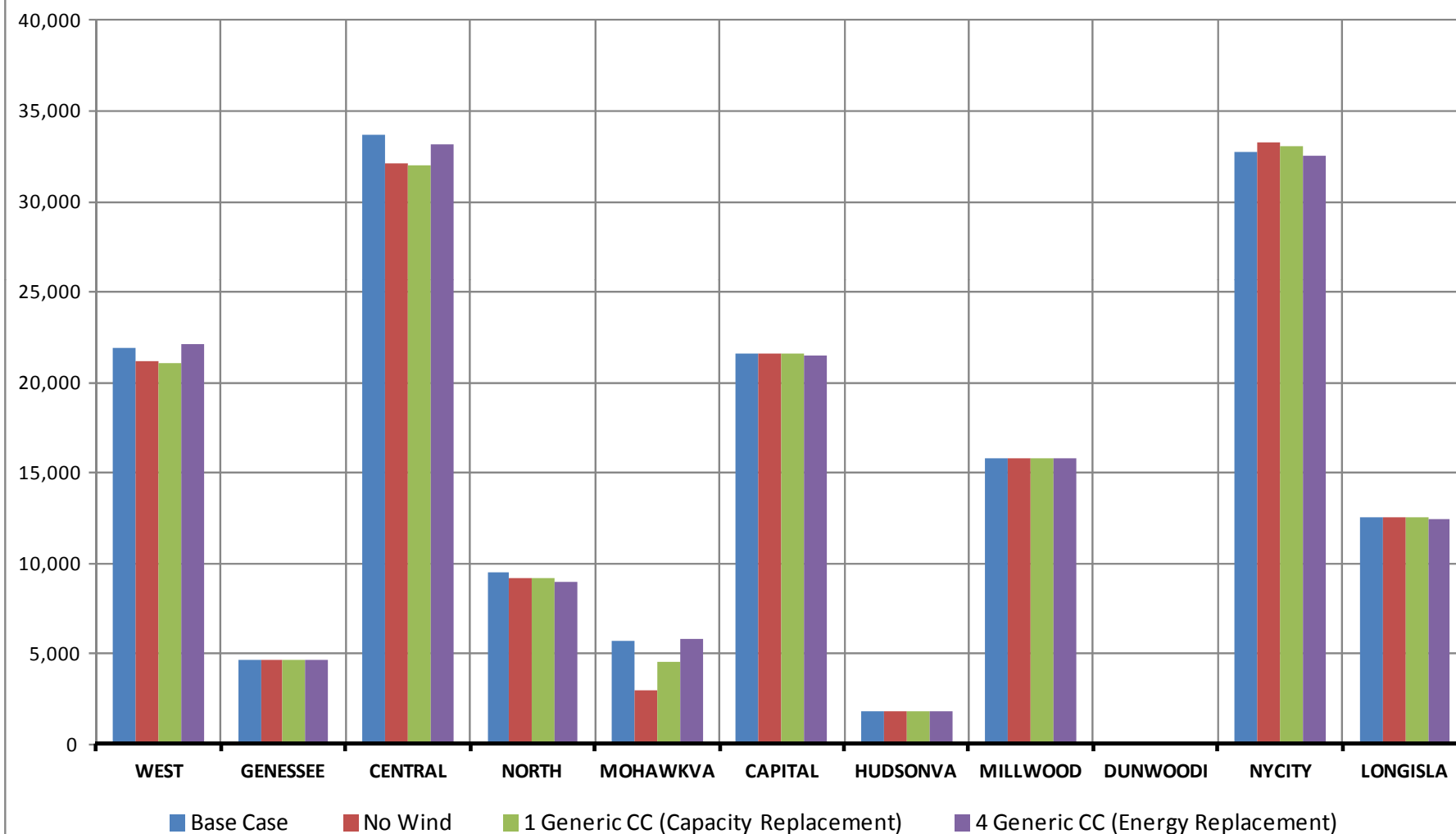
Load Spot Price Metric (\$/MWh)		
	Base Case	Wind Case
WEST	\$ 66.80	\$ 63.73
GENESSEE	\$ 67.60	\$ 64.55
CENTRAL	\$ 69.96	\$ 66.47
NORTH	\$ 66.59	\$ 62.82
MOHAWKVA	\$ 71.23	\$ 66.83
CAPITAL	\$ 77.81	\$ 77.40
HUDSONVA	\$ 81.59	\$ 80.96
MILLWOOD	\$ 82.95	\$ 82.51
DUNWOODI	\$ 83.32	\$ 82.89
NYCITY	\$ 84.61	\$ 84.22
LONGISLA	\$ 88.46	\$ 88.40

2024 Demand Congestion (Million \$)



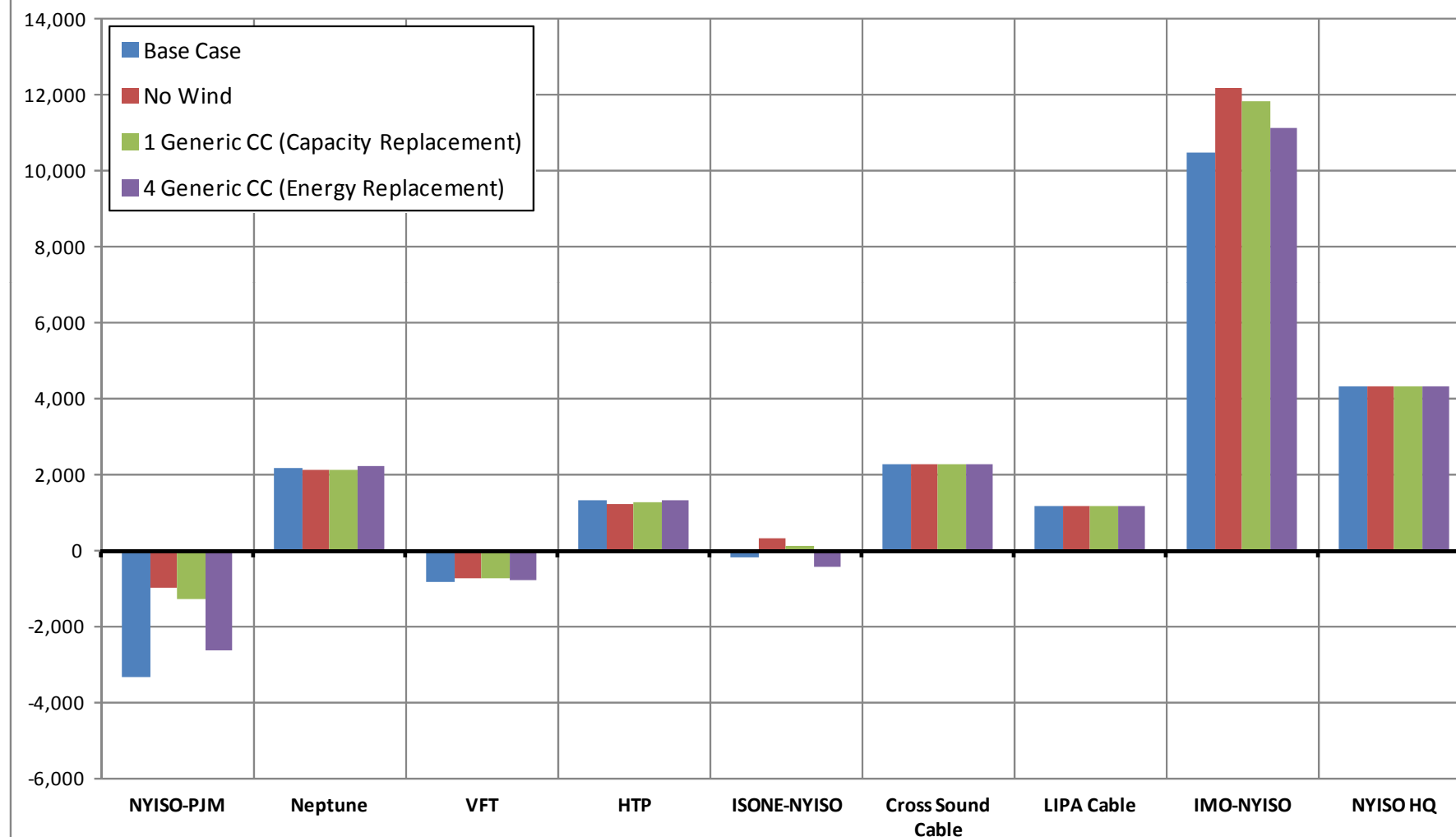
Demand Congestion (Million \$)				
	Base Case	No Wind	1 Generic CC (Capacity Replacement)	4 Generic CC (Energy Replacement)
Total Congestion	\$ 1,868	\$ 1,416	\$ 1,502	\$ 1,707
Central East	\$ 876	\$ 571	\$ 605	\$ 681
Leeds Pleasant Valley	\$ 477	\$ 395	\$ 429	\$ 523
Dunwwodie Shore Road	\$ 69	\$ 64	\$ 65	\$ 69
Greenwood	\$ 31	\$ 31	\$ 31	\$ 32
Gowanus	\$ 11	\$ 10	\$ 10	\$ 11
West Central*	\$ 2	\$ 3	\$ 2	\$ 3
Astoria*	\$ 1	\$ 1	\$ 1	\$ 1

2024 Zonal Generation (GWh)



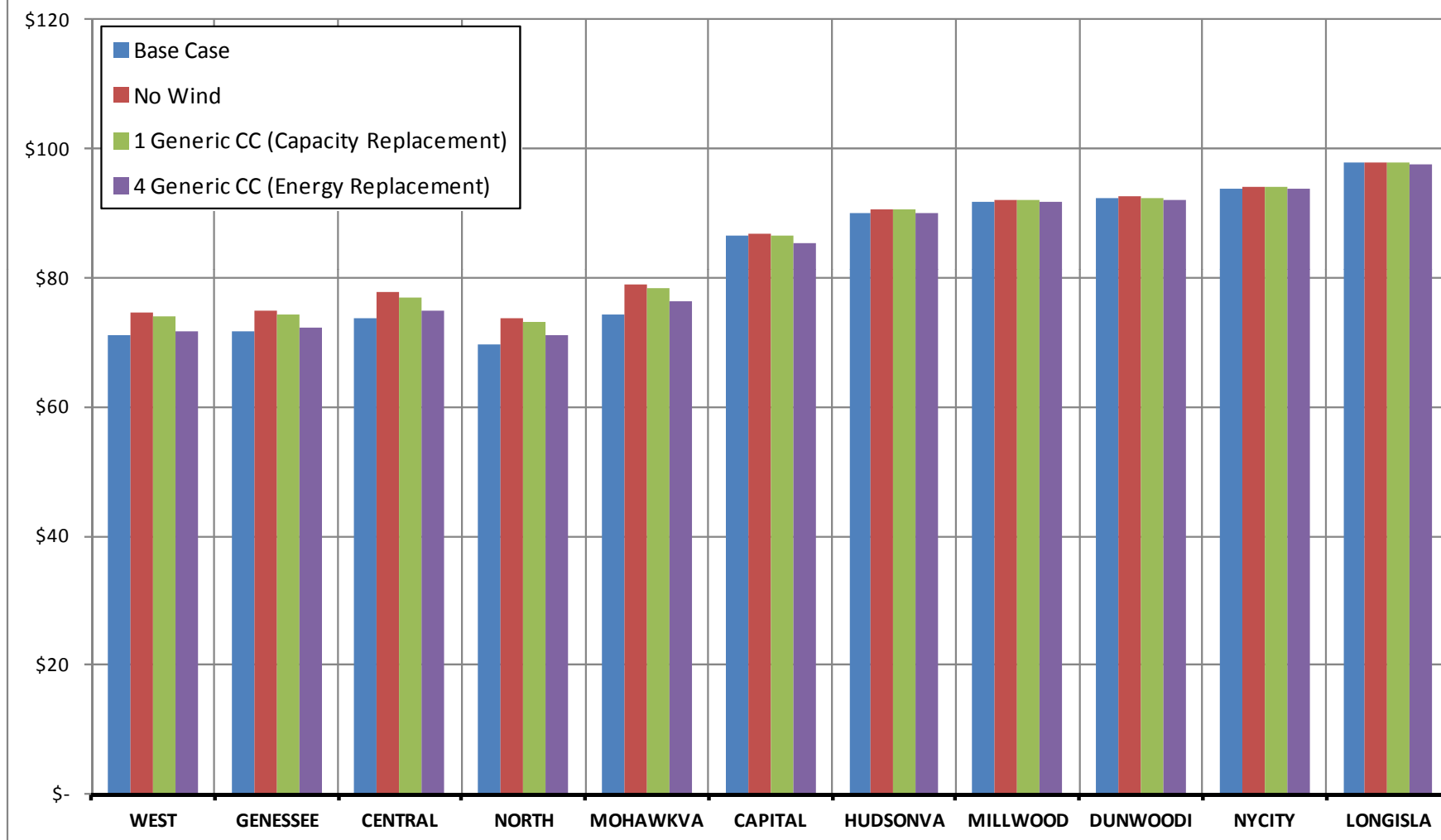
Generation Metric (GWh)				
	Base Case	No Wind	1 Generic CC (Capacity Replacement)	4 Generic CC (Energy Replacement)
WEST	21,877	21,132	21,040	22,122
GENESSE	4,632	4,638	4,636	4,628
CENTRAL	33,665	32,147	32,001	33,214
NORTH	9,542	9,234	9,155	8,989
MOHAWK	5,673	3,022	4,565	5,835
CAPITAL	21,581	21,575	21,564	21,529
HUDSON	1,830	1,820	1,809	1,805
MILLWOOD	15,789	15,788	15,789	15,789
DUNWOOD	6	6	6	6
NYCITY	32,771	33,290	33,038	32,486
LONGISLAND	12,528	12,572	12,555	12,485
Total NYC	159,893	155,225	156,157	158,888

2024 Net Import by Interface (GWh)

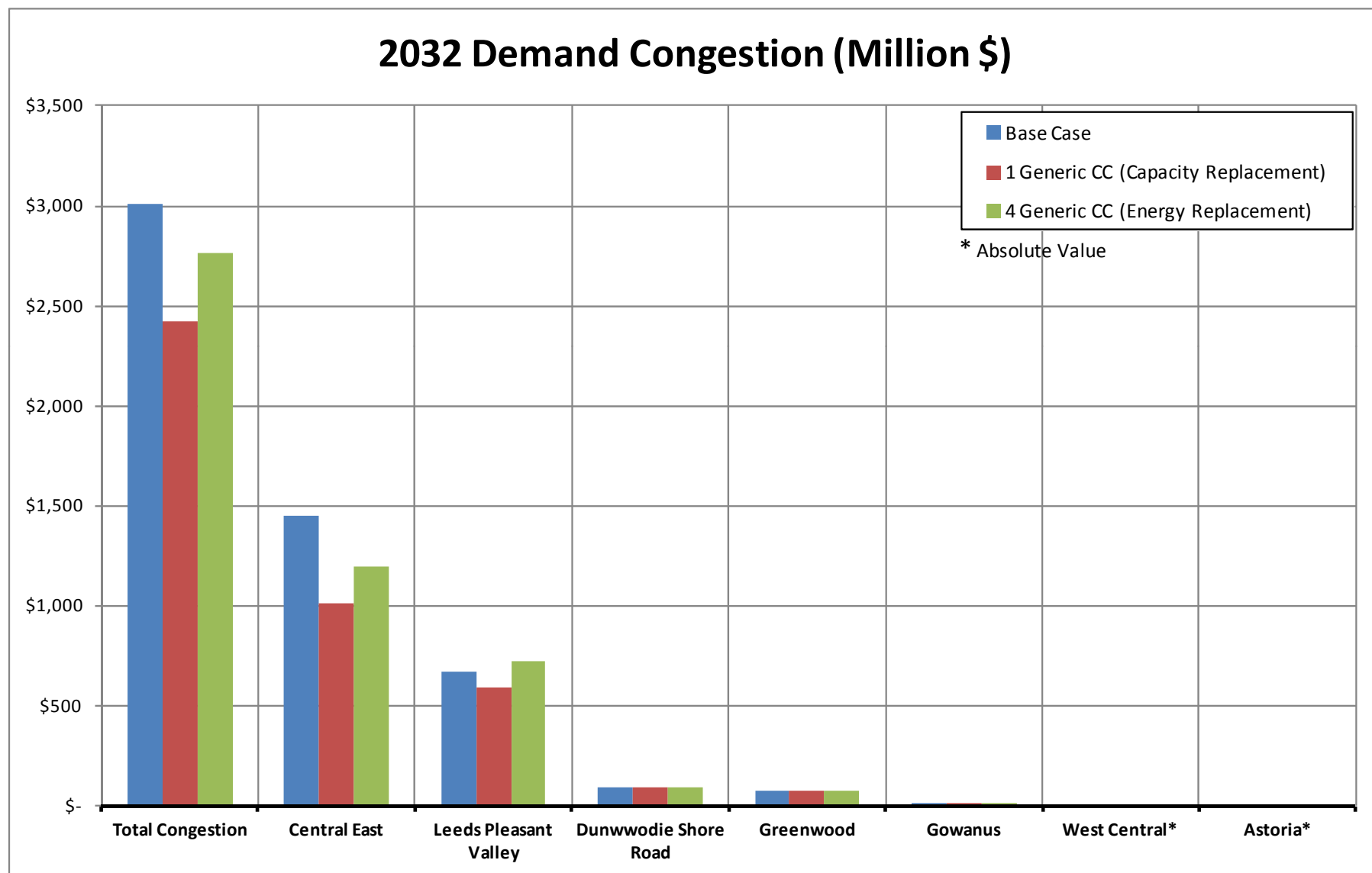


Net Imports Metric (GWh)				
	Base Case	No Wind	1 Generic CC (Capacity Replacement)	4 Generic CC (Energy Replacement)
NYISO-PJM	-3,329	-968	-1,282	-2,637
Neptune	2,210	2,136	2,158	2,225
VFT	-804	-699	-734	-786
HTP	1,344	1,258	1,273	1,334
ISONE-NYISO	-172	352	118	-413
Cross Sound Cable	2,262	2,283	2,280	2,274
LIPA Cable	1,174	1,189	1,184	1,180
IMO-NYISO	10,488	12,183	11,824	11,121
NYISO HQ	4,328	4,328	4,328	4,328
NYISO-HQ CHAT	4,138	4,138	4,138	4,138
NYISO-HQ CEDAR	189	189	189	189
Total Net Imports	17,502	22,061	21,150	18,626

2024 Zonal Spot Price (\$/MWh)

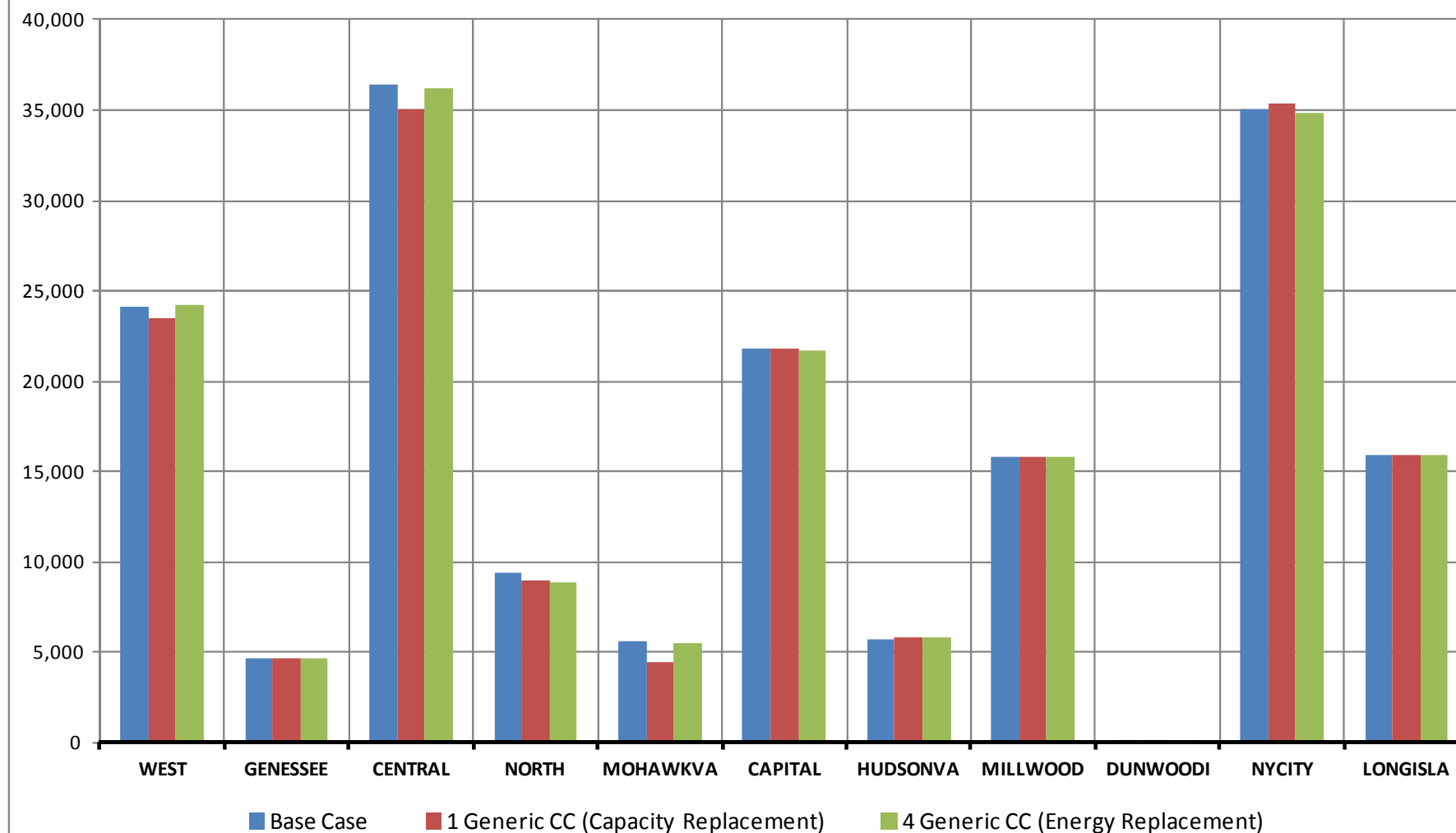


Load Spot Price Metric (\$/MWh)				
	Base Case	No Wind	1 Generic CC (Capacity Replacement)	4 Generic CC (Energy Replacement)
WEST	\$ 71.01	\$ 74.48	\$ 73.97	\$ 71.57
GENESSEE	\$ 71.58	\$ 74.93	\$ 74.29	\$ 72.28
CENTRAL	\$ 73.84	\$ 77.71	\$ 77.00	\$ 74.81
NORTH	\$ 69.62	\$ 73.83	\$ 73.05	\$ 71.09
MOHAWKVA	\$ 74.19	\$ 79.05	\$ 78.28	\$ 76.31
CAPITAL	\$ 86.48	\$ 86.80	\$ 86.43	\$ 85.40
HUDSONVA	\$ 90.15	\$ 90.71	\$ 90.51	\$ 89.91
MILLWOOD	\$ 91.85	\$ 92.19	\$ 92.06	\$ 91.66
DUNWOODI	\$ 92.26	\$ 92.58	\$ 92.46	\$ 92.09
NYCITY	\$ 93.89	\$ 94.21	\$ 94.09	\$ 93.73
LONGISLA	\$ 97.85	\$ 97.80	\$ 97.77	\$ 97.67



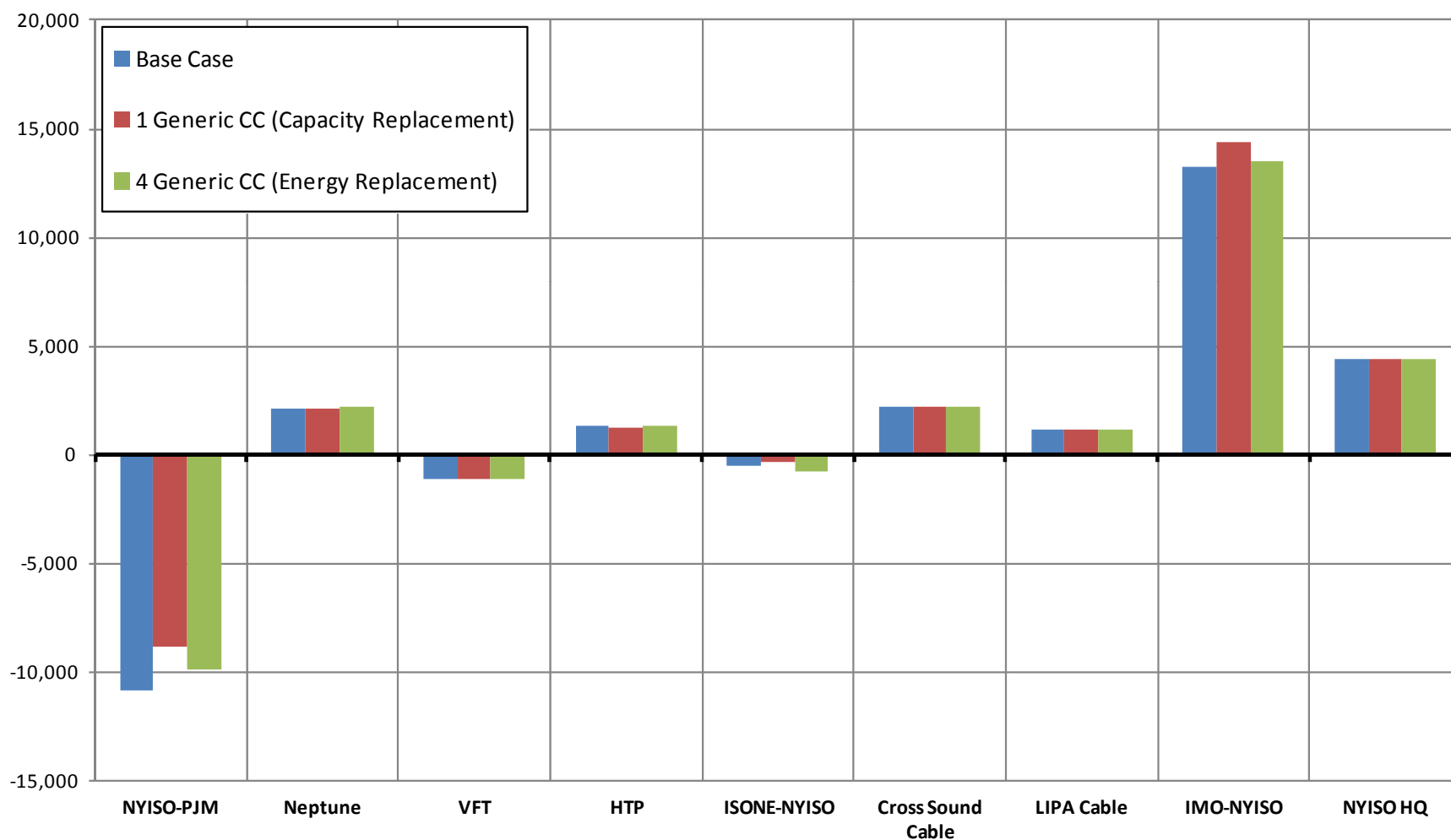
Demand Congestion (Million \$)			
	Base Case	1 Generic CC (Capacity Replacement)	4 Generic CC (Energy Replacement)
Total Congestion	\$ 3,006	\$ 2,422	\$ 2,767
Central East	\$ 1,453	\$ 1,014	\$ 1,198
Leeds Pleasant Valley	\$ 673	\$ 593	\$ 726
Dunwwodie Shore Road	\$ 93	\$ 90	\$ 94
Greenwood	\$ 73	\$ 73	\$ 73
Gowanus	\$ 16	\$ 16	\$ 16
West Central*	\$ 3	\$ 3	\$ 4
Astoria*	\$ 1	\$ 1	\$ 1

2032 Zonal Generation (GWh)



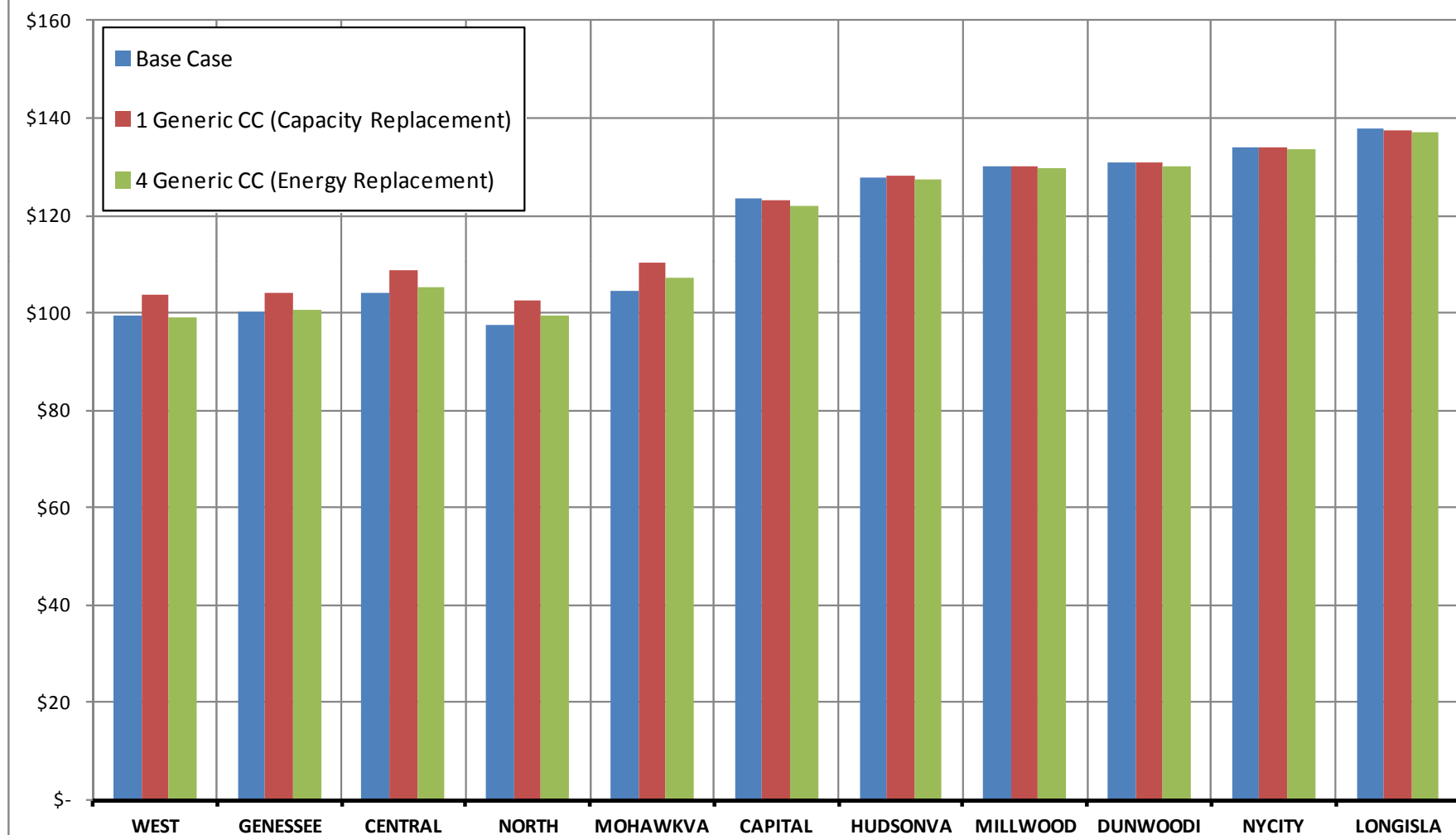
Generation Metric (GWh)			
	Base Case	1 Generic CC (Capacity Replacement)	4 Generic CC (Energy Replacement)
WEST	24,076	23,462	24,244
GENESSEE	4,633	4,636	4,630
CENTRAL	36,370	35,024	36,225
NORTH	9,391	8,960	8,883
MOHAWKVA	5,638	4,430	5,509
CAPITAL	21,840	21,782	21,732
HUDSONVA	5,715	5,811	5,794
MILLWOOD	15,789	15,787	15,788
DUNWOODI	6	6	6
NYCITY	35,099	35,327	34,888
LONGISLA	15,948	15,942	15,907
Total NYCA (GWh)	174,506	171,166	173,607

2032 Net Import by Interface (GWh)



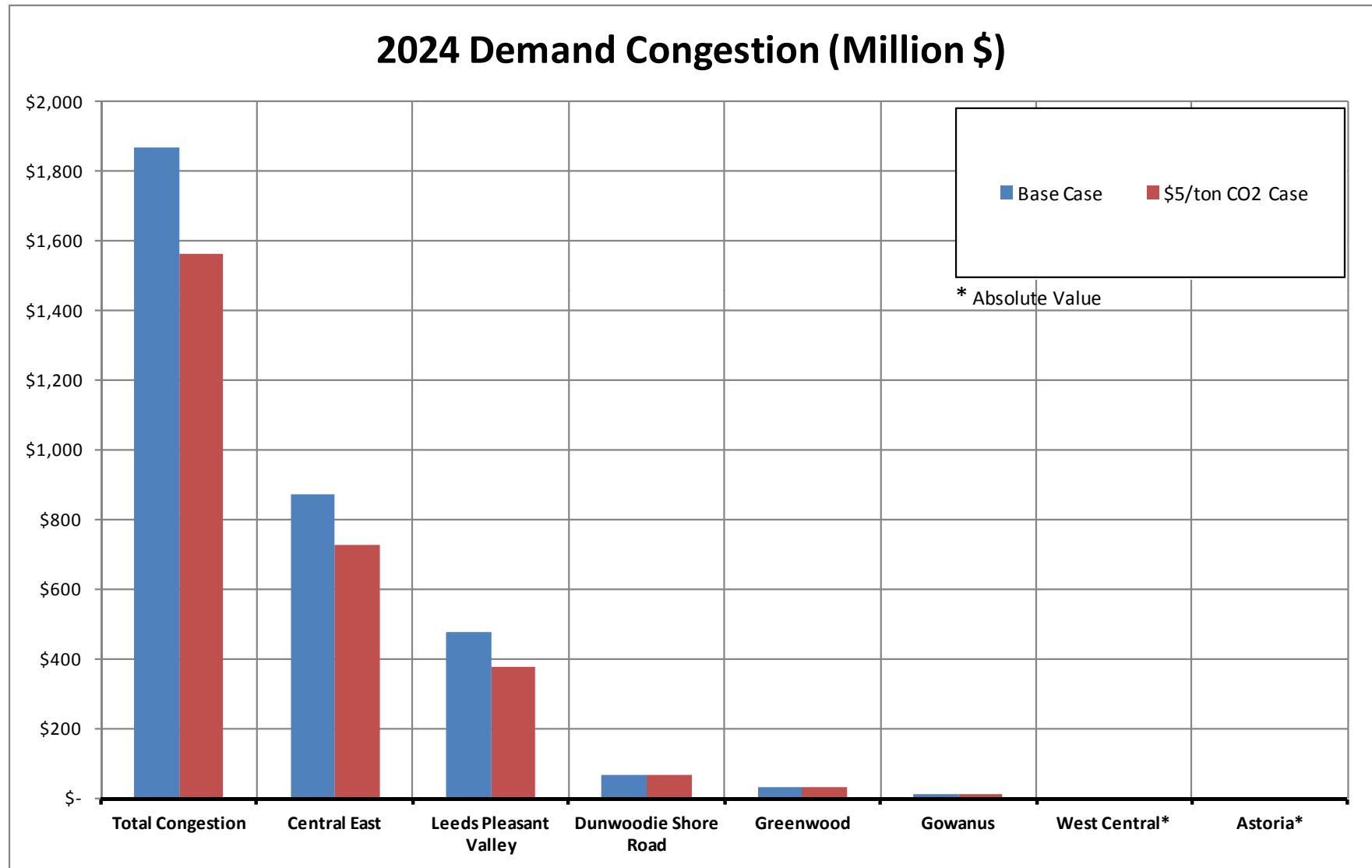
Net Imports Metric (GWh)			
	Base Case	1 Generic CC (Capacity Replacement)	4 Generic CC (Energy Replacement)
NYISO-PJM	-10,840	-8,804	-9,839
Neptune	2,161	2,113	2,178
VFT	-1,102	-1,104	-1,077
HTP	1,303	1,269	1,319
ISONE-NYISO	-475	-339	-762
Cross Sound Cable	2,179	2,233	2,186
LIPA Cable	1,140	1,132	1,139
IMO-NYISO	13,280	14,377	13,512
NYISO HQ	4,390	4,390	4,390
NYISO-HQ CHAT	4,198	4,198	4,198
NYISO-HQ CEDAR	191	191	191
Total Net Imports	12,037	15,267	13,046

2032 Zonal Spot Price (\$/MWh)



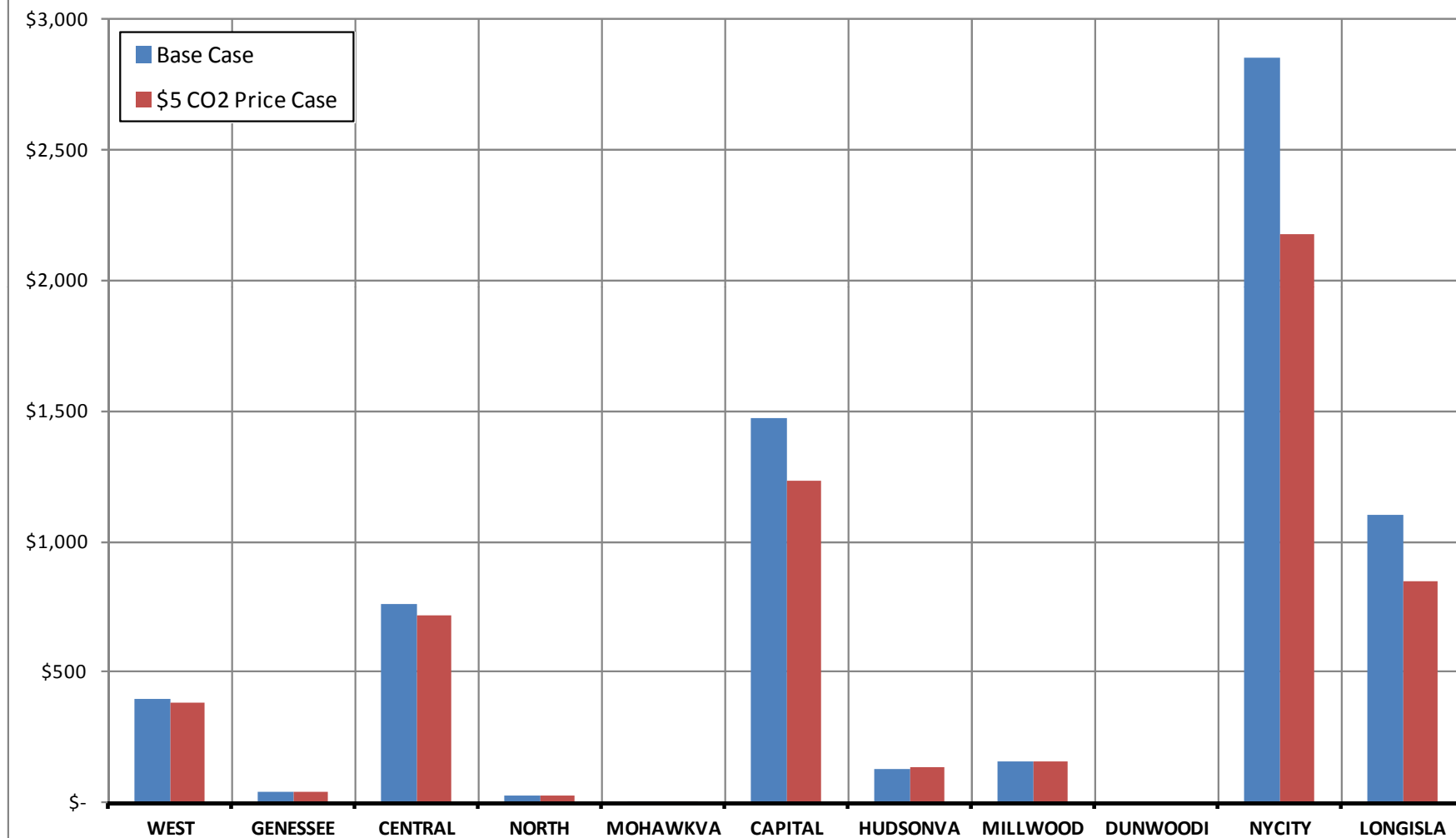
Load Spot Price Metric (\$/MWh)			
	Base Case	1 Generic CC (Capacity Replacement)	4 Generic CC (Energy Replacement)
WEST	\$ 99.42	\$ 103.67	\$ 99.00
GENESSEE	\$ 100.38	\$ 104.16	\$ 100.80
CENTRAL	\$ 104.30	\$ 108.93	\$ 105.38
NORTH	\$ 97.74	\$ 102.65	\$ 99.44
MOHAWKVA	\$ 104.58	\$ 110.38	\$ 107.24
CAPITAL	\$ 123.63	\$ 123.27	\$ 122.09
HUDSONVA	\$ 127.85	\$ 128.04	\$ 127.25
MILLWOOD	\$ 130.25	\$ 130.21	\$ 129.69
DUNWOODI	\$ 130.83	\$ 130.77	\$ 130.28
NYCITY	\$ 134.11	\$ 134.04	\$ 133.57
LONGISLA	\$ 137.76	\$ 137.48	\$ 137.23

\$5/ton CO₂ Price Sensitivity Results



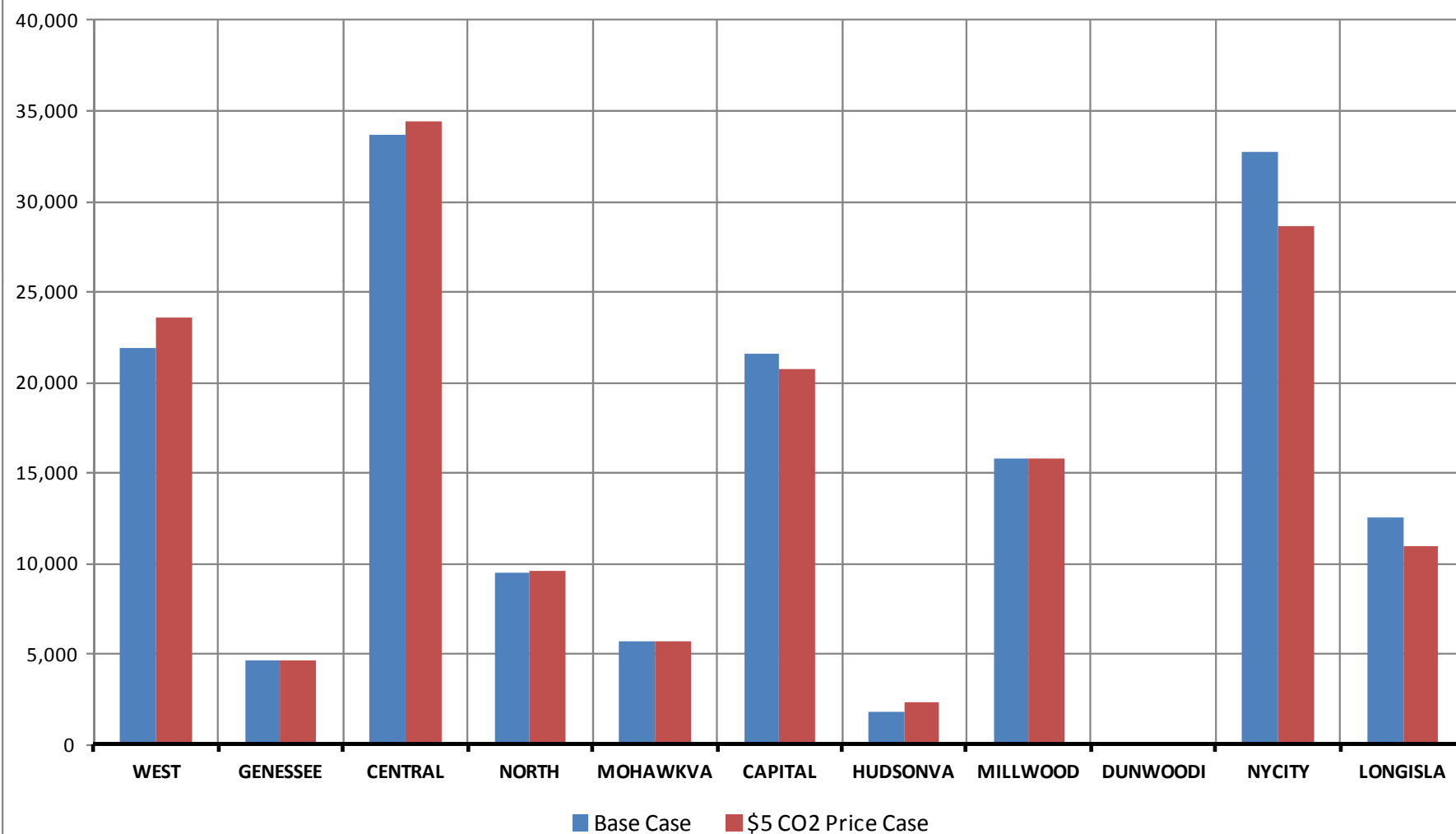
Demand Congestion (\$)		
	Base Case	\$5/ton CO2 Price
Total Congestion	\$ 1,868,224,805	\$ 1,535,664,149
Central East	\$ 875,810,816	\$ 726,186,816
Leeds Pleasant Valley	\$ 476,881,728	\$ 376,432,192
Dunwoodie Shore Road	\$ 68,831,940	\$ 68,957,827
Greenwood	\$ 31,007,875	\$ 35,445,401
Gowanus	\$ 11,198,709	\$ 11,569,978
West Central*	\$ 2,414,319	\$ 262,438
Astoria*	\$ 1,182,494	\$ 399,314

2024 Zonal Production Cost (Million \$)

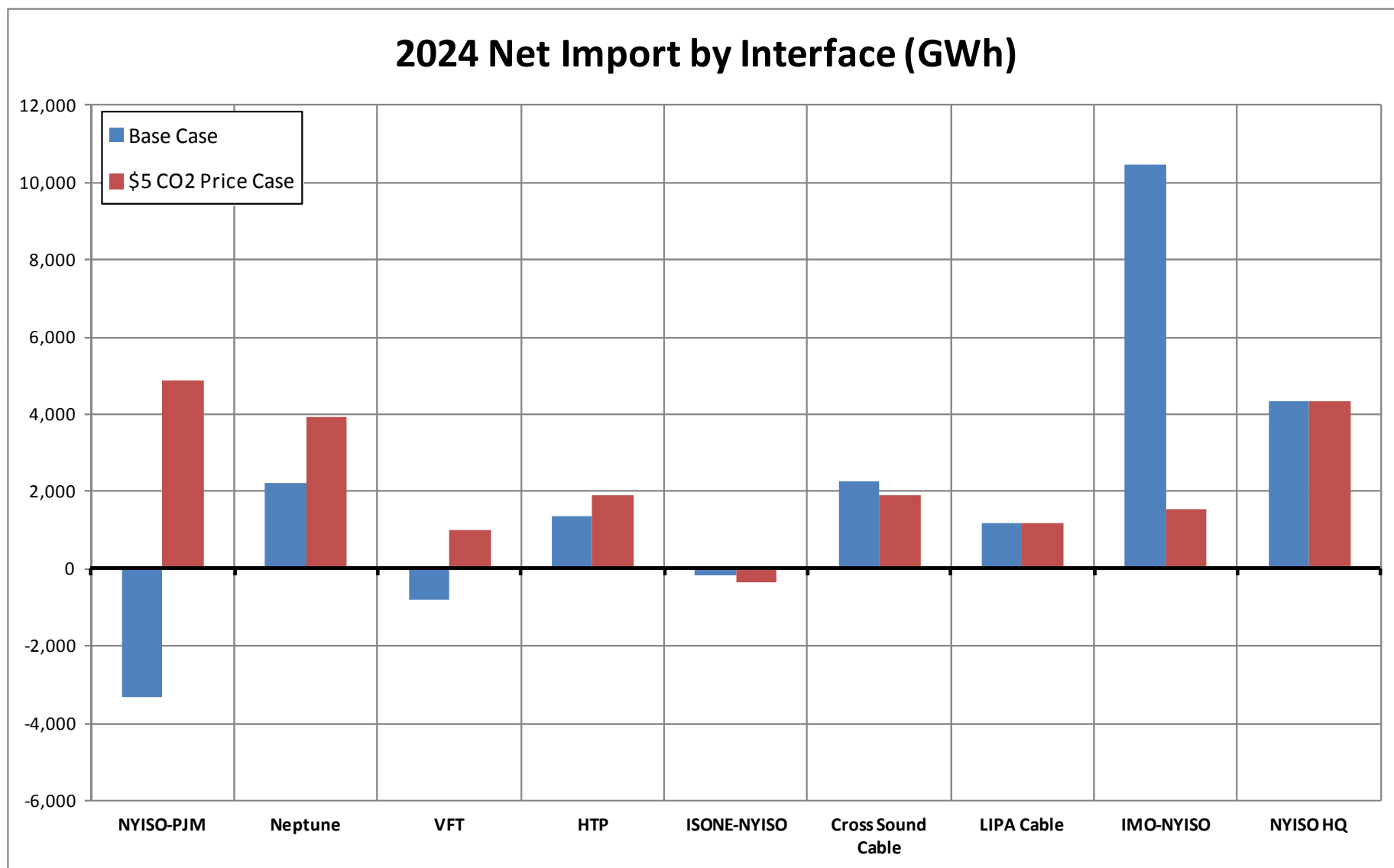


Year 2024		
Production Cost Metric (MM\$)	Base Case	\$5 CO2 Price Case
WEST	398	383
GENESSEE	42	42
CENTRAL	759	716
NORTH	26	24
MOHAWKVA	6	5
CAPITAL	1,471	1,232
HUDSONVA	130	133
MILLWOOD	156	156
DUNWOODI	0	0
NYCITY	2,855	2,175
LONGISLA	1,105	851
Total NYCA	6,948	5,718

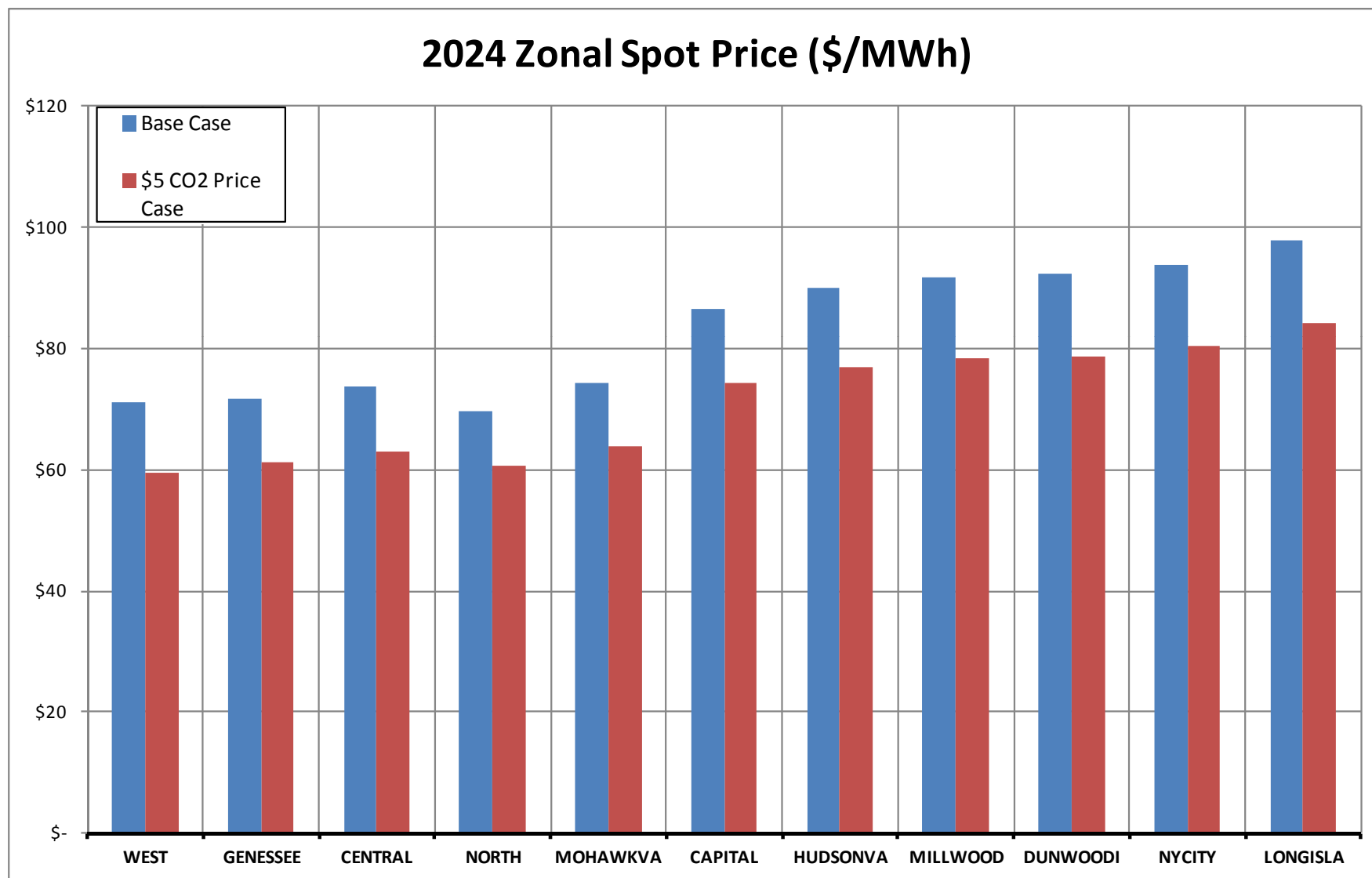
2024 Zonal Generation (GWh)



Year 2024		
Generation Metric (GWh)	Base Case	\$5 CO2 Price Case
WEST	21,877	23,620
GENESSEE	4,632	4,633
CENTRAL	33,665	34,381
NORTH	9,542	9,570
MOHAWKVA	5,673	5,673
CAPITAL	21,581	20,737
HUDSONVA	1,830	2,357
MILLWOOD	15,789	15,789
DUNWOODI	6	6
NYCITY	32,771	28,674
LONGISLA	12,528	10,952
Total NYCA	159,893	156,393

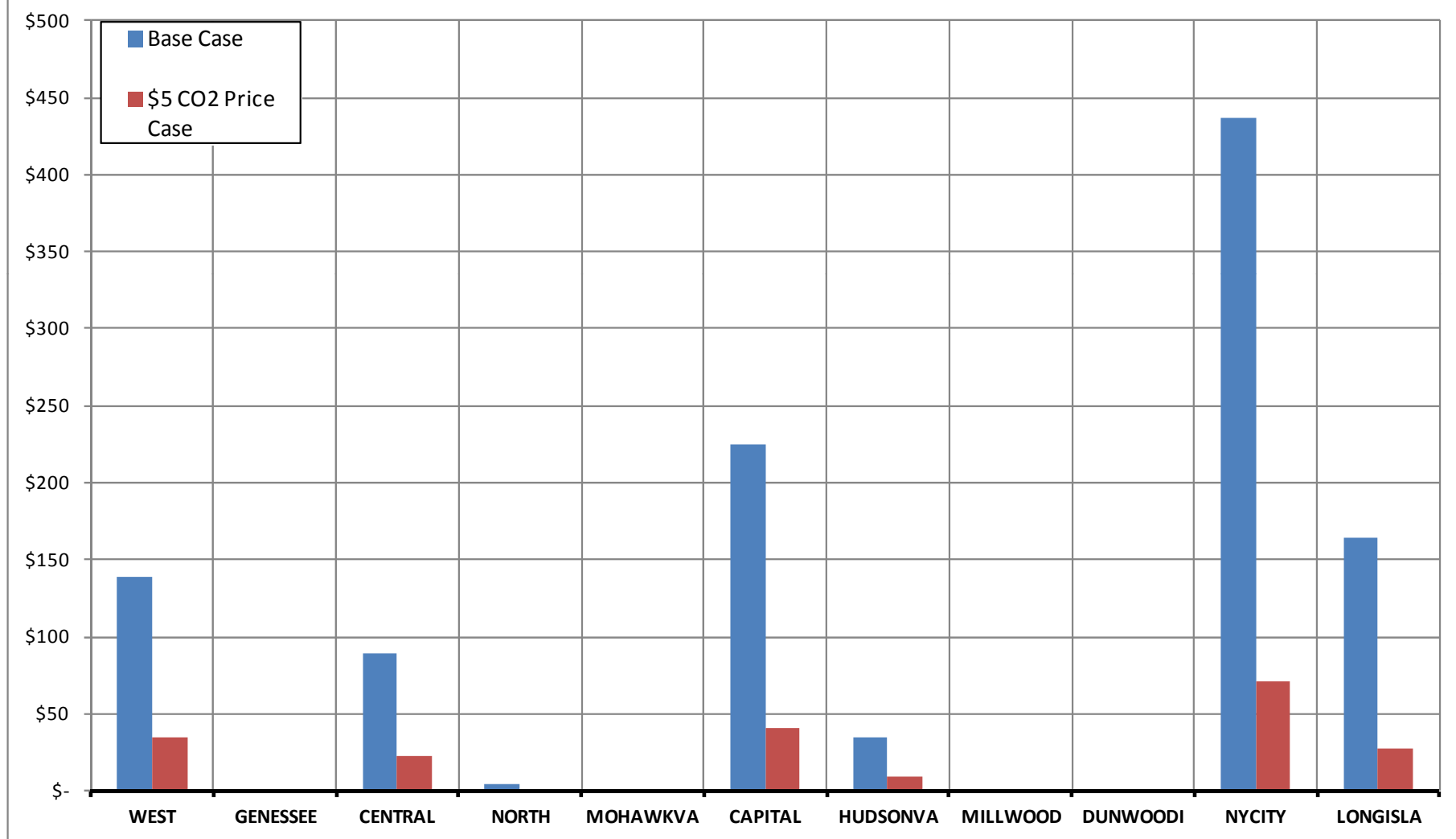


Year 2024		
Net Imports Metric (GWh)	Base Case	\$5 CO2 Price Case
NYISO-PJM_SOFT	(3,329)	4,878
Neptune HVDC	2,210	3,921
Cross Sound Cable	2,262	1,922
IMO-NYISO	10,488	1,568
NYISO-HQ CHAT	4,138	4,138
NYISO-HQ CEDAR	189	189
LIPA Cable	1,174	1,199
VFT4	(804)	1,019
HTP HVDC AC LINE	1,344	1,915
ISONE-NYISO_SOFT	(172)	(346)



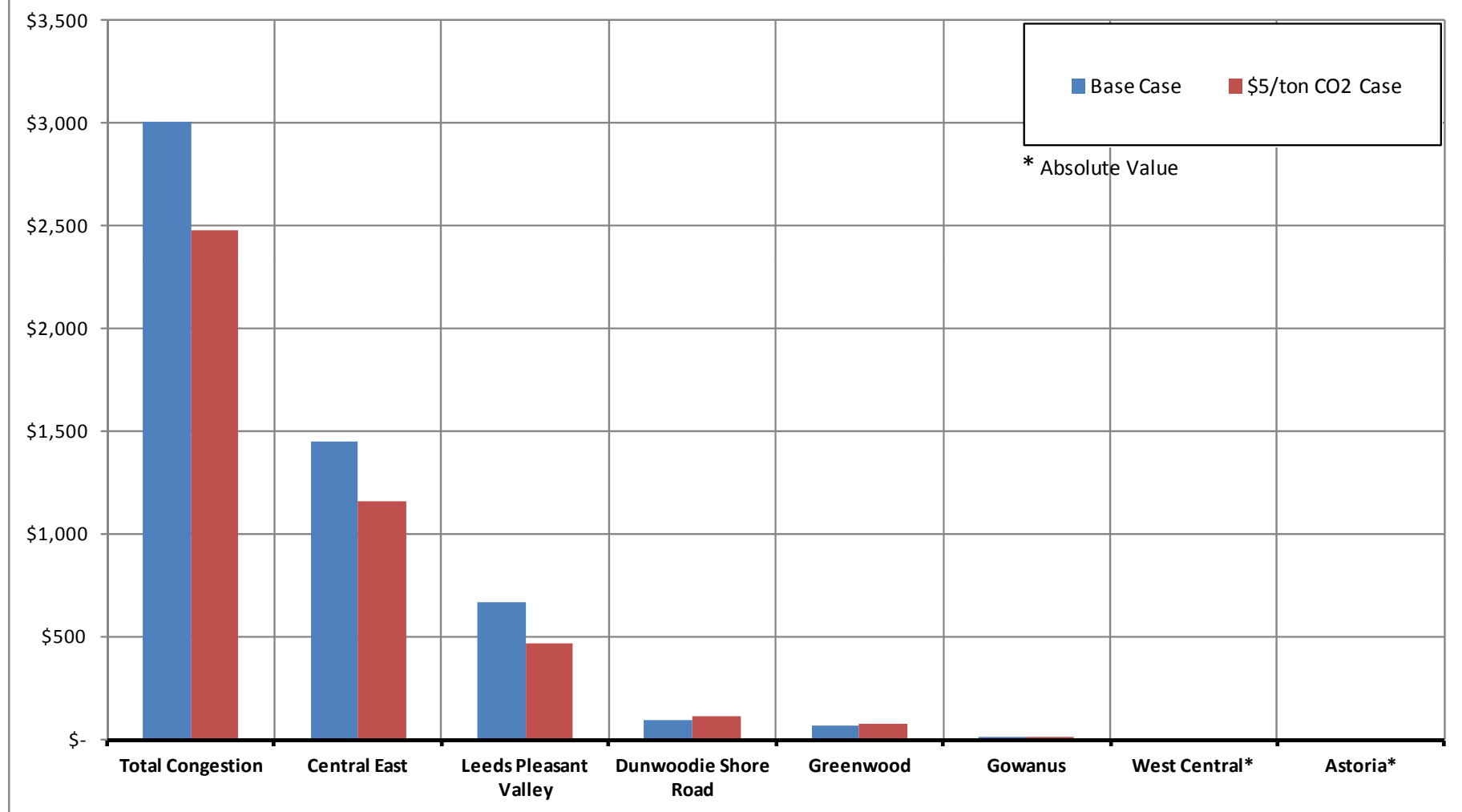
<u>Year 2024</u>		
Load Spot Price Metric (\$/MWh)	Base Case	\$5 CO2 Price Case
WEST	71.01	59.61
GENESSEE	71.58	61.34
CENTRAL	73.84	63.11
NORTH	69.62	60.51
MOHAWKVA	74.19	63.78
CAPITAL	86.48	74.30
HUDSONVA	90.15	76.92
MILLWOOD	91.85	78.37
DUNWOODI	92.26	78.75
NYCITY	93.89	80.48
LONGISLA	97.85	84.22

2024 CO₂ Cost (Million \$)



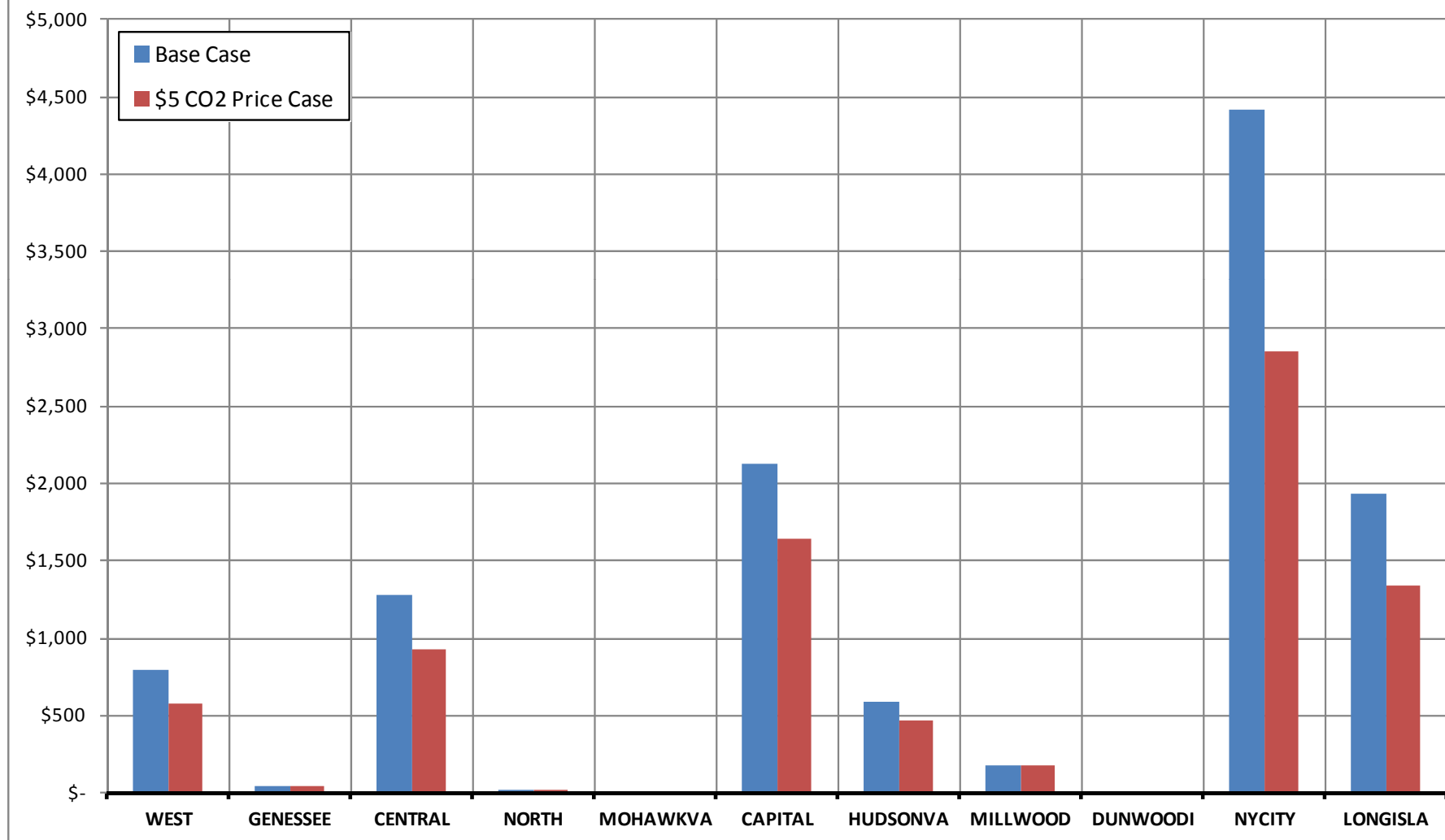
<u>Year 2024</u>		
CO2 Cost Metric (MM\$)	Base Case	\$5 CO2 Price Case
WEST	138.47	34.77
GENESSEE	0.13	0.03
CENTRAL	89.70	21.90
NORTH	4.33	0.89
MOHAWKVA	0.85	0.16
CAPITAL	225.22	40.43
HUDSONVA	34.30	9.20
MILLWOOD	0.00	0.00
DUNWOODI	0.00	0.00
NYCITY	437.50	71.50
LONGISLA	164.18	26.94

2032 Demand Congestion (Million \$)



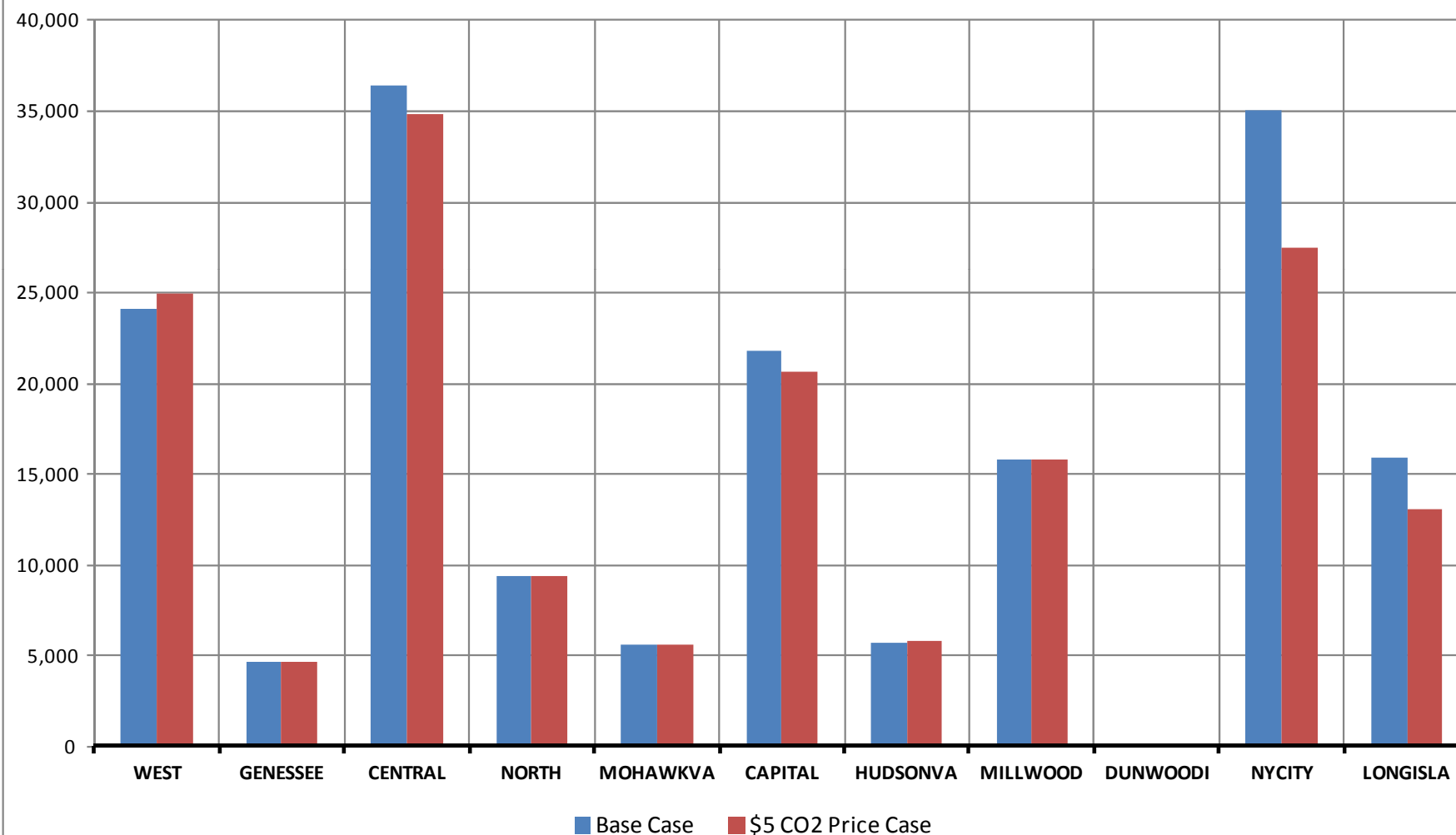
Demand Congestion (\$)		
	Base Case	\$5/ton CO2 Price
Total Congestion	\$ 3,006,387,907	\$ 2,366,647,180
Central East	\$ 1,452,878,976	\$ 1,162,097,152
Leeds Pleasant Valley	\$ 673,320,576	\$ 472,941,984
Dunwoodie Shore Road	\$ 92,990,206	\$ 112,748,111
Greenwood	\$ 72,589,864	\$ 73,745,764
Gowanus	\$ 16,446,336	\$ 17,466,094
West Central*	\$ 3,050,739	\$ 555,052
Astoria*	\$ 1,270,054	\$ 209,067

2032 Zonal Production Cost (Million \$)



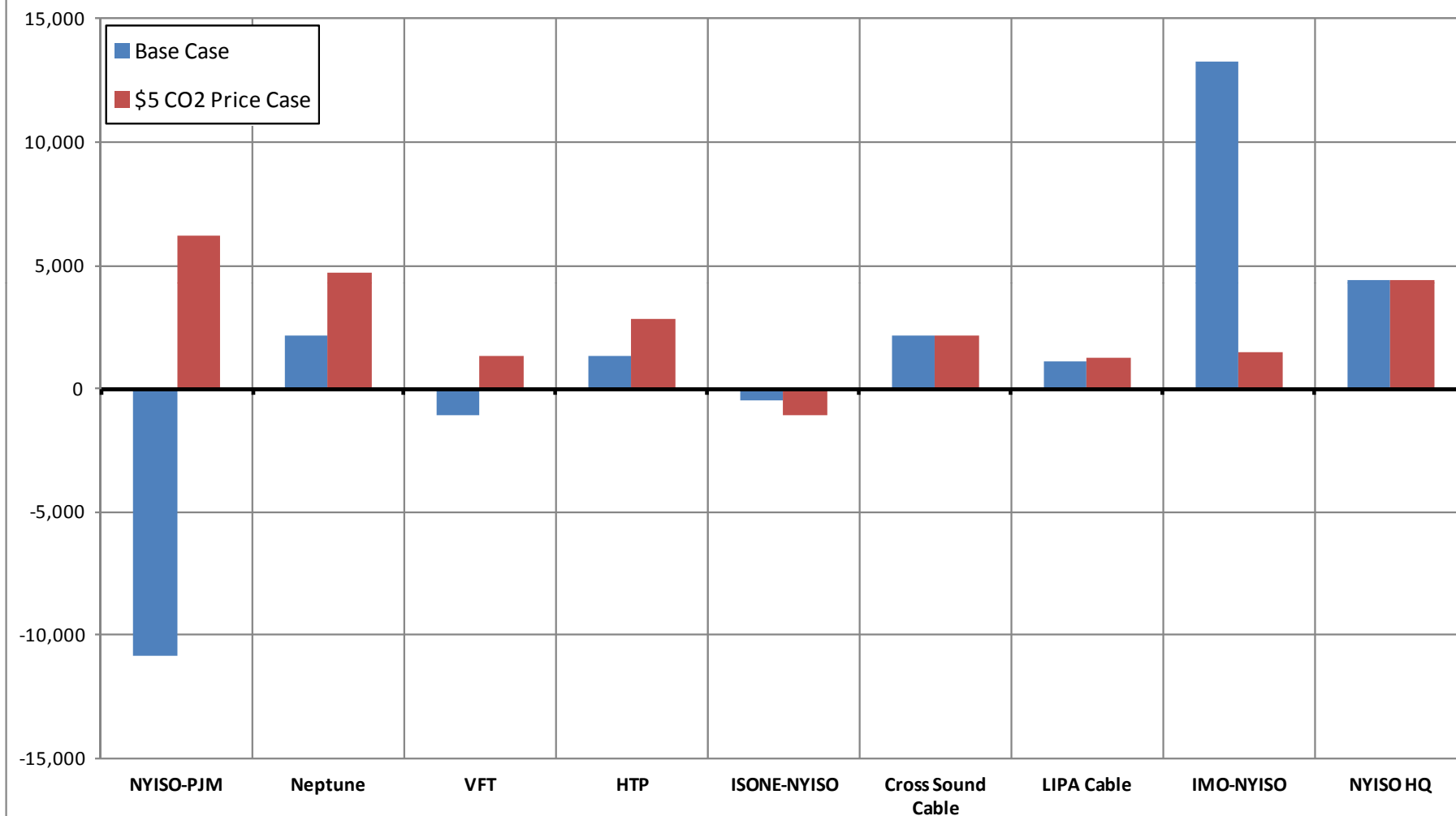
<u>Year 2032</u>		
Production Cost Metric (MM\$)	Base Case	\$5 CO2 Price Case
WEST	790	574
GENESSEE	48	48
CENTRAL	1,279	928
NORTH	21	20
MOHAWKVA	6	4
CAPITAL	2,122	1,638
HUDSONVA	588	463
MILLWOOD	175	175
DUNWOODI	0	0
NYCITY	4,420	2,853
LONGISLA	1,928	1,336
Total NYCA	11,376	8,038

2032 Zonal Generation (GWh)



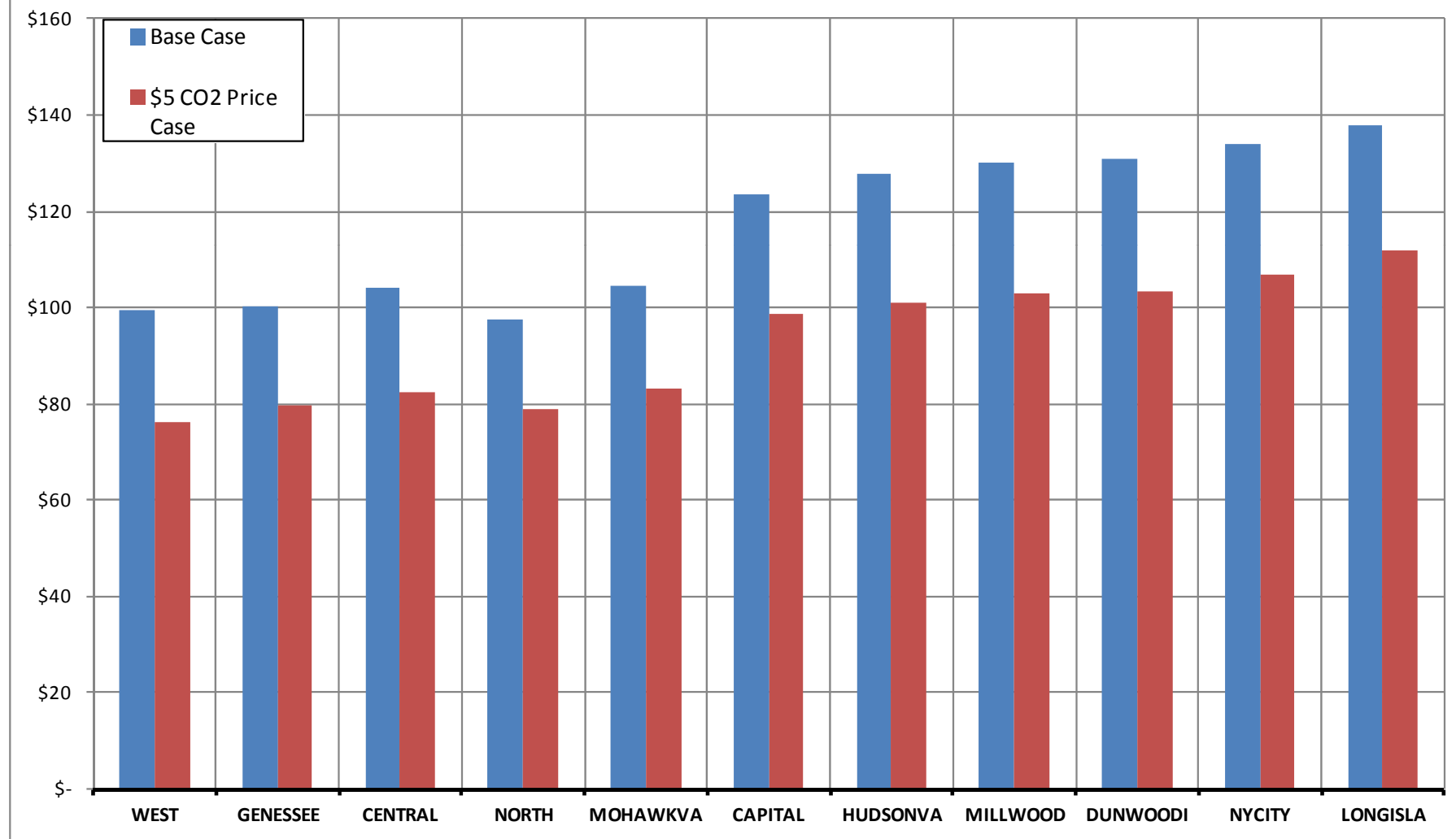
Year 2032		
Generation Metric (GWh)	Base Case	\$5 CO2 Price Case
WEST	24,076	24,916
GENESSEE	4,633	4,636
CENTRAL	36,370	34,831
NORTH	9,391	9,429
MOHAWKVA	5,638	5,628
CAPITAL	21,840	20,637
HUDSONVA	5,715	5,846
MILLWOOD	15,789	15,789
DUNWOODI	6	6
NYCITY	35,099	27,519
LONGISLA	15,948	13,059

2032 Net Import by Interface (GWh)



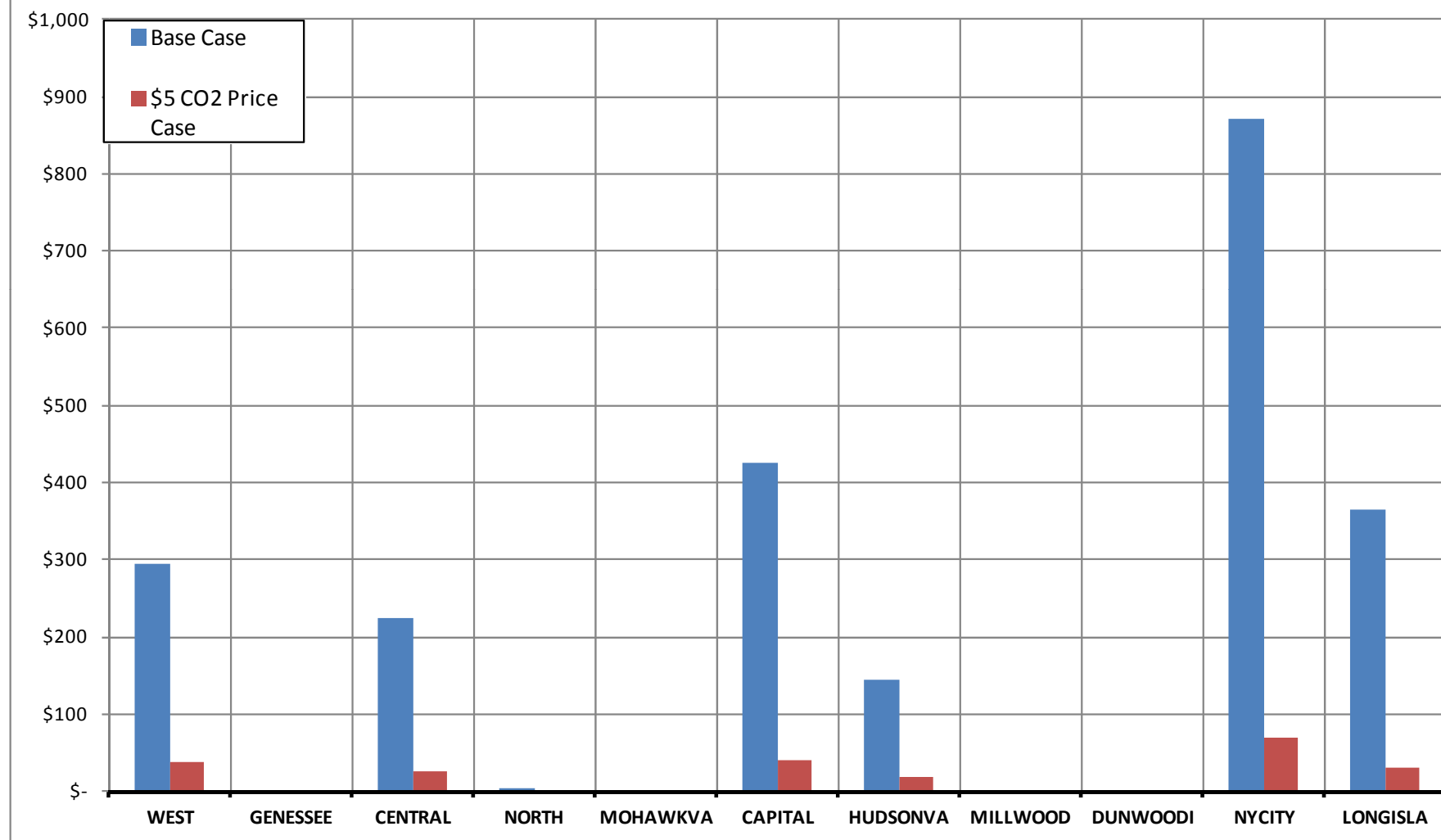
Year 2032		
Net Imports Metric (GWh)	Base Case	\$5 CO2 Price Case
NYISO-PJM_SOFT	(10,840)	6,250
Neptune HVDC	2,161	4,728
Cross Sound Cable	2,179	2,133
IMO-NYISO	13,280	1,477
NYISO-HQ CHAT	4,198	4,198
NYISO-HQ CEDAR	191	191
LIPA Cable	1,140	1,240
VFT4	(1,102)	1,345
HTP HVDC AC LINE	1,303	2,830
ISONE-NYISO_SOFT	(475)	(1,053)

2032 Zonal Spot Price (\$/MWh)



<u>Year 2032</u>		
Load Spot Price Metric (\$/MWh)	Base Case	\$5 CO2 Price Case
WEST	99.42	76.26
GENESSEE	100.38	79.59
CENTRAL	104.30	82.49
NORTH	97.74	78.79
MOHAWKVA	104.58	83.27
CAPITAL	123.63	98.89
HUDSONVA	127.85	101.06
MILLWOOD	130.25	103.00
DUNWOODI	130.83	103.51
NYCITY	134.11	106.88
LONGISLA	137.76	111.72

2032 CO₂ Cost (Million \$)



<u>Year 2032</u>		
CO2 Cost Metric (MM\$)	Base Case	\$5 CO2 Price Case
WEST	293.87	38.69
GENESSEE	0.30	0.04
CENTRAL	223.64	24.86
NORTH	4.37	0.54
MOHAWKVA	1.20	0.09
CAPITAL	424.93	40.04
HUDSONVA	145.14	19.00
MILLWOOD	0.00	0.00
DUNWOODI	0.00	0.00
NYCITY	870.81	68.48
LONGISLA	364.99	30.43

A 3rd Gas Price Region

- ◆ **ESPWG had requested a reexamination of Natural Gas Prices, especially in the context of Upstate**
- ◆ **Previously, the CARIS had a two-tiered representation in which the Upstate Zones (A – I) were proxied by the Tetco-M3 price and Downstate (J, K) were proxied by Transco Z6 (NY)**

A 3rd Gas Region (cont'd)

- ◆ **Review of publicly available information revealed that large units in the Upper Hudson Valley region acquired gas at prices higher than what was assumed in CARIS**
- ◆ **The pipeline hub that is most appropriate for these units is the Tennessee Z6**
- ◆ **Historically, Tennessee Z6 prices have been greater than Tetco M3 (now used for Zones A-E) and less than Transco Z6 (NY)**
- ◆ **The new 3-tiered system makes for a more accurate representation.**

The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.



www.nyiso.com