

Updated 2019 CARIS 1 Base case and Identification of Three Studies

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ESPWG/TPAS

Oct.4 , 2019, KCC

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2019 CARIS 1 Schedule

■ September 11th ESPWG

- Base case preliminary results
- Preliminary 70 x 30 Scenario Development

■ Oct.4th ESPWG

- Updated Base Case and Benchmark results
- Identification of Three Studies
- Scenario Load Forecast development
- Energy Storage Resource Modeling in 70x30 Scenario

■ Oct.23th ESPWG

- 70 x 30 Scenario Resource Assumptions

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2019 CARIS 1 Target Schedule

■ Nov.4th ESPWG

- Generic Cost Data and Preliminary Solution Results
- Preliminary Scenario Results(High/Low Load, High/Low Natural Gas Prices)
- 70x30 Scenario Final Assumptions/Preliminary Results

■ Nov.18th ESPWG

- 2019 CARIS 1 Primary and Additional Metrics
- Final 70 x 30 Scenario Results

■ Dec.16th ESPWG

- 2019 CARIS 1 Draft Report #1

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Updates from Sep 11th ESPWG

- NYISO's analysis revealed numerical instability issues using the current GE MAPS version V14.100
- Per recommendation from GE, NYISO proposes to use MAPS V14.300 for the 2019 CARIS1 Study
- NYISO re-ran the 2019 CARIS1 Base case as well as the 2017 benchmark case with MAPS V14.300

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Updated 2017 Benchmark Results

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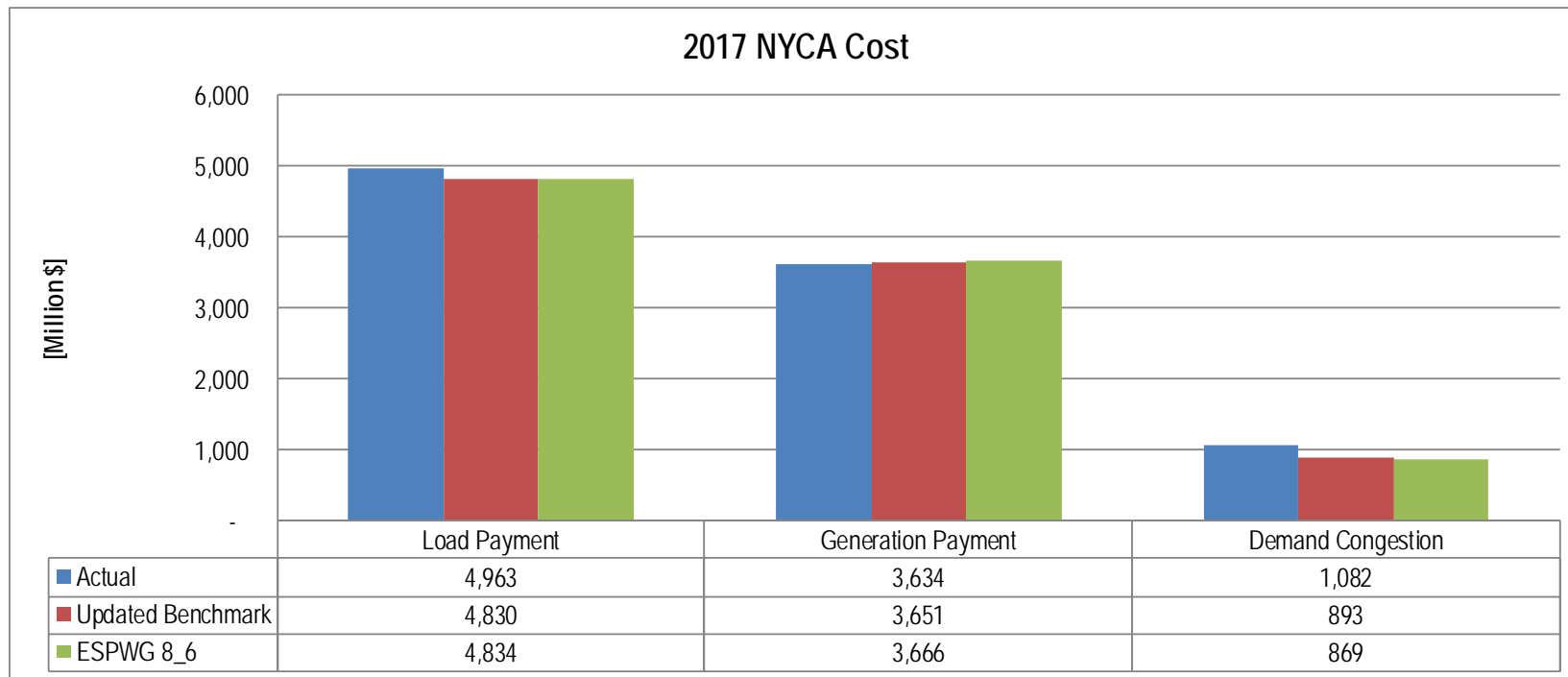


Updated 2017 Benchmark

- Overall, the updated benchmark results align better to actual historical values compared with prior benchmark case results
- Minor changes to CARIS metrics in 2017 Benchmark
 - NYCA Demand Congestion increased \$24M or 3%
 - NYCA generation decreased 198 GWh or 0.2%
 - System Production Cost decreased \$19M or 0.1%
 - Maximum Change in zonal LBMPs showed a decrease of \$0.13 or 0.5% (Zone B)

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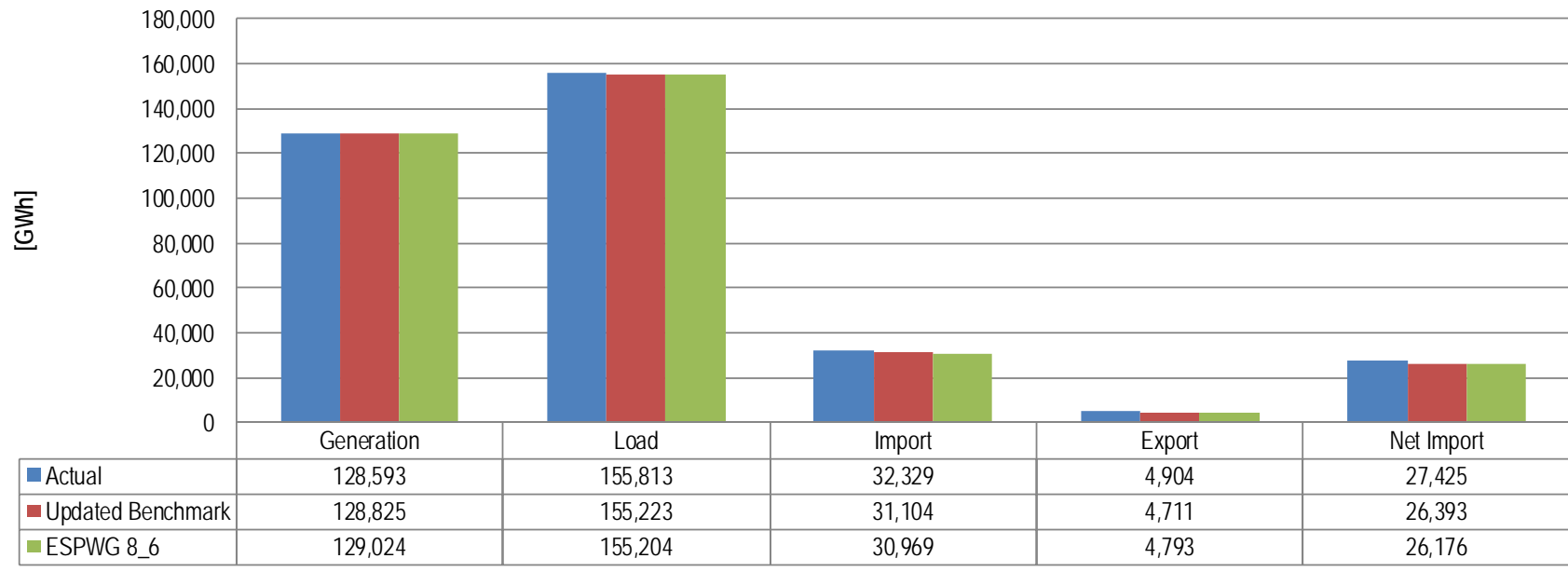
2017 NYCA Cost Summary



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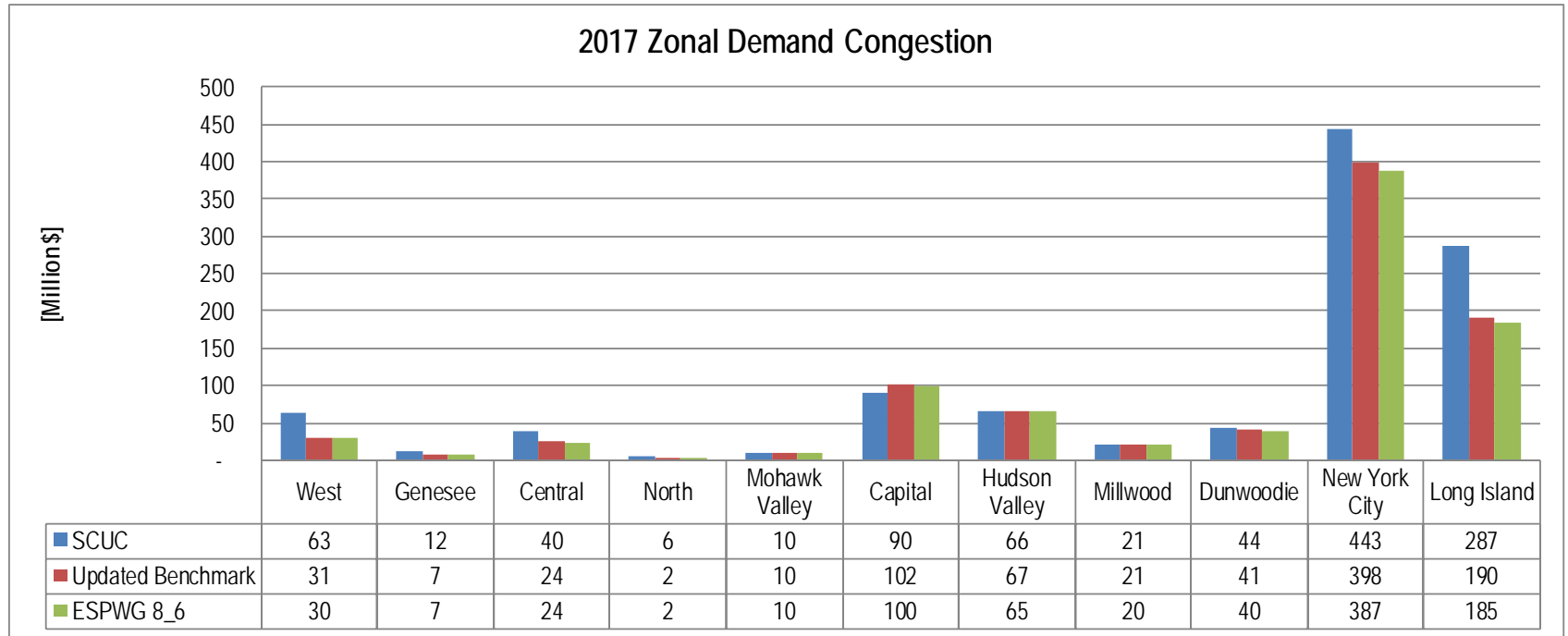
2017 NYCA Energy Summary

2017 NYCA Energy



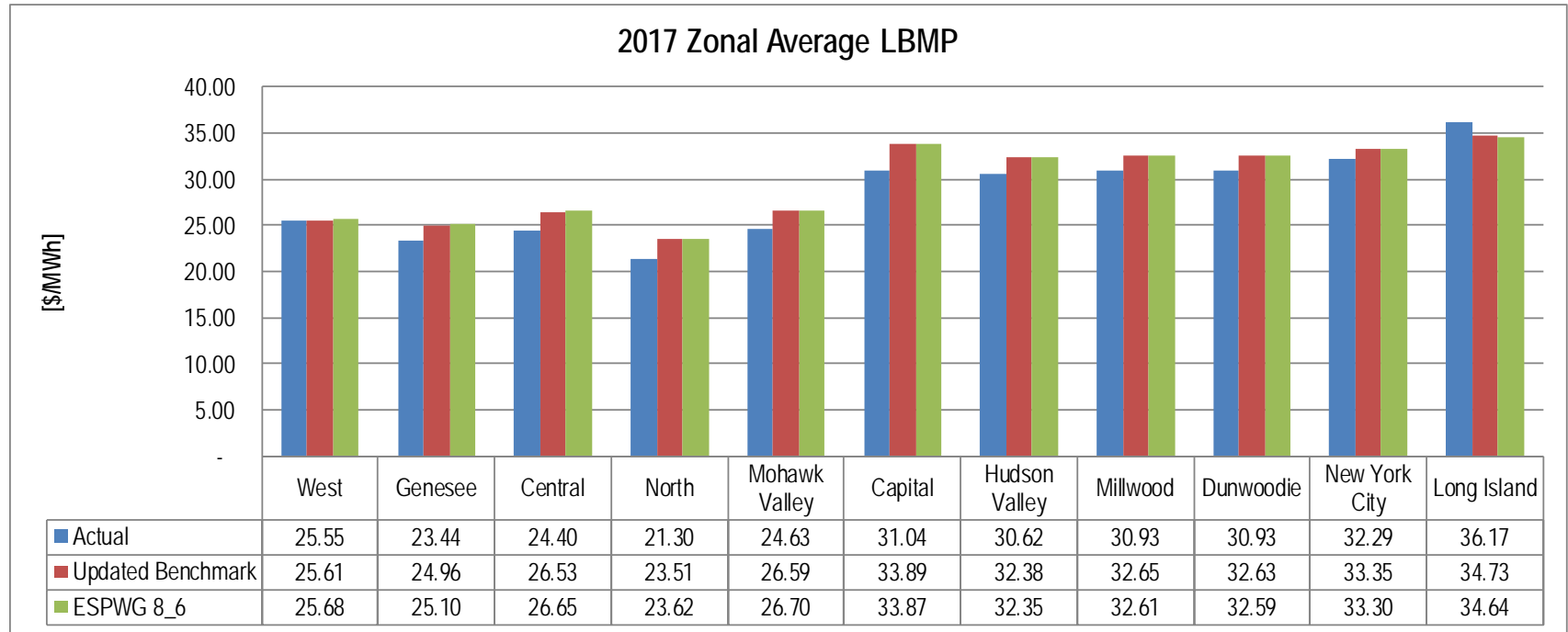
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2017 Demand Congestion Summary



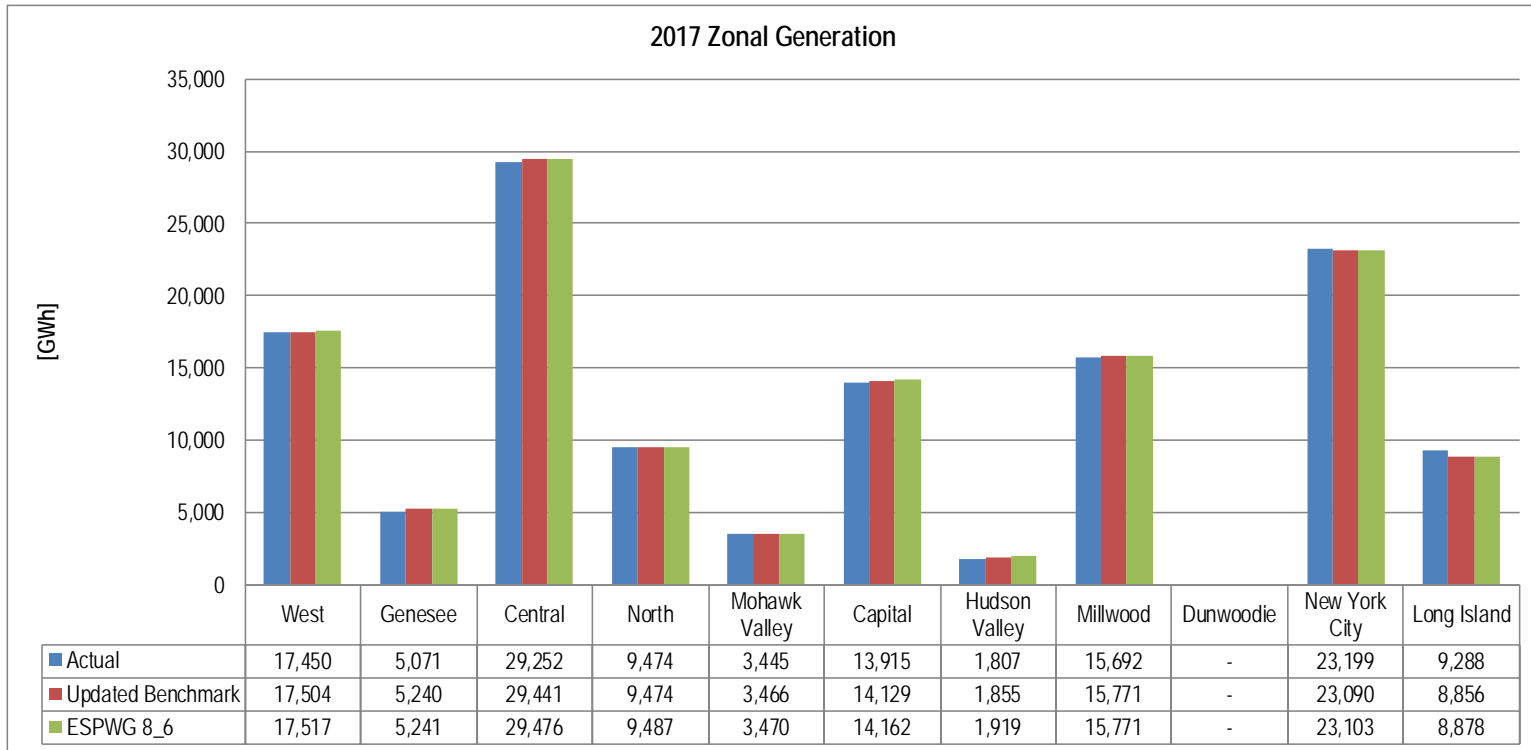
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2017 NYCA Annual Zonal Average LBMP



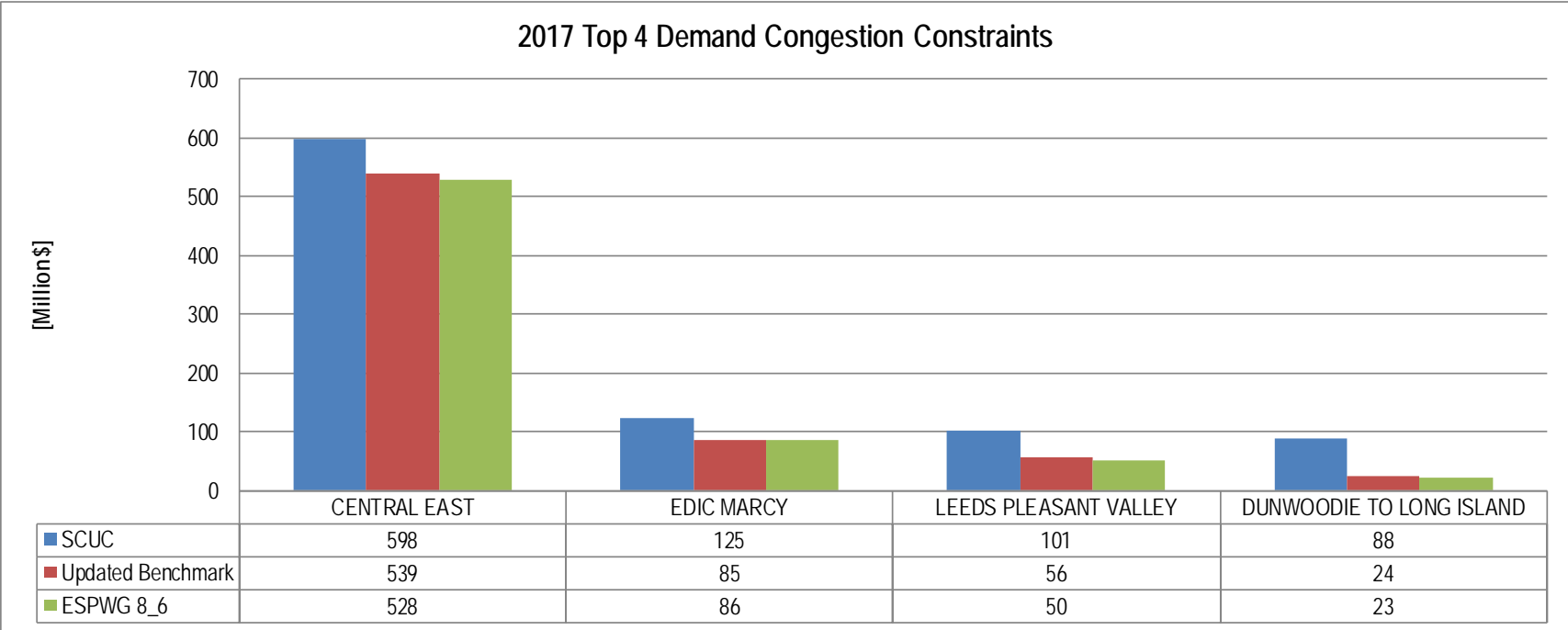
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2017 Zonal Generation Summary



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2017 Demand Congestion by Constraints (Top 4)



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Updated 2019 CARIS 1 Base Case Results

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Updated 2019 CARIS 1 Base Case

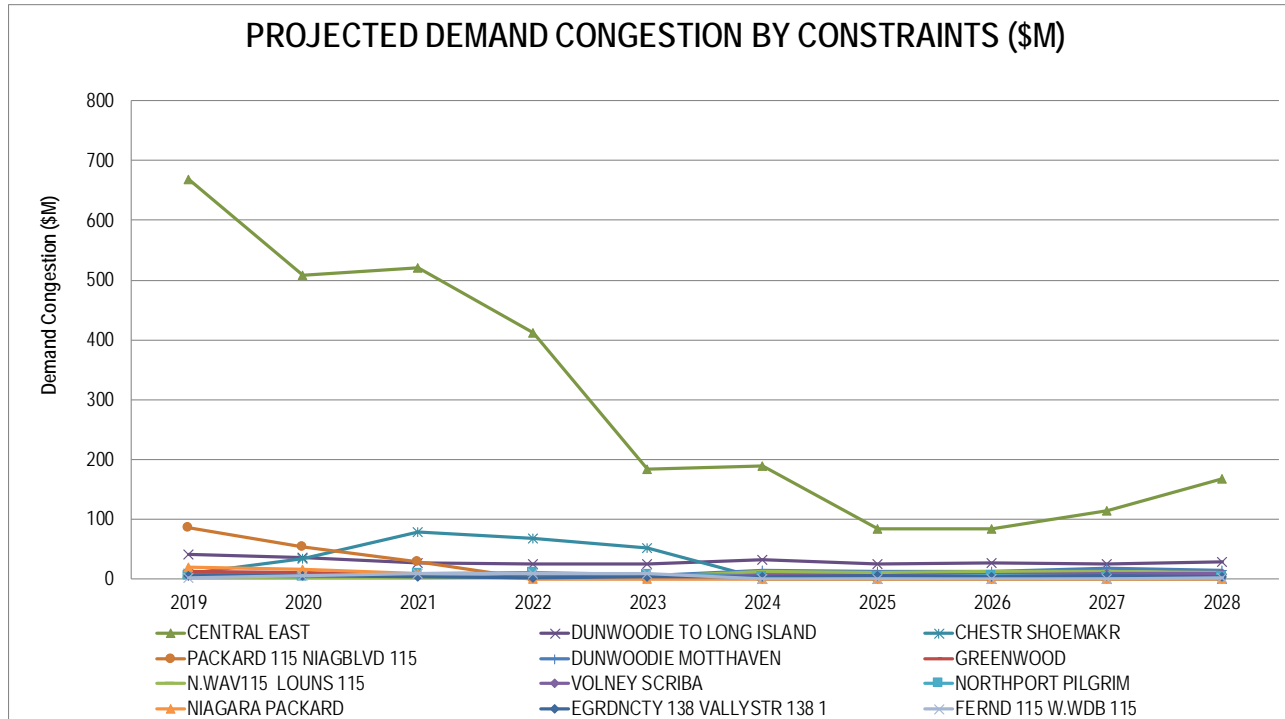
- **Minor changes to CARIS metrics in 2019 CARIS Phase 1 Base Case**
 - Maximum change in NYCA Demand Congestion increased \$40M or 5% in 2020
 - Maximum change in System Production Cost decreased \$45M or 0.1% in 2028
 - Maximum change in LBMPs decreased \$0.38 or 2% in 2020(Zone D)
 - Maximum change in NYCA zonal generation decreased 85GWh or 1% in 2020(Zone G)

Projected Demand Congestion by Constraints (\$M)

Demand Congestion (\$M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
CENTRAL EAST	668	508	521	411	183	188	84	84	114	167
DUNWOODIE TO LONG ISLAND	41	36	28	25	25	31	25	26	25	28
CHESTR SHOEMAKR	9	34	79	68	52	0	0	0	0	0
PACKARD 115 NIAGBLVD 115	85	53	29	0	0	0	0	0	0	0
DUNWOODIE MOTTHAVEN	8	9	10	7	5	14	13	14	18	15
GREENWOOD	12	10	6	6	6	8	8	10	11	10
N.WAV115 LOUNS 115	2	2	3	4	4	13	10	13	12	11
VOLNEY SCRIBA	6	7	6	7	7	6	5	7	9	9
NORTHPORT PILGRIM	6	4	9	10	8	5	4	5	4	4
NIAGARA PACKARD	19	16	10	0	0	0	0	0	0	0
EGRDNCTY 138 VALLYSTR 138 1	6	5	3	2	5	4	5	4	5	4
FERND 115 W.WDB 115	2	5	10	9	9	1	0	0	1	2

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Projected Demand Congestion by Constraints (\$M)

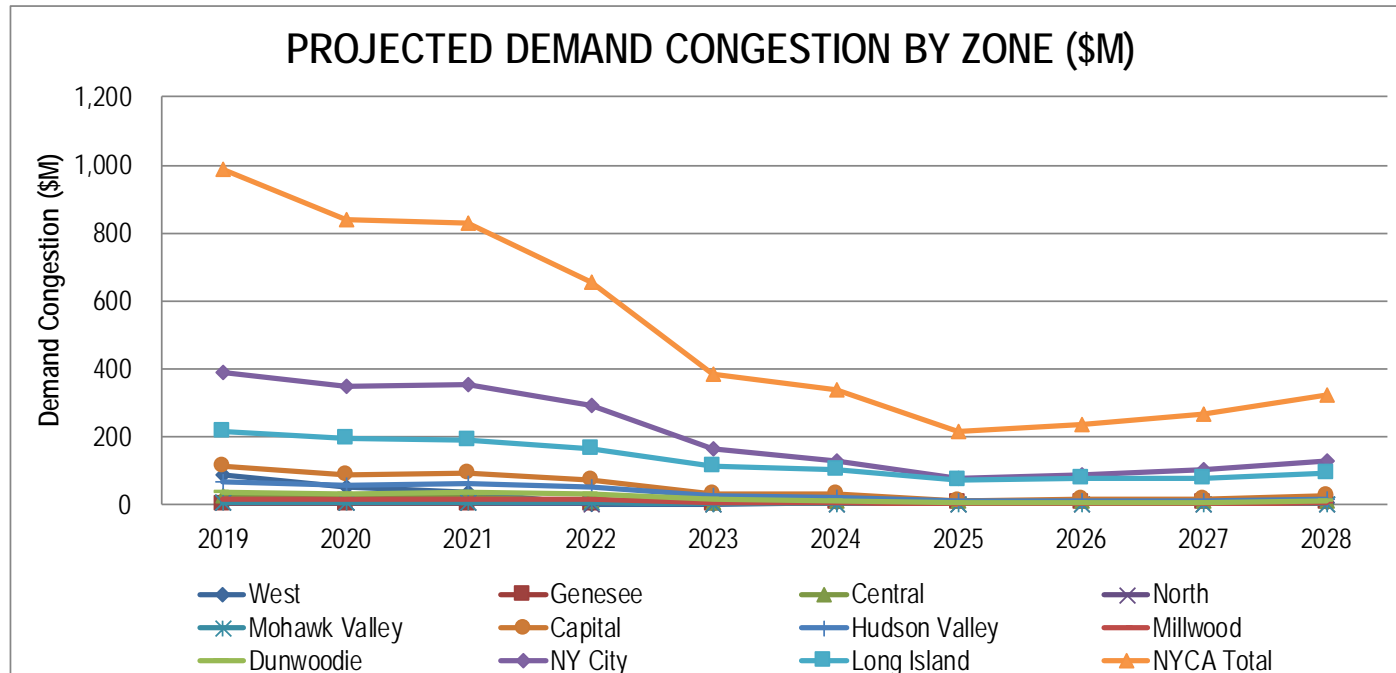


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Projected Demand Congestion by Zone (\$M)

Demand Congestion (\$M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	87	55	36	4	1	9	11	12	11	8
Genesee	4	2	1	2	1	5	6	7	6	5
Central	28	22	21	14	9	12	10	10	12	13
North	6	7	5	4	3	4	3	3	3	3
Mohawk Valley	10	7	7	5	3	4	3	3	4	4
Capital	116	91	92	73	34	31	15	15	19	27
Hudson Valley	66	56	62	51	28	20	11	12	14	19
Millwood	20	17	18	15	8	6	3	3	4	6
Dunwoodie	39	35	37	31	17	12	6	7	8	11
NY City	392	349	356	292	165	132	78	87	106	131
Long Island	218	195	193	163	116	105	75	77	80	96
NYCA Total	986	838	827	655	387	338	219	235	268	322

Projected Demand Congestion by Zone (\$M)

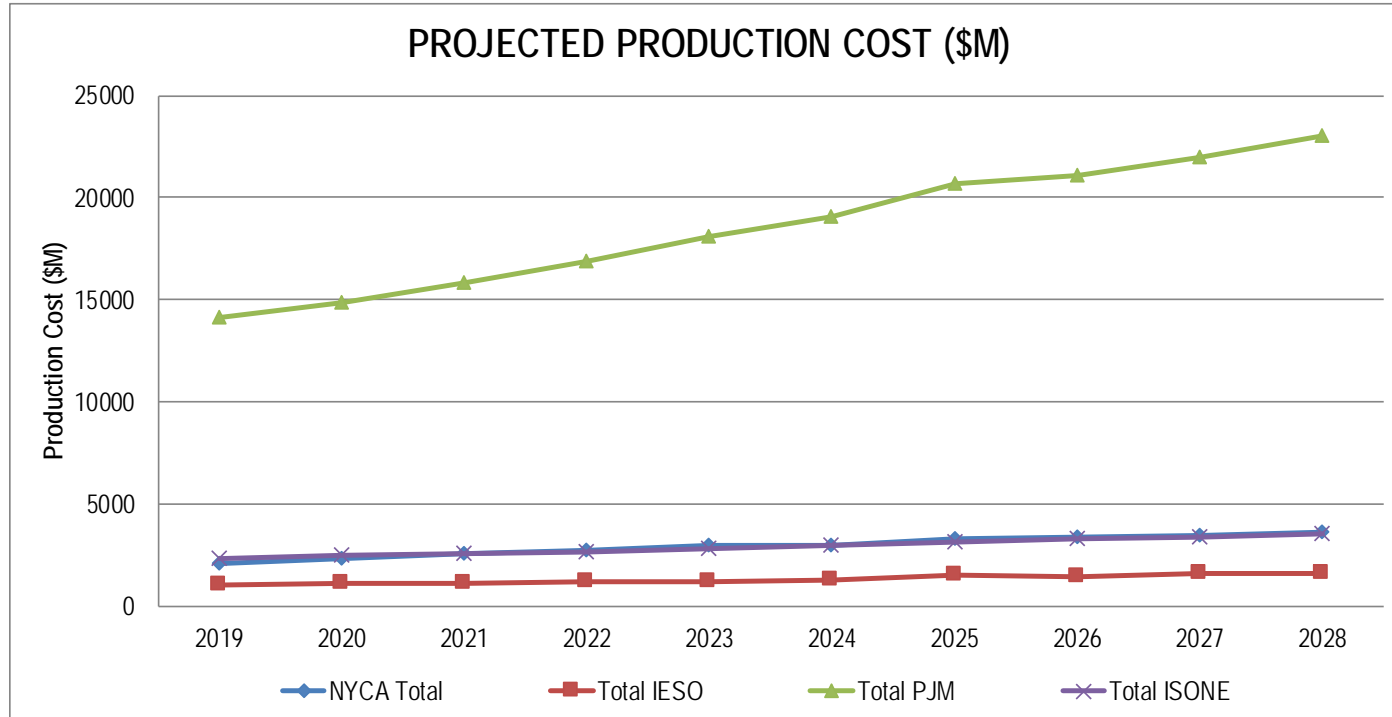


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Projected Production Costs (\$M)

Production Cost (\$M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	14	15	16	16	28	33	76	75	74	84
Genesee	37	39	43	41	43	47	44	46	51	49
Central	261	295	313	331	389	397	446	443	457	476
North	1	1	2	1	2	4	3	3	4	4
Mohawk Valley	1	1	1	1	1	2	2	1	1	2
Capital	449	473	552	594	633	637	699	716	733	774
Hudson Valley	132	264	324	339	371	359	392	386	410	439
Millwood	137	94	24	6	7	7	7	7	7	7
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	769	867	947	1,029	1,111	1,141	1,230	1,293	1,318	1,374
Long Island	293	315	334	348	362	371	390	401	412	429
NYCA Total	2095	2363	2556	2705	2946	2997	3289	3371	3468	3638
NYCA Imports	545	636	694	795	902	1,012	1,147	1,178	1,200	1,280
NYCA Exports	236	259	220	213	347	281	477	402	455	433
NYCA + Imports - Exports	2,403	2,740	3,030	3,287	3,502	3,728	3,960	4,148	4,212	4,484
Total IESO	1,024	1,078	1,095	1,189	1,234	1,277	1,527	1,446	1,580	1,635
Total PJM	14,123	14,860	15,819	16,916	18,070	19,082	20,694	21,106	21,993	23,060
Total ISONE	2,296	2,465	2,570	2,650	2,805	2,987	3,173	3,268	3,406	3,563
Total System	19,538	20,767	22,041	23,461	25,055	26,343	28,684	29,190	30,448	31,897

Projected Production Costs (\$M)



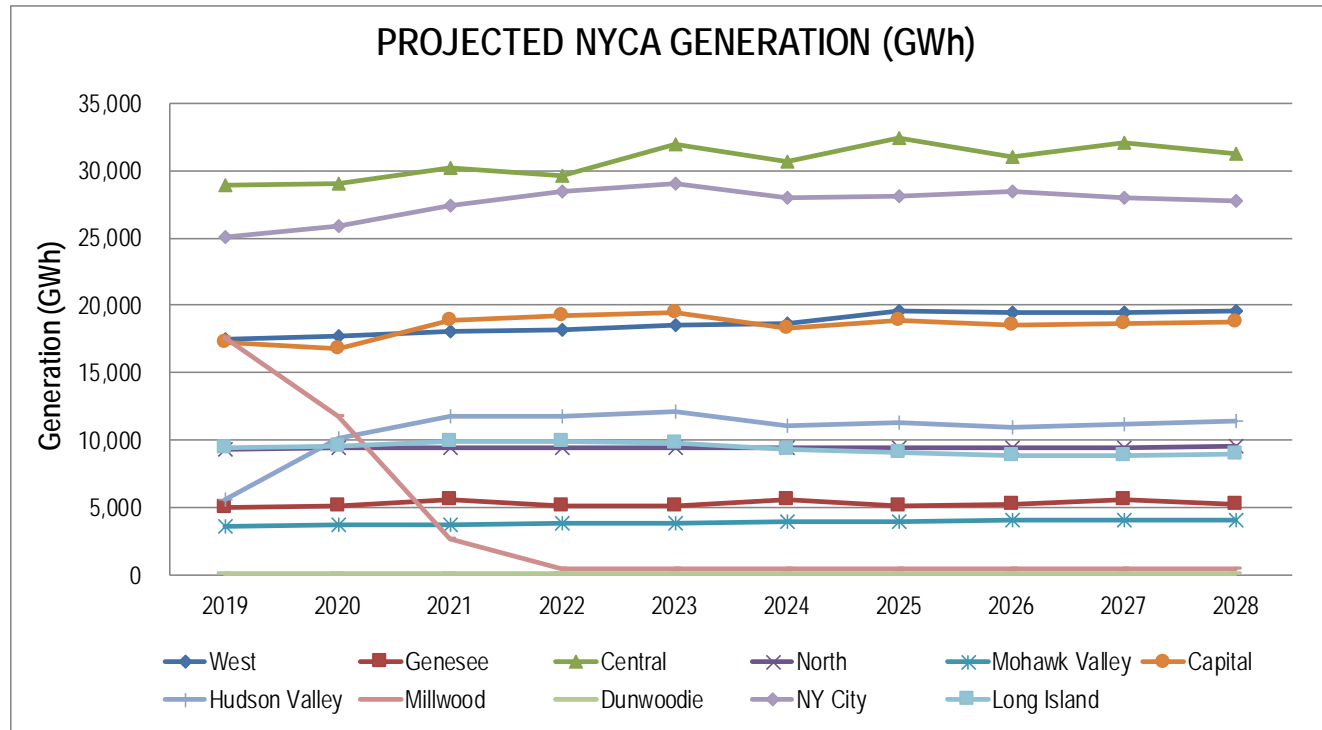
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Projected NYCA Generation (GWh)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	17,451	17,766	18,095	18,144	18,484	18,611	19,530	19,520	19,468	19,578
Genesee	5,046	5,092	5,531	5,120	5,154	5,603	5,162	5,183	5,617	5,213
Central	28,925	29,010	30,188	29,558	31,926	30,671	32,421	31,006	32,081	31,209
North	9,315	9,387	9,386	9,407	9,438	9,489	9,485	9,467	9,488	9,501
Mohawk Valley	3,625	3,676	3,740	3,808	3,872	3,944	3,977	4,020	4,043	4,078
Capital	17,215	16,831	18,866	19,177	19,464	18,305	18,866	18,572	18,653	18,766
Hudson Valley	5,590	10,148	11,743	11,760	12,135	11,106	11,352	10,898	11,223	11,380
Millwood	17,645	11,724	2,631	438	440	443	443	444	445	447
Dunwoodie	55	63	69	75	79	81	83	85	86	88
NY City	25,090	25,851	27,378	28,430	29,053	27,945	28,093	28,428	27,949	27,795
Long Island	9,441	9,511	9,895	9,877	9,742	9,299	9,053	8,907	8,908	8,959
NYCA Total	139,398	139,060	137,521	135,794	139,787	135,497	138,465	136,530	137,959	137,014
Total IESO	154,562	152,749	147,513	146,915	131,767	142,699	130,602	135,682	134,417	138,873
Total PJM	790,508	793,254	799,154	805,772	819,816	822,167	833,443	834,579	838,884	844,932
Total ISONE	107,951	105,479	105,310	105,908	105,716	104,976	104,924	104,424	105,103	105,832
Total HQ *	25,985	25,997	26,093	26,054	26,020	26,068	25,959	26,134	26,093	26,096
Total System	1,218,404	1,216,539	1,215,590	1,220,444	1,223,106	1,231,407	1,233,394	1,237,348	1,242,456	1,252,747

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Projected NYCA Generation (GWh)



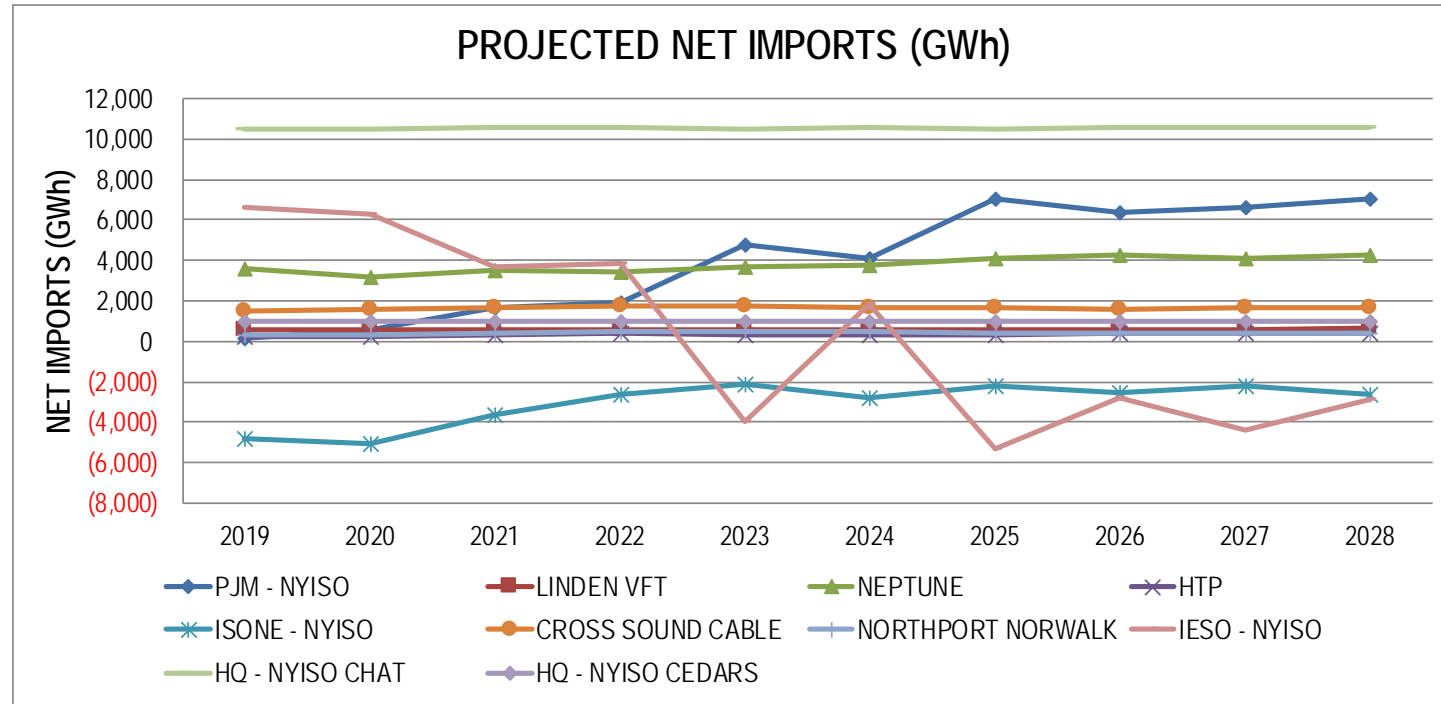
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Projected NYCA Net Imports (GWh)

NET IMPORTS (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	178	541	1,625	1,889	4,737	4,080	7,075	6,388	6,585	6,999
LINDEN VFT	575	531	564	602	542	562	528	581	593	627
NEPTUNE	3,613	3,185	3,506	3,389	3,680	3,740	4,085	4,305	4,112	4,234
HTP	215	229	317	420	351	322	334	393	383	379
ISONE - NYISO	(4,804)	(5,040)	(3,650)	(2,644)	(2,097)	(2,761)	(2,219)	(2,514)	(2,226)	(2,613)
CROSS SOUND CABLE	1,516	1,537	1,620	1,725	1,740	1,691	1,686	1,599	1,651	1,638
NORTHPORT NORWALK	307	351	402	494	481	450	412	359	386	439
IESO - NYISO	6,649	6,253	3,647	3,831	(3,956)	1,843	(5,352)	(2,804)	(4,400)	(2,862)
HQ - NYISO CHAT	10,503	10,497	10,569	10,546	10,520	10,539	10,486	10,598	10,569	10,555
HQ - NYISO CEDARS	1,001	1,000	1,008	1,005	1,004	1,008	1,002	1,014	1,008	1,009
TOTAL	19,752	19,086	19,608	21,257	17,002	21,474	18,037	19,918	18,662	20,405

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Projected NYCA Net Imports (GWh)



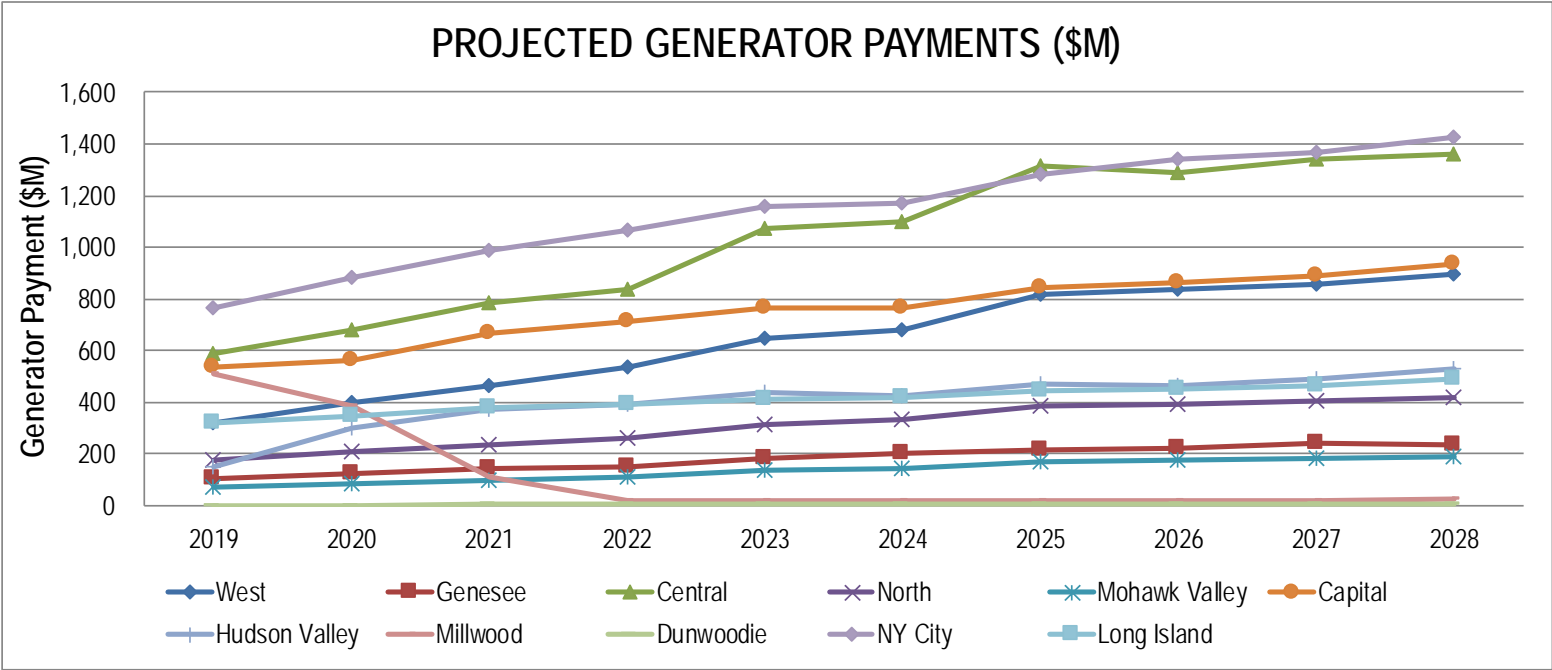
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Projected NYCA Generator Payments (\$M)

Generator Payment (\$M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	317	399	466	537	650	678	817	839	858	894
Genesee	102	122	146	151	179	202	213	219	243	235
Central	589	683	784	840	1,071	1,096	1,315	1,289	1,343	1,361
North	178	211	234	262	315	335	384	392	404	420
Mohawk Valley	72	87	96	111	134	146	167	174	180	188
Capital	539	562	670	714	763	762	844	863	886	938
Hudson Valley	151	300	374	393	435	426	470	466	493	528
Millwood	511	388	109	16	18	19	20	21	21	23
Dunwoodie	2	2	3	3	3	4	4	4	4	5
NY City	765	883	988	1,067	1,159	1,170	1,280	1,340	1,365	1,425
Long Island	319	347	381	391	408	416	441	452	466	489
NYCA Total	3,544	3,982	4,251	4,484	5,137	5,254	5,955	6,060	6,265	6,505

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Projected NYCA Generator Payments (\$M)



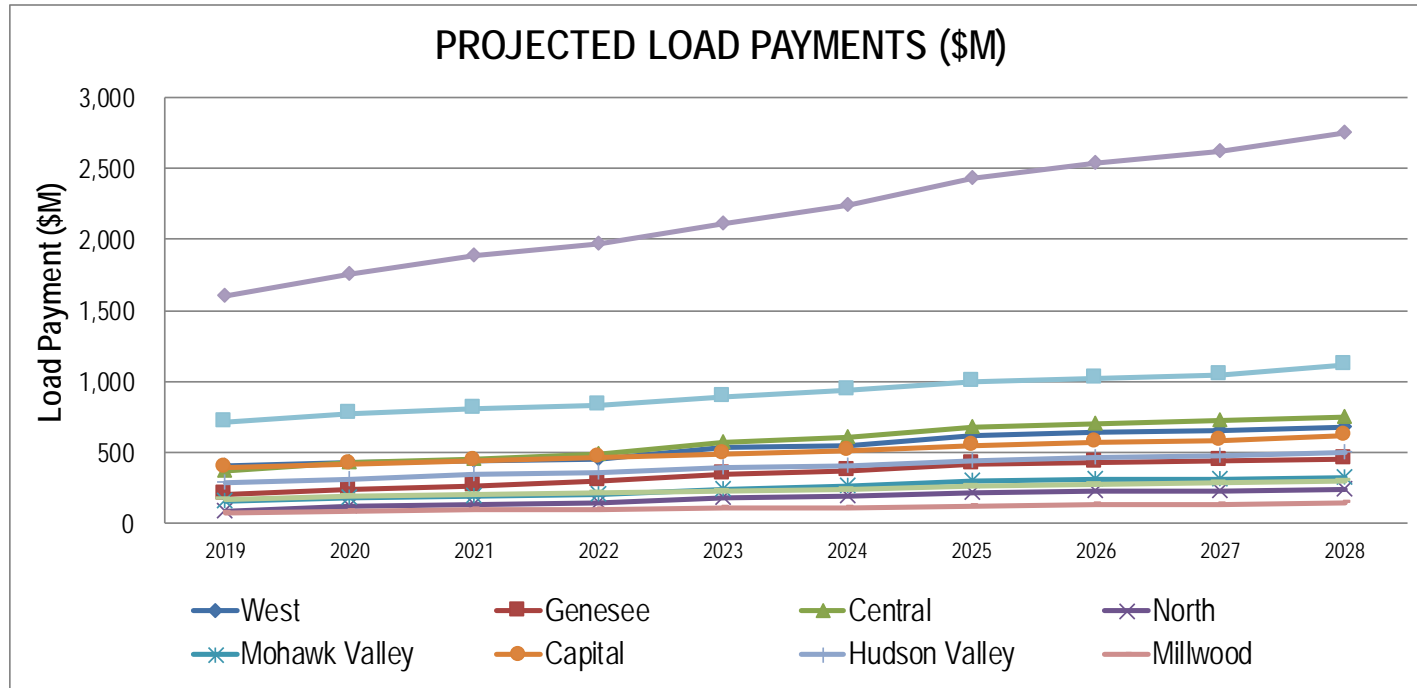
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Projected NYCA Load Payments (\$M)

Load Payment (\$M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	409	427	443	454	534	552	626	640	658	683
Genesee	208	243	268	298	351	366	414	426	437	456
Central	376	426	458	496	575	614	685	706	723	752
North	92	122	135	151	183	193	222	228	233	241
Mohawk Valley	157	179	193	211	244	271	301	311	318	330
Capital	401	420	446	463	490	513	554	572	588	619
Hudson Valley	291	317	346	365	394	408	445	462	477	502
Millwood	80	88	96	101	109	114	125	130	135	143
Dunwoodie	174	191	208	218	235	246	268	279	288	303
NY City	1,604	1,756	1,883	1,970	2,117	2,238	2,435	2,534	2,620	2,753
Long Island	717	770	810	838	895	939	997	1,027	1,052	1,117
NYCA Total	4,509	4,938	5,286	5,565	6,126	6,455	7,072	7,317	7,529	7,899

Projected NYCA Load Payments (\$M)



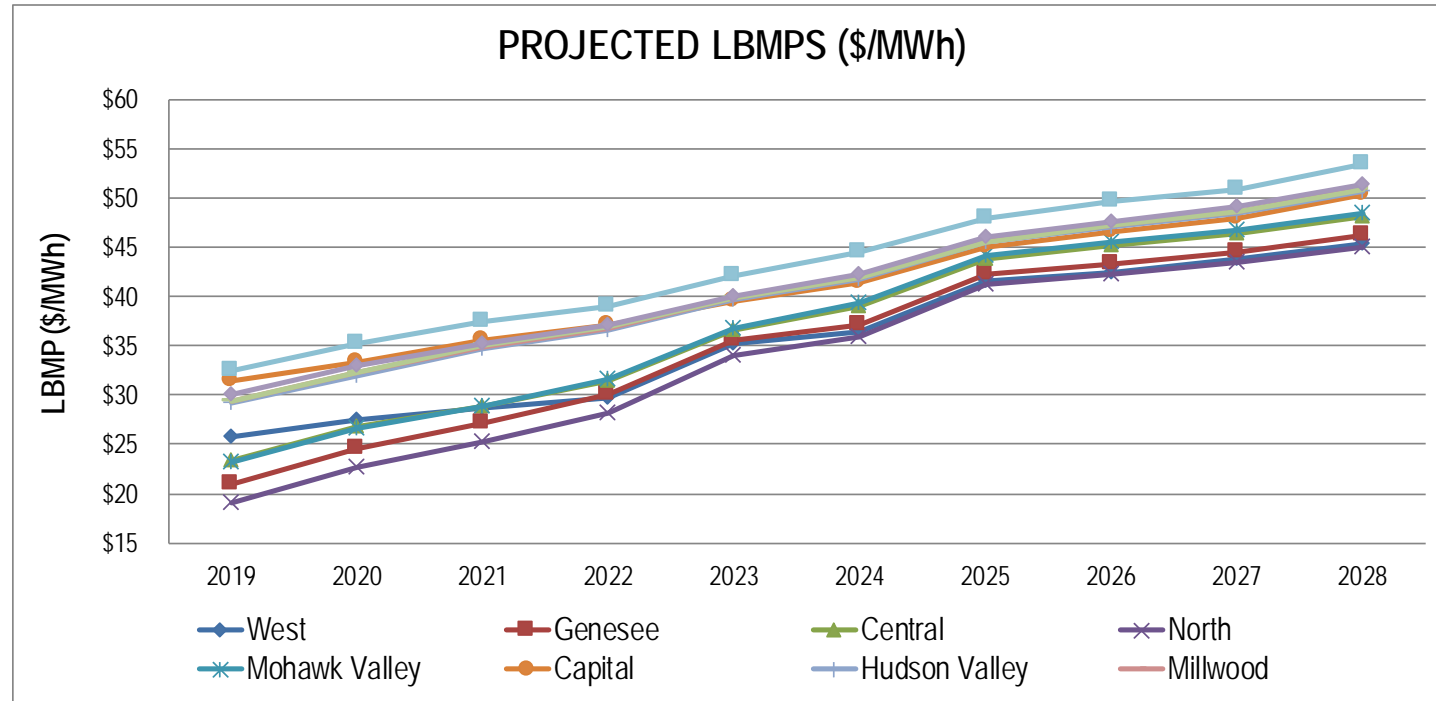
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Projected NYCA LBMPs (\$/MWh)

LBMP (\$/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	25.76	27.42	28.73	29.70	35.23	36.34	41.54	42.49	43.81	45.40
Genesee	20.88	24.61	27.06	30.09	35.62	37.07	42.22	43.36	44.51	46.27
Central	23.38	26.78	28.86	31.40	36.60	39.02	43.79	45.21	46.37	48.14
North	19.13	22.75	25.23	28.24	34.05	35.96	41.21	42.30	43.41	44.99
Mohawk Valley	23.15	26.68	28.81	31.52	36.72	39.32	44.06	45.51	46.63	48.43
Capital	31.41	33.37	35.63	37.10	39.47	41.46	45.05	46.57	47.96	50.30
Hudson Valley	29.20	31.97	34.74	36.65	39.65	41.65	45.43	47.09	48.43	50.73
Millwood	29.39	32.29	34.94	36.83	39.79	41.85	45.61	47.29	48.63	50.93
Dunwoodie	29.37	32.29	34.98	36.86	39.81	41.82	45.58	47.25	48.60	50.88
NY City	29.98	32.89	35.26	37.05	39.96	42.19	45.97	47.66	49.07	51.34
Long Island	32.46	35.21	37.42	38.99	42.13	44.52	47.89	49.60	50.88	53.39

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Projected NYCA LBMPs (\$/MWh)



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2019 CARIS 1 Study Selection

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Demand Congestion by constraints(2019 \$M)

- Sorted by 15Y Total

Constraint Group(2019 \$M)	2014	2015	2016	2017	2018	Hist. Total	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Proj. Total	15Y Total
CENTRAL EAST	1,655	1,245	814	709	598	5,021	691	491	470	347	144	139	57	54	69	93	2,555	7,576
DUNWOODIE TO LONG ISLAND	225	187	209	105	147	873	42	34	25	21	20	23	17	17	15	16	230	1,103
LEEDS PLEASANT VALLEY	62	151	80	120	10	423	2	1	1	2	2	-	-	-	-	-	9	432
EDIC MARCY	10	1	40	148	118	317	-	-	-	-	-	-	-	-	-	-	0	317
DUNWOODIE MOTT HAVEN	58	3	3	36	72	172	8	9	9	6	4	11	9	9	11	8	83	254
GREENWOOD	19	26	40	21	69	174	12	10	6	5	4	6	6	7	6	6	67	241
PACKARD HUNTLEY	10	56	69	35	45	215	-	-	-	-	-	-	-	-	-	-	0	215
CHESTR SHOEMAKR	-	-	-	-	-	-	9	33	71	58	41	-	-	-	-	-	212	212
NIAGARA PACKARD	26	30	56	14	10	135	20	15	9	0	-	0	-	-	-	-	44	179
PACKARD 115 NIAGBLVD 115	-	-	-	-	-	-	88	51	26	0	0	0	-	-	-	0	166	166
SCH-NE-NY	50	38	3	10	35	135	3	5	3	2	2	3	2	3	2	2	27	162
EGRDNCTY 138 VALLYSTR 138 1	29	24	10	20	22	105	6	5	3	2	4	3	3	2	3	2	33	139
NEW SCOTLAND LEEDS	13	44	16	21	5	99	0	-	-	0	0	-	-	-	-	-	0	100
E179THST HELLGT ASTORIAE	5	4	4	17	19	48	2	2	2	2	2	2	1	1	1	1	15	63
SHORE_RD 345 SHORE_RD 138 1	18	37	3	1	0	59	-	-	-	-	-	-	-	-	-	-	0	59
VOLNEY SCRIBA	1	1	0	1	1	3	6	6	6	6	5	4	4	4	5	5	51	55
N.WAV115 LOUNS 115	-	-	-	-	-	-	2	2	2	3	3	10	7	8	7	6	52	52

Projected Demand Congestion - Key Drivers

- **2020**
 - Cricket Valley Energy Center Addition (Zone G, +1177.2MW)
 - Indian Point 2 Retirement (Zone H -1299MW)
- **2021**
 - Indian Point 3 Retirement (Zone H -1012MW)
- **2022**
 - Empire State Line Project/Western Public Policy Transmission Project in service
- **2023**
 - Ontario nuclear generation decreases ~19TWh compared with 2022 due to retirements of two Pickering units and refurbishment of Bruce units
- **2024**
 - Selected AC Public Policy Transmission Project (Segments A and B) in service
 - Ontario nuclear generation increases ~14TWh compared with 2023 due to Bruce and Darlington units returning from refurbishments
- **2025**
 - Ontario nuclear generation decreases ~19TWh compared with 2024 due to retirements of four Pickering units and refurbishment of Bruce units

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Demand Congestion by constraints(2019 \$M)

- Sorted by 10Y Total

Constraint Group(2019 \$M)	2014	2015	2016	2017	2018	Hist. Total	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Proj. Total	15Y Total
CENTRAL EAST	1,655	1,245	814	709	598	5,021	691	491	470	347	144	139	57	54	69	93	2,555	7,576
DUNWOODIE TO LONG ISLAND	225	187	209	105	147	873	42	34	25	21	20	23	17	17	15	16	230	1,103
CHESTR SHOEMAKR	-	-	-	-	-	-	9	33	71	58	41	-	-	-	-	-	212	212
PACKARD 115 NIAGBLVD 115	-	-	-	-	-	-	88	51	26	0	0	0	-	-	-	0	166	166
DUNWOODIE MOTTHAVEN	58	3	3	36	72	172	8	9	9	6	4	11	9	9	11	8	83	254
GREENWOOD	19	26	40	21	69	174	12	10	6	5	4	6	6	7	6	6	67	241
N.WAV115 LOUNS 115	-	-	-	-	-	-	2	2	2	3	3	10	7	8	7	6	52	52
VOLNEY SCRIBA	1	1	0	1	1	3	6	6	6	6	5	4	4	4	5	5	51	55
NORTHPORT PILGRIM	-	-	-	-	-	-	6	4	8	9	6	3	3	3	3	2	47	47
NIAGARA PACKARD	26	30	56	14	10	135	20	15	9	0	-	0	-	-	-	-	44	179
FERND 115 W.WDB 115	-	-	-	-	-	-	2	5	9	7	7	1	-	0	0	1	34	34
EGRDNCTY 138 VALLYSTR 138 1	29	24	10	20	22	105	6	5	3	2	4	3	3	2	3	2	33	139
SCH-NE-NY	50	38	3	10	35	135	3	5	3	2	2	3	2	3	2	2	27	162
NIAGARA ROBINSON	-	-	0	0	0	0	7	7	3	0	-	0	-	-	-	-	17	18
NEW SCOTLAND KNCKRBOC	-	-	-	-	-	-	-	-	-	-	-	3	3	5	3	3	16	16
UPNY-ConEd	-	3	-	5	-	8	-	15	0	-	-	-	-	-	-	-	16	24
E179THST HELLG T ASTORIAE	5	4	4	17	19	48	2	2	2	2	2	2	1	1	1	1	15	63

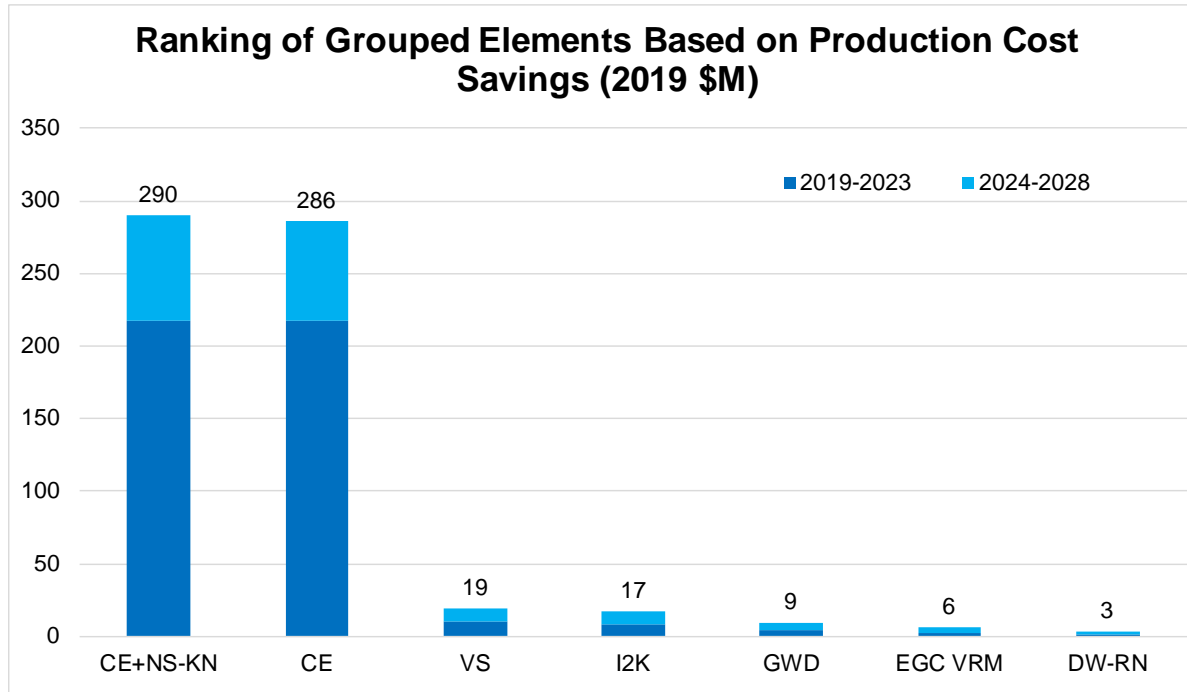
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Relaxation Starting Point

- Relaxation process begins with top 10 transmission constraints based on 15 Year Total
- Process allows for consideration of additional constrains that experience forecasted congestion significantly in excess of historical values
- Relaxation starting point
 - CENTRAL EAST
 - DUNWOODIE TO LONG ISLAND(I2K)
 - DUNWOODIE TO MOTT HAVEN(expanded to DUNWOODIE TO RAINEY)
 - GREENWOOD LP(GWD)
 - EAST GARDEN CITY VALLEY STREAM(EGC VRM)
 - VOLNEY SCRIBA(VS)
 - NEW SCOTLAND KNICKERBOCKER(NS-KN)

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Central and Eastern Relaxation: Production Cost saving



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Final Study Selection

- 3 Studies Identified
 - Central East
 - Central East-Knickerbocker
 - Volney-Scriba

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Feedback/Comments?

- Email additional feedback to: Cyang@nyiso.com

APPENDIX

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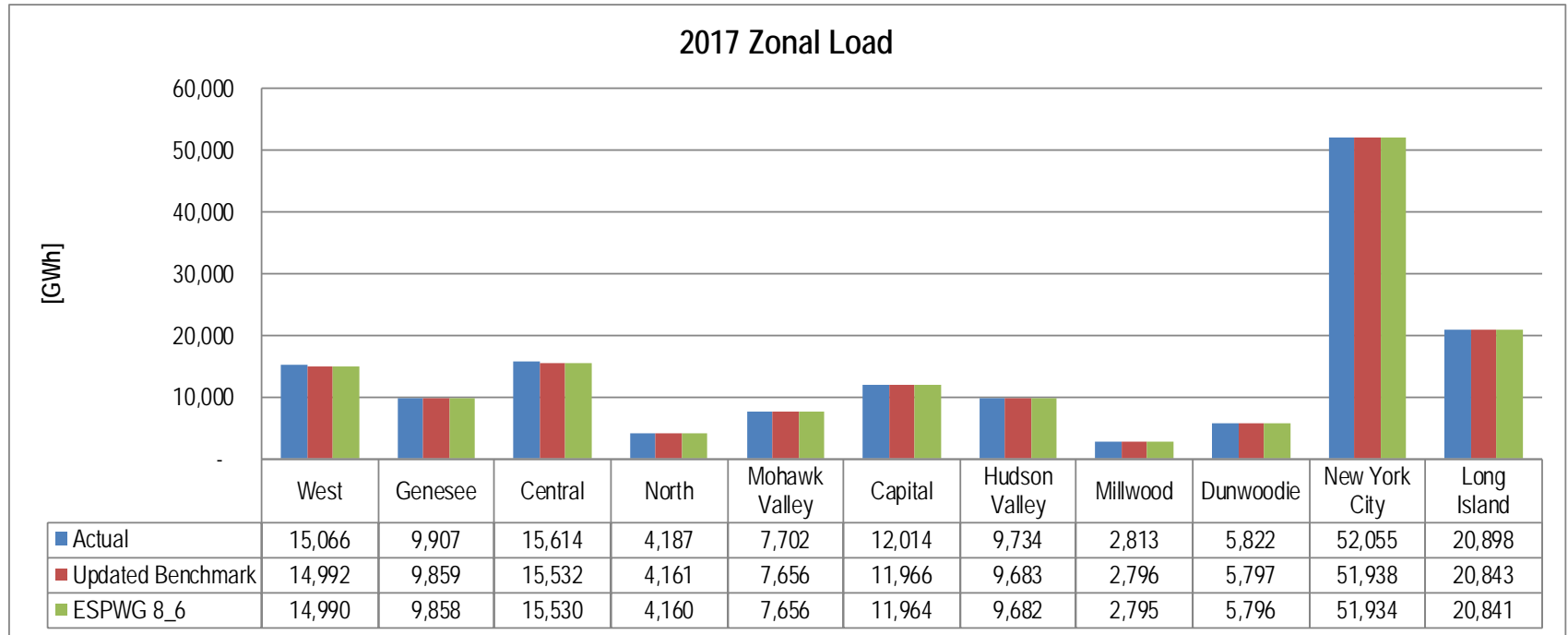
Updated 2017 Benchmark Additional Results

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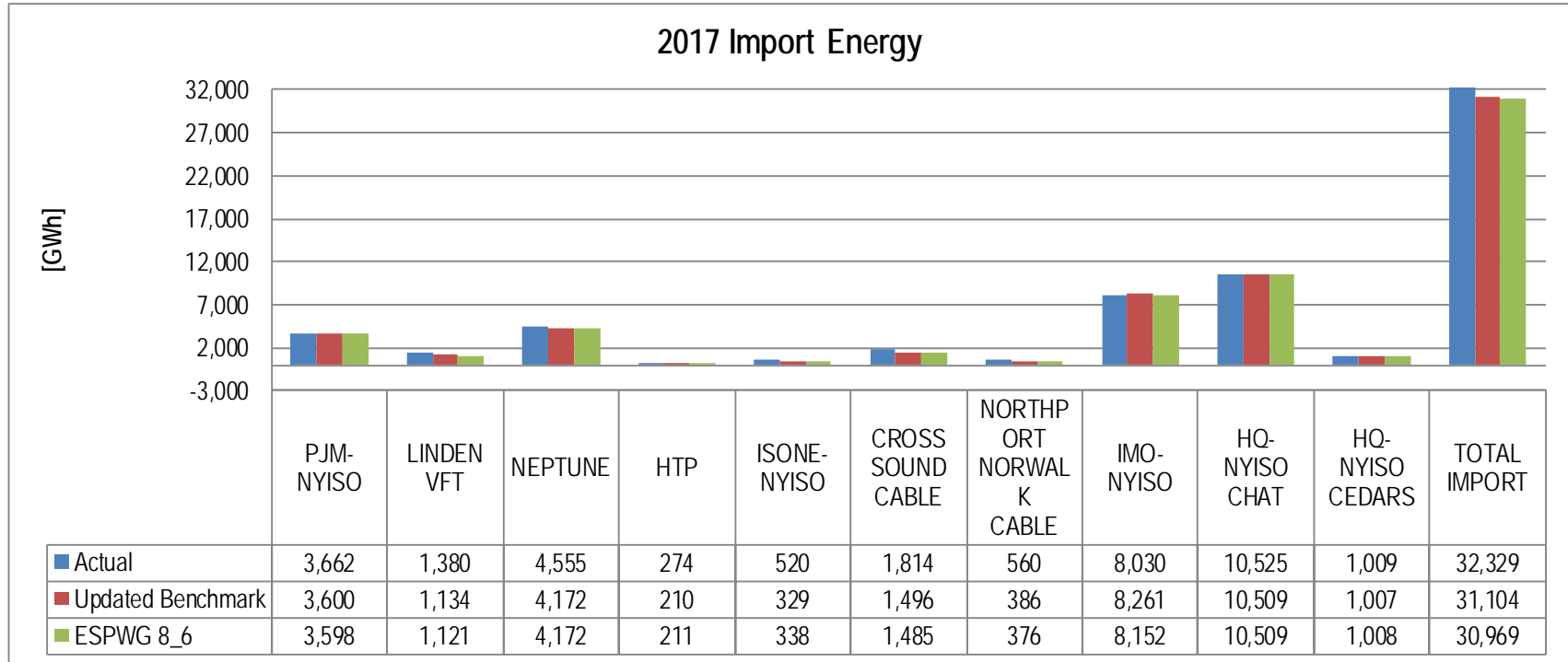


2017 Zonal Load Summary



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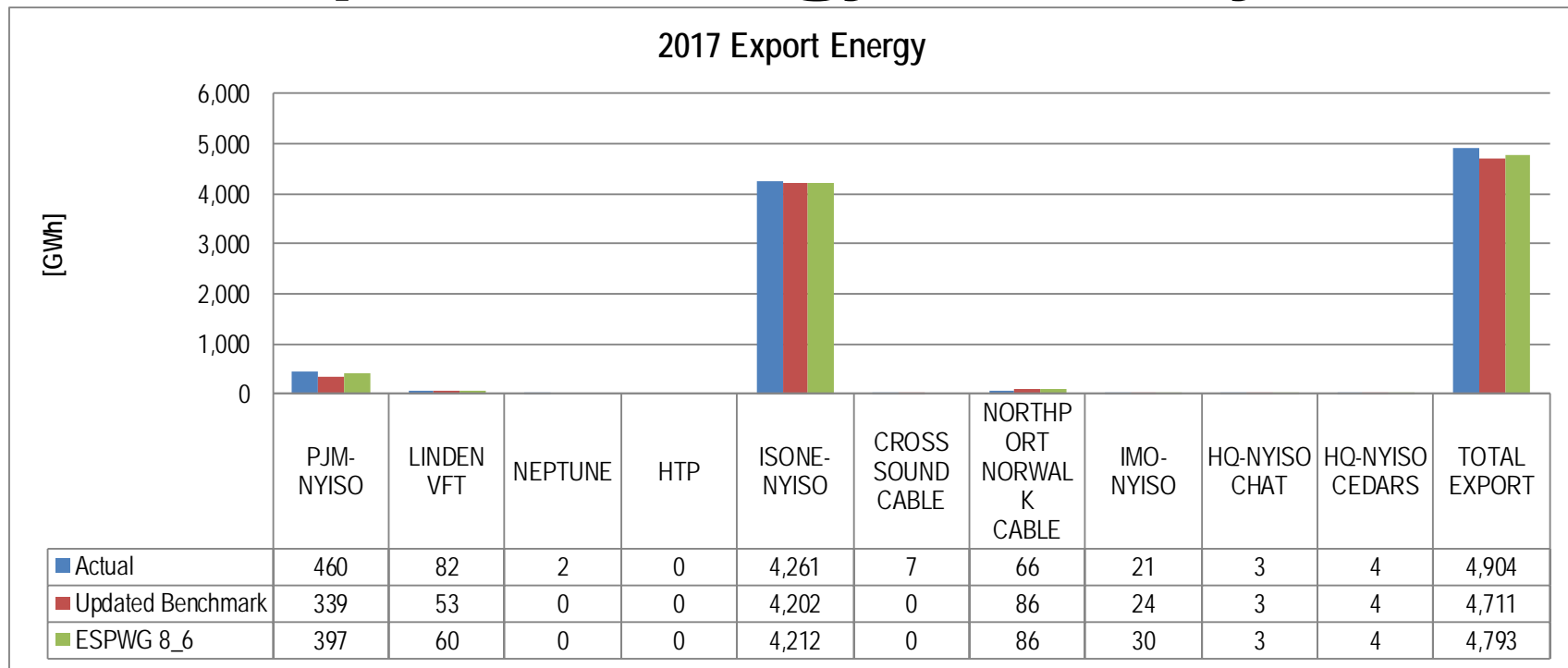
2017 Import* Energy Summary



* Sum of hourly imported GWh from Externals to NYCA

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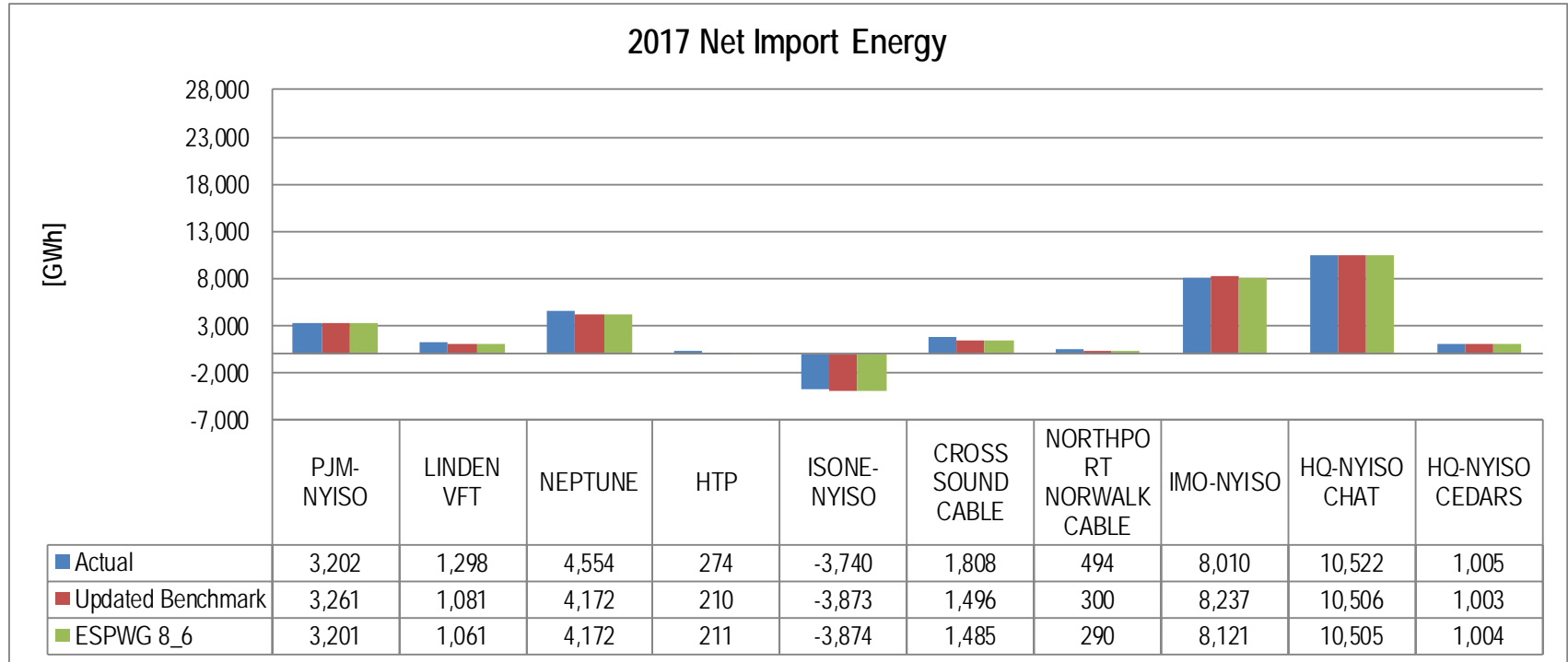
2017 Export** Energy Summary



* **Sum of hourly exported GWh from NYCA to Externals

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2017 Net Import*** Energy Summary

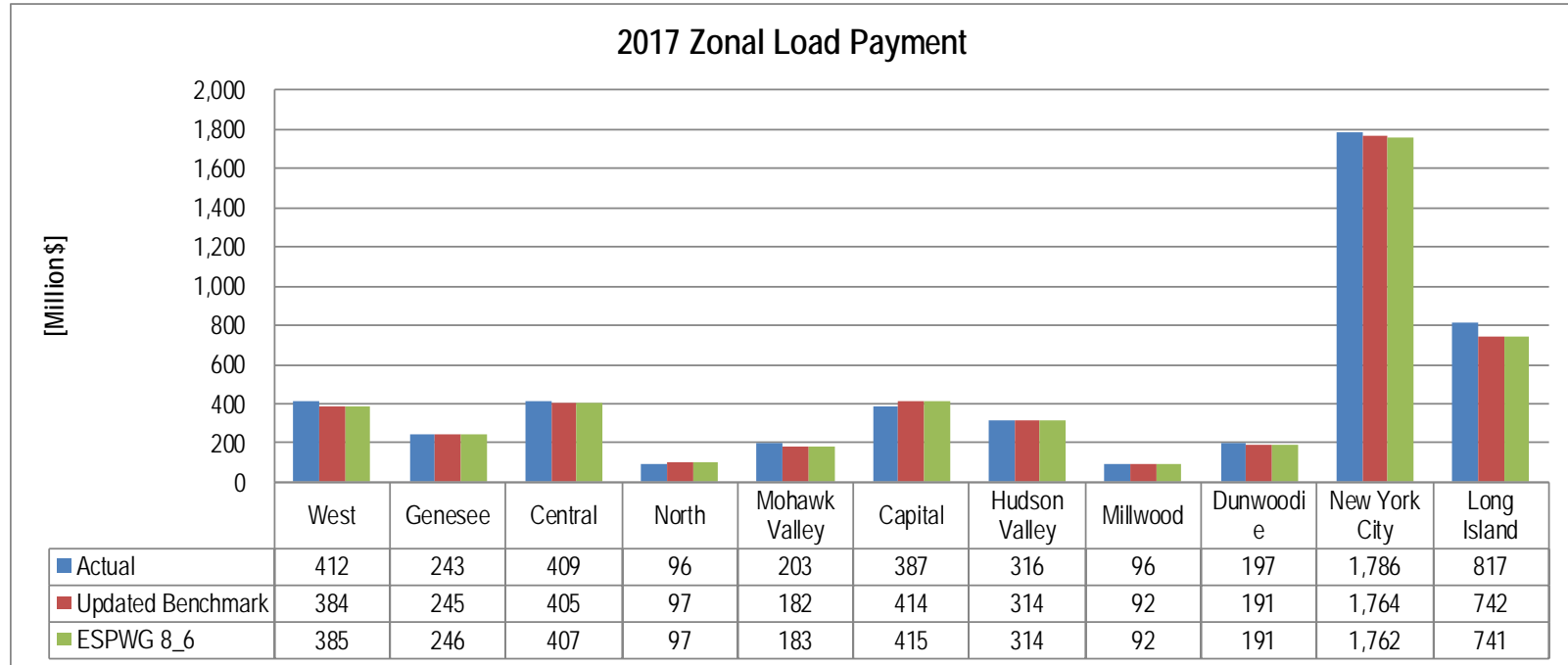


*** Import - Export

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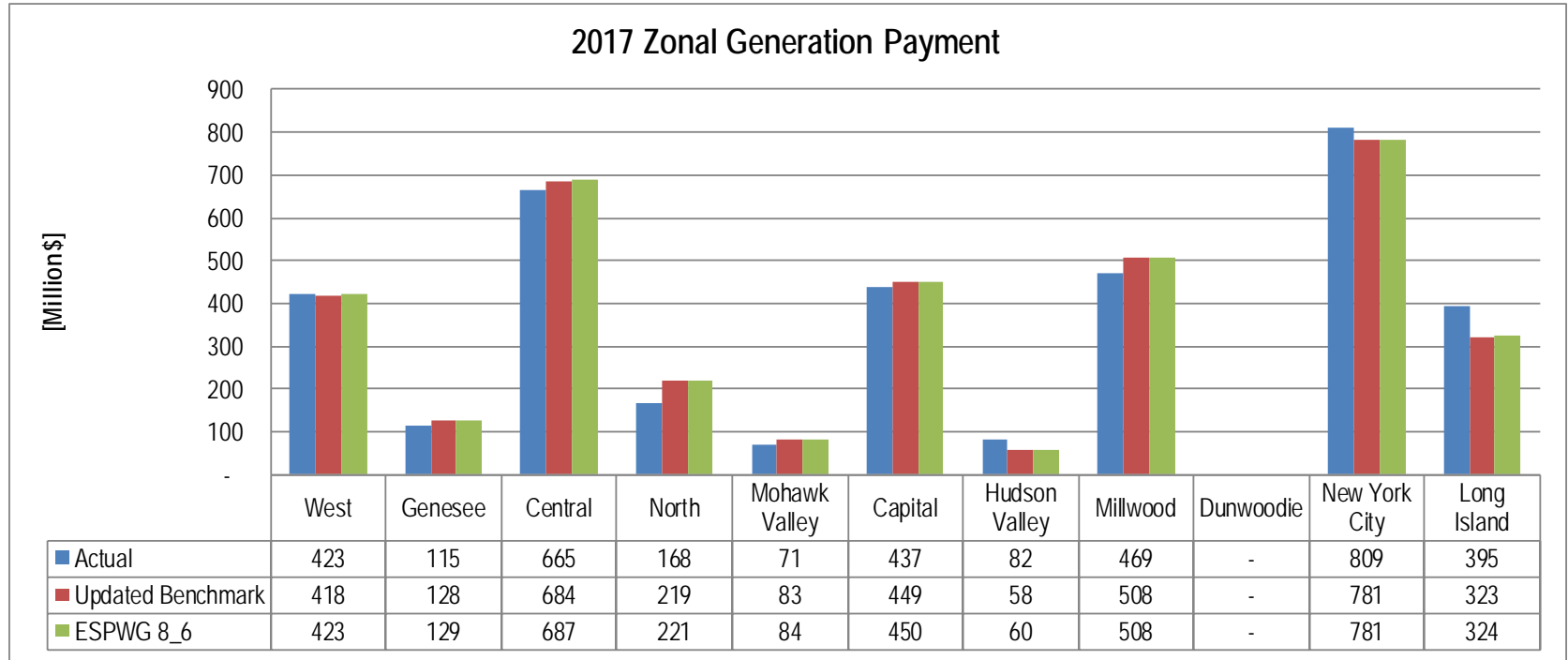


2017 Load Payment Summary



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2017 Gen Payment Summary



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The Mission of the New York Independent System Operator, in collaboration with its stakeholders, is to serve the public interest and provide benefit to consumers by:

- Maintaining and enhancing regional reliability
- Operating open, fair and competitive wholesale electricity markets
- Planning the power system for the future
- Providing factual information to policy makers, stakeholders and investors in the power system



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