New York ISO

A Report by the
New York Independent
System Operator

APPENDICES

2019 Congestion Assessment and Resource Integration Study

Comprehensive System Planning Process

CARIS - Phase 1

Appendices B - M

July 2020

2019 Congestion Assessment and Resource Integration Study

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Appendices B-M

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July 24, 2020

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NYISO System Resources and Planning staff can be reached at 518-356-6000 to address any questions regarding this CARIS report or the NYISO's economic planning processes.

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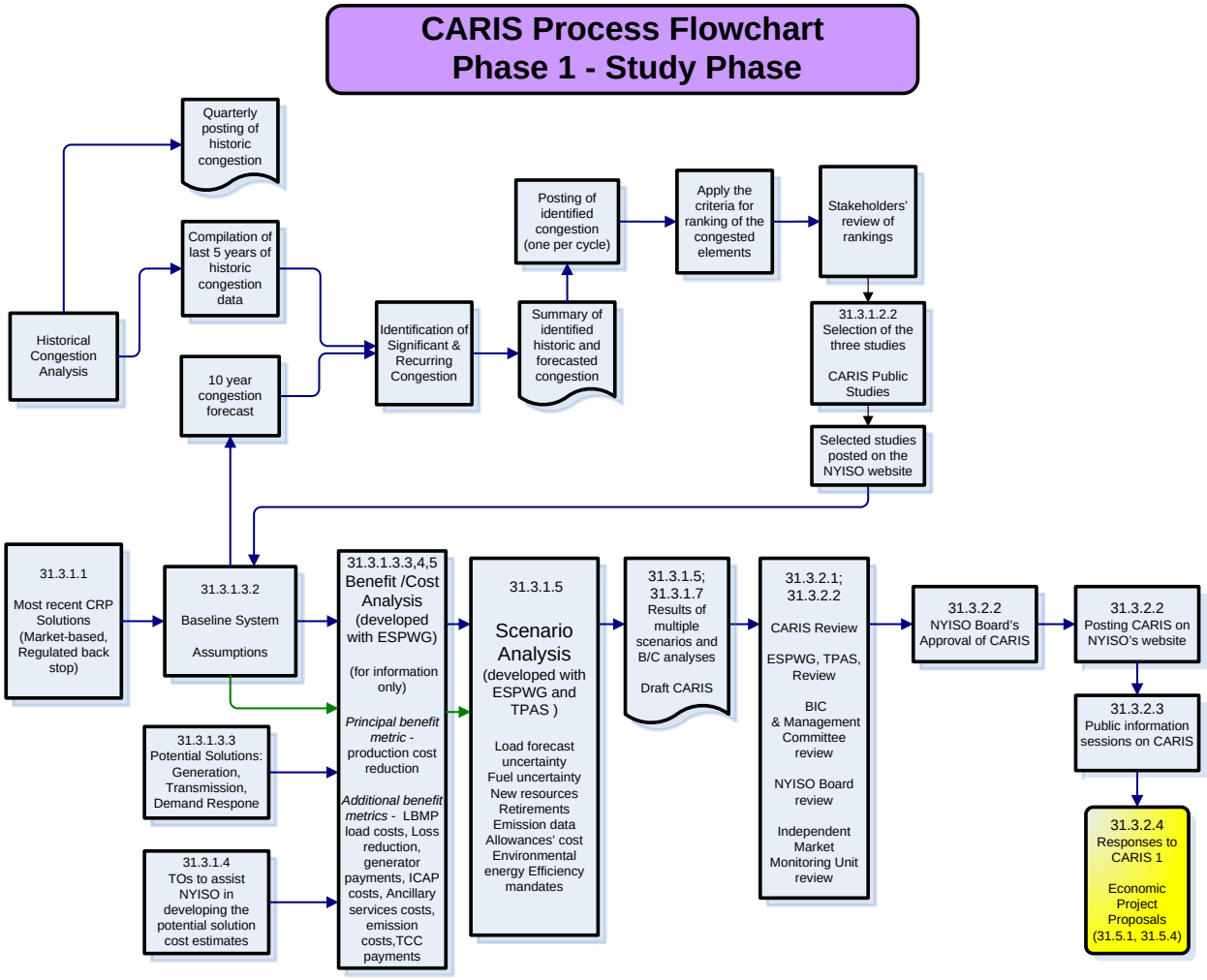
Appendix B - Congestion Assessment and Resource Integration Study Process

CARIS consists of two phases: Phase 1 (the Study Phase) and Phase 2 (the Project Phase). This two-phase process is described below and explained in full detail in the *Economic Planning Process Manual - Congestion Assessment and Resource Integration Studies Manual.*[1]

Phase 1 - Study Process

Phase 1 of the CARIS is depicted in Figure 1.

Figure 1: Phase 1 or Study Phase of the CARIS Process



1https://www.nyiso.com/documents/20142/2924447/epp_caris_mnl.pdf/6510ece7-e0a6-7bee-e776-694abf264bae

Phase 2 - Projects Phase

Phase 2 of the CARIS is depicted in Figure 2 and Figure 3.

Figure 2: Phase 2 or Project Phase of the CARIS Process

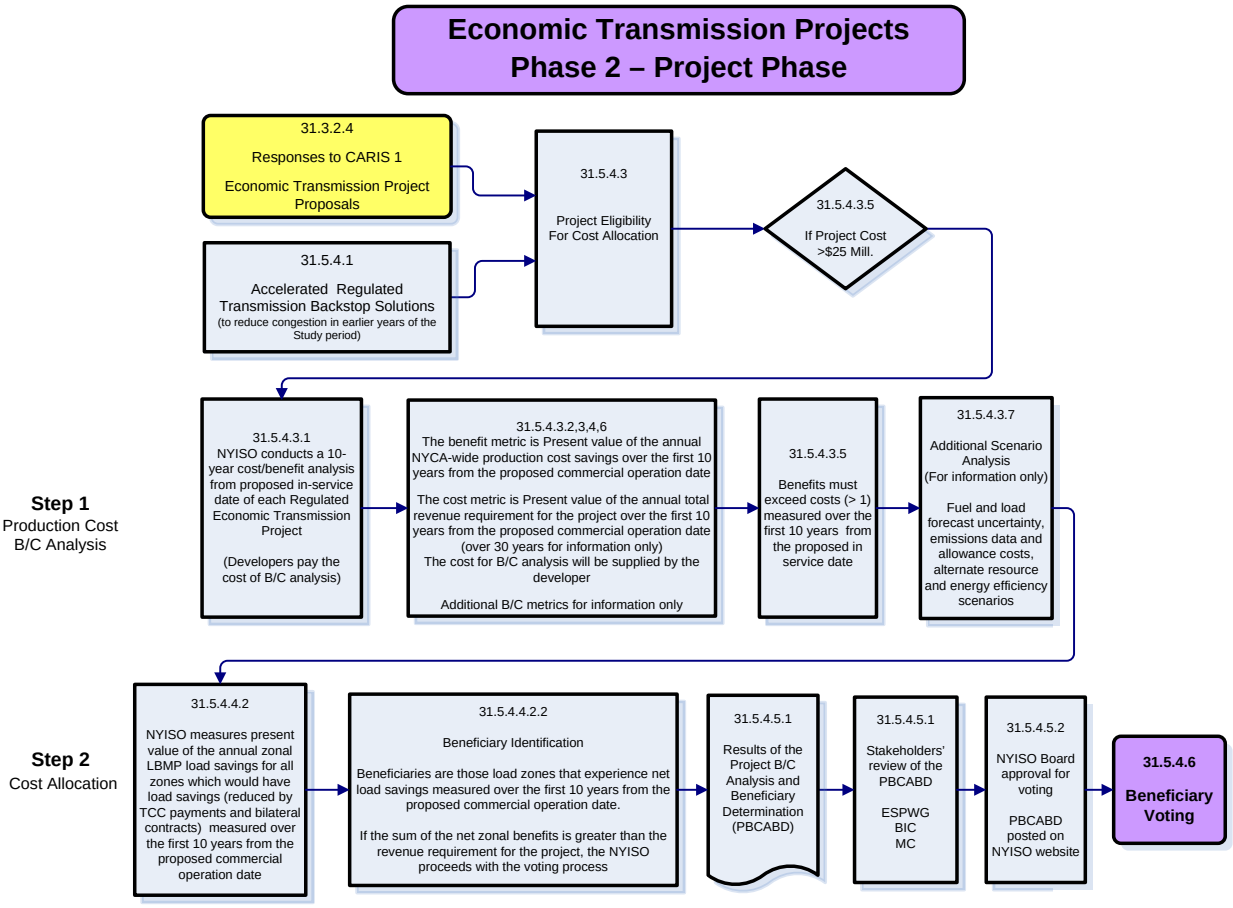
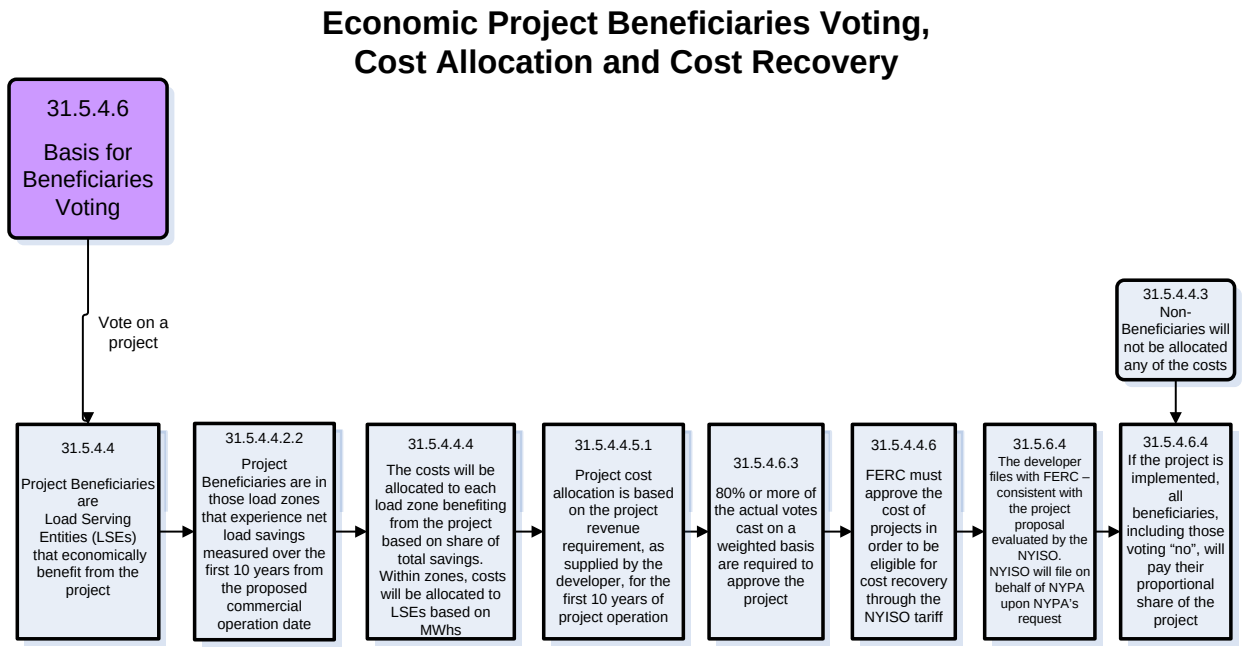


Figure 3: Voting, Cost Allocation, and Cost Recovery of the CARIS Process



Appendix C - Base Case System Assumptions and Methodology

CARIS Model - Base Case Modeling Assumptions for 2019-2028

As described in Section 31.3.1 of Attachment Y, the CARIS will align with the Reliability Planning Process, and the ten-year Study Period covered by the most recently approved CRP shall be the same as the CARIS Phase 1 Study Period. The CARIS will assume a reliable system throughout the Study Period, based first upon the solutions identified in the most recently completed and approved CRP.

The data utilized in the base case simulations for 2019 CARIS Phase 1 is largely derived from the 2019-28 CRP, 2019 Gold Book and CARIS Assumptions Matrix, Figure 4, shown below. Major components of the data include base load flow data, unit heat rates, unit capacities, fuel prices, transmission constraint modeling, load forecasts, load shape, both simulated and actual and scheduled interchange values, O&M cost, and emission costs.

Detailed descriptions of key data used in the 2019 CARIS are listed below. The data was developed based on the NYISO's Tariff requirements and procedures and in collaboration with stakeholders at ESPWG. Key changes from 2017 are noted in red.

Figure 4: 2017 and 2019 CARIS Base Case Assumptions Matrix Comparison

Parameter	Modeling for 2017 CARIS Base Case	Modeling for 2019 CARIS Base Case
Peak Load	Based on 2017 Load & Capacity Data Report ("Gold Book") Baseline Forecast of Non-Coincident Peak Demand , including impacts of statewide Energy Efficiency programs (Table 1-2b-1)	Based on 2019 Load & Capacity Data Report ("Gold Book") Baseline Forecast of Non-Coincident Peak Demand , including impacts of statewide Energy Efficiency programs (Table 1-3a and 1-3b)
Load Shape Model **Energy Forecast**	2002 Load Shape. Energy Forecast based on 2017 Load & Capacity Data Report ("Gold Book") Baseline Forecast of Annual Energy, including impacts of statewide Energy Efficiency programs (Table 1-2a)	2002 Load Shape. Energy Forecast based on 2019 Load & Capacity Data Report ("Gold Book") Baseline Forecast of Annual Energy, including impacts of statewide Energy Efficiency programs (Table 1-2)
Load Uncertainty Model	Only Base Level Forecast utilized; the impact of energy or peak forecasts may be utilized in scenarios	Only Base Level Forecast utilized; the impact of energy or peak forecasts may be utilized in scenarios

Parameter	Modeling for 2017 CARIS Base Case	Modeling for 2019 CARIS Base Case
Generating Unit Capacities	Updated to reflect 2017 Gold Book winter and summer DMNC values	Updated to reflect 2019 Gold Book winter and summer DMNC values
New Units	Updated as per 2017 Gold Book (Application of inclusion rules identified in Reliability Planning Process Manual, Section 3.1.1 and procedures)procedures)	Updated as per 2019 Gold Book (Application of inclusion rules identified in Reliability Planning Process Manual, Section 3.2 and procedures)
Wind Resource Modeling	Units and capacities updated as per 2017 Gold Book. Existing wind resources are modeled based on unit capacities and actual 2015 shapes. New units modeled based on proximate existing units.	Units and capacities updated as per 2019 Gold Book. Existing wind resources are modeled based on unit capacities and actual 2017 shapes. New units modeled based on proximate existing units.
Solar BTM-PV Resource Modeling	Modeled as distributed hourly resource modifiers. Zonal capacities as per 2017 Gold Book. BTM-PV resources are modeled based on synthetically derived historical shapes from NREL PV Watts tool.	Modeled as distributed hourly resource modifiers. Zonal capacities as per 2019 Gold Book. BTM-PV resources are modeled based on synthetically derived historical shapes from NREL PV Watts tool.
Special Case Resources	Not utilized in MAPS production cost modeling; incorporated in ICAP Metric calculation	Not utilized in MAPS production cost modeling; incorporated in ICAP Metric calculation
EDRP Resources	N/A for production cost modeling	N/A for production cost modeling
External Capacity – Purchases and Wheel-Throughs	Flows across schedulable and non-schedulable transmission lines are based on economics.	Flows across schedulable and non-schedulable transmission lines are based on economics.
Retirements	Updated as per 2017 Gold Book (Application of inclusion rules; specific assumptions concerning mothball announcement post-CRP; units with completed studies indicating that the unit is required for reliability are retained in the Base Case; units whose studies are pending are retained in the Base Case; others are excluded from the Base Case)	Updated as per 2019 Gold Book (Application of inclusion rules; specific assumptions concerning mothball announcement post-CRP; units with completed studies indicating that the unit is required for reliability are retained in the Base Case; units whose studies are pending are retained in the Base Case; others are excluded from the Base Case; units that have filed compliance plans prior to July 31st 2019 that are in response to regulatory mandates and indicate that the unit will retire will also be excluded.)

Parameter	Modeling for 2017 CARIS Base Case	Modeling for 2019 CARIS Base Case
Generator Outages	Scheduled to levelize reserves; as per the maintenance schedules in long term adequacy studies.	Scheduled to levelize reserves; as per the maintenance schedules in long term adequacy studies.
Gas Turbines Ambient Derate	Modeling utilizes summer and winter DMNC ratings for all units.	Modeling utilizes summer and winter DMNC ratings for all units.
Environmental Modeling **Externalities** **Allowances**	Allowance costs based on projected RGGI costs. SO_2 and NO_x Allowance Prices reflect CSAPR markets. Detailed allowance costs are provided in the 6/22/17 ESPWG meeting materials.	Allowance costs based on projected RGGI costs. SO_2 and NO_x Allowance Prices reflect CSAPR markets. Detailed allowance costs are provided in the 6/25/19 ESPWG meeting materials.
Commitment and Dispatch Options **Operating Reserves**	Each Balancing Authority commits to serve its own load, firm transactions, and potential transfers Hurdle rates – flat. As presented on 6/22/17 to ESPWG. Operating Reserves as per NYCA requirements.	Each Balancing Authority commits to serve its own load, firm transactions, and potential transfers Hurdle rates – flat As presented on 8/6/19 to ESPWG. Operating Reserves as per NYCA requirements.
Fuel Price Forecast	Annual bases updated to more heavily weight recent trends (2014-075., 2015-0.3, 2016-0.625). Seasonality and spikes based on five-year history (2012-2016). Calculated natural price forecasts based on blends of hub price forecasts for four hubs (A-E, F-I, J and K). Utilized unit capacities and reported pricing hubs to weight price forecasts.	Annual bases updated to more heavily weight recent trends (2016-0.075, 2017-0.3, 2018-0.625). Seasonality and spikes based on five-year history (2014-2018). Calculated natural price forecasts based on blends of hub price forecasts for four hubs (A-E, F-I, J and K). Utilized historic unit production and reported pricing hubs to weight price forecasts.

Parameter	Modeling for 2017 CARIS Base Case	Modeling for 2019 CARIS Base Case
	Fuel oil and coal price forecasts are developed utilizing the EIA's annual forecast of national delivered prices. Regional bases are derived using EIA Form 923 data. The seasonality for fuel oils is based on an analysis of New York Harbor Ultra-Low Sulfur Diesel (ULSD) prices. Coal has no seasonality. Illustrative fuel costs are presented in the 8/28/17 ESPWG meeting materials.	Fuel oil and coal price forecasts are developed utilizing the EIA's annual forecast of national delivered prices. Regional bases are derived using EIA Form 923 data. The seasonality for fuel oils is based on an analysis of New York Harbor Ultra-Low Sulfur Diesel (ULSD) prices. Coal has no seasonality. Illustrative fuel costs are presented in the 8/06/2019 ESPWG meeting materials.
Cost Curve Development (including heat rates and emission rates)	Unit heat rates (and emission rates) developed from vendor supplied data, USEPA CAMD fuel input and emissions data matched with NYISO production data for NYCA and USEIA production data for non NYCA units.	Unit heat rates (and emission rates) developed from vendor supplied data, USEPA CAMD fuel input and emissions data matched with NYISO production data for NYCA and USEIA production data for non NYCA units.
Local Reliability Rules	List and develop appropriate nomograms. Fuel burn restrictions, operating restrictions and exceptions, commitment/dispatch limits	List and develop appropriate nomograms. Fuel burn restrictions, operating restrictions and exceptions, commitment/dispatch limits
Energy Storage **Gilboa PSH** **Lewiston PSH**	Scheduling checked to conform to historical operations.	Scheduling checked to conform to historical operations.
Power Flow Cases	Consistent with 2017-2026 Comprehensive Reliability Plan	Consistent with 2019-2028 Comprehensive Reliability Plan
Interface Limits **Monitored/contingency pairs** **Nomograms** **Joint, Grouping** **Unit Sensitive Voltage**	Data from the results of internal and external planning studies; vendor-supplied data; operational voltage studies; operational limits; transfer limit analysis for critical interfaces.	Data from the results of internal and external planning studies; vendor-supplied data; operational voltage studies; operational limits; transfer limit analysis for critical interfaces.
New Transmission Capability	Updated as per 2017 Gold Book (Application of base case inclusion rules)	Updated as per 2019 Gold Book (Application of base case inclusion rules)

Parameter	Modeling for 2017 CARIS Base Case	Modeling for 2019 CARIS Base Case
Internal Controllable Lines (PARs, DC, VFT)	Optimized in simulation.	Optimized in simulation.
Neighboring Systems		
Outside World Area Models **Fuel Forecast**	Power flow data from CRP, "production" data developed by NYISO with vendor and neighbor input. Fuel forecasts developed utilizing same methodology as NYCA fuel forecasts.	Power flow data from CRP, "production" data developed by NYISO with vendor and neighbor input. Fuel forecasts developed utilizing same methodology as NYCA fuel forecasts.
External Capacity And Load Forecast	Neighboring systems modeled consistent with reserve margins in the RNA/CRP analysis. Neighboring systems data reviewed and held at required reserve margin.	Neighboring systems modeled consistent with reserve margins in the RNA/CRP analysis. Neighboring systems data reviewed and held at required reserve margin.
System Representation in Simulation	HQ modeled as fixed hourly schedule, synchronized with all other external injections. Full Representation/Participation: NYISO ISONE IESO PJM Classic & AP,AEP,CE,DLCO, DAY, VP, EKPC Proxy Bus Injection: HQ-NYISO, HQ-NE-ISO, HQ – IESO Transmission Only/Zeroed Out: MECS,FE,SPP, MAR, NIPS,OVEC,TVA, FRCC,SERC,ERCOT,WECC	HQ modeled as fixed hourly schedule, synchronized with all other external injections. Full Representation/Participation: NYISO ISONE IESO PJM Classic & AP, AEP, CE, DLCO, DAY, VP, EKPC Proxy Bus Injection: HQ-NYISO, HQ-NE-ISO, HQ – IESO Transmission Only/Zeroed Out: MECS,FE,SPP, MAR, NIPS,OVEC,TVA, FRCC,SERC,ERCOT,WECC
External Controllable Lines (PARs,DC,VFT, Radial lines)	Western ties to carry 32% of PJM-NYISO AC Interchange + 20% of RECO Load 5018 line to carry 32% of PJM-NYISO AC Interchange + 80% of RECO Load PAR ABC to carry 21% of PJM-NYISO AC Interchange + 400 MW	B and C modeled as out of service. Current JOA modeled under these outage conditions. Western ties to carry 46% of PJM-NYISO AC Interchange + 20% of RECO Load

Parameter	Modeling for 2017 CARIS Base Case	Modeling for 2019 CARIS Base Case
	OBF (note: OBF to 0 as of 6/1/2021) PAR JK to carry 15% of PJM-NYISO AC Interchange - 400 MW OBF (note: OBF to 0 as of 6/1/2021) Norwalk (-200MW, +200MW) L33,34 (-300MW, +300MW) PV20 (0MW, +150MW) Neptune (0MW, +660MW) CSC (0MW, +330MW) CSC and Neptune optimized subject to "cost of use" HTP (0, 660) Linden VFT (-315,315)	5018 line to carry 32% of PJM-NYISO AC Interchange + 80% of RECO Load PAR A to carry 7% of PJM-NYISO AC Interchange + 100 MW OBF (note: OBF to 0 as of 11/1/2019) PAR J-K to carry 15% of PJM-NYISO AC Interchange - 100 MW OBF (note: OBF to 0 as of 11/1/2019) Norwalk (-200MW, +200MW) L33,34 (-300MW, +300MW) PV20 (0MW, +150MW) Neptune (0MW, +660MW) CSC (0MW, +330MW) CSC and Neptune optimized subject to "cost of use" HTP (0, 660) Linden VFT (-315,315)

Base Case Load Forecast

CARIS Base Case load forecasts, from the 2019 Gold Book baseline forecast, are presented in Figure 5 and Figure 6. Figure 5 presents the Annual Zonal Energy in gigawatt-hours (GWh) and Figure 6 presents summer non-coincident peak demand in megawatts (MW).

Figure 5: Annual Zonal Energy (GWh)

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA
2019	15,550	9,975	16,213	4,845	7,815	12,117	9,793	2,739	5,895	51,874	20,643	157,459
2020	15,327	9,850	15,983	5,397	7,650	11,847	9,657	2,725	5,840	51,391	20,377	156,044
2021	15,172	9,781	15,830	5,386	7,536	11,705	9,568	2,719	5,805	51,080	20,018	154,600
2022	15,078	9,760	15,747	5,382	7,457	11,629	9,540	2,720	5,803	51,067	19,972	154,155
2023	14,955	9,724	15,649	5,373	7,368	11,540	9,509	2,728	5,807	51,102	19,817	153,572
2024	14,879	9,724	15,602	5,367	7,306	11,489	9,515	2,733	5,823	51,245	19,703	153,386
2025	14,738	9,676	15,485	5,355	7,214	11,390	9,475	2,742	5,824	51,248	19,492	152,639
2026	14,656	9,668	15,428	5,348	7,158	11,341	9,476	2,757	5,834	51,336	19,378	152,380
2027	14,596	9,666	15,385	5,341	7,112	11,304	9,492	2,782	5,852	51,494	19,347	152,371
2028	14,590	9,695	15,394	5,337	7,095	11,312	9,544	2,807	5,881	51,749	19,608	153,012

Note: Forecast above includes Retail Solar PV. In the MAPS model, Retail Solar PV is modeled explicitly as a distributed resource at the zonal level.[2]

2 The Retail Solar PV model shapes were based on the publically available data from U.S. Department of Energy/National Renewable Energy Lab/Alliance for Sustainable Energy, LLC.

Figure 6: Summer Non-Coincident Peak Demand by Zone (MW)

Year	A	B	C	D	E	F	G	H	I	J	K
2019	2,732	1,983	2,847	569	1,351	2,425	2,249	640	1,407	11,608	5,240
2020	2,691	1,959	2,801	666	1,320	2,367	2,232	637	1,412	11,651	5,134
2021	2,672	1,953	2,779	663	1,301	2,342	2,210	637	1,417	11,695	5,056
2022	2,653	1,953	2,759	663	1,284	2,317	2,207	637	1,418	11,704	5,035
2023	2,625	1,947	2,735	662	1,264	2,291	2,213	635	1,407	11,608	4,969
2024	2,602	1,944	2,714	661	1,246	2,264	2,209	634	1,406	11,598	4,894
2025	2,582	1,940	2,695	658	1,229	2,242	2,206	635	1,408	11,616	4,823
2026	2,565	1,937	2,678	657	1,214	2,225	2,196	636	1,408	11,616	4,758
2027	2,548	1,937	2,666	654	1,203	2,208	2,184	636	1,406	11,598	4,719
2028	2,537	1,937	2,653	654	1,193	2,197	2,174	637	1,405	11,589	4,730

Note: Forecast above includes Retail Solar PV. In the MAPS model, Retail Solar PV is modeled explicitly as a distributed resource at the zonal level.

Power Flow Data

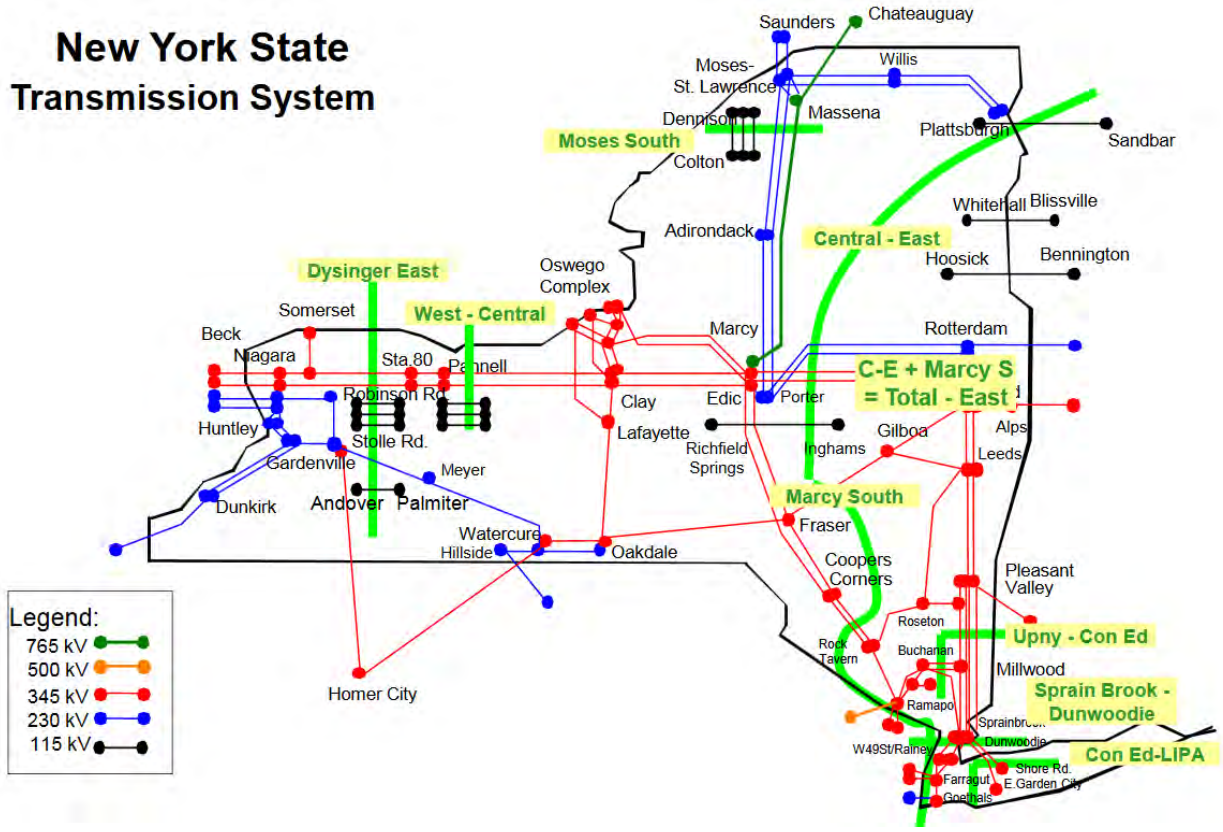
The CARIS uses the network topology, transmission line impedance and ratings as set forth in the assumptions matrix.

Transmission Model

New York Control Area Model

Figure 7 below displays the bulk power system for NYCA, which generally consists of facilities 230 kV and above, but also includes certain 138 kV facilities and a small number of 115 kV facilities. The balance of the facilities at 138 kV and below are considered non-bulk or sub-transmission facilities for purposes of this study. The figure also displays key transmission interfaces for New York.

Figure 7: NYISO 115 kV and Above Transmission Map



New York Control Area Changes, Upgrades and Resource Additions

System changes modeled for 2019 and beyond are as follows:

a) Conforming the modeling of the PJM/NYISO interface to the current NYISO-PJM Joint Operating Agreement

b) Seasonal (winter) by-pass of the Marcy South Series Compensation (MSSC)

c) Erie – South Ripley series reactor in-service (2019)

d) Rainey – Corona PAR in-service (2019)

e) Leeds Hurley SDU in-service (2020)

f) Empire State Line/Western NY Public Policy Transmission project modeled in-service (2022)

g) Selected AC Public Policy Transmission projects (segments A and B) modeled in-service (2024)

External Area Model

ISO-NE, IESO, and PJM are actively modeled in the production cost simulation. HQ is not since it is asynchronously tied to the bulk system. Proxy buses representing the direct ties from HQ to

NYISO, HQ to IESO and HQ to ISO-NE are modeled. The HQ to NYISO capacity modeled is 1,310 MW. Figure 8 through Figure 10 lists the additions, retirements and rerates for the external control areas by fuel source by year as reported by the external control areas in their planning documents. Figure 11 and Figure 12 present the aggregate capacities by unit type, and the peak and energy forecasts for each external control area modeled.

Figure 8: PJM Unit Additions, Retirements and Rerates (MW)

Year	Source	Additions	Retirements	Rerates
2019	Coal		3,183	-
	Fossil Fuel	485	198	410
	Hydro			
	Landfill Gas/Bio			
	Nuclear		805	
	Solar	447		
	Wind	1,065		
2020	Coal		1,850	
	Fossil Fuel	1,157	233	
	Hydro			
	Landfill Gas/Bio		60	
	Nuclear			
	Solar			
	Wind	300		
2021	Coal		850	
	Fossil Fuel	2,162	1,221	50
	Hydro			
	Landfill Gas/Bio			
	Nuclear		1,852	
	Solar			
	Wind			
2022	Coal		1,288	
	Fossil Fuel			
	Hydro			
	Landfill Gas/Bio			
	Nuclear			
	Solar			
	Wind			

Figure 9: IESO Unit Additions, Retirements and Rerates (MW)

Year	Source	Additions	Retirements	Rerates
2019	Coal			
	Fossil Fuel	903		
	Hydro			
	Landfill Gas/Bio			
	Nuclear			
	Solar	98		
	Wind	300		
2020	Coal			
	Fossil Fuel			
	Hydro			
	Landfill Gas/Bio			
	Nuclear			
	Solar			
	Wind	160		
2021	Coal			
	Fossil Fuel	224		
	Hydro			
	Landfill Gas/Bio			
	Nuclear			
	Solar			
	Wind			
2022	Coal			
	Fossil Fuel		38	
	Hydro			
	Landfill Gas/Bio			
	Nuclear		1,030	
	Solar			
	Wind			
2023	Coal			
	Fossil Fuel	1,120		
	Hydro			
	Landfill Gas/Bio			
	Nuclear			
	Solar			
	Wind			
2024	Coal			
	Fossil Fuel			
	Hydro			
	Landfill Gas/Bio			
	Nuclear		2,064	
	Solar			
	Wind			
2025	Coal			
	Fossil Fuel	1,568		
	Hydro			
	Landfill Gas/Bio			
	Nuclear			
	Solar			
	Wind			

Figure 10: ISO-NE Unit Additions, Retirements and Rerates (MW)

Year	Source	Additions	Retirements	Rerates
2019	Coal			
	Fossil Fuel	817		
	Hydro			
	Landfill Gas/Bio			
	Nuclear		702	
	Solar			
	Wind			
2020	Coal			
	Fossil Fuel		17	54
	Hydro			
	Landfill Gas/Bio			
	Nuclear			
	Solar			
	Wind			
2021	Coal			
	Fossil Fuel		383	
	Hydro			80
	Landfill Gas/Bio			
	Nuclear			
	Solar	100		
	Wind			
2022	Coal			
	Fossil Fuel	1,521	651	
	Hydro			
	Landfill Gas/Bio			
	Nuclear			
	Solar			
	Wind			
2024	Coal			
	Fossil Fuel		1,382	
	Hydro			
	Landfill Gas/Bio			
	Nuclear			
	Solar			
	Wind			

Figure 11: Control Area Capacity Values

SUMMER CAP (MW)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
IESO	**35,176**	**35,336**	**35,559**	**35,637**	**35,689**	**35,689**	**35,115**	**35,115**	**35,115**	**35,193**
Combined Cycle	6,923	6,923	6,923	6,923	6,885	6,885	6,885	6,885	6,885	6,885
Combustion Turbine	493	493	716	716	1,836	1,836	3,404	3,404	3,404	3,404
Conventional Hydro	7,034	7,034	7,034	7,112	7,112	7,112	7,034	7,034	7,034	7,112
Other Steam Turbines	332	332	332	332	332	332	332	332	332	332
Pumped Storage Hydro	175	175	175	175	175	175	175	175	175	175
Solar	478	478	478	478	478	478	478	478	478	478
Steam Turbine (Nuclear)	12,959	12,959	12,959	12,959	11,929	11,929	9,865	9,865	9,865	9,865
Steam Turbine (Oil and Gas)	2,018	2,018	2,018	2,018	2,018	2,018	2,018	2,018	2,018	2,018
Wind	4,764	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924	4,924
NYISO	**39,715**	**40,841**	**39,693**	**38,675**	**38,675**	**38,675**	**38,655**	**38,655**	**38,655**	**38,675**
Combined Cycle	9,941	10,961	10,961	10,961	10,961	10,961	10,961	10,961	10,961	10,961
Combustion Turbine	4,493	4,478	4,478	4,478	4,478	4,478	4,478	4,478	4,478	4,478
Conventional Hydro	4,480	4,480	4,480	4,500	4,500	4,500	4,480	4,480	4,480	4,500
Internal Combustion Engine	22	22	22	22	22	22	22	22	22	22
Landfill Gas	102	97	97	97	97	97	97	97	97	97
Other Steam Turbines	205	205	224	224	224	224	224	224	224	224
Pumped Storage Hydro	1,410	1,410	1,410	1,410	1,410	1,410	1,410	1,410	1,410	1,410
Solar	77	77	77	77	77	77	77	77	77	77
Steam Turbine (Coal)	837	837	686	686	686	686	686	686	686	686
Steam Turbine (Nuclear)	5,400	5,400	4,384	3,346	3,346	3,346	3,346	3,346	3,346	3,346
Steam Turbine (Oil and Gas)	10,662	10,662	10,662	10,662	10,662	10,662	10,662	10,662	10,662	10,662
Wind	2,086	2,212	2,212	2,212	2,212	2,212	2,212	2,212	2,212	2,212
PJM	**203,191**	**200,452**	**200,472**	**196,513**	**195,225**	**195,225**	**195,261**	**195,261**	**195,261**	**195,225**
Combined Cycle	49,194	50,351	52,513	52,513	52,513	52,513	52,513	52,513	52,513	52,513
Combustion Turbine	30,389	30,288	30,056	29,736	29,736	29,736	29,736	29,736	29,736	29,736
Conventional Hydro	2,951	2,951	2,951	2,915	2,915	2,915	2,951	2,951	2,951	2,915
Internal Combustion Engine	664	664	664	651	651	651	651	651	651	651
Landfill Gas	406	406	406	406	406	406	406	406	406	406
Other Steam Turbines	3,495	3,398	3,228	3,228	3,228	3,228	3,228	3,228	3,228	3,228
Pumped Storage Hydro	5,182	5,182	5,182	5,182	5,182	5,182	5,182	5,182	5,182	5,182
Solar	2,226	2,226	2,226	2,226	2,226	2,226	2,226	2,226	2,226	2,226
Steam Turbine (Coal)	55,834	52,738	50,998	50,148	48,860	48,860	48,860	48,860	48,860	48,860
Steam Turbine (Nuclear)	34,223	33,418	33,418	31,566	31,566	31,566	31,566	31,566	31,566	31,566
Steam Turbine (Oil and Gas)	8,051	7,954	7,954	7,066	7,066	7,066	7,066	7,066	7,066	7,066
Wind	10,576	10,876	10,876	10,876	10,876	10,876	10,876	10,876	10,876	10,876
ISO-NE	**32,382**	**31,735**	**31,899**	**33,447**	**32,796**	**32,796**	**31,387**	**31,387**	**31,387**	**31,414**
Combined Cycle	13,934	13,988	13,988	15,509	15,446	15,446	14,064	14,064	14,064	14,064
Combustion Turbine	3,429	3,429	3,413	3,413	3,403	3,403	3,403	3,403	3,403	3,403
Conventional Hydro	1,961	1,961	1,961	1,988	1,988	1,988	1,961	1,961	1,961	1,988
Internal Combustion Engine	185	185	185	185	185	185	185	185	185	185
Landfill Gas	62	62	62	62	62	62	62	62	62	62
Other Steam Turbines	1,052	1,052	1,052	1,052	1,052	1,052	1,052	1,052	1,052	1,052
Pumped Storage Hydro	1,780	1,780	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860
Solar	10	10	110	110	110	110	110	110	110	110
Steam Turbine (Nuclear)	4,081	3,380	3,380	3,380	3,380	3,380	3,380	3,380	3,380	3,380
Steam Turbine (Oil and Gas)	4,751	4,751	4,751	4,751	4,173	4,173	4,173	4,173	4,173	4,173
Wind	1,137	1,137	1,137	1,137	1,137	1,137	1,137	1,137	1,137	1,137
Grand Total	**310,464**	**308,364**	**307,623**	**304,272**	**302,385**	**302,385**	**300,418**	**300,418**	**300,418**	**300,507**

Figure 12: External Area Forecasted Load Values

Year	IESO		ISONE		PJM	
	Peak (MW)	Energy (GWh)	Peak (MW)	Energy (GWh)	Peak (MW)	Energy (GWh)
2019	22,061	136,145,332	25,323	125,825	151,357	801,154
2020	22,094	136,577,634	25,025	123,562	150,869	802,388
2021	22,372	136,973,890	24,794	121,876	151,545	803,791
2022	22,649	137,370,146	24,620	121,288	152,252	809,281
2023	22,819	137,958,727	24,480	120,575	152,853	812,713
2024	23,128	139,912,143	24,384	120,543	153,435	818,415
2025	23,307	141,353,379	24,328	119,924	153,989	819,914
2026	23,195	142,127,738	24,315	119,918	154,494	823,256
2027	23,289	143,288,003	24,341	120,226	155,107	826,768
2028	23,723	145,343,816	24,408	121,336	155,892	833,280

Hurdle Rates and Interchange Models

Hurdle rates set the conditions under which economic interchange is transacted between neighboring markets/control area in the model. They represent a minimum savings level that needs to be achieved before energy will flow across the interface. Hurdle rates help ensure that the production-cost simulation is reasonably consistent with the historical pattern of internal NYCA generation and imports. Hurdle rates are used to allow the simulation model to reflect inter-regional energy market transaction costs.

Two independent hurdle rates are used in the CARIS, one for the commitment of generation and a separate one for the dispatch of generation. Both commitment and dispatch hurdle rates are held constant throughout the 2019-2028 study period, as discussed with NYISO stakeholders at ESPWG. The hurdle rate values produce results consistent with NYCA historic total import levels.

The flow on the CSC line was modeled to allow up to 330 MW from ISO-NE to Long Island. The flow on the Linden VFT was modeled to allow up to 315 MW in both directions. The Neptune and HTP flows were modeled to allow up to 660 MW of flow from PJM into Long Island and New York City respectively.

The hourly interchange flow for each interface connecting the NYISO with neighboring control areas was priced at the LBMP of its corresponding proxy bus. The summation of all 8,760 hours determined the annual cost of the energy for each interface. Figure 13 lists the proxy bus location for each interface.

Figure 13: Interchange LBMP Proxy Bus Area

Interface	Proxy Bus
PJM	Keystone
Ontario	Bruce
Quebec	Chateauguay and Cedars
Neptune	Raritan River
New England	Sandy Pd
Cross Sound Cable	New Haven Harbor
HTP	Bergen
VFT	Linden 138 kV
Northport Norwalk Cable	Norwalk Harbor

Production Cost Model

Production cost models require input data to develop cost curves for the resources that the model will commit and dispatch to serve the load, subject to the constraints given in the model.

This section discusses how the "production cost input data" is developed. The incremental cost of generation is the product of the incremental heat rate multiplied by the sum of fuel cost, emissions cost, and variable operation and maintenance expenses.

Heat Rates

Fuel costs represent the largest variable expense for fossil fueled generating units. Cost curves are the product of fuel prices and incremental heat rates. Individual unit heat rates are commercially sensitive confidential information and thus are not widely available from generator owners. Unit heat rate input data is based on the U.S. Environmental Protection Agency's (EPA) Clean Air Market Data and, where available, unit production data from the U.S. Energy Information Administration (EIA).

CARIS simulation models employ power points which represent minimum, intermediate, and maximum power production levels where generating units can be simulated to operate on a sustained basis. Each power point is tied to a point on the heat rate curve allowing incremental heat rates to be determined for each unit. The power points and incremental heat rates are developed on a Summer/Winter capability period basis.

External Area Fuel Forecasts

Figure 14 shows the regional bases expressed as a multiple of the U.S. national average annual price for each fuel. Figure 15 through Figure 18 illustrate forecasted fuel price prices for external areas from which weekly fuel price forecasts were developed.

Figure 14: External Areas Fuel Forecast Regional Multiplier

Fuel	PJM-East	PJM-West	ISONE-North	ISONE-South	IESO
Fuel Oil #2	1.000	1.100	0.970	0.970	1.075
Fuel Oil #6	1.000	1.100	0.970	0.970	1.075
Natural Gas	0.914	0.858	1.116	1.076	0.987
Coal	1.275	1.050	2.000	2.000	1.300

Figure 15: Forecasted Fuel Prices for PJM East (nominal $)

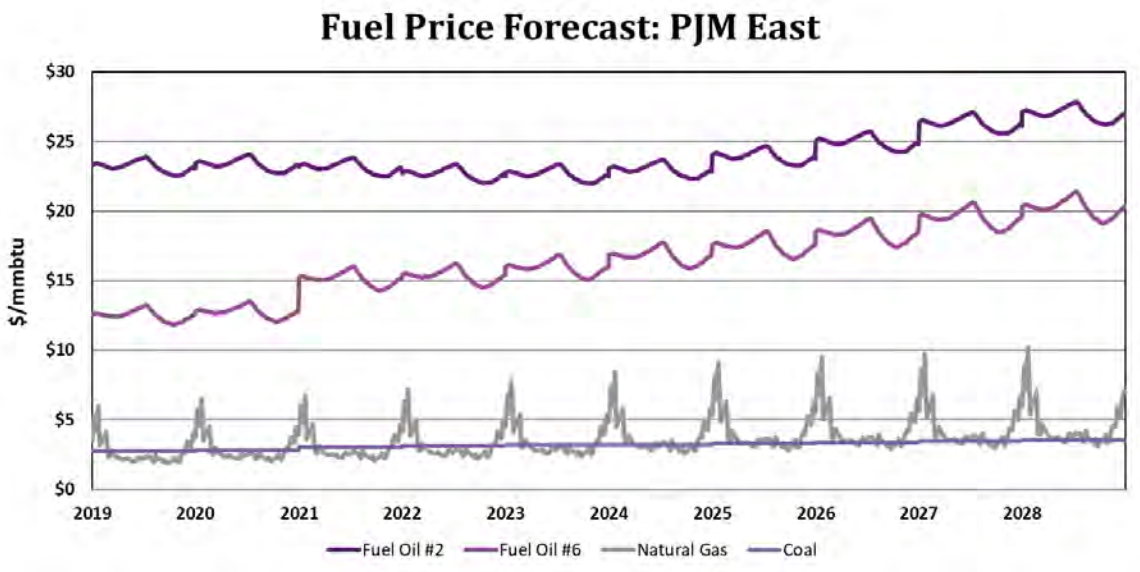


Figure 16: Forecasted Fuel Prices for PJM West (nominal $)

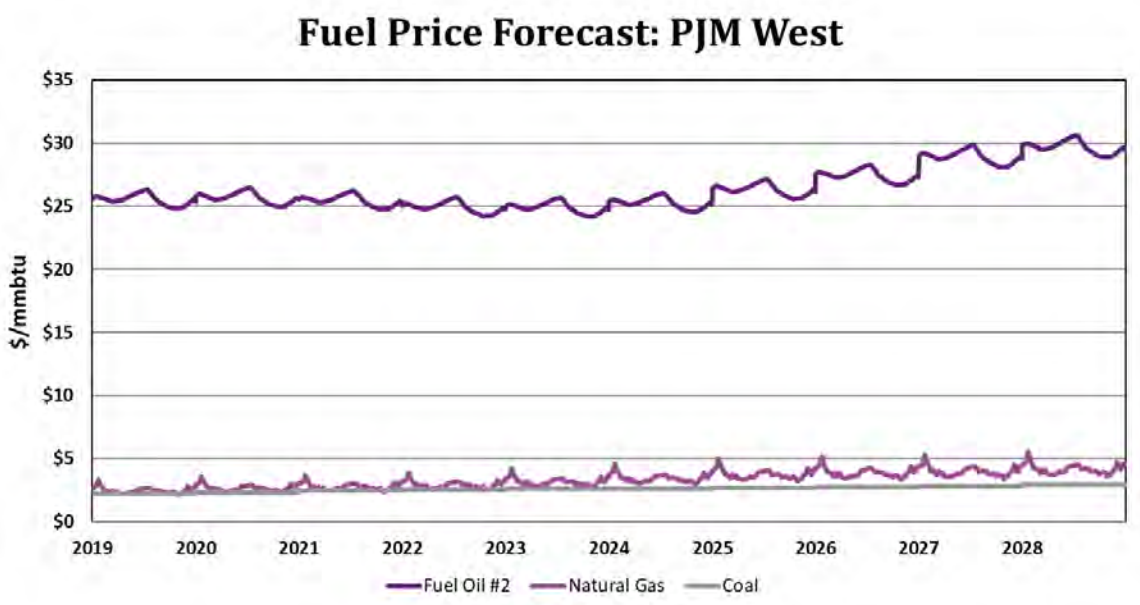


Figure 17: Forecasted Fuel Prices for ISO-NE (nominal $)

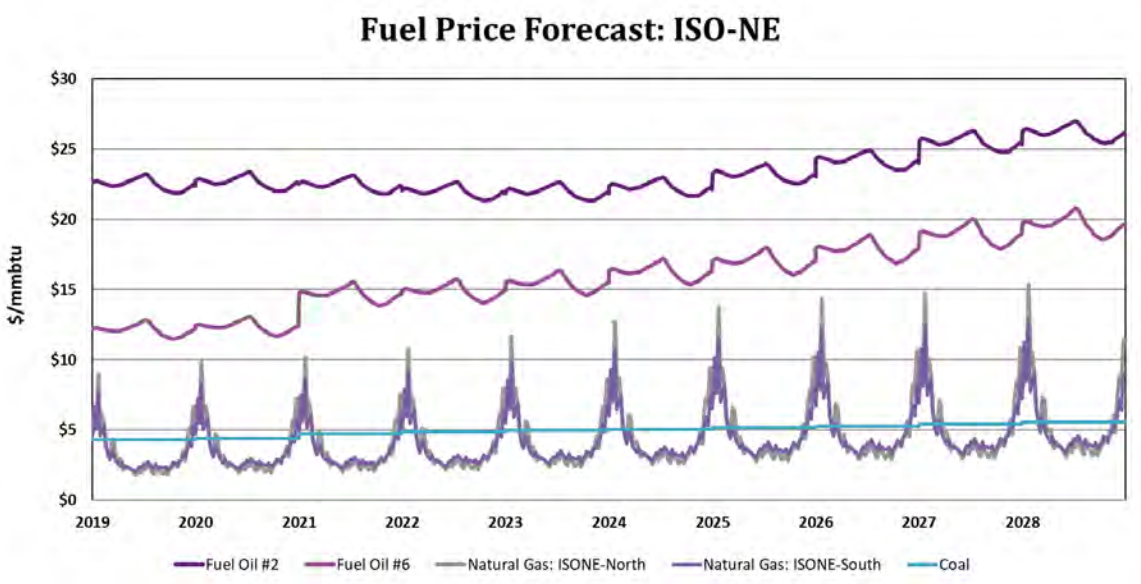
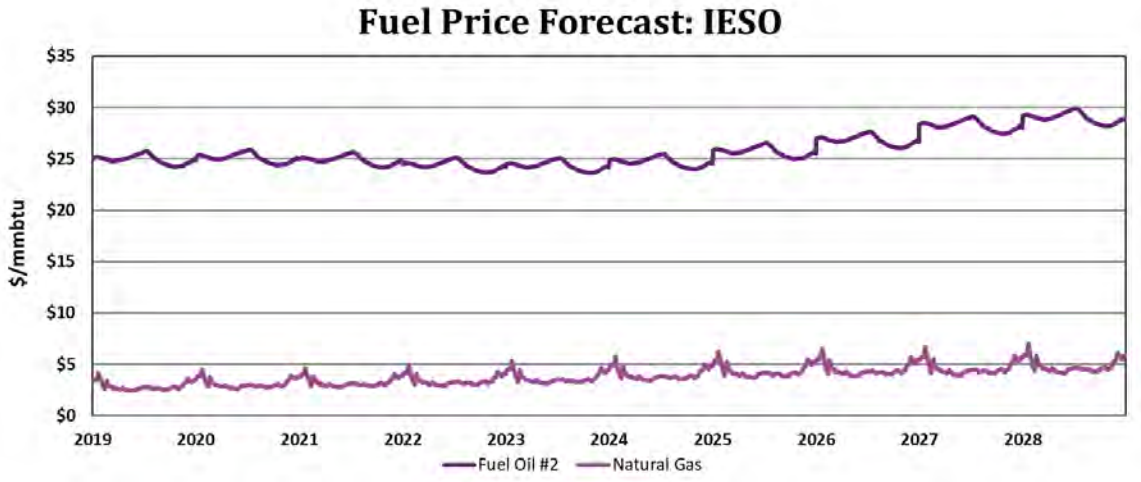


Figure 18: Forecasted Fuel Prices for IESO (nominal $)



Fuel Switching

Fuel switching capability is widespread within the NYCA. According to date from the 2017 Gold Book, 46% of the 2017 generating capacity in the NYCA – 17,684 MW of generation – has the ability to burn either oil or gas. For such units, the production-cost simulation model selects the economic fuel based on weekly production costs for units with dual-fuel capability.

The New York State Reliability Council (NYSRC) establishes rules for the reliable operation of the New York Bulk Power System. Two of those rules guard against the loss of electric load because of the loss of gas supply. The loss of a gas facility may lead to the loss of some generating units. This

loss becomes critical because it may result in voltage collapse when load levels are high enough. Therefore, criteria are established whereby certain units that are capable of doing so are required to switch to minimum oil burn levels so that in the event of the worst single gas system contingency these units stay on-line at minimum generation levels and support system voltage.

Rule I-R3 states that "The New York State bulk power system shall be operated so that the loss of a single gas facility does not result in the loss of electric load within the New York City zone." Rule I-R5 similarly states "The New York State bulk power system shall be operated so that the loss of a single gas facility will not result in the uncontrolled loss of electricity within the Long Island zone."

To satisfy the I-R3 and I-R5 criteria, annual studies are performed by the TOs that update the configurations of the electricity and gas systems and simulate the loss of critical gas supply facilities.

Some new combined cycle gas turbine units in the New York City and Long Island Zones have the ability to "auto-swap" from gas-burn to oil-burn with a limited loss of output that can be quickly recovered. As the generator fleets in these zones have experienced a shift to increased use of combined cycle units with auto-swap capability, the amount of oil used in steam units to satisfy minimum oil burn criteria has decreased.

Minimum oil burn rules have not been explicitly modeled in the production cost simulations for the 2019 CARIS. Minimum oil burn units are committed and dispatched in the NYISO markets using the cost of the most economic fuel. Any cost incurred from firing oil when it is not economic to do so is recovered outside the market. Consequently, the minimum oil burn program does not affect LBMPs or any derivative metric (Demand Congestion, Load, Payment, *etc*.) and is more appropriately accounted for outside the GE-MAPS simulation.

Generation Maintenance

NYCA generation maintenance modeling was updated for this CARIS cycle utilizing the latest planned and random outage rates from the 2019-2028 CRP process. External control areas (IESO, ISO-NE, and PJM) generation planned and forced outage were developed using the latest NERC class average outage data.

Hourly Modifier Models (HRMs)

Several types of generation technologies, such as non-pondage hydro, wind, and solar were represented using MAPS hourly modifier models. This approach uses a fixed 8,760 hourly input

schedule that represents the hourly generation dispatch for each unit. The shape applied to the HRM inputs for each generator type is based on historical data. Capacity and energy capabilities are adjusted for individual generator parameters.

Hourly modifier output matches the input schedule with the one exception of energy curtailment mostly due to transmission constraints. In MAPS, curtailment occurs when the LBMP at a generator node drops below the modeled dispatch cost of the hourly modifier which is an indication of local transmission congestion caused by renewable generation injection. The amount of energy curtailed is approximately the amount necessary to limit LBMP at or above the dispatch cost of the generator, to the extent that a generator has energy to curtail.

The dispatch costs modeled for hydro, wind, and solar in the 2019 CARIS database were based on historical observations. Hydro generators are modeled with a lower dispatch cost compared with Wind and Solar. This implies that if a hydro generator and a wind generator were sited at the same exact location and LBMP were to approach $0, the wind generator would be curtailed first.

Generally, as hydro, wind, and solar units are not co-located they experience different nodal LBMP impacts of transmission congestion and losses. In the base, sensitivity, and scenario analyses performed in the 2019 CARIS study a majority of the curtailment observed was a direct result of local transmission congestion.

Appendix D - Overview of CARIS Model

Model Overview (MAPS)

The NYISO primarily employs two software tools to construct the fifteen-year time-series of congestion and production costs. The NYISO utilizes Security Constrained Unit Commitment (SCUC) results to develop the five-year historic values and General Electric's Multi Area Production Simulation ("MAPS") to construct the ten-year projected values. In each case the software performs a security constrained economic commitment and dispatch, and calculates the minimum hourly production cost of supply resources to meet the load.

Historic Congestion

Historic Congestion is reported using actual congestion related data from the Day-Ahead market. The following elements of historic congestion-related data are reported: (i) LBMP load costs (energy, congestion and losses) by Load Zone; (ii) LBMP payments to generators (energy, congestion and losses) by Load Zone; (iii) congestion cost by constraint; and (iv) congestion cost of each constraint to load (demand$ congestion).

MAPS

In conducting the 2019 CARIS analysis and developing projected congestion and production costs (as well as other metrics), the NYISO utilized GE MAPS Version 14.300 as the production cost simulation software. MAPS software mimics the operation of the NYISO Day-Ahead market by simulating SCUC and economic dispatch of the generation, and by monitoring transmission system flows under both normal and contingency conditions, including thunder storm alerts. This enables calculation of hourly production costs accounting for the constraints imposed by the transmission system on the economic dispatch of generation.

MAPS features the following:

- **Detailed representation of the large scale transmission network.** The transmission system is modeled in terms of individual transmission lines, interfaces (group of lines), phase-angle regulators (PARs), and HVDC lines. MAPS software models voltage and stability considerations through operating nomograms that define how voltage and stability limits can change hourly as a function of loads, generation, and flows elsewhere on the system.
- **Detailed generation modeling for thermal, hydro, pumped storage, wind, solar, and other renewables.** Generation system data capabilities include multi-step cost

curves based on heat rates, emission costs, fuel costs, and unit cycling capabilities. The generation units, along with chronological hourly load profiles, are assigned to individual buses on the system. Hourly load profiles are adjusted to meet peak and energy forecasts, which are inputs entered into the model on a monthly or annual basis. Information on hourly loads at each bus in the system is required to calculate electrical flows on the transmission system. This parameter is specified by assigning one or a combination of several hourly load profiles to each load bus.

The major difference between the projected MAPS results and historic congestion is that MAPS does not simulate: (a) virtual bidding; (b) transmission outages; (c) price-capped load; (d) production costs based on mitigated bids; (e) Bid Production Cost Guarantee (BPCG) payments; and (f) co-optimization with ancillary services.

Modeling Validation

Database Verification

To verify the 2019 CARIS database, the NYISO conducted a data and modeling verification process in conjunction with GE. First, the NYISO Planning Staff reviewed all input data and program parameters. After Staff completed its review, modifications and any necessary corrections, the base cases were sent to GE for further verification.

The following topics were examined as part of data verification:

- Spinning reserves and thermal unit commitment options;
- Generation planned and random outages;
- Transmission interface transfer limits, contingencies and nomograms;
- Commitment and dispatch hurdle rates;
- Generator incremental heat rates, variable O&M, startup costs, installed reserve margin, and emissions rates;
- Fuel price forecasts;
- Modeling of pumped storage and hydro units; and,
- Accuracy of generator size, type and location

GE reviewed all the warnings created by the programs to ensure that the results were not affected. Discrepancies noted by GE were corrected by NYISO as necessary. All of these changes were accomplished before the finalization of the 2019 CARIS base case.

Benchmark Summary

The final 2019 CARIS Phase 1 benchmark results are listed in Figure 19 to Figure 28 below for

the 2017 benchmark year. The results were presented to NYISO stakeholders for discussion at the ESPWG.

Figure 19: Zonal Load Payment Summary (nominal $M)

2017 Zonal Load Payment	Actual	Benchmark
West	412	384
Genesee	243	245
Central	409	405
North	96	97
Mohawk Valley	203	182
Capital	387	414
Hudson Valley	316	314
Millwood	96	92
Dunwoodie	197	191
New York City	1,786	1,764
Long Island	817	742
NYCA	4,963	4,830

Figure 20: Zonal Generator Payment Summary (nominal $M)

2017 Zonal Generation Payment	Actual	Benchmark
West	423	418
Genesee	115	128
Central	665	684
North	168	219
Mohawk Valley	71	83
Capital	437	449
Hudson Valley	82	58
Millwood	469	508
Dunwoodie	0	0
New York City	809	781
Long Island	395	323
NYCA	3,634	3,651

Figure 21: Zonal Demand Congestion Summary (nominal $M)

2017 Zonal Demand Congestion	SCUC	Benchmark
West	63	31
Genesee	12	7
Central	40	24
North	6	2
Mohawk Valley	10	10
Capital	90	102
Hudson Valley	66	67
Millwood	21	21
Dunwoodie	44	41
New York City	443	398
Long Island	287	190
NYCA	1,082	893

Figure 22: Top Constraint Congestion Summary (nominal $M)

2017 Top 10 Demand Congestion Constraints	SCUC	Benchmark
CENTRAL EAST	598	539
EDIC MARCY	125	85
LEEDS PLEASANT VALLEY	101	56
DUNWOODIE TO LONG ISLAND	88	24
MOTTHAVEN RAINEY	32	1
DUNWOODIE MOTTHAVEN	30	4
PACKARD HUNTLEY	30	26
NEW SCOTLAND LEEDS	18	3
GREENWOOD	14	23
NIAGARA PACKARD	12	0

Figure 23: Zonal LBMP Summary ($/MWh)

2017 Zonal Average LBMP	Actual	Benchmark
West	$25.55	$25.61
Genesee	$23.44	$24.96
Central	$24.40	$26.53
North	$21.30	$23.51
Mohawk Valley	$24.63	$26.59
Capital	$31.04	$33.89
Hudson Valley	$30.62	$32.38
Millwood	$30.93	$32.65
Dunwoodie	$30.93	$32.63
New York City	$32.29	$33.35
Long Island	$36.17	$34.73

Figure 24: Zonal Generation Summary (GWh)

2017 Zonal Generation	Actual	Benchmark
West	17,450	17,504
Genesee	5,071	5,240
Central	29,252	29,441
North	9,474	9,474
Mohawk Valley	3,445	3,466
Capital	13,915	14,129
Hudson Valley	1,807	1,855
Millwood	15,692	15,771
Dunwoodie	0	0
New York City	23,199	23,090
Long Island	9,288	8,856
NYCA	128,593	128,825

Figure 25: Zonal Load Summary (GWh)

2017 Zonal Load	Actual	Benchmark
West	15,066	14,992
Genesee	9,907	9,859
Central	15,614	15,532
North	4,187	4,161
Mohawk Valley	7,702	7,656
Capital	12,014	11,966
Hudson Valley	9,734	9,683
Millwood	2,813	2,796
Dunwoodie	5,822	5,797
New York City	52,055	51,938
Long Island	20,898	20,843
NYCA	155,813	155,223

Figure 26: Import Summary (GWh)

2017 Import Energy	Actual	Benchmark
PJM-NYISO	3,662	3,600
LINDEN VFT	1,380	1,134
NEPTUNE	4,555	4,172
HTP	274	210
ISONE-NYISO	520	329
CROSS SOUND CABLE	1,814	1,496
NORTHPORT NORWALK CABLE	560	386
IMO-NYISO	8,030	8,261
HQ-NYISO CHAT	10,525	10,509
HQ-NYISO CEDARS	1,009	1,007
TOTAL IMPORT	32,329	31,104

Figure 27: Export Summary (GWh)

2017 Export Energy	Actual	Benchmark
PJM-NYISO	460	339
LINDEN VFT	82	53
NEPTUNE	2	0
HTP	0	0
ISONE-NYISO	4,261	4,202
CROSS SOUND CABLE	7	0
NORTHPORT NORWALK CABLE	66	86
IMO-NYISO	21	24
HQ-NYISO CHAT	3	3
HQ-NYISO CEDARS	4	4
TOTAL EXPORT	4,904	4,711

Figure 28: Net Import Summary (GWh)

2017 Net Import Energy	Actual	Benchmark
PJM-NYISO	3,202	3,261
LINDEN VFT	1,298	1,081
NEPTUNE	4,554	4,172
HTP	274	210
ISONE-NYISO	-3,740	-3,873
CROSS SOUND CABLE	1,808	1,496
NORTHPORT NORWALK CABLE	494	300
IMO-NYISO	8,010	8,237
HQ-NYISO CHAT	10,522	10,506
HQ-NYISO CEDARS	1,005	1,003
TOTAL NET IMPORT	27,425	26,393

Appendix E - Detailed Results of 2019 CARIS Phase 1

Congestion Assessment - Historic and Projected

One of the features of a Locational Based Marginal Price (LBMP) market is the ability to identify grid locations that are difficult to serve with economic generation due to transmission bottlenecks (constraints) and quantify the cost of this congestion. The NYISO calculates and publishes LBMP's with three components:

1. **Energy component** – marginal electricity cost without the adjusted cost of congestion and losses;
2. **Congestion component** – the cost of out-of merit generation dispatch relative to an assumed unconstrained reference point at Marcy substation; and
3. **Losses component** – the cost for supplying the losses from the accessible marginal generators to a specific point on the grid.

Historic Congestion Reporting

The NYISO reports historic congestion results on its website[3] as required in OATT, Section 31.7. The cost of congestion reported is the sum of the day ahead market LBMP congestion component multiplied by the amount of load being affected (positively or negatively) by congestion (later referred to as "congestion payments").

Historic Congestion Results

The historic congestion analysis results for a constrained system (base case) are presented in Figure 29 through Figure 31.

[3] https://www.nyiso.com/ny-power-system-information-outlook

Figure 29: Historic Congestion Demand$ Congestion (2014-2018) by Zone (nominal $M)

Zone	2014	2015	2016	2017	2018
West	$36	$83	$116	$63	$65
Genesee	$9	$9	$7	$12	$10
Central	$38	$34	$29	$40	$37
North	$3	$5	$7	$6	$15
Mohawk Valley	$12	$10	$7	$10	$7
Capital	$149	$123	$95	$90	$80
Hudson Valley	$95	$86	$64	$66	$50
Millwood	$30	$26	$19	$21	$16
Dunwoodie	$55	$49	$41	$44	$34
New York City	$531	$459	$378	$443	$405
Long Island	$409	$404	$339	$287	$303
NYCA Total	**$1,367**	**$1,287**	**$1,102**	**$1,082**	**$1,022**

Notes: Reported values do not deduct TCCs. DAM data include Virtual Bidding & planned Transmission outages.

For Figure 30, year 2017 and 2018 values are calculated using DSS net meter energy and actual hourly LBMP.

Figure 30: Historic Generator Payments (2014-2018) by Zone (nominal $M)

Generator Payment ($M)	Historic				
	2014	2015	2016	2017	2018
West	$924	$472	$358	$423	$571
Genesee	$388	$199	$141	$115	$146
Central	$1,854	$1,133	$752	$665	$929
North	$447	$255	$182	$168	$225
Mohawk Valley	$181	$100	$72	$71	$81
Capital	$873	$647	$529	$437	$503
Hudson Valley	$326	$210	$141	$82	$154
Millwood	$1,033	$642	$475	$469	$618
Dunwoodie	$34	$19	$54	$0	$0
NY City	$1,679	$1,023	$837	$809	$1,072
Long Island	$932	$637	$487	$395	$560
NYCA Total	$8,670	$5,337	$4,028	$3,634	$4,859

Note: Reported values are exclusive of BPCG and Ancillary Services

Figure 31: Historic Load Payments (2014-2018) by Zone (nominal $M)

Load Payment ($M)	Historic				
	2014	2015	2016	2017	2018
West	$873	$595	$501	$412	$542
Genesee	$545	$291	$206	$243	$327
Central	$1,183	$715	$499	$409	$557
North	$243	$117	$80	$96	$124
Mohawk Valley	$395	$231	$152	$203	$273
Capital	$808	$513	$374	$387	$504
Hudson Valley	$656	$424	$309	$316	$399
Millwood	$195	$122	$88	$96	$117
Dunwoodie	$375	$240	$203	$197	$244
NY City	$3,358	$2,184	$1,721	$1,786	$2,328
Long Island	$1,712	$1,208	$938	$817	$1,036
NYCA Total	$10,343	$6,640	$5,071	$4,963	$6,451

Metrics Assessment

CARIS Metrics

In conducting the CARIS analysis, seven metrics are used. The primary metric is the production cost metric. Additional metrics that are included in this report are load payments, generator payments, emissions, TCCs, losses, and the ICAP metric. All benefit metrics are determined by measuring the difference (change) between the CARIS base case system value and a system value when the generic solution is added. The discount rate of 7.08% used for the present value analysis is the current weighted average cost of capital for the NYTOs.

1. NYCA Production Cost Metric

NYCA production cost is the total generation cost of producing power to serve NYCA load. The total cost includes the following components:

1. Fuel cost (fuel consumption mmBtu multiplied by fuel cost $/mmBtu);
2. Variable O&M cost (VOM adder $/MWh);
3. Emission cost (emission allowance price multiplied by total allowance);
4. Start-up Cost (number of starts multiplied by start-up cost); and
5. NYCA Imports and Exports evaluated at the solution case proxy bus LBMP values.

2. Demand$ Congestion Metric

The congestion value (Demand$ Congestion) is calculated as the congestion component of the LBMP paid by NYCA load (sum of the total zonal loads). It is defined as the shadow price of each constrained element multiplied by the load affected. The Demand$ Congestion for all areas and all

hours is equal to the product of the Shadow Price, the Zonal Generation Shift Factor, and the Zonal Load. The Total Demand$ Congestion is equal to the summation of Demand$ Congestion across all constraints.

Demand$ Congestion by constraint for all areas and all hours =

$$\{Shadow\ Price * (Zonal\ Generation\ Shift\ Factor\ (GSF) * Zonal\ Load)\}$$

Total Demand$ Congestion = $\sum_{constraints} Demand\$\ Congestion$

3. Generator Payment Metric

This metric measures the change in NYCA generation payments plus net imports. The NYCA generation payments are calculated by measuring only the LBMP payments (energy, congestion, losses). Thus, total generator payments are estimated for this information metric as the sum of the LBMP payments to NYCA generators plus the payments for net imports.

Generator payment by zone represents zonal LBMP based payment to generators located in a zone. The hourly payment to each generator is determined as the hourly generator MW dispatch multiplied by the generator's LBMP or spot price. The annual generator payment for NYCA generators is then the sum of all 8,760 hourly generator payments.

$$\text{Annual generator LBMP payment} = \sum_{Hour} (\text{generator LBMP x generator MW dispatch})$$

$$\text{Zonal generator payment} = \sum_{Generator\ in\ Zone} Generator\ LBMP\ payment$$

4. LBMP Load Payment Metric

The LBMP Load Payment metric is the hourly load-weighted average LBMP price for each Zone multiplied by the zonal load. The annual load payment is then the sum of all 8,760 hourly load payments.

$$\text{Annual Zonal LBMP payment} = \sum_{Hour} (\text{zonal LBMP x zonal load})$$

$$\text{Zonal LBMP} = \text{zonal average load} - \text{weighted LMP}$$

Note: actual consumer payments will be net of any TCC hedges or bilateral contracts.

5. TCC Payment Metric

The TCC payment metric is calculated differently for Phase 1 than for Phase 2 of the CARIS

process, as described in the NYISO Tariff. In this CARIS Phase 1, the TCC Payment is calculated as (Demand Congestion Costs + Export Congestion Costs) – (Supply Congestion Costs + Import Congestion Costs). This is not a measure of the Transmission Owners' TCC auction revenues.

6. ICAP Metric

The Installed Capacity (ICAP) savings metric quantifies the potential NYISO ICAP market savings created by a generation, transmission, demand response, or energy efficiency project.

The ICAP savings calculation[4] consists of two steps, which are performed for each NYISO capacity zone[5]. In the first step, the MW impact of a generic solution is determined through Loss of Load Expectation (LOLE) analysis, where LOLE is the resource adequacy criterion. The MW impact is indicative of reduced installed capacity requirement made possible by the congestion mitigation solutions. A transmission solution that enables better utilization of the existing generating resources in the State will allow a lower IRM and lower LCRs. Generation solutions, depending on their location in the NYCA, will contribute as an ICAP source and may reduce the IRM and LCR requirements. For DR and EE, the reduced load downstream of congestion will lower both the overall ICAP and the LCR requirements. The ICAP reduction can be larger than the nameplate of the solution. Using year 2028, the ICAP MW impact for each study area resulting from the application of generic solutions is calculated. This represents the potential reduction in ICAP procurement obligations and the associated ICAP costs.

Second, the ICAP cost reduction benefit is translated to a dollar amount through two pricing variations for each of the years of the ten year study period. For Variant 1, the ISO measured the cost impact of a solution for each planning year by: (i) forecasting the cost per megawatt-year of Installed Capacity under the assumption that the solution is not in place, based on the latest available Summer and Winter ICAP Demand Curves and the amount of Installed Capacity available in the NYCA, and (ii) multiplying that forecasted cost per megawatt-year by the sum of the megawatt impact. For Variant 2, the ISO measured the cost impact of a solution for each planning year by: (i) forecasting the cost per megawatt-year of Installed Capacity under the assumption that

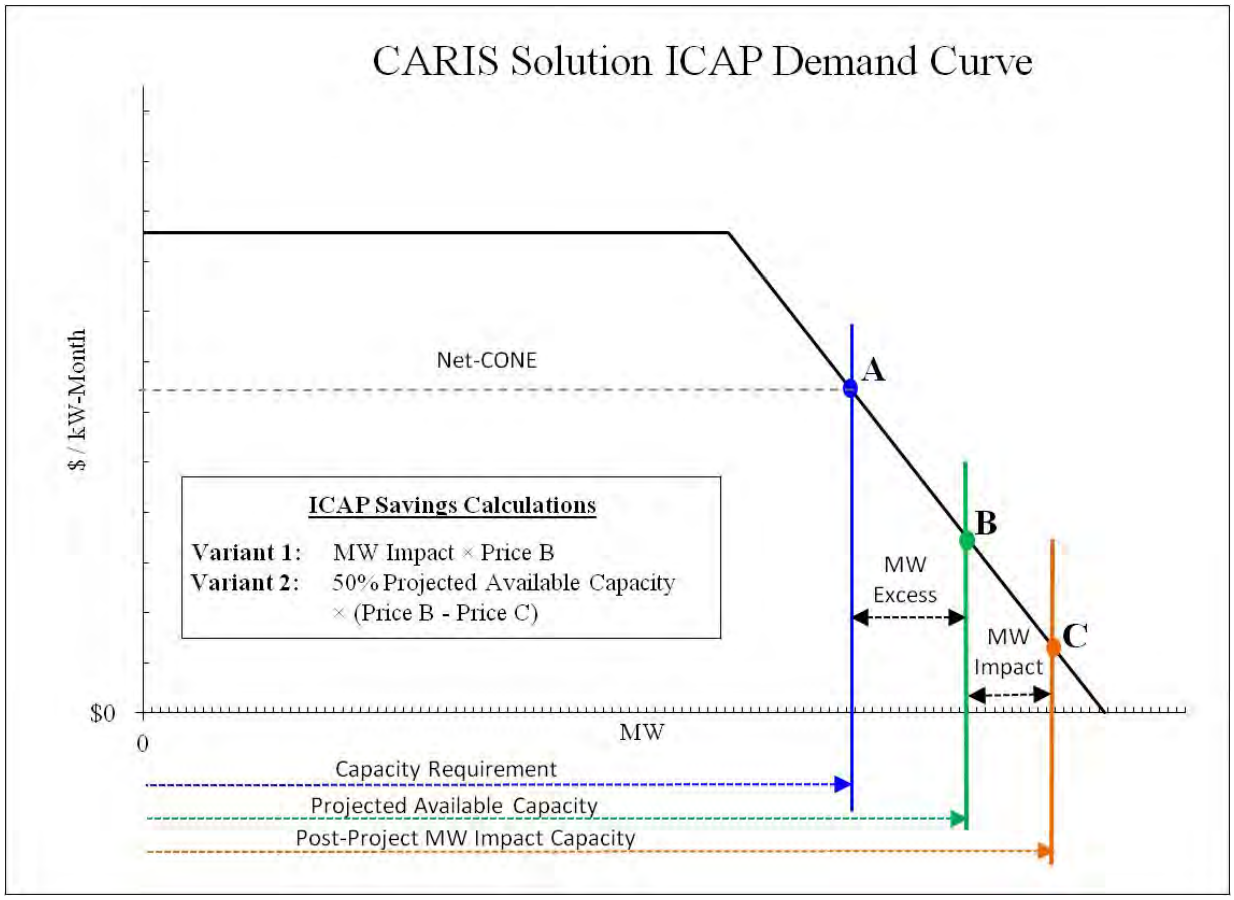
[4] Calculations used to determine ICAP savings are described in NYISO OATT Attachment Y Section 31.3.1.3.5.6. Information regarding the determination of the currently published NYISO ICAP demand curve is beyond the scope of this document and can be found in the NYISO Installed Capacity Manual (https://www.nyiso.com/documents/20142/2923301/icap_mnl.pdf/234db95c-9a91-66fe-7306-2900ef905338)

5 As of 2013, The NYISO has four separate capacity zones: New York City (NYC), Long Island (LI), Lower Hudson Valley (G-J), and the New York Control Area (NYCA). Capacity demand curves are used to set the clearing price for existing generation capacity in the capacity market auctions. Locational capacity requirements are inherent within each demand curve so as to meet reliability criteria.

the solution is in place, based on the latest available Summer and Winter ICAP Demand Curves and the amount of Installed Capacity available in the NYCA; (ii) subtracting that forecasted cost per megawatt-year from the forecasted cost per megawatt-year of Installed Capacity calculated in Variant 1 (without the solution in place); and (iii) multiplying that difference by fifty percent (50%) of the assumed amount of NYCA Installed Capacity available. The ICAP cost metrics are indicative measures of the additional potential benefits resulting from the implementation of a CARIS solution. The metrics are not precise determinants of future capacity prices and are calculated for the purpose of providing additional information.

The two variants for savings calculations can be better defined and understood through the ICAP Demand Curve diagram below, Figure 32.

Figure 32: CARIS ICAP Demand Curve



The MW Impact calculation from the first step described above uses the GE-MARS base case for LOLE calculations, which is based upon the 2019-2028 Comprehensive Reliability Plan (CRP). Version 3.22.6 of MARS was used for this analysis. Updates were made to capacity resources contained in the production cost simulation base case to match the CRP assumptions. A series of project cases were created to simulate transmission, generation, demand response, and energy efficiency projects. Each type of project was modeled with different changes to the MARS topology to accurately represent the effect of the project on the system.

To simulate the three transmission project cases, the following changes to interface transfer limits were made, as indicated in Figure 33.

Figure 33: MARS Interface Modifications for Transmission Solution ICAP Calculations (MW)

Incremental Change			
MARS Interface	**Study 1: Central East**	**Study 2: Central East-Knickerbocker**	**Study 3: Volney-Scriba**
Central East MARS(E-F)	350.00	350.00	-
Central East Group(E-F&E-G)	300.00	300.00	-
F-G	100.00	150.00	-
UPNY-SENY	100.00	150.00	-
Oswego Export	-	-	200.00

To simulate the generation project cases, capacity was added downstream of the congested element, as indicated in Figure 34.

Figure 34: MARS Capacity Additions for Generation Solution ICAP Calculations

Study	Generator Bus Location	# Units	Unit Size (MW)	Total Capacity Addition (MW)
Study 1: Central East	New Scotland	1	340	340
Study 2: Central East-Knickerbocker	Pleasant Valley	1	340	340
Study 3: Volney-Scriba	Volney	1	340	340

Energy efficiency project cases were modeled by reducing the load forecast downstream of the congested element, as indicated in Figure 35.

Figure 35: MARS Load Reductions for Energy Efficiency Solution ICAP Calculations (MW)

Zone & Load Reduction (MW)	Study 1: Central East	Study 2: Central East-Knickerbocker	Study 3: Volney-Scriba
F	100	100	100
G	100	100	100
J	200	200	-

The demand response project cases were created by adding SCRs downstream of the congested element, as indicated in Figure 36.

Figure 36: MARS SCR Capacity Additions for Demand Response Solution ICAP Calculations (MW)

Zone & SCR Addition Amount (MW)	Study 1: Central East	Study 2: Central East-Knickerbocker	Study 3: Volney-Scriba
F	100	100	100
G	100	100	100
J	200	200	-

After the base case and project cases were simulated and LOLE values determined, capacity was removed from each NYISO Zone in the each project case, based on the zonal total capacity ratio, until the base case LOLE was reached. The resultant amount of capacity removed is equivalent to the MW Impact of that project case. The MW Impact results for each of the project cases, for the 2028 study year are presented in Figure 37.

Figure 37: MARS SCR Capacity Additions for Demand Response Solution ICAP Calculations

Study	Solution	MW Impact (MW)			
		J	G-J	K	NYCA
Study 1: Central East	Transmission	-	-	-	-
	Generation	54	81	29	220
	Energy Efficiency	142	212	77	574
	Demand Response	122	182	66	493
Study 2: Central East-Knickerbocker	Transmission	-	-	-	-
	Generation	54	81	29	220
	Energy Efficiency	142	212	77	574
	Demand Response	122	182	66	493
Study 3: Volney Scriba	Transmission	-	-	-	-
	Generation	54	81	29	220
	Energy Efficiency	36	54	19	145
	Demand Response	30	44	16	120

Variant #1 of the ICAP savings calculation can now be determined by simply multiplying the MW impact values in the table above with the pre-project capacity price of the demand curve for the corresponding study year. The MW impact values are also used to calculate the post-project capacity price for Variant #2, which is then subtracted from the pre-project price and multiplied by 50% of the projected available capacity for the four capacity zones in that year. The results of these calculations for all 10 years of the CARIS study are contained in Figure 38 and Figure 39 below.

The two ICAP cost variants are indicative of a range of the potential benefits to load resulting from the implementation of a CARIS solution. The metrics are not precise determinants of future capacity prices and are calculated for the purpose of providing additional information. The results of the metric calculations are shown in Figure 38 and Figure 39 below.

Figure 38: ICAP Costs Savings - Variant 1

CARIS 2019 ICAP Variant #1 Savings (2019 $M)													
Study	**Solution**	**Capacity Zone**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**10 Year Total**
Study 1: Central East	**Transmission**	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	0	0	0	0	0	0	0	0	0	0	**0**
		J:	0	0	0	0	0	0	0	0	0	0	**0**
		K:	0	0	0	0	0	0	0	0	0	0	**0**
		Total:	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Generation	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	1	1	3	3	2	2	2	2	2	2	**19**
		J:	5	5	6	5	5	4	4	4	4	4	**46**
		K:	1	0	0	0	0	0	0	0	0	0	**1**
		Total:	**7**	**6**	**9**	**8**	**7**	**7**	**6**	**6**	**6**	**5**	**66**
	Energy Efficiency	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	2	2	7	7	6	6	5	5	5	4	**50**
		J:	13	13	15	14	12	12	11	11	10	9	**120**
		K:	2	1	0	0	0	0	0	0	0	0	**4**
		Total:	**17**	**17**	**22**	**21**	**18**	**17**	**17**	**16**	**15**	**14**	**173**
	Demand Response	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	2	2	6	6	5	5	5	4	4	4	**43**
		J:	11	11	13	12	11	10	10	9	8	8	**103**
		K:	2	1	0	0	0	0	0	0	0	0	**3**
		Total:	**15**	**14**	**19**	**18**	**16**	**15**	**14**	**14**	**13**	**12**	**149**
Study 2: Central East-Knickerbocker	**Transmission**	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	0	0	0	0	0	0	0	0	0	0	**0**
		J:	0	0	0	0	0	0	0	0	0	0	**0**
		K:	0	0	0	0	0	0	0	0	0	0	**0**
		Total:	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Generation	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	1	1	3	3	2	2	2	2	2	2	**19**
		J:	5	5	6	5	5	4	4	4	4	4	**46**
		K:	1	0	0	0	0	0	0	0	0	0	**1**
		Total:	**7**	**6**	**9**	**8**	**7**	**7**	**6**	**6**	**6**	**5**	**66**
	Energy Efficiency	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	2	2	7	7	6	6	5	5	5	4	**50**
		J:	13	13	15	14	12	12	11	11	10	9	**120**
		K:	2	1	0	0	0	0	0	0	0	0	**4**
		Total:	**17**	**17**	**22**	**21**	**18**	**17**	**17**	**16**	**15**	**14**	**173**
	Demand Response	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	2	2	6	6	5	5	5	4	4	4	**43**
		J:	11	11	13	12	11	10	10	9	8	8	**103**
		K:	2	1	0	0	0	0	0	0	0	0	**3**
		Total:	**15**	**14**	**19**	**18**	**16**	**15**	**14**	**14**	**13**	**12**	**149**
Study 3: Volney Scriba	**Transmission**	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	0	0	0	0	0	0	0	0	0	0	**0**
		J:	0	0	0	0	0	0	0	0	0	0	**0**
		K:	0	0	0	0	0	0	0	0	0	0	**0**
		Total:	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Generation	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	1	1	3	3	2	2	2	2	2	2	**19**
		J:	5	5	6	5	5	4	4	4	4	4	**46**
		K:	1	0	0	0	0	0	0	0	0	0	**1**
		Total:	**7**	**6**	**9**	**8**	**7**	**7**	**6**	**6**	**6**	**5**	**66**
	Energy Efficiency	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	1	1	2	2	2	1	1	1	1	1	**13**
		J:	3	3	4	4	3	3	3	3	2	2	**30**
		K:	1	0	0	0	0	0	0	0	0	0	**1**
		Total:	**4**	**4**	**6**	**5**	**5**	**4**	**4**	**4**	**4**	**3**	**44**
	Demand Response	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	0	0	1	1	1	1	1	1	1	1	**10**
		J:	3	3	3	3	3	2	2	2	2	2	**25**
		K:	0	0	0	0	0	0	0	0	0	0	**1**
		Total:	**4**	**3**	**5**	**4**	**4**	**4**	**3**	**3**	**3**	**3**	**36**

Figure 39: ICAP Costs Savings - Variant 2

CARIS 2019 ICAP Variant #2 Savings (2019 $M)													
Study	**Solution**	**Capacity Zone**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**10 Year Total**
Study 1: Central East	**Transmission**	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	0	0	0	0	0	0	0	0	0	0	**0**
		J:	0	0	0	0	0	0	0	0	0	0	**0**
		K:	0	0	0	0	0	0	0	0	0	0	**0**
		Total:	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Generation	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	11	10	17	16	15	15	14	13	13	12	**136**
		J:	46	44	40	38	34	33	31	31	30	29	**356**
		K:	9	9	9	5	0	0	0	0	0	0	**32**
		Total:	**66**	**63**	**65**	**59**	**50**	**48**	**45**	**45**	**43**	**41**	**524**
	Energy Efficiency	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	28	27	44	42	40	38	36	35	33	32	**356**
		J:	120	114	103	98	90	86	82	79	77	74	**924**
		K:	24	23	13	5	0	0	0	0	0	0	**65**
		Total:	**173**	**165**	**160**	**145**	**130**	**124**	**118**	**114**	**110**	**106**	**1,345**
	Demand Response	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	24	23	38	36	34	33	31	30	29	27	**305**
		J:	103	98	89	85	77	74	70	68	66	64	**794**
		K:	21	20	13	5	0	0	0	0	0	0	**58**
		Total:	**148**	**142**	**139**	**125**	**112**	**107**	**102**	**98**	**95**	**91**	**1,158**
Study 2: Central East-Knickerbocker	**Transmission**	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	0	0	0	0	0	0	0	0	0	0	**0**
		J:	0	0	0	0	0	0	0	0	0	0	**0**
		K:	0	0	0	0	0	0	0	0	0	0	**0**
		Total:	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Generation	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	11	10	17	16	15	15	14	13	13	12	**136**
		J:	46	44	40	38	34	33	31	31	30	29	**356**
		K:	9	9	9	5	0	0	0	0	0	0	**32**
		Total:	**66**	**63**	**65**	**59**	**50**	**48**	**45**	**45**	**43**	**41**	**524**
	Energy Efficiency	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	28	27	44	42	40	38	36	35	33	32	**356**
		J:	120	114	103	98	90	86	82	79	77	74	**924**
		K:	24	23	13	5	0	0	0	0	0	0	**65**
		Total:	**173**	**165**	**160**	**145**	**130**	**124**	**118**	**114**	**110**	**106**	**1,345**
	Demand Response	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	24	23	38	36	34	33	31	30	29	27	**305**
		J:	103	98	89	85	77	74	70	68	66	64	**794**
		K:	21	20	13	5	0	0	0	0	0	0	**58**
		Total:	**148**	**142**	**139**	**125**	**112**	**107**	**102**	**98**	**95**	**91**	**1,158**
Study 3: Volney Scriba	**Transmission**	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	0	0	0	0	0	0	0	0	0	0	**0**
		J:	0	0	0	0	0	0	0	0	0	0	**0**
		K:	0	0	0	0	0	0	0	0	0	0	**0**
		Total:	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Generation	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	11	10	17	16	15	15	14	13	13	12	**136**
		J:	46	44	40	38	34	33	31	31	30	29	**356**
		K:	9	9	9	5	0	0	0	0	0	0	**32**
		Total:	**66**	**63**	**65**	**59**	**50**	**48**	**45**	**45**	**43**	**41**	**524**
	Energy Efficiency	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	7	7	11	11	10	10	9	9	8	8	**90**
		J:	30	29	26	25	23	22	21	21	20	19	**235**
		K:	6	6	6	5	0	0	0	0	0	0	**23**
		Total:	**44**	**42**	**43**	**40**	**33**	**31**	**30**	**30**	**28**	**27**	**347**
	Demand Response	ROS:	0	0	0	0	0	0	0	0	0	0	**0**
		G-I:	6	6	9	9	8	8	8	7	7	7	**74**
		J:	25	24	22	21	19	18	17	17	16	16	**195**
		K:	5	5	5	5	0	0	0	0	0	0	**19**
		Total:	**36**	**35**	**35**	**34**	**27**	**26**	**25**	**24**	**23**	**22**	**288**

CARIS Base Case Metrics Results

When comparing historic values of congestion and other metrics with the projected CARIS values, it is important to note that there are significant differences in assumptions used by these tools. MAPS, unlike SCUC, did not simulate the following: (a) virtual bidding; (b) transmission outages; (c) fixed load and price-capped load; (d) production costs based on mitigated bids;(e) BPCG payments; and (f) co-optimization with ancillary services.

Figure 40 through Figure 53 below presents the summation of the NYCA zonal results for the ten-year study period (except for NYCA-wide production costs) for the base case developed in 2019 CARIS.

Figure 40: Projected Base Case Results 2019-2028 (nominal $M)

Case Summary	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
NYCA-Wide Production Cost ($M)	2,403	2,740	3,030	3,287	3,502	3,728	3,960	4,148	4,212	4,484
NYCA Demand Congestion ($M)	986	838	827	655	387	338	219	235	268	322
Load LBMP Payment ($M)	4,509	4,938	5,286	5,565	6,126	6,455	7,072	7,317	7,529	7,899
Generator LBMP Payment ($M)	3,544	3,982	4,251	4,484	5,137	5,254	5,955	6,060	6,265	6,505
Load Payment Losses ($M)	105	119	131	130	140	148	155	162	171	176
SO_2 Costs ($M)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
SO_2 Emission (Short Tons)	519	536	565	569	857	1,217	3,237	3,147	2,975	3,168
CO_2 Costs ($M)	128	171	207	226	248	252	278	295	313	337
CO_2 Emission (Short Tons)	27,527	29,996	32,373	33,100	34,065	32,234	33,366	33,000	32,710	32,925
NO_X Costs ($M)	0.74	0.73	0.80	0.72	0.65	0.47	0.47	0.44	0.46	0.44
NO_X Emission (Short Tons)	10,784	11,272	12,197	12,324	12,551	11,792	12,007	11,974	11,861	11,912
NYCA Avg. LBMP ($/MWh)	26.74	29.66	31.97	34.04	38.09	40.11	44.39	45.85	47.12	49.16

Figure 41: Projected Base Case Production Costs (2019-2028) by Zone (nominal $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	**2,095**	**2,363**	**2,556**	**2,705**	**2,946**	**2,997**	**3,289**	**3,371**	**3,468**	**3,638**
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**

Figure 42: Projected Base Case Load Payments (2019-2028) by Zone (nominal $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

Figure 43: Projected Base Case Generator Payments (2019-2028) by Zone (nominal $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

Figure 44: Projected Base Case Generation (2019-2028) by Zone (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

Figure 45: Projected Base Case Loss Payments (2019-2028) by Zone (nominal $M)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	-10	-14	-11	-14	-8	-20	-14	-19	-16	-21
Genesee	-4	-5	-4	-3	-1	-6	-3	-5	-4	-5
Central	4	4	4	4	4	3	3	3	3	3
North	-5	-7	-7	-7	-7	-9	-8	-9	-9	-9
Mohawk Valley	3	3	3	3	3	4	5	5	5	5
Capital	11	13	12	12	12	11	11	12	12	12
Hudson Valley	10	12	13	13	13	15	15	16	16	17
Millwood	3	3	4	4	4	5	5	5	5	5
Dunwoodie	6	7	8	8	8	10	9	10	11	11
NY City	62	73	78	79	79	97	95	104	107	113
Long Island	27	31	31	31	31	38	37	40	41	44
NYCA Total	105	119	131	130	140	148	155	162	171	176

Figure 46: Projected Base Case SO_2 Emissions Costs (2019-2028) by Zone (nominal $M)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01
Genesee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Central	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
North	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mohawk Valley	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hudson Valley	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Millwood	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dunwoodie	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NY City	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Long Island	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NYCA Total	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01

Figure 47: Projected Base Case SO_2 Emissions (2019-2028) by Zone (Tons)

SO_2 Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	171	173	172	173	457	828	2,848	2,759	2,588	2,780
Genesee	0	0	0	0	0	0	0	0	0	0
Central	7	9	9	10	12	12	13	12	12	13
North	0	0	0	0	0	0	0	0	0	0
Mohawk Valley	0	0	0	0	0	0	0	0	0	0
Capital	63	62	66	67	67	65	66	65	65	65
Hudson Valley	14	24	44	45	45	42	42	41	41	42
Millwood	106	106	105	106	106	106	106	106	106	106
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	64	66	70	72	73	70	70	71	70	69
Long Island	96	96	98	97	96	94	93	93	93	93
NYCA Total	519	536	565	569	857	1,217	3,237	3,147	2,975	3,168

Figure 48: Projected Base Case CO_2 Emissions Costs (2019-2028) by Zone (nominal $M)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.7	0.8	1.0	1.0	2.4	3.5	10.7	11.1	11.1	12.9
Genesee	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.2
Central	6.6	10.2	11.2	13.5	17.2	18.4	21.0	22.1	22.6	25.8
North	0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.2	0.3	0.3
Mohawk Valley	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Capital	33.1	36.6	46.1	50.1	54.3	54.4	59.8	62.8	67.3	72.4
Hudson Valley	12.8	25.2	32.7	34.5	37.9	36.4	39.2	39.9	44.2	47.9
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	53.2	73.6	87.1	96.3	104.5	107.2	114.5	124.4	130.4	138.2
Long Island	21.2	24.3	28.4	30.3	31.7	31.8	32.7	34.3	36.6	39.3
NYCA Total	127.9	170.9	206.7	226.0	248.3	252.2	278.4	295.1	312.9	337.2

Figure 49: Projected Base Case CO_2 Emissions (2019-2028) by Zone (1,000 Tons)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	136	135	151	143	315	431	1,276	1,230	1,148	1,239
Genesee	20	18	19	18	24	19	16	22	19	22
Central	1,295	1,776	1,718	1,957	2,344	2,328	2,512	2,468	2,361	2,511
North	13	9	14	11	14	32	27	19	29	31
Mohawk Valley	10	5	5	3	3	9	8	6	5	7
Capital	6,565	6,347	7,143	7,245	7,368	6,849	7,076	6,929	6,946	6,969
Hudson Valley	2,522	4,358	5,055	4,981	5,127	4,587	4,627	4,396	4,551	4,604
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	12,658	13,053	13,785	14,284	14,504	13,884	13,882	14,076	13,804	13,685
Long Island	4,307	4,296	4,483	4,460	4,367	4,095	3,941	3,854	3,848	3,856
NYCA Total	27,527	29,996	32,373	33,100	34,065	32,234	33,366	33,000	32,710	32,925

Figure 50: Projected Base Case NO_X Emissions Costs (2019-2028) by Zone (nominal $M)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Genesee	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Central	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mohawk Valley	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Hudson Valley	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2
Long Island	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
NYCA Total	0.7	0.7	0.8	0.7	0.6	0.5	0.5	0.4	0.5	0.4

Figure 51: Projected Base Case NO_X Emissions (2019-2028) by Zone (Tons)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1,006	1,038	1,051	1,071	1,177	1,223	1,626	1,607	1,568	1,644
Genesee	151	158	160	170	178	177	176	178	177	178
Central	385	432	426	457	513	518	541	534	520	543
North	33	36	34	33	35	48	45	39	41	45
Mohawk Valley	33	32	31	32	33	35	34	34	34	34
Capital	826	850	926	977	967	945	945	960	940	951
Hudson Valley	1,324	1,360	1,739	1,617	1,699	1,400	1,312	1,216	1,302	1,309
Millwood	989	992	989	989	989	993	990	990	990	992
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	2,945	3,280	3,654	3,817	3,844	3,474	3,446	3,561	3,435	3,369
Long Island	3,093	3,093	3,187	3,161	3,116	2,978	2,891	2,856	2,854	2,847
NYCA Total	10,784	11,272	12,197	12,324	12,551	11,792	12,007	11,974	11,861	11,912

Figure 52: Projected Congestion Rents (2019-2028) (nominal $M)

Congestion Rent ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
NYCA Total	573	465	464	392	327	323	299	323	361	378

Figure 53: Projected Base Case LBMP (2019-2028) by Zone ($/MWh)

LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	25.76	27.42	28.73	29.70	35.23	36.34	41.54	42.49	43.81	45.40
Genesee	20.88	24.61	27.06	30.09	35.62	37.07	42.22	43.36	44.51	46.27
Central	23.38	26.78	28.86	31.40	36.60	39.02	43.79	45.21	46.37	48.14
North	19.13	22.75	25.23	28.24	34.05	35.96	41.21	42.30	43.41	44.99
Mohawk Valley	23.15	26.68	28.81	31.52	36.72	39.32	44.06	45.51	46.63	48.43
Capital	31.41	33.37	35.63	37.10	39.47	41.46	45.05	46.57	47.96	50.30
Hudson Valley	29.20	31.97	34.74	36.65	39.65	41.65	45.43	47.09	48.43	50.73
Millwood	29.39	32.29	34.94	36.83	39.79	41.85	45.61	47.29	48.63	50.93
Dunwoodie	29.37	32.29	34.98	36.86	39.81	41.82	45.58	47.25	48.60	50.88
NY City	29.98	32.89	35.26	37.05	39.96	42.19	45.97	47.66	49.07	51.34
Long Island	32.46	35.21	37.42	38.99	42.13	44.52	47.89	49.60	50.88	53.39
Average LBMP ($/MWh)	26.74	29.66	31.97	34.04	38.09	40.11	44.39	45.85	47.12	49.16

Selection of Studies

The process for selecting the three CARIS studies occurs in two steps, as described below.

In Step 1, the top five congested elements for the fifteen-year period (both historic (5 years) and projected (10 years)) are ranked in descending order based on the calculated present value of demand congestion for further assessment. The discount rate to be used for the present value analysis shall be the current weighted average cost of capital for the NY Transmission Owners, which was 7.08% for 2019 CARIS cycle. The top congested elements are then iteratively relieved independently by relaxing their limits. This is to determine if any of the congested elements need to be grouped with other elements, depending on whether new electrically adjacent elements appear as limiting with significant congestion when a primary element is relieved.

In Step 2, the assessed element groupings are then ranked based upon the highest change in production cost as shown with the top 3 groupings selected to be studied.

Note that the procedure provides that if future system changes (*e.g.*, generation, transmission, energy efficiency or demand side additions) produce a significant declining trend in congestion over an identified congested element in later years of the study period, such element shall be excluded from the rankings. Elements with significant increasing trend in congestion could also be evaluated in addition to the top five elements. As a result, New Scotland-Knickerbocker line was included in the relaxation and grouping process.

The study selection procedures provide the NYISO with flexibility for grouping, assessing and recommending the three studies. The grouping process for each CARIS is reviewed with ESPWG. It is expected that the three groupings/elements with the most production cost savings will be selected as the three studies. The production cost savings based on modifying an existing element's transfer limit will be different than the savings achieved when applying a transmission solution because an impedance value for the line is not being introduced.

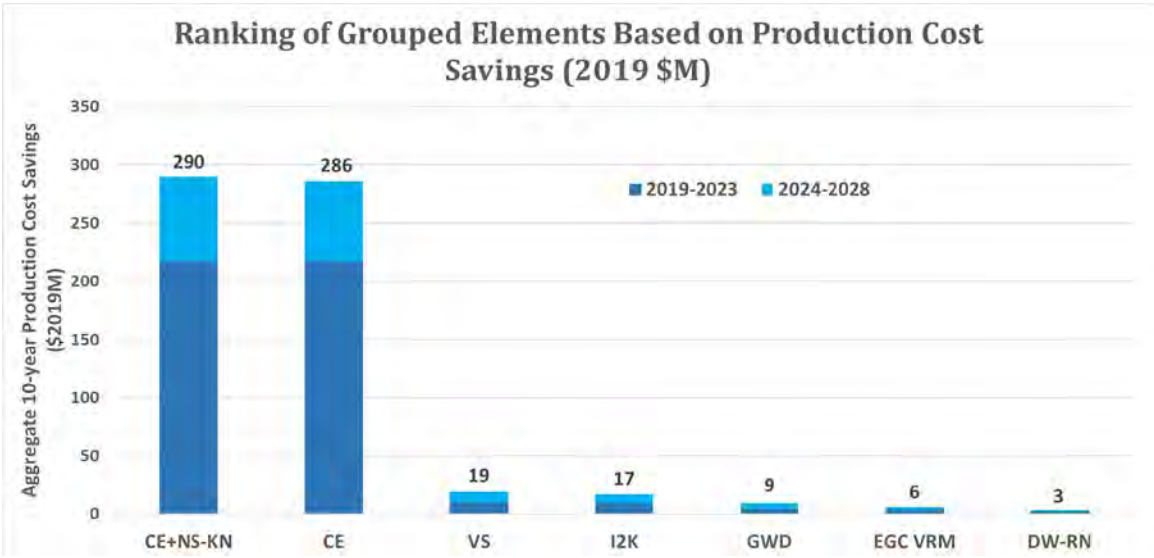
Figure 54 the demand congestion for the base case and the relaxation cases over the 10-year study period.

Figure 54: Base Case and Relaxation Case Demand Congestion

Demand Congestion ($2019M)	Base Case	10 YEAR RELAXATION						
		CENTRAL EAST (CE)	DUNWOODIE TO LONG ISLAND (I2K)	DUNWOODIE TO RAINEY (DW-RN)	GREENWOOD LP (GWD)	EAST GARDEN CITY-VALLEY STREAM (EGC VRM)	VOLNEY SCRIBA (VS)	CENTRAL EAST-NEW SCOTLAND KNICKERBOCKER (CE-NS-KN)
CENTRAL EAST	$2,555	$0	$2,513	$2,540	$2,555	$2,556	$2,551	$0
DUNWOODIE TO LONG ISLAND	$230	$220	$0	$221	$229	$229	$232	$219
DUNWOODIE MOTTHAVEN	$83	$80	$70	$0	$89	$81	$84	$79
GREENWOOD	$67	$68	$64	$67	$0	$67	$68	$68
VOLNEY SCRIBA	$51	$51	$53	$52	$51	$51	$0	$51
EGRDNCTY 138 VALLYSTR 138 1	$33	$33	$30	$33	$33	$0	$33	$33
NEW SCOTLAND KNCKRBOC	$16	$26	$12	$17	$15	$16	$16	$0
LEEDS PLEASANT VALLEY	$9	$8	$11	$12	$10	$9	$10	$8
MOTTHAVEN RAINEY	$3	$2	$2	$0	$4	$3	$3	$2

Figure 55 shows the change in production cost when the top congested elements are relieved. The NYISO presented the ranking and grouping analysis to ESPWG stakeholders and recommended three studies based upon the highest production cost savings: Central East, Central East-New Scotland-Knickerbocker, and Volney-Scriba. The recommendation was based upon these groupings meeting the NYISO's grouping and ranking guidelines.

Figure 55: Production Cost Savings Due to Relaxation



Generic Solutions

The NYISO developed generic solutions for each of the three studies. The generic solutions are each added to the base case in order to determine the impact on congestion for the grouped elements in each study. It is assumed that each of the generic solutions is installed in the first study year (2019). This assumption allows for the calculation of the full ten-year production cost and additional metrics resulting from the generic solution. The transfer limits were adjusted as necessary in the generic solution cases.

For each study, the NYISO considered whether a majority of the congestion on the grouped elements being studied could be relieved and whether diminishing returns could be realized from implementing additional blocks of solutions. The NYISO implemented transmission solutions in 1986 MVA block sizes for 345 kV, generation solutions in 340MW block sizes, energy efficiency solutions in 100 MW block sizes in Zone F-G, 200 MW in Zone J, and demand response in 100 MW block sizes in Zone F-G, 200 MW in Zone J.

Note:

- Other solutions may exist that would better alleviate the congestion on the studied elements.
- No engineering, physical feasibility study, routing study or siting study has been completed for the generic solutions. Therefore, it is unknown if the generic solutions can be physically constructed as proposed.

Study 1: Central East

- Transmission: 345 kV line from Edic to New Scotland, 85 Miles
- Generation: 340 MW Plant at New Scotland
- Demand Response : 100 MW in Zone F; 100 MW in Zone G; 200 MW in Zone J
- Energy Efficiency : 100 MW in Zone F; 100 MW in Zone G; 200 MW in Zone J

Figure 56 below presents the change in the number of congested hours by constraints after the generic solution has been applied. Negative values indicate a reduction in congested hours. Detailed results for all CARIS metrics, representing the change between the base case values and the values after the three generic solutions have been applied, are presented in Appendix H - Generic Solution Results - Additional Details.

Figure 56: Change in Number of Congested Hours in Study 1 (Solution Case – Base Case)

Study	Solution	Constraint	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Study 1: Central East	Transmission Solution	CENTRAL EAST	(386)	(595)	(448)	(380)	(264)	(458)	(311)	(359)	(270)	(284)
		DUNWOODIE TO LONG ISLAND	46	36	130	94	149	45	70	30	11	27
		DUNWOODIE MOTTHAVEN	68	60	117	46	106	55	80	36	72	38
		GREENWOOD	(63)	(58)	(30)	(72)	(82)	(43)	(34)	(22)	(7)	16
		VOLNEY SCRIBA	60	149	128	11	14	5	(16)	(7)	(15)	12
		EGRDNCTY 138 VALLYSTR 138 1	(57)	(47)	4	22	(31)	(40)	5	20	11	2
		NEW SCOTLAND KNCKRBOC	0	0	0	0	0	249	91	117	120	183
		LEEDS PLEASANT VALLEY	30	17	9	24	40	0	0	0	0	0
		MOTTHAVEN RAINEY	149	206	44	23	33	30	10	21	7	17
	Generation Solution	CENTRAL EAST	(2)	102	(41)	6	(96)	26	7	(65)	(28)	18
		DUNWOODIE TO LONG ISLAND	62	(72)	35	63	172	30	93	131	169	187
		DUNWOODIE MOTTHAVEN	3	62	55	47	79	136	(4)	164	174	65
		GREENWOOD	21	(24)	(3)	61	(4)	(101)	(10)	(50)	(33)	155
		VOLNEY SCRIBA	(228)	(74)	142	(136)	25	9	17	(75)	347	(30)
		EGRDNCTY 138 VALLYSTR 138 1	70	26	69	(39)	161	(171)	(108)	16	(77)	11
		NEW SCOTLAND KNCKRBOC	0	0	0	0	0	0	(3)	40	7	(6)
		LEEDS PLEASANT VALLEY	8	12	13	23	22	0	0	0	0	0
		MOTTHAVEN RAINEY	61	80	62	29	26	31	(6)	44	(30)	14
	Demand Response	CENTRAL EAST	(4)	(3)	1	1	24	(2)	(3)	(5)	(1)	7
		DUNWOODIE TO LONG ISLAND	0	(12)	(7)	(1)	9	0	10	4	2	(1)
		DUNWOODIE MOTTHAVEN	(10)	(10)	(6)	(5)	3	31	(2)	(4)	2	20
		GREENWOOD	5	(1)	(1)	3	7	0	2	5	2	(3)
		VOLNEY SCRIBA	4	(10)	1	7	(2)	0	1	0	(2)	0
		EGRDNCTY 138 VALLYSTR 138 1	(1)	6	(2)	(1)	4	5	(7)	3	4	6
		NEW SCOTLAND KNCKRBOC	0	0	0	0	0	(1)	0	0	0	1
		LEEDS PLEASANT VALLEY	2	2	0	1	1	0	0	0	0	0
		MOTTHAVEN RAINEY	11	13	1	3	2	2	4	(1)	(2)	2
	Energy Efficiency	CENTRAL EAST	(48)	(28)	(38)	(44)	16	(63)	(24)	(127)	(23)	(17)
		DUNWOODIE TO LONG ISLAND	99	43	119	123	248	175	161	234	211	195
		DUNWOODIE MOTTHAVEN	(86)	(128)	(173)	(223)	(119)	(211)	(218)	(270)	(269)	(241)
		GREENWOOD	(271)	(407)	(329)	(388)	(357)	(371)	(321)	(351)	(433)	(349)
		VOLNEY SCRIBA	(256)	(178)	(109)	(13)	(42)	(76)	(31)	(69)	(79)	(91)
		EGRDNCTY 138 VALLYSTR 138 1	(62)	(57)	(56)	(28)	(75)	(149)	(34)	(30)	(54)	(54)
		NEW SCOTLAND KNCKRBOC	0	0	0	0	0	29	9	(12)	5	8
		LEEDS PLEASANT VALLEY	3	(1)	(1)	5	(1)	0	0	0	0	0
		MOTTHAVEN RAINEY	13	56	39	(3)	38	24	16	2	25	(16)

Study 2: Central East – New Scotland - Knickerbocker

- Transmission: 345 kV line from Edic to Knickerbocker, 100 Miles
- Generation: 340 MW Plant at Pleasant Valley
- Demand Response : 100 MW in Zone F; 100 MW in Zone G; 200 MW in Zone J
- Energy Efficiency : 100 MW in Zone F; 100 MW in Zone G; 200 MW in Zone J

Figure 57 below presents the change in the number of congested hours by constraints after the generic solution has been applied. Negative values indicate a reduction in congested hours. Detailed results for all CARIS metrics, representing the change between the base case values and the values after the three generic solutions have been applied, are presented in Appendix H - Generic Solution Results - Additional Details.

Figure 57: Change in Number of Congested Hours in Study 2 (Solution Case – Base Case)

Study	Solution	Constraint	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Study 2: Central East - New Scotland - Knickerbocker	Transmission Solution	CENTRAL EAST	(386)	(595)	(448)	(380)	(264)	(303)	(235)	(233)	(170)	(175)
		DUNWOODIE TO LONG ISLAND	46	36	130	94	149	22	37	51	1	24
		DUNWOODIE MOTTHAVEN	68	60	117	46	106	49	32	41	51	42
		GREENWOOD	(63)	(58)	(30)	(72)	(82)	(49)	(39)	(14)	(37)	24
		VOLNEY SCRIBA	60	149	128	11	14	5	(2)	(7)	(20)	(2)
		EGRDNCTY 138 VALLYSTR 138 1	(57)	(47)	4	22	(31)	(37)	(19)	5	5	12
		NEW SCOTLAND KNCKRBOC	0	0	0	0	0	(33)	(21)	(61)	(37)	(28)
		LEEDS PLEASANT VALLEY	30	17	9	24	40	0	0	0	0	0
		MOTTHAVEN RAINEY	149	206	44	23	33	39	10	17	(1)	6
	Generation Solution	CENTRAL EAST	(15)	90	(23)	53	(87)	49	13	(48)	(8)	15
		DUNWOODIE TO LONG ISLAND	67	(48)	35	56	213	52	78	156	182	204
		DUNWOODIE MOTTHAVEN	(17)	34	132	89	86	138	7	202	177	88
		GREENWOOD	26	(27)	0	65	5	(109)	(25)	(46)	(26)	125
		VOLNEY SCRIBA	(201)	(66)	182	(128)	12	7	22	(72)	341	(66)
		EGRDNCTY 138 VALLYSTR 138 1	66	34	103	(22)	165	(162)	(128)	18	(86)	(3)
		NEW SCOTLAND KNCKRBOC	0	0	0	0	0	(16)	(4)	(1)	(14)	(13)
		LEEDS PLEASANT VALLEY	(5)	(10)	(8)	1	(7)	0	0	0	0	0
		MOTTHAVEN RAINEY	91	149	81	26	31	38	(5)	48	(24)	16
	Demand Response	CENTRAL EAST	(4)	(3)	1	1	24	(2)	(3)	(5)	(1)	7
		DUNWOODIE TO LONG ISLAND	0	(12)	(7)	(1)	9	0	10	4	2	(1)
		DUNWOODIE MOTTHAVEN	(10)	(10)	(6)	(5)	3	31	(2)	(4)	2	20
		GREENWOOD	5	(1)	(1)	3	7	0	2	5	2	(3)
		VOLNEY SCRIBA	4	(10)	1	7	(2)	0	1	0	(2)	0
		EGRDNCTY 138 VALLYSTR 138 1	(1)	6	(2)	(1)	4	5	(7)	3	4	6
		NEW SCOTLAND KNCKRBOC	0	0	0	0	0	(1)	0	0	0	1
		LEEDS PLEASANT VALLEY	2	2	0	1	1	0	0	0	0	0
		MOTTHAVEN RAINEY	11	13	1	3	2	2	4	(1)	(2)	2
	Energy Efficiency	CENTRAL EAST	(48)	(28)	(38)	(44)	16	(63)	(24)	(127)	(23)	(17)
		DUNWOODIE TO LONG ISLAND	99	43	119	123	248	175	161	234	211	195
		DUNWOODIE MOTTHAVEN	(86)	(128)	(173)	(223)	(119)	(211)	(218)	(270)	(269)	(241)
		GREENWOOD	(271)	(407)	(329)	(388)	(357)	(371)	(321)	(351)	(433)	(349)
		VOLNEY SCRIBA	(256)	(178)	(109)	(13)	(42)	(76)	(31)	(69)	(79)	(91)
		EGRDNCTY 138 VALLYSTR 138 1	(62)	(57)	(56)	(28)	(75)	(149)	(34)	(30)	(54)	(54)
		NEW SCOTLAND KNCKRBOC	0	0	0	0	0	29	9	(12)	5	8
		LEEDS PLEASANT VALLEY	3	(1)	(1)	5	(1)	0	0	0	0	0
		MOTTHAVEN RAINEY	13	56	39	(3)	38	24	16	2	25	(16)

Study 3: Volney - Scriba

- Transmission: 345 kV line from Volney to Scriba, 10 Miles
- Generation: 340 MW Plant at Volney
- Demand Response : 100 MW in Zone F; 100 MW in Zone G
- Energy Efficiency : 100 MW in Zone F; 100 MW in Zone G

Figure 58 below presents the change in the number of congested hours by constraint after the generic solution has been applied. Negative values indicate a reduction in congested hours. Detailed results for all CARIS metrics, representing the change between the base case values and the values after the three generic solutions have been applied, are presented in Appendix H - Generic Solution Results - Additional Details.

Figure 58: Change in Number of Congested Hours in Study 3 (Solution Case – Base Case)

Study	Solution	Constraint	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Study 3: Volney - Scriba	Transmission Solution	CENTRAL EAST	23	1	18	21	27	6	1	(20)	13	20
		DUNWOODIE TO LONG ISLAND	0	(8)	(2)	(4)	5	(12)	28	17	(23)	(21)
		DUNWOODIE MOTTHAVEN	5	(1)	(6)	(12)	(9)	(5)	21	8	24	19
		GREENWOOD	(5)	4	(11)	(3)	5	(1)	(5)	22	(14)	5
		VOLNEY SCRIBA	(1,434)	(1,593)	(1,224)	(1,330)	(1,444)	(1,258)	(1,334)	(1,486)	(1,798)	(1,745)
		EGRDNCTY 138 VALLYSTR 138 1	(13)	(10)	(20)	34	13	(8)	20	5	15	17
		NEW SCOTLAND KNCKRBOC	0	0	0	0	0	7	1	(10)	1	(4)
		LEEDS PLEASANT VALLEY	1	1	(1)	3	0	0	0	0	0	0
		MOTTHAVEN RAINEY	35	50	(6)	11	4	3	(3)	(4)	2	12
	Generation Solution	CENTRAL EAST	102	175	115	223	217	338	220	286	255	231
		DUNWOODIE TO LONG ISLAND	26	(74)	35	41	174	30	54	93	138	151
		DUNWOODIE MOTTHAVEN	(13)	46	37	10	52	69	31	170	130	39
		GREENWOOD	18	(22)	5	46	7	(125)	(57)	(37)	(6)	122
		VOLNEY SCRIBA	(1,018)	(1,264)	(896)	(1,106)	(1,289)	(1,092)	(1,286)	(1,471)	(1,768)	(1,683)
		EGRDNCTY 138 VALLYSTR 138 1	105	44	129	(71)	149	(155)	(117)	10	(62)	0
		NEW SCOTLAND KNCKRBOC	0	0	0	0	0	(2)	5	21	(7)	(4)
		LEEDS PLEASANT VALLEY	4	12	8	9	4	0	0	0	0	0
		MOTTHAVEN RAINEY	28	85	49	(1)	29	15	(14)	46	(32)	0
	Demand Response	CENTRAL EAST	(12)	0	(1)	0	17	(1)	(3)	(6)	(1)	7
		DUNWOODIE TO LONG ISLAND	2	(3)	(4)	0	2	(3)	17	0	2	(2)
		DUNWOODIE MOTTHAVEN	(3)	0	14	0	(2)	12	(4)	2	2	6
		GREENWOOD	4	0	(3)	4	1	0	1	3	(1)	0
		VOLNEY SCRIBA	3	(7)	1	5	(2)	0	0	1	(2)	(1)
		EGRDNCTY 138 VALLYSTR 138 1	(3)	4	2	(1)	(5)	2	(2)	1	0	6
		NEW SCOTLAND KNCKRBOC	0	0	0	0	0	1	0	0	0	1
		LEEDS PLEASANT VALLEY	(1)	3	0	1	0	0	0	0	0	0
		MOTTHAVEN RAINEY	7	3	1	2	0	3	3	(1)	(2)	(1)
	Energy Efficiency	CENTRAL EAST	(46)	(60)	(52)	(46)	(19)	(55)	(17)	(69)	(24)	27
		DUNWOODIE TO LONG ISLAND	59	53	103	98	151	80	112	145	117	106
		DUNWOODIE MOTTHAVEN	31	49	144	117	181	75	129	83	136	119
		GREENWOOD	17	(9)	(9)	(15)	(26)	(11)	(3)	18	(42)	20
		VOLNEY SCRIBA	(237)	(89)	(47)	(30)	(11)	(38)	(10)	(36)	(38)	(72)
		EGRDNCTY 138 VALLYSTR 138 1	(25)	(13)	(40)	(4)	(61)	(109)	(16)	(26)	(17)	(41)
		NEW SCOTLAND KNCKRBOC	0	0	0	0	0	31	10	0	16	8
		LEEDS PLEASANT VALLEY	2	3	5	8	3	0	0	0	0	0
		MOTTHAVEN RAINEY	105	120	62	22	15	39	25	22	20	27

Benefit/Cost Analysis

The NYISO defines generic solutions to alleviate congestion for each resource type (generation, transmission, demand response, and energy efficiency), as required by the Tariff, Attachment Y, Section 31.3.1.3.3. The costs of each solution must be estimated to report B/C ratios in CARIS Phase 1 for each generic solution. The NYISO, in consultation with its stakeholders, estimates a high, mid and low cost for each solution type in CARIS Phase 1. This establishes a broader range of costs in order to provide more useful information to developers and other interested parties. The NYISO bases the costs upon data from publicly available sources.

The Generic Solution Cost Matrix should not be utilized for purposes outside of the CARIS generic solution process. No assessment was made concerning the actual feasibility of any generic solution proposed. These estimates should not be assumed as reflective or predictive of actual projects or imply that specific facilities can necessarily be built for these generic solution estimates.

Transmission cost estimates are based on cost estimates for specific projects submitted for

consideration in the New York State PSC's AC Transmission proceeding.[6] The NYISO analyzed the cost data presented for the various proposed projects and developed low, mid and high cost estimates for total project costs on a per-mile basis for new 345 kV transmission facilities.

Generation costs estimates were based on available NYISO consultant estimates for developing new combined cycle units in Zones F and G provided as part of the 2016 Demand-Curve Reset process[7].

Demand-response cost estimates were derived from recent utility filings with the NYPSC on Commercial System Relief Program (CSRP) costs and enrollments. [8]

Energy-efficiency cost estimates were derived from DPS filings on energy efficiency costs from the relevant TOs.[9]

The generic solutions cost matrix and assumptions for all four types of solutions are presented in Figure 59 through Figure 62 below.

6 12-T-0502-Proceeding on Motion of the Commission to Examine Alternating Current Transmission Upgrades; 13-E-0488 –In the Matter of Alternating Current Transmission Upgrades-Comparative Proceeding

7 *NYISO Staff Recommendations Initial Draft – Demand Curve Reset*, August 17, 2016.

8 Case 14-E-0423 – Proceeding on Motion of the Commission to Develop Load Management Programs

9 Case 18-M-0084 – In the Matter of a Comprehensive Energy Efficiency Initiative.

Figure 59: Transmission Cost Matrix

Base Case Modeling Assumptions for 2019-2028 CARIS Phase 1
Generic Transmission Cost Matrix
Order of Magnitude Unit Prices
(Estimates should not be assumed reflective or predictive of actual project costs)

Cost Range	Zone	Transmission			
		Line System Voltage (kV)	Block Capacity (MVA)	Construction Type	Transmission Cost ($M/Mile)
High	Zones E-G	345	1986	Overhead	7.5
Mid	Zones E-G	345	1986	Overhead	6
Low	Zones E-G	345	1986	Overhead	4

Assumptions:

1. Estimates herein should not be utilized for purposes outside of the CARIS process. Also, these estimates should not be assumed as reflective or predictive of actual projects or imply that facilities can necessarily be built for these generic solution order of magnitude estimates. Estimate ranges were identified after Transmission Owner input and discussions at the ESPWG.
2. Lines constructed will be comprised of single circuit AC overhead construction.
3. The transmission line will be interconnected into an existing 345kV substation for Zones F and G.
4. The line can be permitted and constructed utilizing the shortest distance between the two selected substations.
5. The control house at the existing substations selected as the interconnection point has sufficient space for installing the new protection and communication equipment for the new line terminal.
6. Estimates include costs for material, construction labor, engineering labor, permits, testing and commissioning. The estimates do not include Allowance of Funds During Construction (AFDC).
7. The cost per mile includes a range to account for the variable land and permitting costs associated with a project such as utilizing an existing ROW, expanding an existing ROW or obtaining new ROW.

Figure 60: Generation Cost Matrix

Base Case Modeling Assumptions for 2019-2028 CARIS Phase 1
Generic Generation Cost Matrix
Order of Magnitude Unit Costs
(Estimates should not be assumed reflective or predictive of actual project costs)

Cost Range	Plant Location	Plant Block Size Capacity (MW)	Plant Cost per Block Size ($M)
High	New Scotland (Zone F)	340	750
Mid	New Scotland (Zone F)	340	600
Low	New Scotland (Zone F)	340	450
High	Pleasant Valley (Zone G/Dutchess County)	340	845
Mid	Pleasant Valley (Zone G/Dutchess County)	340	675
Low	Pleasant Valley (Zone G/Dutchess County)	340	505
High	Volney (Zone C)	340	655
Mid	Volney (Zone C)	340	525
Low	Volney (Zone C)	340	395

Assumptions:

1. Estimates herein should not be utilized for purposes outside of the CARIS process. Also, these estimates should not be assumed as reflective or predictive of actual projects or imply that facilities can necessarily be built for these generic solution order of magnitude estimates. Estimate ranges were identified based upon NYISO filings at FERC and Consultant estimates.

2. It is assumed the plants will be gas fired combined cycles, configured 1x1x1 Siemens SGT6-5000F(5), total generation 340 MW.

Figure 61: Generator Cost per Unit - 2017 Price Level[10]

GENERATOR COST PER UNIT - 2016 Demand Curve Reset Cost Estimates						
Zone	**Size**	**Combined Cycle**	**EPC Costs ($M)**	**Non-EPC Costs ($M)**	**Total ($M)**	**Unit Cost ($/kW)**
Zone F (Capital)	340 MW	1 x 1 x 1 SGT6-5000F(5)	435	83	518	1524
Zone G (Hudson Valley-Dutchess)	340 MW	1 x 1 x 1 SGT6-5000F(5)	487	93	580	1706
Zone C (Central)	340 MW	1 x 1 x 1 SGT6-5000F(5)	415	79	494	1453

Figure 62: Demand Response and Energy Efficiency Cost Matrix

Base Case Modeling Assumptions for 2019-2028 CARIS Phase 1 **Generic Demand Response and Energy Efficiency Cost Matrix** **Order of Magnitude Unit Costs** *(Estimates should not be assumed reflective or predictive of actual project costs)*			
Cost Range	**Zone**	**Portfolio Type**	**Per-Unit ($M/MW)**
High	F	Demand Response	0.25
Mid	F	Demand Response	0.2
Low	F	Demand Response	0.15
High	G	Demand Response	0.375
Mid	G	Demand Response	0.3
Low	G	Demand Response	0.225
High	J	Demand Response	1.375
Mid	J	Demand Response	1.1
Low	J	Demand Response	0.825
High	F	Energy Efficiency	9.97
Mid	F	Energy Efficiency	7.98
Low	F	Energy Efficiency	5.98
High	G	Energy Efficiency	10.09
Mid	G	Energy Efficiency	8.08
Low	G	Energy Efficiency	6.06
High	J	Energy Efficiency	14.8
Mid	J	Energy Efficiency	11.9
Low	J	Energy Efficiency	8.9
Note: Estimates herein should not be utilized for purposes outside of the CARIS process. Also, these estimates should not be assumed as reflective or predictive of actual projects or imply that facilities can necessarily be built.			

Figure 63 through Figure 67 present overnight installation costs for the generic solutions associated with each study. No verification was conducted to determine if the generic solution can be built within the generic cost estimate ranges. The generic solutions analysis is performed to provide a rough estimate of the benefit to cost opportunity based upon the assumptions contained in this report.

10 *Study to Establish New York Electricity Market ICAP Demand Curve Parameter*, September 13, 2016, The Analysis Group, pg. 129.

Figure 63: Generic Generation, Demand Response, and Energy Efficiency Solution Costs for Each Study

Generic Solutions Cost Summary ($M)			
Studies	**Central East (Study 1)**	**Central East-Knickerbocker (Study 2)**	**Volney-Scriba (Study 3)**
GENERATION			
Unit Siting	New Scotland	Pleasant Valley	Volney
# of 340 MW Blocks	1	1	1
High	$750	$845	$655
Mid	$600	$675	$525
Low	$450	$505	$395
DEMAND RESPONSE			
Location (# of Blocks)	F(1), G(1), and J(2)	F(1), G(1), and J(2)	F(1) and G(1)
Total # 100MW Blocks	4	4	2
High	$338	$338	$63
Mid	$270	$270	$50
Low	$203	$203	$38
ENERGY EFFICIENCY			
Location (# of Blocks)	F(1), G(1), and J(2)	F(1), G(1), and J(2)	F(1) and G(1)
Total # 200MW Blocks	4	4	2
High	$4,975	$4,975	$2,006
Mid	$3,980	$3,980	$1,605
Low	$2,985	$2,985	$1,204

Figure 64: Generic Transmission Solution Costs for Each Study

Generic Transmission Solution Cost Summary ($M)			
Studies	**Central East (study 1)**	**Central East-Knickerbocker (Study 2)**	**Volney-Scriba (Study 3)**
Transmission Path	Edic-New Scotland	Edic-New Scotland-Knickerbocker	Volney-Scriba
Voltage	345 kV	345 kV	345 kV
2019-2023			
Miles	85	85	10
High	$638	$638	$75
Mid	$510	$510	$60
Low	$340	$340	$40
2024-2028			
Miles	85	100	10
High	$638	$750	$75
Mid	$510	$600	$60
Low	$340	$400	$40

Figure 65: Generic Solutions for Study 1: Central East

Generic Solution Study 1: Central East *(Estimates should not be assumed reflective or predictive of actual project costs)*			
Transmission Solution: Edic - New Scotland			
Cost Range	**Quantity**	**Unit Pricing ($M)**	**Total ($M)**
High			
Transmission Line (Miles)	85	$7.50	$638
Total High Transmission Solution Cost			$638
Mid			
Transmission Line (Miles)	85	$6.00	$510
Total Mid Transmission Solution Cost			$510
Low			
Transmission Line (Miles)	85	$4.00	$340
Total Low Transmission Solution Cost			$340
Generation Solution: New Scotland			
Cost Range	**Quantity**	**Unit Pricing ($M)**	**Total ($M)**
High			
Plant in Zone F (340 MW Block)	1	$750	$750
Total High Generation Solution Cost			$750
Mid			
Plant in Zone F (340 MW Block)	1	$600	$600
Total Mid Generation Solution Cost			$600
Low			
Plant in Zone F (340 MW Block)	1	$450	$450
Total Low Generation Solution Cost			$450
Demand Response Solution: Zones F, G, and J			
Cost Range	**Quantity**	**Unit Pricing ($M/100 MW block)**	**Total ($M)**
High		**(100 MW Blocks)**	
Zone F	1	$25	$25
Zone G	1	$38	$38
Zone J	2	$138	$275
Total High Demand Response Solution Costs			$338
Mid		**(100 MW Blocks)**	
Zone F	1	$20	$20
Zone G	1	$30	$30
Zone J	2	$110	$220
Total Mid Demand Response Solution Costs			$270
Low		**(100 MW Blocks)**	
Zone F	1	$15	$15
Zone G	1	$23	$22.50
Zone J	2	$83	$165
Total Low Demand Response Solution Costs			$203
Energy Efficiency Solution: Zones F, G, and J			
Cost Range	**Quantity**	**Unit Pricing ($M/100 MW block)**	**Total ($M)**
High		**(100 MW Blocks)**	
Zone F	1	$997	$997
Zone G	1	$1,009	$1,009
Zone J	2	$1,484	$2,969
Total High Energy Efficiency Solution Costs			$4,975
Mid		**(100 MW Blocks)**	
Zone F	1	$798	$798
Zone G	1	$808	$808
Zone J	2	$1,188	$2,375
Total Mid Energy Efficiency Solution Costs			$3,980
Low		**(100 MW Blocks)**	
Zone F	1	$598	$598
Zone G	1	$606	$606
Zone J	2	$891	$1,781
Total Low Demand Response Solution Costs			$2,985

Figure 66: Generic Solutions for Study 2: Central East - Knickerbocker

Generic Solution Study 2: Central East- Knickerbocker *(Estimates should not be assumed reflective or predictive of actual project costs)*			
Transmission Solution: Edic - New Scotland - Knickerbocker			
2019-2023			
Cost Range	**Quantity**	**Unit Pricing ($M)**	**Total ($M)**
High			
Transmission Line (Miles)	85	$7.50	$638
Total High Transmission Solution Cost			$638
Mid			
Transmission Line (Miles)	85	$6.00	$510
Total Mid Transmission Solution Cost			$510
Low			
Transmission Line (Miles)	85	$4.00	$340
Total Low Transmission Solution Cost			$340
2024-2028			
Cost Range	**Quantity**	**Unit Pricing ($M)**	**Total ($M)**
High			
Transmission Line (Miles)	100	$7.50	$750
Total High Transmission Solution Cost			$750
Mid			
Transmission Line (Miles)	100	$6.00	$600
Total Mid Transmission Solution Cost			$600
Low			
Transmission Line (Miles)	100	$4.00	$400
Total Low Transmission Solution Cost			$400
Generation Solution: Pleasant Valley			
Cost Range	**Quantity**	**Unit Pricing ($M)**	**Total ($M)**
High			
Plant in Zone G (340 MW Block)	1	$845	$845
Total High Generation Solution Cost			$845
Mid			
Plant in Zone G (340 MW Block)	1	$675	$675
Total Mid Generation Solution Cost			$675
Low			
Plant in Zone G (340 MW Block)	1	$505	$505
Total Low Generation Solution Cost			$505
Demand Response Solution: Zones F, G, and J			
Cost Range	**Quantity**	**Unit Pricing ($M/100 MW block)**	**Total ($M)**
High		**(100 MW Blocks)**	
Zone F	1	$25	$25
Zone G	1	$38	$38
Zone J	2	$138	$275
Total High Demand Response Solution Costs			$338
Mid		**(100 MW Blocks)**	
Zone F	1	$20	$20
Zone G	1	$30	$30
Zone J	2	$110	$220
Total Mid Demand Response Solution Costs			$270
Low		**(100 MW Blocks)**	
Zone F	1	$15	$15
Zone G	1	$23	$23
Zone J	2	$83	$165
Total Low Demand Response Solution Costs			$203
Energy Efficiency Solution: Zones F, G, and J			
Cost Range	**Quantity**	**Unit Pricing ($M/100 MW block)**	**Total ($M)**
High		**(100 MW Blocks)**	
Zone F	1	$997	$997
Zone G	1	$1,009	$1,009
Zone J	2	$1,484	$2,969
Total High Energy Efficiency Solution Costs			$4,975
Mid		**(100 MW Blocks)**	
Zone F	1	$798	$798
Zone G	1	$808	$808
Zone J	2	$1,188	$2,375
Total Mid Energy Efficiency Solution Costs			$3,980
Low		**(100 MW Blocks)**	
Zone F	1	$598	$598
Zone G	1	$606	$606
Zone J	2	$891	$1,781
Total Low Demand Response Solution Costs			$2,985

Figure 67: Generic Solutions for Study 3: Volney - Scriba

Generic Solution Study 3: Volney-Scriba *(Estimates should not be assumed reflective or predictive of actual project costs)*			
Transmission Solution: Volney - Scriba			
Cost Range	**Quantity**	**Unit Pricing ($M)**	**Total ($M)**
High			
Transmission Line (Miles)	10	$7.50	$75
Total High Transmission Solution Cost			$75
Mid			
Transmission Line (Miles)	10	$6.00	$60
Total Mid Transmission Solution Cost			$60
Low			
Transmission Line (Miles)	10	$4.00	$40
Total Low Transmission Solution Cost			$40
Generation Solution: Volney			
Cost Range	**Quantity**	**Unit Pricing ($M)**	**Total ($M)**
High			
Plant in Zone C (340 MW Block)	1	$655	$655
Total High Generation Solution Cost			$655
Mid			
Plant in Zone C (340 MW Block)	1	$525	$525
Total Mid Generation Solution Cost			$525
Low			
Plant in Zone C (340 MW Block)	1	$395	$395
Total Low Generation Solution Cost			$395
Demand Response Solution: Zones F and G			
Cost Range	**Quantity**	**Unit Pricing ($M/100 MW block)**	**Total ($M)**
High		**(100 MW Blocks)**	
Zone F	1	$25	$25
Zone G	1	$38	$38
Total High Demand Response Solution Costs			$63
Mid		**(100 MW Blocks)**	
Zone F	1	$20	$20
Zone G	1	$30	$30
Total Mid Demand Response Solution Costs			$50
Low		**(100 MW Blocks)**	
Zone F	1	$15	$15
Zone G	1	$23	$23
Total Low Demand Response Solution Costs			$38
Energy Efficiency Solution: Zones F and G			
Cost Range	**Quantity**	**Unit Pricing ($M/100 MW block)**	**Total ($M)**
High		**(100 MW Blocks)**	
Zone F	1	$997	$997
Zone G	1	$1,009	$1,009
Total High Energy Efficiency Solution Costs			$2,006
Mid		**(100 MW Blocks)**	
Zone F	1	$798	$798
Zone G	1	$808	$808
Total Mid Energy Efficiency Solution Costs			$1,605
Low		**(100 MW Blocks)**	
Zone F	1	$598	$598
Zone G	1	$606	$606
Total Low Demand Response Solution Costs			$1,204

Appendix F - Economic Planning Process Manual - Congestion Assessment and Resource Integration Study (link)

https://www.nyiso.com/documents/20142/2924447/epp_caris_mnl.pdf/6510ece7-e0a6-7bee-e776-694abf264bae

Appendix G - 2018 RNA and 2019-2028 CRP Reports (link)

The 2018 RNA and 2019 – 2028 CRP reports can be found through the following links:

https://www.nyiso.com/documents/20142/2248793/2018-Reliability-Needs-Assessment.pdf/c17f6a4a-6d22-26ee-9e28-4715af52d3c7

https://www.nyiso.com/documents/20142/2248481/2019-2028CRP-FinalReportJuly-2019.pdf/51b573b7-9edb-bbb9-8a87-742e9e7c3b7f

Appendix H - Generic Solution Results - Additional Details

The tables below present the CARIS metrics results for each of the three studies. The CARIS metrics are calculated as the change between the base case values and the change case values after each of the respective generic solutions have been added to the base case. The values are expressed in nominal $M and are calculated as Solution minus base case. Negative values are shown in red and with brackets (except for tables showing percentage changes) and represent a reduction in costs/payments.

Study 1: Central East

Generic Transmission Solution (Study 1: Central East)

PROJECTED DEMAND CONGESTION BY ZONE ($M) | Generic Transmission Solution (Study 1: Central East)

Demand Congestion ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(8.9)	(7.1)	(6.9)	(3.4)	1.0	3.2	1.7	1.9	1.8	2.1
Genesee	1.4	2.2	0.8	(1.4)	0.5	1.6	0.9	1.0	1.0	1.1
Central	(3.5)	(3.4)	(2.9)	(1.7)	(0.9)	(1.9)	(0.7)	(0.6)	(0.9)	(1.3)
North	(1.8)	(2.4)	(1.7)	(1.3)	(1.0)	(0.6)	(0.6)	(0.6)	(0.6)	(0.5)
Mohawk Valley	(1.0)	(1.1)	(0.9)	(0.5)	(0.4)	(0.8)	(0.4)	(0.3)	(0.4)	(0.6)
Capital	(27.2)	(27.4)	(23.5)	(17.2)	(10.7)	(13.0)	(6.8)	(6.9)	(7.6)	(10.2)
Hudson Valley	(14.0)	(14.7)	(13.0)	(10.0)	(6.6)	(6.6)	(3.8)	(4.0)	(3.9)	(5.3)
Millwood	(4.1)	(4.2)	(3.8)	(2.8)	(1.8)	(1.9)	(1.1)	(1.2)	(1.1)	(1.5)
Dunwoodie	(8.3)	(8.5)	(7.4)	(5.7)	(3.7)	(3.8)	(2.2)	(2.3)	(2.3)	(3.0)
NY City	(74.2)	(75.1)	(66.6)	(50.7)	(33.1)	(33.8)	(18.7)	(20.9)	(19.5)	(25.6)
Long Island	(27.8)	(28.5)	(25.5)	(19.6)	(11.9)	(12.8)	(7.2)	(8.1)	(6.4)	(9.8)
NYCA Total	(169.4)	(170.1)	(151.4)	(114.3)	(68.5)	(70.2)	(38.9)	(42.2)	(39.9)	(54.5)

PROJECTED PRODUCTION COST ($M) | Generic Transmission Solution (Study 1: Central East)

Production Cost ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	2	1	1	2	6	10	7	7	10	10
Genesee	0	0	0	0	0	0	0	0	0	0
Central	14	13	10	10	11	11	8	9	8	9
North	1	0	0	1	1	1	1	1	0	1
Mohawk Valley	(0)	0	0	0	0	1	1	1	0	0
Capital	(9)	(10)	(10)	(11)	(8)	(18)	(14)	(17)	(12)	(20)
Hudson Valley	1	(4)	(2)	(4)	(4)	(1)	(1)	2	(0)	4
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(9)	(10)	(5)	(6)	(6)	(4)	(6)	(8)	(7)	(7)
Long Island	0	0	(1)	(1)	(2)	(1)	(0)	(0)	0	(0)
NYCA Total	(0)	(9)	(6)	(9)	(1)	(1)	(5)	(5)	(0)	(3)
NYCA Imports	3	9	10	12	(1)	(2)	(6)	(0)	(3)	(4)
NYCA Exports	24	20	26	21	9	6	(2)	2	6	4
NYCA + Imports - Exports	(22)	(21)	(22)	(18)	(11)	(10)	(8)	(7)	(9)	(11)

PROJECTED NYCA GENERATION (GWh) | Generic Transmission Solution (Study 1: Central East)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	54	24	38	48	161	214	174	152	235	207
Genesee	12	6	6	4	2	1	0	1	3	1
Central	571	504	382	341	327	302	196	213	150	191
North	81	40	35	28	24	29	15	12	5	20
Mohawk Valley	11	7	8	3	2	8	12	8	7	4
Capital	(237)	(259)	(246)	(246)	(167)	(326)	(207)	(256)	(178)	(287)
Hudson Valley	28	(109)	(33)	(78)	(81)	(21)	(21)	34	(6)	66
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(308)	(315)	(151)	(170)	(117)	(80)	(95)	(139)	(109)	(101)
Long Island	(2)	6	(33)	(15)	(39)	(15)	(8)	(6)	0	(4)
NYCA Total	209	(96)	6	(85)	113	113	66	21	107	97

PROJECTED NET IMPORTS (GWh) | Generic Transmission Solution (Study 1: Central East)

Net Imports (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	335	327	428	362	127	30	(50)	50	32	(60)
LINDEN VFT	(103)	(115)	(71)	(68)	(40)	(31)	(20)	(22)	(14)	(14)
NEPTUNE	(47)	(55)	(29)	(37)	(19)	(3)	(8)	10	8	3
HTP	(57)	(36)	(71)	(54)	(53)	(39)	(37)	(49)	(37)	(34)
ISONE - NYISO	(818)	(644)	(730)	(579)	(334)	(196)	(78)	(120)	(149)	(87)
CROSS SOUND CABLE	26	23	15	21	(7)	7	(12)	(5)	(11)	(0)
NORTHPORT NORWALK	7	2	1	(7)	(8)	(5)	(2)	(6)	(5)	(8)
IESO - NYISO	440	586	433	439	214	138	153	138	87	117
HQ - NYISO CHAT	(0)	(1)	0	(0)	0	(0)	(0)	0	0	0
HQ - NYISO CEDARS	2	3	0	(0)	0	0	(0)	(0)	0	0
TOTAL	(215)	90	(24)	77	(121)	(99)	(54)	(4)	(89)	(85)

PROJECTED GENERATOR PAYMENTS ($M) | Generic Transmission Solution (Study 1: Central East)

Generator Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	21	17	15	12	15	14	11	10	13	14
Genesee	5	6	5	3	2	2	1	1	1	1
Central	42	42	35	32	26	27	21	20	18	21
North	15	16	13	11	7	7	4	4	4	5
Mohawk Valley	5	6	5	4	3	3	2	2	2	2
Capital	(19)	(19)	(20)	(18)	(14)	(24)	(17)	(19)	(17)	(26)
Hudson Valley	1	(5)	(2)	(5)	(4)	(1)	(1)	1	(1)	4
Millwood	(2)	(2)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NY City	(13)	(13)	(11)	(11)	(10)	(8)	(7)	(10)	(9)	(10)
Long Island	(0)	0	(3)	(2)	(3)	(1)	(1)	(1)	(1)	(2)
NYCA Total	54	48	36	27	21	18	15	9	10	10

PROJECTED LOAD PAYMENTS ($M) | Generic Transmission Solution (Study 1: Central East)

Load Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	9	11	8	8	5	3	2	2	2	2
Genesee	11	10	8	6	4	3	2	2	1	2
Central	17	18	15	12	7	6	4	4	3	4
North	8	10	8	6	4	3	2	2	2	2
Mohawk Valley	11	11	10	8	7	5	4	4	4	4
Capital	(12)	(12)	(11)	(8)	(7)	(6)	(3)	(3)	(4)	(6)
Hudson Valley	(2)	(2)	(3)	(2)	(2)	(2)	(1)	(2)	(2)	(2)
Millwood	(0)	(0)	(1)	(0)	(1)	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(1)	(1)	(1)
NY City	(8)	(6)	(11)	(8)	(9)	(6)	(2)	(4)	(5)	(7)
Long Island	(1)	(0)	(3)	(2)	(2)	(2)	(1)	(2)	(1)	(3)
NYCA Total	32	38	19	19	5	4	6	3	(2)	(3)

PROJECTED LBMPS ($/MWh) | Generic Transmission Solution (Study 1: Central East)

Average LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.65	0.77	0.60	0.54	0.34	0.21	0.12	0.10	0.08	0.14
Genesee	1.09	1.04	0.85	0.62	0.37	0.29	0.16	0.15	0.12	0.19
Central	1.08	1.12	0.93	0.73	0.40	0.38	0.24	0.24	0.20	0.26
North	1.60	1.72	1.38	1.04	0.63	0.59	0.39	0.39	0.37	0.43
Mohawk Valley	1.20	1.23	1.03	0.81	0.45	0.43	0.28	0.28	0.24	0.31
Capital	(0.82)	(0.81)	(0.76)	(0.55)	(0.39)	(0.48)	(0.21)	(0.24)	(0.34)	(0.44)
Hudson Valley	(0.14)	(0.18)	(0.24)	(0.20)	(0.21)	(0.16)	(0.09)	(0.10)	(0.15)	(0.20)
Millwood	(0.16)	(0.17)	(0.23)	(0.18)	(0.19)	(0.15)	(0.09)	(0.10)	(0.15)	(0.18)
Dunwoodie	(0.15)	(0.16)	(0.22)	(0.17)	(0.19)	(0.15)	(0.08)	(0.10)	(0.14)	(0.18)
NY City	(0.15)	(0.14)	(0.21)	(0.17)	(0.17)	(0.12)	(0.05)	(0.08)	(0.12)	(0.14)
Long Island	(0.05)	(0.03)	(0.13)	(0.12)	(0.11)	(0.10)	(0.05)	(0.08)	(0.07)	(0.14)
Average	0.38	0.40	0.27	0.21	0.09	0.07	0.06	0.04	0.00	0.01

PROJECTED SO2 EMISSIONS (Tons) | Generic Transmission Solution (Study 1: Central East)

SO_2 Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	14	1	1	44	239	390	272	234	496	383
Genesee	0	0	0	0	0	0	0	0	0	0
Central	1	1	1	1	1	1	0	0	0	0
North	0	0	0	0	0	0	0	0	0	0
Mohawk Valley	(0)	0	0	0	0	0	0	0	0	0
Capital	(1)	(1)	(1)	(1)	(0)	(1)	(0)	(1)	(0)	(1)
Hudson Valley	(0)	(0)	0	(0)	(0)	(0)	(0)	0	(0)	0
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(1)	(1)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	0	(1)	0	(0)	(0)	(0)	(0)	0	(0)
NYCA Total	14	0	0	44	239	390	272	234	496	383

PROJECTED SO2 EMISSION COSTS ($M) | Generic Transmission Solution (Study 1: Central East)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	0	0	0	0	0	0	0	0	0
Genesee	0	0	0	0	0	0	0	0	0	0
Central	0	0	0	0	0	0	0	0	0	0
North	0	0	0	0	0	0	0	0	0	0
Mohawk Valley	(0)	0	0	0	0	0	0	0	0	0
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	0
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	0	(0)	0	(0)	(0)	(0)	(0)	0	(0)
NYCA Total	0	(0)	(0)	0	0	0	0	0	0	0

PROJECTED NOX EMISSIONS (Tons) | Generic Transmission Solution (Study 1: Central East)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	23	13	18	31	53	103	57	60	107	82
Genesee	10	5	6	3	0	1	0	0	0	0
Central	38	31	27	23	22	21	16	17	15	14
North	11	8	8	5	7	8	4	8	2	1
Mohawk Valley	1	1	2	1	0	2	2	2	1	1
Capital	(17)	(13)	(12)	(11)	(8)	(12)	(8)	(9)	(7)	(9)
Hudson Valley	(10)	(9)	(10)	(2)	(4)	(4)	(10)	7	2	4
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(43)	(67)	(55)	(41)	(17)	(5)	(24)	(29)	(10)	(12)
Long Island	(1)	(2)	(13)	(7)	(13)	(5)	(1)	(2)	(1)	(3)
NYCA Total	12	(31)	(28)	2	41	108	36	55	109	78

PROJECTED NOX EMISSION COSTS ($M) | Generic Transmission Solution (Study 1: Central East)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	0	0	0	0	0	0	0	0	0
Genesee	0	0	0	0	0	0	(0)	0	0	0
Central	0	0	0	0	0	0	0	0	0	0
North	0	0	0	0	0	0	0	0	0	0
Mohawk Valley	(0)	0	0	0	0	0	0	0	0	0
Capital	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	0	0	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	0	0	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	0	(0)

PROJECTED CO2 EMISSIONS (1000 Tons) | Generic Transmission Solution (Study 1: Central East)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	24	11	14	33	126	183	136	124	216	177
Genesee	1	1	0	1	1	1	0	1	2	1
Central	214	194	146	136	135	124	83	89	64	79
North	8	5	6	8	11	13	7	6	3	10
Mohawk Valley	(1)	0	2	1	1	4	6	4	3	2
Capital	(105)	(113)	(105)	(107)	(68)	(129)	(85)	(107)	(70)	(116)
Hudson Valley	5	(47)	(18)	(33)	(34)	(10)	(13)	16	(3)	28
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(149)	(159)	(84)	(85)	(59)	(34)	(48)	(74)	(51)	(48)
Long Island	(1)	5	(18)	(7)	(21)	(9)	(4)	(3)	1	(1)
NYCA Total	(4)	(102)	(57)	(51)	92	143	82	56	164	131

PROJECTED CO2 EMISSION COSTS ($M) | Generic Transmission Solution (Study 1: Central East)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.1	0.1	0.1	0.2	0.9	1.4	1.1	1.1	2.0	1.8
Genesee	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Central	1.0	1.1	0.9	0.9	1.0	0.9	0.7	0.8	0.6	0.8
North	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1
Mohawk Valley	(0.0)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Capital	(0.5)	(0.6)	(0.6)	(0.7)	(0.5)	(1.0)	(0.7)	(1.0)	(0.7)	(1.2)
Hudson Valley	0.0	(0.3)	(0.1)	(0.2)	(0.3)	(0.1)	(0.1)	0.2	(0.0)	0.3
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	(0.5)	(0.9)	(0.5)	(0.6)	(0.4)	(0.2)	(0.4)	(0.6)	(0.5)	(0.5)
Long Island	(0.0)	0.0	(0.1)	(0.0)	(0.2)	(0.1)	(0.0)	(0.0)	0.0	(0.0)
NYCA Total	0.2	(0.6)	(0.3)	(0.3)	0.7	1.1	0.7	0.5	1.5	1.3

PROJECTED DEMAND LOSS PAYMENT ($M) | Generic Transmission Solution (Study 1: Central East)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(2.0)	(2.2)	(1.7)	(1.5)	(1.1)	(1.7)	(1.3)	(1.6)	(1.3)	(1.6)
Genesee	(0.8)	(1.0)	(0.8)	(0.6)	(0.5)	(0.8)	(0.7)	(0.8)	(0.7)	(0.8)
Central	(0.3)	(0.5)	(0.4)	(0.4)	(0.5)	(0.6)	(0.5)	(0.6)	(0.5)	(0.5)
North	(0.4)	(0.5)	(0.4)	(0.3)	(0.1)	(0.2)	(0.1)	(0.2)	(0.1)	(0.2)
Mohawk Valley	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Capital	0.0	(0.0)	(0.2)	(0.4)	(0.5)	(0.2)	(0.2)	(0.3)	(0.4)	(0.3)
Hudson Valley	0.1	0.1	(0.1)	(0.2)	(0.3)	(0.1)	(0.2)	(0.2)	(0.3)	(0.3)
Millwood	0.1	0.0	(0.0)	(0.0)	(0.1)	0.0	(0.0)	(0.0)	(0.1)	(0.1)
Dunwoodie	0.1	0.1	(0.0)	(0.1)	(0.1)	(0.0)	(0.1)	(0.1)	(0.1)	(0.1)
NY City	1.5	1.2	0.1	(0.5)	(1.0)	0.3	(0.4)	(0.2)	(1.1)	(0.9)
Long Island	0.8	0.6	0.3	(0.0)	(0.2)	0.3	(0.1)	(0.0)	(0.4)	(0.3)
NYCA Total	(0.7)	(1.9)	(3.0)	(3.8)	(4.2)	(3.0)	(3.4)	(3.8)	(5.0)	(4.9)

Generic Generation Solution (Study 1: Central East)

PROJECTED DEMAND CONGESTION BY ZONE ($M) | Generic Generation Solution (Study 1: Central East)

Demand Congestion ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.2)	0.4	0.5	(0.1)	0.2	0.1	(0.0)	(0.3)	(0.6)	(0.2)
Genesee	0.2	(0.1)	0.2	(0.0)	0.1	0.1	0.0	(0.2)	(0.3)	(0.0)
Central	(0.8)	(0.0)	0.2	(0.8)	(0.5)	(0.2)	0.1	(0.5)	0.5	0.1
North	0.1	(0.2)	(0.2)	0.0	0.2	0.2	(0.2)	0.1	(0.1)	0.0
Mohawk Valley	(0.1)	0.0	(0.0)	(0.3)	(0.3)	(0.1)	0.0	(0.2)	0.1	0.1
Capital	(2.9)	1.0	(0.2)	(1.5)	(3.0)	(0.6)	0.5	(1.1)	(0.8)	0.9
Hudson Valley	(1.4)	1.0	0.6	0.1	(1.0)	0.1	0.5	(0.6)	0.8	1.0
Millwood	(0.4)	0.4	0.1	(0.0)	(0.3)	0.0	0.1	(0.1)	0.0	0.1
Dunwoodie	(0.8)	0.8	0.3	0.1	(0.5)	(0.0)	0.2	(0.3)	0.0	0.3
NY City	(7.5)	8.1	6.4	2.6	(1.5)	3.5	2.0	2.3	4.2	8.4
Long Island	(0.7)	3.5	1.7	2.6	(5.5)	4.6	2.4	0.7	1.5	4.2
NYCA Total	(14.5)	14.8	9.6	2.7	(12.1)	7.8	5.5	(0.2)	5.5	14.9

PROJECTED PRODUCTION COST ($M) | Generic Generation Solution (Study 1: Central East)

Production Cost ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(1)	(1)	(1)	(1)	1	(2)	(1)	(1)	(1)
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(2)	(0)	(5)	(0)	(8)	(3)	(12)	(6)	(5)	(7)
North	0	(0)	(0)	(0)	1	0	(0)	1	(0)	0
Mohawk Valley	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
Capital	8	10	20	22	27	27	28	31	36	31
Hudson Valley	1	(2)	(4)	(6)	(6)	(5)	(11)	9	(1)	(11)
Millwood	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(2)	(11)	(14)	(19)	(5)	(5)	9	(16)	(20)	(8)
Long Island	(0)	4	1	(0)	(2)	(2)	(0)	(1)	(5)	(4)
NYCA Total	5	1	(3)	(5)	5	12	13	16	4	(0)
NYCA Imports	(3)	(4)	(6)	(7)	(7)	(12)	(20)	(18)	(14)	(20)
NYCA Exports	4	4	4	6	12	12	3	12	12	11
NYCA + Imports - Exports	(2)	(7)	(13)	(18)	(14)	(12)	(10)	(15)	(22)	(31)

PROJECTED NYCA GENERATION (GWh) | Generic Generation Solution (Study 1: Central East)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	9	(2)	(11)	(39)	(23)	36	(11)	(8)	(9)	19
Genesee	(3)	(6)	(3)	(4)	(4)	(8)	(2)	(7)	(1)	(11)
Central	(89)	(29)	(207)	3	(242)	(94)	(317)	(151)	(119)	(138)
North	3	2	(11)	(1)	11	3	(2)	11	(8)	0
Mohawk Valley	0	0	0	(1)	1	(5)	(1)	(2)	(0)	(3)
Capital	365	429	742	829	1,073	1,035	1,174	984	1,114	1,076
Hudson Valley	30	(74)	(124)	(144)	(148)	(139)	(219)	175	(37)	(247)
Millwood	0	(0)	(0)	(0)	0	(0)	(0)	0	(0)	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(123)	(166)	(205)	(268)	(173)	(217)	4	(336)	(303)	98
Long Island	(11)	45	34	(9)	(37)	(26)	(2)	(16)	(51)	(59)
NYCA Total	181	198	214	367	460	587	626	650	586	735

PROJECTED NET IMPORTS (GWh) | Generic Generation Solution (Study 1: Central East)

Net Imports (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	(47)	(60)	(46)	(103)	(76)	(203)	(311)	(240)	(173)	(383)
LINDEN VFT	(24)	19	4	(7)	(9)	(3)	(13)	1	(20)	(10)
NEPTUNE	(1)	(0)	(37)	(13)	(8)	(39)	(76)	(42)	(51)	(39)
HTP	(20)	5	16	(2)	2	13	(6)	(13)	1	3
ISONE - NYISO	(92)	(87)	(122)	(180)	(306)	(298)	(105)	(238)	(244)	(166)
CROSS SOUND CABLE	9	(3)	(22)	9	(34)	18	(4)	(18)	(3)	10
NORTHPORT NORWALK	5	0	1	(2)	(1)	0	(8)	5	10	3
IESO - NYISO	(13)	(71)	(16)	(68)	(29)	(75)	(106)	(109)	(109)	(156)
HQ - NYISO CHAT	(0)	(0)	0	0	0	0	0	0	0	0
HQ - NYISO CEDARS	0	1	(0)	(0)	(0)	(0)	(0)	0	0	0
TOTAL	(182)	(197)	(220)	(365)	(460)	(587)	(630)	(653)	(589)	(738)

PROJECTED GENERATOR PAYMENTS ($M) | Generic Generation Solution (Study 1: Central East)

Generator Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(2)	(4)	(4)	(3)	(3)	(3)	(2)	(5)	(3)
Genesee	(0)	(1)	(1)	(1)	(1)	(2)	(1)	(1)	(1)	(2)
Central	6	(0)	(14)	4	(10)	(11)	(16)	(7)	(25)	(11)
North	(0)	(1)	(2)	(2)	(1)	(3)	(1)	(1)	(3)	(2)
Mohawk Valley	(0)	(0)	(1)	(1)	(0)	(1)	(1)	(1)	(1)	(1)
Capital	8	14	22	25	31	33	41	38	43	43
Hudson Valley	0	(3)	(6)	(8)	(8)	(6)	(13)	8	(3)	(14)
Millwood	(2)	0	(0)	0	(1)	(0)	0	0	1	(0)
Dunwoodie	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NY City	(7)	(8)	(14)	(17)	(8)	(12)	1	(18)	(19)	11
Long Island	(1)	3	(2)	(1)	(2)	(1)	(0)	(0)	(5)	(4)
NYCA Total	4	2	(21)	(4)	(4)	(7)	8	15	(18)	17

PROJECTED LOAD PAYMENTS ($M) | Generic Generation Solution (Study 1: Central East)

Load Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(1)	(2)	(2)	(1)	(4)	(2)	(2)	(3)	(3)
Genesee	(0)	(1)	(2)	(2)	(1)	(3)	(1)	(1)	(2)	(2)
Central	(0)	(2)	(3)	(3)	(2)	(4)	(2)	(3)	(4)	(3)
North	0	(0)	(1)	(1)	(1)	(2)	(1)	(1)	(1)	(1)
Mohawk Valley	(0)	(1)	(1)	(1)	(1)	(2)	(1)	(1)	(2)	(2)
Capital	(3)	(1)	(3)	(4)	(5)	(4)	(2)	(3)	(4)	(2)
Hudson Valley	(1)	(0)	(2)	(2)	(2)	(2)	(1)	(2)	(2)	(1)
Millwood	(0)	(0)	(1)	(0)	(1)	(1)	(0)	(1)	(1)	(1)
Dunwoodie	(1)	(0)	(1)	(1)	(1)	(2)	(1)	(1)	(1)	(1)
NY City	(7)	0	(8)	(7)	(9)	(10)	(6)	(5)	(9)	(5)
Long Island	(1)	0	(4)	(2)	(8)	(1)	(1)	(3)	(4)	(1)
NYCA Total	(13)	(7)	(29)	(25)	(32)	(35)	(18)	(24)	(32)	(22)

PROJECTED LBMPS ($/MWh) | Generic Generation Solution (Study 1: Central East)

Average LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.00	(0.08)	(0.13)	(0.11)	(0.08)	(0.25)	(0.10)	(0.11)	(0.18)	(0.16)
Genesee	0.00	(0.11)	(0.15)	(0.12)	(0.09)	(0.27)	(0.12)	(0.13)	(0.21)	(0.19)
Central	(0.02)	(0.12)	(0.16)	(0.17)	(0.11)	(0.28)	(0.12)	(0.19)	(0.22)	(0.19)
North	0.00	(0.08)	(0.13)	(0.12)	(0.12)	(0.31)	(0.11)	(0.18)	(0.24)	(0.21)
Mohawk Valley	0.01	(0.12)	(0.18)	(0.16)	(0.13)	(0.29)	(0.14)	(0.20)	(0.26)	(0.21)
Capital	(0.19)	(0.04)	(0.22)	(0.25)	(0.32)	(0.33)	(0.14)	(0.26)	(0.33)	(0.17)
Hudson Valley	(0.10)	(0.03)	(0.14)	(0.15)	(0.20)	(0.27)	(0.11)	(0.21)	(0.20)	(0.14)
Millwood	(0.10)	(0.01)	(0.15)	(0.15)	(0.20)	(0.27)	(0.11)	(0.20)	(0.23)	(0.17)
Dunwoodie	(0.10)	(0.01)	(0.15)	(0.14)	(0.19)	(0.27)	(0.11)	(0.20)	(0.24)	(0.17)
NY City	(0.11)	0.01	(0.10)	(0.11)	(0.14)	(0.22)	(0.11)	(0.11)	(0.17)	(0.09)
Long Island	(0.02)	0.01	(0.16)	(0.05)	(0.38)	(0.06)	(0.05)	(0.13)	(0.18)	(0.03)
Average	(0.06)	(0.05)	(0.15)	(0.14)	(0.18)	(0.26)	(0.11)	(0.18)	(0.22)	(0.16)

PROJECTED SO2 EMISSIONS (Tons) | Generic Generation Solution (Study 1: Central East)

SO_2 Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1	(0)	1	(0)	(23)	102	(7)	(60)	(20)	33
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(0)	(0)	(1)	(0)	(1)	(0)	(0)	(0)
North	(0)	(0)	(0)	(0)	0	0	(0)	0	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
Capital	27	35	47	58	69	72	75	68	75	74
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(1)	0	(0)	(1)
Millwood	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(1)	(1)	(1)	(0)	(1)	0	(1)	(1)	0
Long Island	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	27	35	46	56	44	173	67	8	54	105

PROJECTED SO2 EMISSION COSTS ($M) | Generic Generation Solution (Study 1: Central East)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	0
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	(0)	(0)	(0)	(0)	0	0	(0)	0	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
Capital	0	0	0	0	0	0	0	0	0	0
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	0
Long Island	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	0	0	0	0	0	0	0	0	0	0

PROJECTED NOX EMISSIONS (Tons) | Generic Generation Solution (Study 1: Central East)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(1)	(7)	(11)	(17)	(25)	19	(14)	(3)	(4)	(9)
Genesee	(0)	(2)	0	0	(0)	(1)	(0)	(1)	(0)	(1)
Central	(5)	(3)	(12)	(5)	(14)	(12)	(17)	(10)	(8)	(13)
North	3	(4)	(1)	1	5	0	(0)	3	(0)	(0)
Mohawk Valley	1	(0)	1	(0)	0	(1)	0	(1)	(0)	(1)
Capital	101	98	136	165	241	206	217	185	220	206
Hudson Valley	13	(28)	(58)	(50)	(69)	(57)	(62)	3	(49)	(54)
Millwood	0	(0)	(1)	(1)	0	(2)	(1)	0	(2)	1
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(15)	(63)	(55)	(46)	(113)	(49)	53	(71)	(59)	3
Long Island	(0)	34	7	(1)	(25)	(13)	5	(11)	(14)	(10)
NYCA Total	96	24	3	47	(1)	89	180	94	82	123

PROJECTED NOX EMISSION COSTS ($M) | Generic Generation Solution (Study 1: Central East)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	0	0	(0)	0	(0)	(0)	(0)
Capital	0	0	0	0	0	0	0	0	0	0
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)
Long Island	(0)	(0)	0	0	(0)	(0)	0	(0)	(0)	(0)
NYCA Total	0	(0)	0	0	0	0	0	0	0	0

PROJECTED CO2 EMISSIONS (1000 Tons) | Generic Generation Solution (Study 1: Central East)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(2)	(11)	(14)	(22)	(28)	26	(18)	(23)	(18)	(1)
Genesee	(1)	(3)	(2)	(2)	(2)	(3)	(1)	(3)	(1)	(5)
Central	(44)	(12)	(84)	(5)	(101)	(43)	(130)	(63)	(50)	(62)
North	(0)	(1)	(3)	(1)	5	2	(1)	5	(4)	(0)
Mohawk Valley	(1)	(1)	(0)	(0)	1	(2)	(0)	(1)	(0)	(2)
Capital	146	177	299	333	442	421	468	395	454	432
Hudson Valley	16	(39)	(75)	(79)	(90)	(79)	(114)	71	(37)	(121)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(56)	(94)	(123)	(153)	(96)	(111)	39	(190)	(164)	43
Long Island	(6)	39	19	(3)	(24)	(16)	(3)	(11)	(29)	(30)
NYCA Total	51	56	17	68	106	194	241	180	153	254

PROJECTED CO2 EMISSION COSTS ($M) | Generic Generation Solution (Study 1: Central East)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.0)	(0.1)	(0.1)	(0.2)	(0.2)	0.2	(0.2)	(0.2)	(0.2)	(0.0)
Genesee	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)
Central	(0.2)	(0.1)	(0.5)	(0.1)	(0.7)	(0.3)	(1.1)	(0.6)	(0.5)	(0.7)
North	(0.0)	(0.0)	(0.0)	(0.0)	0.0	0.0	(0.0)	0.0	(0.0)	(0.0)
Mohawk Valley	(0.0)	(0.0)	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Capital	0.7	1.0	2.0	2.3	3.2	3.3	3.9	3.6	4.4	4.5
Hudson Valley	0.1	(0.2)	(0.5)	(0.6)	(0.7)	(0.6)	(1.0)	0.7	(0.4)	(1.3)
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	(0.1)	(0.6)	(0.7)	(1.0)	(0.6)	(0.8)	0.4	(1.7)	(1.5)	0.5
Long Island	(0.0)	0.2	0.1	(0.0)	(0.1)	(0.1)	(0.1)	(0.1)	(0.2)	(0.3)
NYCA Total	0.4	0.3	0.2	0.5	0.9	1.6	2.0	1.7	1.5	2.6

PROJECTED DEMAND LOSS PAYMENT ($M) | Generic Generation Solution (Study 1: Central East)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.0	0.3	0.5	0.4	0.4	0.7	0.7	0.6	0.8	0.9
Genesee	0.0	0.1	0.2	0.1	0.2	0.3	0.4	0.3	0.3	0.4
Central	0.1	0.0	0.1	0.1	0.2	0.2	0.4	0.3	0.3	0.4
North	(0.0)	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1
Mohawk Valley	0.0	(0.0)	(0.0)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital	(0.0)	(0.1)	(0.3)	(0.0)	(0.1)	(0.1)	(0.3)	(0.0)	(0.2)	(0.1)
Hudson Valley	0.1	0.0	(0.1)	0.2	0.1	0.2	0.1	0.2	0.3	0.2
Millwood	0.0	0.0	(0.0)	0.1	0.0	0.1	0.0	0.1	0.1	0.0
Dunwoodie	0.1	0.0	(0.0)	0.1	0.1	0.2	0.1	0.2	0.2	0.1
NY City	0.6	0.3	(0.4)	1.2	0.8	1.6	0.6	2.0	2.3	1.0
Long Island	0.3	0.0	(0.2)	0.4	0.4	0.7	0.2	0.6	0.8	0.5
NYCA Total	1.1	0.7	(0.2)	2.6	2.0	3.9	2.2	4.3	5.1	3.5

Generic Demand Response Solution (Study 1: Central East)

PROJECTED DEMAND CONGESTION BY ZONE ($M) | Generic Demand Response Solution (Study 1: Central East)

Demand Congestion ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.1)	(0.0)	(1.5)	0.1	0.0	0.1	(0.0)	0.1	(0.0)	(0.0)
Genesee	(0.0)	(0.0)	0.1	0.1	0.0	0.0	0.0	0.0	(0.0)	(0.0)
Central	0.2	(0.1)	(0.2)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.0)	0.0
North	(0.0)	(0.0)	(0.1)	(0.1)	0.0	(0.0)	(0.1)	(0.0)	(0.0)	0.0
Mohawk Valley	0.1	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0
Capital	0.2	0.0	0.1	0.1	(0.2)	(0.0)	0.3	0.0	0.2	0.2
Hudson Valley	(0.2)	(0.3)	(0.6)	(0.4)	(0.4)	0.0	(0.1)	(0.2)	(0.1)	(0.2)
Millwood	(0.0)	(0.1)	(0.1)	(0.1)	(0.1)	(0.0)	0.0	(0.0)	(0.0)	0.0
Dunwoodie	(0.1)	(0.3)	(0.3)	(0.2)	(0.2)	(0.0)	0.0	(0.0)	(0.0)	0.0
NY City	(0.6)	(3.2)	(3.3)	(2.4)	(1.6)	(0.4)	0.4	(2.0)	(1.4)	(1.6)
Long Island	(0.1)	(0.7)	(1.1)	(0.2)	(0.1)	0.1	0.5	(0.1)	0.4	0.2
NYCA Total	(0.6)	(4.8)	(7.0)	(3.3)	(2.5)	(0.3)	1.1	(2.4)	(1.2)	(1.3)

PROJECTED PRODUCTION COST ($M) | Generic Demand Response Solution (Study 1: Central East)

Production Cost ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	1	0	0	(1)	0	0
Genesee	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	0
Central	(0)	0	(0)	0	(0)	(0)	0	(0)	(0)	(0)
North	(0)	0	0	0	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	0	0	(0)	0	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(1)	0	0	0	(0)	(0)
Hudson Valley	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(1)	(1)	(1)	(0)	(1)	(2)	(1)	(0)	(1)	(2)
Long Island	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
NYCA Total	(2)	(1)	(1)	(1)	(2)	(2)	(1)	(2)	(1)	(2)
NYCA Imports	0	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(1)	(0)
NYCA Exports	(0)	0	0	1	0	(0)	0	0	1	(0)
NYCA + Imports - Exports	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	(3)	(2)

PROJECTED NYCA GENERATION (GWh) | Generic Demand Response Solution (Study 1: Central East)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(2)	(1)	(2)	(5)	15	1	(1)	(18)	(1)	7
Genesee	(0)	0	0	(0)	0	(0)	(0)	(0)	0	0
Central	(16)	1	(3)	(0)	(5)	(1)	6	(2)	(0)	0
North	1	1	(0)	(0)	(1)	(1)	(4)	(2)	(1)	(1)
Mohawk Valley	(0)	(0)	1	1	(1)	0	(1)	(1)	(1)	(1)
Capital	3	(4)	(5)	(1)	(14)	2	9	2	(4)	(6)
Hudson Valley	(2)	7	(3)	(8)	7	0	(4)	(2)	2	(8)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(36)	(22)	(17)	(2)	(22)	(30)	(13)	(7)	(10)	(38)
Long Island	(1)	2	2	(1)	(6)	2	(2)	(0)	(2)	0
NYCA Total	(53)	(16)	(26)	(17)	(26)	(27)	(9)	(30)	(16)	(45)

PROJECTED NET IMPORTS (GWh) | Generic Demand Response Solution (Study 1: Central East)

Net Imports (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	2	(9)	2	(20)	(14)	(3)	(23)	0	(11)	2
LINDEN VFT	0	(3)	(0)	(3)	(2)	3	(2)	(1)	(7)	3
NEPTUNE	0	0	(0)	(2)	(4)	0	(1)	(5)	(2)	(0)
HTP	4	(1)	(1)	(3)	1	(0)	(0)	(0)	2	2
ISONE - NYISO	10	(8)	(7)	5	10	(9)	5	2	(3)	1
CROSS SOUND CABLE	(1)	(1)	(1)	(1)	4	0	(0)	1	1	0
NORTHPORT NORWALK	(1)	0	(2)	(1)	(2)	(1)	(1)	1	0	(2)
IESO - NYISO	1	(4)	(5)	3	(5)	(4)	(8)	(7)	(3)	(0)
HQ - NYISO CHAT	(0)	0	0	(0)	0	0	(0)	0	0	0
HQ - NYISO CEDARS	(0)	0	0	0	0	0	0	0	0	(0)
TOTAL	15	(24)	(14)	(23)	(13)	(13)	(31)	(9)	(23)	6

PROJECTED GENERATOR PAYMENTS ($M) | Generic Demand Response Solution (Study 1: Central East)

Generator Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(1)	(0)	1	(0)	(0)	(1)	(0)	0
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(1)	0	(1)	(0)	(1)	(0)	(0)	0	(0)	(0)
North	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(1)	(1)	(2)	(1)	(1)	0	(0)	0	(1)	(0)
Hudson Valley	(1)	(0)	(2)	(1)	0	(0)	(1)	(1)	(0)	(0)
Millwood	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NY City	(3)	(4)	(7)	(3)	(2)	(2)	(2)	(2)	(2)	(3)
Long Island	(1)	(1)	(2)	(1)	(0)	0	(0)	(0)	(0)	(0)
NYCA Total	(7)	(6)	(15)	(6)	(4)	(3)	(4)	(4)	(5)	(4)

PROJECTED LOAD PAYMENTS ($M) | Generic Demand Response Solution (Study 1: Central East)

Load Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(1)	(0)	(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Genesee	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Hudson Valley	(1)	(1)	(2)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Millwood	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NY City	(3)	(5)	(10)	(5)	(3)	(2)	(3)	(4)	(5)	(3)
Long Island	(1)	(1)	(4)	(1)	(0)	(0)	(0)	(1)	(0)	0
NYCA Total	(8)	(10)	(23)	(9)	(5)	(4)	(6)	(7)	(8)	(5)

PROJECTED LBMPS ($/MWh) | Generic Demand Response Solution (Study 1: Central East)

Average LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.03)	(0.01)	(0.12)	(0.01)	(0.02)	(0.01)	(0.02)	(0.00)	(0.02)	(0.01)
Genesee	(0.02)	(0.01)	(0.04)	(0.01)	(0.02)	(0.01)	(0.02)	(0.00)	(0.02)	(0.01)
Central	(0.02)	(0.02)	(0.06)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
North	(0.02)	(0.01)	(0.03)	0.01	(0.02)	(0.00)	(0.01)	(0.00)	(0.02)	(0.01)
Mohawk Valley	(0.02)	(0.01)	(0.05)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Capital	(0.01)	(0.01)	(0.05)	(0.01)	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	0.01
Hudson Valley	(0.03)	(0.03)	(0.08)	(0.03)	(0.03)	(0.00)	(0.02)	(0.02)	(0.03)	(0.01)
Millwood	(0.03)	(0.04)	(0.08)	(0.03)	(0.03)	(0.01)	(0.02)	(0.01)	(0.02)	(0.00)
Dunwoodie	(0.03)	(0.04)	(0.08)	(0.04)	(0.03)	(0.01)	(0.02)	(0.01)	(0.02)	(0.00)
NY City	(0.02)	(0.04)	(0.08)	(0.04)	(0.03)	(0.01)	(0.01)	(0.03)	(0.03)	(0.02)
Long Island	(0.02)	(0.03)	(0.08)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	0.00
Average	(0.02)	(0.02)	(0.07)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)

PROJECTED SO2 EMISSIONS (Tons) | Generic Demand Response Solution (Study 1: Central East)

SO_2 Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(0)	(0)	(0)	50	2	0	(46)	(2)	8
Genesee	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	0
Central	(0)	0	(0)	0	(0)	(0)	0	(0)	(0)	0
North	(0)	0	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	0	0	(0)	0	(0)	(0)	(0)	(0)
Capital	0	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(1)	(0)	0	0	0	0	0	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	(0)	(1)	(0)	(0)	0	(0)	(0)	(0)	0
NYCA Total	(1)	(1)	(3)	(0)	50	2	(0)	(46)	(3)	7

PROJECTED SO2 EMISSION COSTS ($M) | Generic Demand Response Solution (Study 1: Central East)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(0)	(0)	(0)	0	0	0	(0)	(0)	0
Genesee	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	0
Central	(0)	0	(0)	0	(0)	(0)	0	(0)	(0)	0
North	(0)	0	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	0	0	(0)	0	(0)	(0)	(0)	(0)
Capital	0	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	0	0	0	0	0	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)	0
NYCA Total	(0)	(0)	(0)	(0)	0	0	(0)	(0)	(0)	0

PROJECTED NOX EMISSIONS (Tons) | Generic Demand Response Solution (Study 1: Central East)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1	(1)	(0)	(2)	4	1	(0)	(10)	1	8
Genesee	(0)	0	0	0	0	(0)	(0)	(0)	0	0
Central	(1)	(0)	(0)	(0)	(1)	(0)	0	(0)	(0)	0
North	0	0	0	(0)	(0)	(0)	(0)	(0)	0	(0)
Mohawk Valley	(0)	(0)	0	0	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(1)	(0)	(1)	(1)	(1)	(1)	0	(0)	(0)	(1)
Hudson Valley	(2)	(2)	(6)	(7)	1	(0)	(0)	1	(2)	(2)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(16)	(20)	(24)	(13)	(17)	(20)	(19)	(14)	(17)	(25)
Long Island	1	(1)	(2)	(1)	(3)	1	0	(1)	(1)	1
NYCA Total	(20)	(25)	(32)	(24)	(17)	(20)	(20)	(26)	(20)	(19)

PROJECTED NOX EMISSION COSTS ($M) | Generic Demand Response Solution (Study 1: Central East)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(0)	(0)	(0)	(0)	0	(0)	(0)	0	0
Genesee	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	0	0
Central	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	0
North	(0)	0	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	0	0	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	0	(0)	(0)	0	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	0	(0)	(0)	(0)	(0)	0	0	(0)	(0)	0
NYCA Total	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

PROJECTED CO2 EMISSIONS (1000 Tons) | Generic Demand Response Solution (Study 1: Central East)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1	(0)	(0)	(1)	18	1	0	(18)	(0)	5
Genesee	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	0
Central	(6)	0	(1)	0	(3)	(0)	2	(1)	(0)	0
North	(0)	0	0	(0)	(0)	(1)	(2)	(1)	(1)	(0)
Mohawk Valley	(0)	(0)	0	0	(0)	0	(0)	(0)	(0)	(0)
Capital	0	(3)	(3)	(1)	(6)	(1)	3	(0)	(2)	(4)
Hudson Valley	(2)	2	(3)	(5)	3	(0)	(3)	(0)	(1)	(4)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(19)	(14)	(13)	(3)	(14)	(19)	(10)	(5)	(7)	(24)
Long Island	(0)	1	1	(0)	(4)	1	(1)	(0)	(1)	0
NYCA Total	(28)	(14)	(20)	(11)	(6)	(18)	(11)	(26)	(13)	(27)

PROJECTED CO2 EMISSION COSTS ($M) | Generic Demand Response Solution (Study 1: Central East)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.0	(0.0)	(0.0)	(0.0)	0.1	0.0	0.0	(0.2)	(0.0)	0.1
Genesee	(0.0)	0.0	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	0.0	0.0
Central	(0.0)	0.0	(0.0)	0.0	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)
North	(0.0)	0.0	0.0	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Mohawk Valley	(0.0)	(0.0)	0.0	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Capital	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0	0.0	(0.0)	(0.0)
Hudson Valley	(0.0)	0.0	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	(0.1)	(0.1)	(0.1)	(0.0)	(0.1)	(0.1)	(0.0)	(0.0)	(0.0)	(0.2)
Long Island	(0.0)	0.0	0.0	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)
NYCA Total	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.2)	(0.1)	(0.2)

PROJECTED DEMAND LOSS PAYMENT ($M) | Generic Demand Response Solution (Study 1: Central East)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	(0.0)
Genesee	0.0	0.0	0.0	0.0	0.0	(0.0)	0.0	0.0	0.0	(0.0)
Central	(0.0)	(0.0)	(0.0)	(0.0)	0.0	0.0	0.0	0.0	0.0	(0.0)
North	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mohawk Valley	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0
Capital	(0.1)	(0.0)	(0.1)	(0.1)	(0.1)	(0.0)	(0.1)	(0.1)	(0.0)	(0.0)
Hudson Valley	(0.0)	(0.0)	(0.1)	(0.0)	(0.0)	(0.0)	(0.1)	(0.1)	(0.1)	(0.0)
Millwood	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Dunwoodie	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0
NY City	(0.2)	(0.2)	(0.5)	(0.2)	(0.2)	(0.1)	(0.3)	(0.3)	(0.2)	(0.1)
Long Island	(0.1)	(0.1)	(0.2)	(0.1)	(0.1)	(0.0)	(0.1)	(0.1)	(0.1)	0.0
NYCA Total	(0.4)	(0.3)	(0.9)	(0.4)	(0.2)	(0.2)	(0.3)	(0.4)	(0.4)	(0.2)

Generic Energy Efficiency Solution (Study 1: Central East)

PROJECTED DEMAND CONGESTION BY ZONE ($M) | Generic Energy Efficiency Solution (Study 1: Central East)

Demand Congestion ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1.7	0.1	2.4	0.6	(0.4)	(0.9)	(0.9)	(0.7)	(1.6)	(0.6)
Genesee	(0.1)	(0.1)	(0.0)	0.3	(0.2)	(0.3)	(0.3)	(0.3)	(0.7)	(0.2)
Central	(0.1)	(0.5)	(0.2)	(0.4)	(0.2)	(0.4)	0.0	(0.7)	(0.4)	(0.2)
North	0.1	0.2	0.3	(0.1)	0.1	0.1	0.2	(0.0)	(0.0)	(0.0)
Mohawk Valley	(0.0)	(0.2)	(0.2)	(0.2)	(0.1)	(0.3)	(0.1)	(0.4)	(0.2)	(0.1)
Capital	(9.5)	(7.9)	(8.6)	(6.9)	(3.9)	(3.6)	(1.4)	(3.1)	(1.9)	(2.5)
Hudson Valley	(7.1)	(6.3)	(7.2)	(6.7)	(4.1)	(2.7)	(1.6)	(3.0)	(1.9)	(2.8)
Millwood	(0.4)	(0.6)	(0.6)	(0.7)	(0.6)	(0.3)	(0.2)	(0.6)	(0.2)	(0.3)
Dunwoodie	(0.9)	(1.2)	(1.3)	(1.6)	(1.2)	(0.6)	(0.3)	(1.2)	(0.4)	(0.6)
NY City	(24.1)	(24.5)	(25.8)	(24.8)	(16.7)	(13.0)	(7.3)	(17.1)	(9.7)	(11.2)
Long Island	2.4	0.8	1.2	0.0	1.1	3.7	5.0	1.3	4.4	3.3
NYCA Total	(38.0)	(40.3)	(40.1)	(40.5)	(26.3)	(18.4)	(6.9)	(25.9)	(12.6)	(15.3)

PROJECTED PRODUCTION COST ($M) | Generic Energy Efficiency Solution (Study 1: Central East)

Production Cost ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(1)	(1)	(1)	(1)	0	(2)	(4)	(4)	(1)
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(5)	(4)	(5)	(5)	(6)	(7)	(11)	(6)	(8)	(9)
North	0	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	0	(0)	0	(0)	(0)	0	(0)
Capital	(26)	(26)	(21)	(23)	(28)	(30)	(29)	(33)	(34)	(37)
Hudson Valley	(7)	(16)	(17)	(22)	(18)	(21)	(19)	(18)	(22)	(22)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(32)	(36)	(32)	(35)	(38)	(35)	(40)	(43)	(42)	(40)
Long Island	(2)	(1)	(3)	(3)	(3)	(2)	(3)	(3)	(2)	(3)
NYCA Total	(72)	(84)	(79)	(88)	(96)	(96)	(104)	(107)	(112)	(112)
NYCA Imports	(12)	(11)	(17)	(19)	(21)	(23)	(29)	(30)	(28)	(34)
NYCA Exports	21	18	25	20	20	25	24	27	30	30
NYCA + Imports - Exports	(104)	(113)	(121)	(127)	(137)	(144)	(157)	(165)	(169)	(175)

PROJECTED NYCA GENERATION (GWh) | Generic Energy Efficiency Solution (Study 1: Central East)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	6	(15)	(4)	(15)	(13)	14	(14)	(61)	(44)	(16)
Genesee	(3)	(3)	(4)	(4)	(8)	(5)	(4)	(6)	(4)	(4)
Central	(239)	(171)	(208)	(183)	(204)	(219)	(296)	(157)	(212)	(221)
North	2	(1)	(6)	(3)	(2)	0	0	(4)	(1)	(2)
Mohawk Valley	(1)	0	(2)	(1)	(1)	2	(1)	(3)	0	(3)
Capital	(926)	(826)	(687)	(658)	(751)	(754)	(668)	(709)	(709)	(733)
Hudson Valley	(253)	(503)	(519)	(625)	(463)	(533)	(421)	(378)	(479)	(459)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(1,020)	(1,056)	(918)	(944)	(940)	(807)	(830)	(884)	(806)	(731)
Long Island	(47)	(37)	(66)	(60)	(65)	(40)	(52)	(53)	(45)	(45)
NYCA Total	(2,481)	(2,613)	(2,413)	(2,493)	(2,447)	(2,341)	(2,286)	(2,255)	(2,299)	(2,214)

PROJECTED NET IMPORTS (GWh) | Generic Energy Efficiency Solution (Study 1: Central East)

Net Imports (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	(248)	(295)	(342)	(408)	(349)	(347)	(499)	(434)	(388)	(534)
LINDEN VFT	(94)	(84)	(75)	(64)	(71)	(57)	(60)	(72)	(60)	(63)
NEPTUNE	(32)	(48)	(80)	(56)	(107)	(95)	(82)	(82)	(90)	(72)
HTP	(46)	(23)	(53)	(30)	(21)	(33)	(28)	(40)	(46)	(42)
ISONE - NYISO	(553)	(427)	(537)	(463)	(427)	(545)	(404)	(450)	(478)	(406)
CROSS SOUND CABLE	9	15	36	17	7	18	1	6	(0)	10
NORTHPORT NORWALK	14	21	18	8	5	15	8	12	5	(1)
IESO - NYISO	(61)	(44)	(49)	(2)	(80)	(116)	(139)	(179)	(140)	(178)
HQ - NYISO CHAT	(0)	(0)	(0)	(0)	0	0	0	0	0	0
HQ - NYISO CEDARS	1	(0)	(2)	(0)	0	(0)	0	(0)	(0)	(0)
TOTAL	(1,011)	(887)	(1,082)	(999)	(1,043)	(1,160)	(1,205)	(1,239)	(1,197)	(1,286)

PROJECTED GENERATOR PAYMENTS ($M) | Generic Energy Efficiency Solution (Study 1: Central East)

Generator Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(3)	(3)	(4)	(3)	(3)	(4)	(7)	(6)	(8)	(6)
Genesee	(1)	(1)	(1)	(1)	(1)	(2)	(2)	(1)	(2)	(2)
Central	(5)	(1)	(7)	(8)	(10)	(14)	(19)	(10)	(16)	(15)
North	(2)	(2)	(2)	(2)	(2)	(3)	(3)	(3)	(3)	(3)
Mohawk Valley	(1)	(1)	(1)	(1)	(1)	(1)	(2)	(1)	(2)	(2)
Capital	(34)	(33)	(30)	(30)	(36)	(38)	(38)	(41)	(42)	(43)
Hudson Valley	(8)	(19)	(20)	(25)	(21)	(24)	(23)	(21)	(26)	(25)
Millwood	(7)	(4)	(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NY City	(41)	(46)	(46)	(49)	(49)	(47)	(52)	(56)	(55)	(53)
Long Island	(3)	(3)	(5)	(5)	(4)	(3)	(4)	(5)	(5)	(4)
NYCA Total	(104)	(114)	(117)	(124)	(128)	(136)	(150)	(143)	(157)	(151)

PROJECTED LOAD PAYMENTS ($M) | Generic Energy Efficiency Solution (Study 1: Central East)

Load Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(1)	(2)	(0)	(2)	(2)	(3)	(4)	(2)	(4)	(3)
Genesee	(2)	(2)	(2)	(2)	(2)	(3)	(3)	(2)	(3)	(3)
Central	(3)	(3)	(4)	(3)	(3)	(5)	(6)	(5)	(7)	(5)
North	(1)	(1)	(1)	(1)	(1)	(2)	(2)	(1)	(2)	(2)
Mohawk Valley	(2)	(1)	(2)	(2)	(2)	(3)	(3)	(2)	(3)	(2)
Capital	(32)	(34)	(37)	(38)	(39)	(42)	(45)	(47)	(48)	(49)
Hudson Valley	(28)	(30)	(33)	(35)	(37)	(38)	(42)	(43)	(45)	(46)
Millwood	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Dunwoodie	(2)	(2)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
NY City	(76)	(82)	(89)	(93)	(93)	(101)	(107)	(114)	(117)	(117)
Long Island	(3)	(4)	(4)	(5)	(3)	(3)	(4)	(5)	(5)	(4)
NYCA Total	(152)	(164)	(176)	(185)	(186)	(204)	(220)	(226)	(238)	(236)

PROJECTED LBMPS ($/MWh) | Generic Energy Efficiency Solution (Study 1: Central East)

Average LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.09)	(0.14)	(0.05)	(0.12)	(0.15)	(0.23)	(0.27)	(0.18)	(0.26)	(0.23)
Genesee	(0.19)	(0.14)	(0.19)	(0.14)	(0.17)	(0.27)	(0.31)	(0.22)	(0.31)	(0.27)
Central	(0.21)	(0.19)	(0.21)	(0.20)	(0.21)	(0.33)	(0.35)	(0.31)	(0.42)	(0.31)
North	(0.22)	(0.19)	(0.24)	(0.16)	(0.21)	(0.32)	(0.38)	(0.25)	(0.39)	(0.29)
Mohawk Valley	(0.22)	(0.20)	(0.24)	(0.23)	(0.23)	(0.36)	(0.39)	(0.34)	(0.45)	(0.34)
Capital	(0.40)	(0.39)	(0.46)	(0.46)	(0.43)	(0.52)	(0.50)	(0.55)	(0.57)	(0.49)
Hudson Valley	(0.39)	(0.37)	(0.46)	(0.49)	(0.44)	(0.50)	(0.52)	(0.55)	(0.57)	(0.53)
Millwood	(0.36)	(0.36)	(0.43)	(0.45)	(0.40)	(0.47)	(0.47)	(0.50)	(0.52)	(0.47)
Dunwoodie	(0.37)	(0.36)	(0.44)	(0.46)	(0.41)	(0.47)	(0.47)	(0.50)	(0.52)	(0.47)
NY City	(0.43)	(0.43)	(0.49)	(0.50)	(0.44)	(0.54)	(0.53)	(0.58)	(0.59)	(0.52)
Long Island	(0.13)	(0.14)	(0.16)	(0.22)	(0.16)	(0.20)	(0.20)	(0.26)	(0.26)	(0.23)
Average	(0.27)	(0.26)	(0.31)	(0.31)	(0.30)	(0.38)	(0.40)	(0.38)	(0.44)	(0.38)

PROJECTED SO2 EMISSIONS (Tons) | Generic Energy Efficiency Solution (Study 1: Central East)

SO_2 Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(0)	(0)	(0)	21	61	(19)	(121)	(61)	25
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)
North	0	0	(0)	(0)	(0)	0	0	(0)	(0)	(0)
Mohawk Valley	(0)	0	(0)	0	(0)	0	(0)	(0)	0	(0)
Capital	(2)	(2)	(1)	(1)	(1)	(2)	(1)	(1)	(1)	(2)
Hudson Valley	(1)	(1)	(1)	(2)	(1)	(1)	(1)	(1)	(1)	(1)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(3)	(3)	(3)	(3)	(3)	(2)	(2)	(2)	(2)	(2)
Long Island	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	(6)	(7)	(7)	(6)	15	56	(24)	(126)	(66)	19

PROJECTED SO2 EMISSION COSTS ($M) | Generic Energy Efficiency Solution (Study 1: Central East)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	0	0	(0)	(0)	(0)	0
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	0	0	(0)	(0)	(0)	0	0	(0)	(0)	(0)
Mohawk Valley	(0)	0	(0)	0	(0)	0	(0)	(0)	0	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	(0)	(0)	(0)	(0)	0	0	(0)	(0)	(0)	0

PROJECTED NOX EMISSIONS (Tons) | Generic Energy Efficiency Solution (Study 1: Central East)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(12)	(4)	(10)	(10)	17	(1)	(36)	(26)	0
Genesee	(1)	(1)	(1)	(0)	(1)	(0)	(0)	(1)	(0)	(1)
Central	(13)	(9)	(11)	(10)	(12)	(13)	(18)	(10)	(13)	(15)
North	4	3	2	1	0	4	(3)	7	1	1
Mohawk Valley	(0)	(0)	(0)	0	(0)	0	(0)	(1)	(0)	(1)
Capital	(41)	(38)	(36)	(40)	(49)	(49)	(37)	(43)	(37)	(47)
Hudson Valley	(109)	(73)	(120)	(96)	(96)	(73)	(77)	(61)	(69)	(86)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(196)	(254)	(250)	(270)	(310)	(210)	(247)	(240)	(227)	(205)
Long Island	(15)	(14)	(25)	(18)	(24)	(13)	(13)	(17)	(13)	(13)
NYCA Total	(372)	(399)	(445)	(443)	(501)	(336)	(396)	(401)	(385)	(365)

PROJECTED NOX EMISSION COSTS ($M) | Generic Energy Efficiency Solution (Study 1: Central East)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	(0)	0	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)
Mohawk Valley	(0)	0	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

PROJECTED CO2 EMISSIONS (1000 Tons) | Generic Energy Efficiency Solution (Study 1: Central East)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(2)	(15)	(9)	(14)	(12)	13	(18)	(62)	(45)	(10)
Genesee	(1)	(1)	(2)	(2)	(4)	(2)	(2)	(3)	(2)	(2)
Central	(98)	(70)	(85)	(74)	(85)	(91)	(123)	(66)	(89)	(93)
North	1	1	(1)	(1)	(1)	0	0	(2)	(0)	(1)
Mohawk Valley	(1)	0	(0)	0	(0)	1	(0)	(1)	0	(1)
Capital	(364)	(329)	(269)	(277)	(297)	(310)	(267)	(295)	(291)	(304)
Hudson Valley	(145)	(233)	(260)	(291)	(224)	(241)	(200)	(173)	(219)	(219)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(505)	(544)	(477)	(489)	(500)	(413)	(436)	(461)	(420)	(376)
Long Island	(28)	(18)	(37)	(33)	(35)	(22)	(28)	(29)	(23)	(23)
NYCA Total	(1,142)	(1,209)	(1,141)	(1,180)	(1,157)	(1,065)	(1,073)	(1,092)	(1,090)	(1,028)

PROJECTED CO2 EMISSION COSTS ($M) | Generic Energy Efficiency Solution (Study 1: Central East)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.0)	(0.1)	(0.1)	(0.1)	(0.1)	0.1	(0.2)	(0.6)	(0.5)	(0.1)
Genesee	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Central	(0.5)	(0.4)	(0.5)	(0.5)	(0.6)	(0.7)	(1.0)	(0.6)	(0.8)	(1.0)
North	0.0	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Mohawk Valley	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	(0.0)	0.0	(0.0)
Capital	(1.8)	(1.8)	(1.6)	(1.8)	(2.1)	(2.4)	(2.2)	(2.6)	(2.7)	(3.0)
Hudson Valley	(0.7)	(1.3)	(1.7)	(2.0)	(1.7)	(1.9)	(1.7)	(1.6)	(2.1)	(2.3)
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	(1.9)	(2.9)	(2.8)	(3.1)	(3.4)	(3.0)	(3.4)	(3.8)	(3.8)	(3.6)
Long Island	(0.1)	(0.1)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.3)	(0.2)	(0.2)
NYCA Total	(5.0)	(6.6)	(7.0)	(7.8)	(8.2)	(8.1)	(8.7)	(9.5)	(10.2)	(10.3)

PROJECTED DEMAND LOSS PAYMENT ($M) | Generic Energy Efficiency Solution (Study 1: Central East)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.3	0.3	0.5	0.5	0.4	0.5	0.7	0.8	0.7	0.8
Genesee	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Central	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3
North	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Mohawk Valley	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.1)	(0.0)	(0.1)	(0.1)
Capital	(1.5)	(1.7)	(1.8)	(1.9)	(2.0)	(1.6)	(1.9)	(1.9)	(2.0)	(2.0)
Hudson Valley	(1.2)	(1.3)	(1.5)	(1.5)	(1.5)	(1.8)	(1.8)	(1.9)	(2.0)	(2.1)
Millwood	(0.1)	(0.0)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
Dunwoodie	(0.2)	(0.1)	(0.2)	(0.2)	(0.1)	(0.2)	(0.3)	(0.2)	(0.3)	(0.3)
NY City	(3.8)	(3.7)	(4.4)	(4.5)	(4.3)	(5.8)	(6.0)	(6.0)	(6.5)	(7.0)
Long Island	(0.5)	(0.3)	(0.4)	(0.4)	(0.3)	(0.6)	(0.7)	(0.5)	(0.7)	(0.8)
NYCA Total	(6.7)	(6.6)	(7.5)	(7.6)	(7.5)	(9.2)	(9.5)	(9.2)	(10.1)	(10.7)

Study 2: Central East – Knickerbocker – New Scotland

Generic Transmission Solution (Study 2: Central East – Knickerbocker – New Scotland)

PROJECTED DEMAND CONGESTION BY ZONE ($M) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

Demand Congestion ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(8.9)	(7.1)	(6.9)	(3.4)	1.0	3.4	2.0	2.5	2.3	2.4
Genesee	1.4	2.2	0.8	(1.4)	0.5	1.7	1.1	1.3	1.2	1.2
Central	(3.5)	(3.4)	(2.9)	(1.7)	(0.9)	(1.2)	(0.2)	(0.1)	(0.3)	(0.7)
North	(1.8)	(2.4)	(1.7)	(1.3)	(1.0)	(0.7)	(0.8)	(0.8)	(0.7)	(0.7)
Mohawk Valley	(1.0)	(1.1)	(0.9)	(0.5)	(0.4)	(0.5)	(0.2)	(0.1)	(0.2)	(0.4)
Capital	(27.2)	(27.4)	(23.5)	(17.2)	(10.7)	(10.1)	(5.4)	(4.9)	(5.5)	(7.6)
Hudson Valley	(14.0)	(14.7)	(13.0)	(10.0)	(6.6)	(6.3)	(3.7)	(3.8)	(3.8)	(5.2)
Millwood	(4.1)	(4.2)	(3.8)	(2.8)	(1.8)	(1.9)	(1.1)	(1.1)	(1.1)	(1.6)
Dunwoodie	(8.3)	(8.5)	(7.4)	(5.7)	(3.7)	(3.7)	(2.2)	(2.3)	(2.3)	(3.1)
NY City	(74.2)	(75.1)	(66.6)	(50.7)	(33.1)	(33.5)	(20.3)	(21.2)	(20.8)	(29.0)
Long Island	(27.8)	(28.5)	(25.5)	(19.6)	(11.9)	(12.6)	(7.3)	(7.9)	(7.3)	(11.1)
NYCA Total	(169.4)	(170.1)	(151.4)	(114.3)	(68.5)	(65.3)	(38.2)	(38.5)	(38.6)	(55.8)

PROJECTED PRODUCTION COST ($M) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

Production Cost ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	2	1	1	2	6	10	7	8	11	13
Genesee	0	0	0	0	0	0	0	0	0	0
Central	14	13	10	10	11	12	8	10	8	8
North	1	0	0	1	1	1	1	1	1	1
Mohawk Valley	(0)	0	0	0	0	1	1	1	1	1
Capital	(9)	(10)	(10)	(11)	(8)	(12)	(11)	(10)	(9)	(13)
Hudson Valley	1	(4)	(2)	(4)	(4)	(1)	(2)	(1)	(3)	(2)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(9)	(10)	(5)	(6)	(6)	(4)	(4)	(7)	(6)	(5)
Long Island	0	0	(1)	(1)	(2)	(0)	0	0	0	(0)
NYCA Total	(0)	(9)	(6)	(9)	(1)	6	(0)	2	4	2
NYCA Imports	3	9	10	12	(1)	(2)	(5)	(1)	(3)	(3)
NYCA Exports	24	20	26	21	9	14	3	9	10	10
NYCA + Imports - Exports	(22)	(21)	(22)	(18)	(11)	(10)	(9)	(8)	(10)	(11)

PROJECTED NYCA GENERATION (GWh) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	54	24	38	48	161	212	184	155	249	249
Genesee	12	6	6	4	2	1	0	1	6	1
Central	571	504	382	341	327	312	194	241	156	171
North	81	40	35	28	24	33	19	13	16	18
Mohawk Valley	11	7	8	3	2	12	11	11	7	7
Capital	(237)	(259)	(246)	(246)	(167)	(227)	(175)	(171)	(137)	(181)
Hudson Valley	28	(109)	(33)	(78)	(81)	(26)	(51)	(9)	(44)	(28)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(308)	(315)	(151)	(170)	(117)	(95)	(62)	(129)	(92)	(77)
Long Island	(2)	6	(33)	(15)	(39)	(3)	(2)	1	3	(3)
NYCA Total	209	(96)	6	(85)	113	218	119	112	163	158

PROJECTED NET IMPORTS (GWh) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

Net Imports (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	335	327	428	362	127	51	(36)	57	35	(49)
LINDEN VFT	(103)	(115)	(71)	(68)	(40)	(28)	(17)	(31)	(15)	(16)
NEPTUNE	(47)	(55)	(29)	(37)	(19)	0	0	3	7	(3)
HTP	(57)	(36)	(71)	(54)	(53)	(38)	(38)	(44)	(40)	(36)
ISONE - NYISO	(818)	(644)	(730)	(579)	(334)	(325)	(147)	(214)	(218)	(157)
CROSS SOUND CABLE	26	23	15	21	(7)	3	(10)	(3)	(8)	10
NORTHPORT NORWALK	7	2	1	(7)	(8)	(12)	(9)	(10)	(13)	(7)
IESO - NYISO	440	586	433	439	214	147	152	150	107	116
HQ - NYISO CHAT	(0)	(1)	0	(0)	0	0	0	0	0	(0)
HQ - NYISO CEDARS	2	3	0	(0)	0	0	(0)	(0)	0	0
TOTAL	(215)	90	(24)	77	(121)	(201)	(105)	(92)	(144)	(143)

PROJECTED GENERATOR PAYMENTS ($M) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

Generator Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	21	17	15	12	15	14	12	11	14	17
Genesee	5	6	5	3	2	2	1	1	1	1
Central	42	42	35	32	26	27	21	23	18	22
North	15	16	13	11	7	7	5	5	5	6
Mohawk Valley	5	6	5	4	3	3	2	3	2	3
Capital	(19)	(19)	(20)	(18)	(14)	(15)	(11)	(9)	(11)	(14)
Hudson Valley	1	(5)	(2)	(5)	(4)	(1)	(2)	(2)	(3)	(2)
Millwood	(2)	(2)	(1)	(0)	(0)	(0)	(0)	0	0	(0)
Dunwoodie	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NY City	(13)	(13)	(11)	(11)	(10)	(6)	(4)	(7)	(8)	(8)
Long Island	(0)	0	(3)	(2)	(3)	(0)	0	0	(0)	(2)
NYCA Total	54	48	36	27	21	30	24	25	17	23

PROJECTED LOAD PAYMENTS ($M) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

Load Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	9	11	8	8	5	3	2	2	1	3
Genesee	11	10	8	6	4	3	2	2	1	2
Central	17	18	15	12	7	7	5	5	4	6
North	8	10	8	6	4	4	3	3	2	3
Mohawk Valley	11	11	10	8	7	5	4	5	4	5
Capital	(12)	(12)	(11)	(8)	(7)	(3)	(1)	0	(2)	(2)
Hudson Valley	(2)	(2)	(3)	(2)	(2)	(2)	(2)	(2)	(3)	(3)
Millwood	(0)	(0)	(1)	(0)	(1)	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(1)	(1)	(1)	(1)	(1)	(0)	(0)	(0)	(1)	(1)
NY City	(8)	(6)	(11)	(8)	(9)	(3)	(0)	0	(4)	(5)
Long Island	(1)	(0)	(3)	(2)	(2)	(1)	0	0	(1)	(2)
NYCA Total	32	38	19	19	5	13	14	15	3	7

PROJECTED LBMPS ($/MWh) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

Average LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.65	0.77	0.60	0.54	0.34	0.20	0.13	0.10	0.05	0.16
Genesee	1.09	1.04	0.85	0.62	0.37	0.28	0.18	0.17	0.10	0.22
Central	1.08	1.12	0.93	0.73	0.40	0.42	0.30	0.32	0.23	0.34
North	1.60	1.72	1.38	1.04	0.63	0.62	0.47	0.47	0.39	0.51
Mohawk Valley	1.20	1.23	1.03	0.81	0.45	0.47	0.33	0.36	0.27	0.38
Capital	(0.82)	(0.81)	(0.76)	(0.55)	(0.39)	(0.27)	(0.09)	(0.06)	(0.19)	(0.22)
Hudson Valley	(0.14)	(0.18)	(0.24)	(0.20)	(0.21)	(0.10)	(0.03)	(0.01)	(0.11)	(0.12)
Millwood	(0.16)	(0.17)	(0.23)	(0.18)	(0.19)	(0.10)	(0.03)	(0.02)	(0.11)	(0.12)
Dunwoodie	(0.15)	(0.16)	(0.22)	(0.17)	(0.19)	(0.10)	(0.03)	(0.02)	(0.11)	(0.11)
NY City	(0.15)	(0.14)	(0.21)	(0.17)	(0.17)	(0.08)	(0.02)	(0.01)	(0.10)	(0.11)
Long Island	(0.05)	(0.03)	(0.13)	(0.12)	(0.11)	(0.05)	0.01	0.01	(0.07)	(0.11)
Average	0.38	0.40	0.27	0.21	0.09	0.12	0.11	0.12	0.03	0.08

PROJECTED SO2 EMISSIONS (Tons) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

SO_2 Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	14	1	1	44	239	416	311	227	500	438
Genesee	0	0	0	0	0	0	0	0	0	0
Central	1	1	1	1	1	1	0	1	0	0
North	0	0	0	0	0	0	0	0	0	0
Mohawk Valley	(0)	0	0	0	0	0	0	0	0	0
Capital	(1)	(1)	(1)	(1)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(1)	(1)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	0	(1)	0	(0)	(0)	(0)	(0)	0	0
NYCA Total	14	0	0	44	239	416	311	227	500	438

PROJECTED SO2 EMISSION COSTS ($M) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	0	0	0	0	0	0	0	0	0
Genesee	0	0	0	0	0	0	0	0	0	0
Central	0	0	0	0	0	0	0	0	0	0
North	0	0	0	0	0	0	0	0	0	0
Mohawk Valley	(0)	0	0	0	0	0	0	0	0	0
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	0	(0)	0	(0)	(0)	(0)	(0)	0	0
NYCA Total	0	(0)	(0)	0	0	0	0	0	0	0

PROJECTED NOX EMISSIONS (Tons) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	23	13	18	31	53	116	60	64	114	104
Genesee	10	5	6	3	0	0	0	0	1	0
Central	38	31	27	23	22	24	16	20	16	14
North	11	8	8	5	7	5	6	4	5	2
Mohawk Valley	1	1	2	1	0	3	2	3	1	1
Capital	(17)	(13)	(12)	(11)	(8)	(8)	(5)	(5)	(5)	(6)
Hudson Valley	(10)	(9)	(10)	(2)	(4)	(1)	(10)	3	5	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(43)	(67)	(55)	(41)	(17)	(10)	(15)	(29)	(13)	(9)
Long Island	(1)	(2)	(13)	(7)	(13)	(1)	(0)	(1)	0	(2)
NYCA Total	12	(31)	(28)	2	41	129	53	59	124	104

PROJECTED NOX EMISSION COSTS ($M) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	0	0	0	0	0	0	0	0	0
Genesee	0	0	0	0	0	0	(0)	0	0	0
Central	0	0	0	0	0	0	0	0	0	0
North	0	0	0	0	0	0	0	0	0	0
Mohawk Valley	(0)	0	0	0	0	0	0	0	(0)	0
Capital	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	0	0	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	0	0	(0)	0	(0)	(0)	0	(0)	0	(0)
NYCA Total	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	0	0

PROJECTED CO2 EMISSIONS (1000 Tons) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	24	11	14	33	126	189	149	124	225	210
Genesee	1	1	0	1	1	0	0	1	3	1
Central	214	194	146	136	135	129	82	101	67	72
North	8	5	6	8	11	15	9	6	8	9
Mohawk Valley	(1)	0	2	1	1	6	5	5	4	4
Capital	(105)	(113)	(105)	(107)	(68)	(91)	(73)	(72)	(53)	(75)
Hudson Valley	5	(47)	(18)	(33)	(34)	(12)	(25)	(3)	(17)	(11)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(149)	(159)	(84)	(85)	(59)	(41)	(30)	(67)	(45)	(35)
Long Island	(1)	5	(18)	(7)	(21)	(2)	(1)	(0)	3	0
NYCA Total	(4)	(102)	(57)	(51)	92	194	117	94	194	173

PROJECTED CO2 EMISSION COSTS ($M) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.1	0.1	0.1	0.2	0.9	1.5	1.2	1.1	2.1	2.2
Genesee	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Central	1.0	1.1	0.9	0.9	1.0	1.0	0.7	0.9	0.6	0.7
North	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Mohawk Valley	(0.0)	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0
Capital	(0.5)	(0.6)	(0.6)	(0.7)	(0.5)	(0.7)	(0.6)	(0.7)	(0.5)	(0.8)
Hudson Valley	0.0	(0.3)	(0.1)	(0.2)	(0.3)	(0.1)	(0.2)	(0.0)	(0.2)	(0.1)
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	(0.5)	(0.9)	(0.5)	(0.6)	(0.4)	(0.3)	(0.2)	(0.6)	(0.4)	(0.3)
Long Island	(0.0)	0.0	(0.1)	(0.0)	(0.2)	(0.0)	(0.0)	(0.0)	0.0	0.0
NYCA Total	0.2	(0.6)	(0.3)	(0.3)	0.7	1.5	0.9	0.9	1.8	1.8

PROJECTED DEMAND LOSS PAYMENT ($M) | Generic Transmission Solutino (Study 2: Central East - Knickerbocker - New Scotland)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(2.0)	(2.2)	(1.7)	(1.5)	(1.1)	(1.7)	(1.3)	(1.6)	(1.4)	(1.7)
Genesee	(0.8)	(1.0)	(0.8)	(0.6)	(0.5)	(0.8)	(0.6)	(0.7)	(0.7)	(0.8)
Central	(0.3)	(0.5)	(0.4)	(0.4)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)
North	(0.4)	(0.5)	(0.4)	(0.3)	(0.1)	(0.2)	(0.1)	(0.2)	(0.1)	(0.2)
Mohawk Valley	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2
Capital	0.0	(0.0)	(0.2)	(0.4)	(0.5)	(0.2)	(0.3)	(0.4)	(0.5)	(0.4)
Hudson Valley	0.1	0.1	(0.1)	(0.2)	(0.3)	0.1	(0.0)	0.0	(0.1)	(0.0)
Millwood	0.1	0.0	(0.0)	(0.0)	(0.1)	0.1	0.0	0.1	0.0	0.0
Dunwoodie	0.1	0.1	(0.0)	(0.1)	(0.1)	0.2	0.1	0.1	0.1	0.1
NY City	1.5	1.2	0.1	(0.5)	(1.0)	1.7	1.0	1.5	0.7	1.1
Long Island	0.8	0.6	0.3	(0.0)	(0.2)	0.9	0.5	0.6	0.4	0.5
NYCA Total	(0.7)	(1.9)	(3.0)	(3.8)	(4.2)	(0.5)	(1.0)	(0.9)	(1.9)	(1.7)

Generic Generation Solution (Study 2: Central East – Knickerbocker – New Scotland)

PROJECTED DEMAND CONGESTION BY ZONE ($M) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

Demand Congestion ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.3)	0.4	(0.2)	(0.1)	0.1	(0.3)	(0.2)	0.0	(0.5)	(0.2)
Genesee	0.2	(0.2)	0.3	(0.0)	0.1	(0.1)	(0.1)	0.0	(0.2)	(0.0)
Central	(0.6)	0.2	0.2	(0.7)	(0.5)	0.2	0.2	(0.4)	0.7	0.1
North	0.1	(0.2)	(0.2)	0.0	0.2	0.1	(0.0)	(0.0)	(0.2)	0.0
Mohawk Valley	(0.1)	0.0	0.0	(0.2)	(0.3)	0.0	0.1	(0.1)	0.1	0.0
Capital	(2.1)	1.2	0.1	(1.1)	(3.3)	1.0	1.0	(0.6)	0.2	1.0
Hudson Valley	(1.5)	0.4	(0.2)	(1.1)	(2.4)	0.5	0.1	(1.0)	(0.0)	(0.2)
Millwood	(0.4)	0.2	(0.1)	(0.3)	(0.7)	0.2	0.1	(0.2)	(0.0)	(0.0)
Dunwoodie	(0.8)	0.6	(0.3)	(0.6)	(1.4)	0.3	0.1	(0.4)	(0.0)	(0.0)
NY City	(8.0)	6.4	3.7	(3.0)	(9.4)	6.7	2.6	0.5	3.8	5.8
Long Island	(1.4)	3.4	0.1	0.7	(8.8)	5.4	2.6	0.6	2.1	3.9
NYCA Total	(14.9)	12.5	3.5	(6.5)	(26.3)	14.0	6.5	(1.6)	5.9	10.3

PROJECTED PRODUCTION COST ($M) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

Production Cost ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(1)	(1)	(1)	(3)	1	(2)	(2)	(2)	(0)
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1)
Central	(2)	(0)	(4)	2	(5)	(3)	(12)	(5)	(4)	(7)
North	(0)	(0)	(0)	(0)	1	0	(0)	0	(0)	(0)
Mohawk Valley	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	(0)
Capital	(2)	(4)	1	(2)	(6)	(9)	(8)	(7)	(8)	(12)
Hudson Valley	9	12	16	17	25	29	27	47	41	36
Millwood	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(2)	(13)	(18)	(20)	(8)	(5)	7	(17)	(21)	(11)
Long Island	(0)	3	1	(0)	(2)	(2)	(0)	(1)	(5)	(5)
NYCA Total	3	(2)	(5)	(5)	2	11	12	14	1	(0)
NYCA Imports	(2)	(3)	(7)	(7)	(7)	(13)	(19)	(18)	(13)	(20)
NYCA Exports	3	3	3	6	10	10	5	12	12	12
NYCA + Imports - Exports	(2)	(8)	(15)	(19)	(15)	(12)	(11)	(16)	(24)	(32)

PROJECTED NYCA GENERATION (GWh) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	11	(3)	0	(30)	(30)	45	(3)	(22)	(21)	27
Genesee	(3)	(5)	(3)	(1)	(3)	(8)	(1)	(8)	(3)	(13)
Central	(83)	(38)	(169)	62	(171)	(69)	(320)	(134)	(114)	(145)
North	(2)	2	(7)	(2)	13	4	(1)	4	(9)	(1)
Mohawk Valley	(1)	1	(0)	(1)	1	(5)	(1)	(3)	1	(3)
Capital	(67)	(196)	(96)	(199)	(186)	(270)	(152)	(224)	(260)	(275)
Hudson Valley	447	639	779	868	1,099	1,118	1,149	1,429	1,389	1,212
Millwood	0	(0)	(0)	(0)	0	(0)	(0)	0	(0)	0
Dunwoodie	0	0	(0)	0	0	0	0	0	0	0
NY City	(124)	(237)	(311)	(314)	(249)	(227)	(43)	(371)	(340)	28
Long Island	(12)	33	32	(17)	(43)	(24)	(6)	(13)	(66)	(76)
NYCA Total	166	195	224	366	430	563	622	659	577	755

PROJECTED NET IMPORTS (GWh) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

Net Imports (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	(48)	(83)	(103)	(127)	(90)	(220)	(326)	(270)	(201)	(421)
LINDEN VFT	(31)	13	0	(12)	(19)	(2)	(13)	0	(21)	(11)
NEPTUNE	(14)	(5)	(43)	(10)	(21)	(50)	(75)	(47)	(49)	(41)
HTP	(2)	(0)	27	(6)	(5)	10	(2)	(10)	(4)	0
ISONE - NYISO	(90)	(69)	(57)	(144)	(256)	(258)	(85)	(220)	(202)	(149)
CROSS SOUND CABLE	12	2	(26)	0	(37)	16	(2)	(24)	3	20
NORTHPORT NORWALK	11	6	(8)	(8)	(3)	4	(8)	1	11	5
IESO - NYISO	(4)	(60)	(22)	(59)	(0)	(65)	(116)	(95)	(116)	(165)
HQ - NYISO CHAT	(0)	(0)	(0)	(0)	0	(0)	0	0	0	0
HQ - NYISO CEDARS	(1)	1	(0)	(0)	0	(0)	(0)	0	0	0
TOTAL	(167)	(194)	(231)	(365)	(433)	(566)	(628)	(665)	(580)	(762)

PROJECTED GENERATOR PAYMENTS ($M) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

Generator Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1	(1)	(3)	(2)	(1)	(2)	(2)	(2)	(5)	(2)
Genesee	(0)	(1)	(1)	(0)	0	(2)	(1)	(1)	(1)	(2)
Central	5	(0)	(14)	6	(5)	(10)	(16)	(4)	(24)	(10)
North	0	(1)	(1)	(1)	1	(2)	(1)	(1)	(2)	(2)
Mohawk Valley	0	(0)	(1)	(0)	0	(1)	(0)	(0)	(0)	(1)
Capital	(4)	(5)	(4)	(5)	(11)	(12)	(9)	(10)	(13)	(15)
Hudson Valley	12	17	23	26	36	40	41	60	56	51
Millwood	(1)	(0)	(0)	0	(1)	(0)	0	0	1	(0)
Dunwoodie	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NY City	(7)	(12)	(19)	(19)	(12)	(11)	(1)	(20)	(21)	5
Long Island	(2)	2	(2)	(1)	(3)	(1)	(1)	0	(6)	(5)
NYCA Total	4	(1)	(22)	3	5	(1)	12	23	(14)	19

PROJECTED LOAD PAYMENTS ($M) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

Load Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(1)	(3)	(1)	0	(3)	(1)	(1)	(2)	(2)
Genesee	0	(1)	(2)	(1)	0	(2)	(1)	(1)	(2)	(2)
Central	0	(2)	(3)	(2)	0	(4)	(1)	(2)	(3)	(3)
North	0	(0)	(1)	(0)	0	(1)	(0)	(0)	(1)	(1)
Mohawk Valley	0	(1)	(1)	(1)	(0)	(2)	(1)	(1)	(1)	(1)
Capital	(2)	(0)	(3)	(2)	(3)	(2)	(1)	(1)	(3)	(2)
Hudson Valley	(1)	(1)	(3)	(2)	(3)	(2)	(1)	(2)	(3)	(3)
Millwood	(0)	(0)	(1)	(1)	(1)	(1)	(0)	(1)	(1)	(1)
Dunwoodie	(1)	(0)	(2)	(1)	(2)	(1)	(1)	(1)	(2)	(2)
NY City	(6)	(2)	(10)	(9)	(11)	(8)	(7)	(6)	(10)	(10)
Long Island	(1)	(0)	(6)	(2)	(9)	(0)	(1)	(2)	(3)	(2)
NYCA Total	(10)	(10)	(33)	(21)	(26)	(27)	(16)	(17)	(29)	(29)

PROJECTED LBMPS ($/MWh) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

Average LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.01	(0.08)	(0.15)	(0.05)	0.03	(0.21)	(0.07)	(0.07)	(0.15)	(0.15)
Genesee	0.01	(0.10)	(0.13)	(0.06)	0.04	(0.23)	(0.08)	(0.07)	(0.17)	(0.17)
Central	0.00	(0.11)	(0.14)	(0.09)	0.01	(0.24)	(0.08)	(0.10)	(0.16)	(0.18)
North	0.02	(0.07)	(0.11)	(0.05)	0.01	(0.27)	(0.09)	(0.08)	(0.17)	(0.18)
Mohawk Valley	0.02	(0.11)	(0.16)	(0.08)	0.00	(0.25)	(0.10)	(0.11)	(0.20)	(0.19)
Capital	(0.11)	(0.02)	(0.16)	(0.14)	(0.21)	(0.16)	(0.05)	(0.12)	(0.20)	(0.12)
Hudson Valley	(0.08)	(0.08)	(0.20)	(0.17)	(0.21)	(0.23)	(0.13)	(0.20)	(0.24)	(0.25)
Millwood	(0.08)	(0.05)	(0.21)	(0.17)	(0.22)	(0.24)	(0.13)	(0.19)	(0.26)	(0.25)
Dunwoodie	(0.08)	(0.05)	(0.21)	(0.17)	(0.22)	(0.23)	(0.13)	(0.19)	(0.25)	(0.25)
NY City	(0.09)	(0.02)	(0.12)	(0.12)	(0.16)	(0.18)	(0.11)	(0.11)	(0.18)	(0.16)
Long Island	(0.02)	0.00	(0.20)	(0.05)	(0.41)	(0.03)	(0.06)	(0.11)	(0.16)	(0.08)
Average	(0.04)	(0.06)	(0.16)	(0.10)	(0.12)	(0.21)	(0.09)	(0.12)	(0.20)	(0.18)

PROJECTED SO2 EMISSIONS (Tons) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

SO_2 Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(0)	1	(0)	(66)	104	(4)	(81)	(62)	77
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(0)	0	(0)	(0)	(1)	(0)	(0)	(0)
North	(0)	(0)	(0)	(0)	0	0	(0)	0	(0)	(0)
Mohawk Valley	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(1)	(1)
Hudson Valley	24	40	49	57	67	68	77	70	79	79
Millwood	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(1)	(1)	(1)	(1)	(1)	0	(1)	(1)	0
Long Island	(0)	0	(1)	0	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	23	38	47	56	(1)	170	72	(12)	14	156

PROJECTED SO2 EMISSION COSTS ($M) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	0
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)
North	(0)	(0)	(0)	(0)	0	0	(0)	0	(0)	(0)
Mohawk Valley	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	0	0	0	0	0	0	0	0	0	0
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	0
Long Island	(0)	0	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	0	0	0	0	(0)	0	0	(0)	0	0

PROJECTED NOX EMISSIONS (Tons) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1	(7)	(4)	(18)	(27)	23	(15)	(7)	(15)	(11)
Genesee	0	(1)	0	0	(0)	(1)	(0)	(1)	(0)	(1)
Central	(4)	(5)	(10)	(0)	(10)	(11)	(17)	(10)	(8)	(14)
North	4	(2)	(2)	1	5	0	(2)	1	(0)	(1)
Mohawk Valley	1	0	0	(1)	0	(1)	0	(1)	(0)	(1)
Capital	15	(18)	(15)	(20)	15	(28)	(24)	(37)	(29)	(35)
Hudson Valley	80	86	80	106	142	160	180	225	197	191
Millwood	0	(0)	(1)	(1)	0	(2)	(1)	0	(2)	1
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(20)	(82)	(91)	(64)	(134)	(53)	42	(92)	(68)	(18)
Long Island	(2)	29	4	(4)	(27)	(13)	4	(10)	(22)	(15)
NYCA Total	75	0	(38)	0	(37)	74	168	69	54	96

PROJECTED NOX EMISSION COSTS ($M) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	0	0	0	0	0	0	0	0	0	0
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)
Long Island	(0)	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)
NYCA Total	(0)	(0)	0	0	(0)	0	0	0	0	(0)

PROJECTED CO2 EMISSIONS (1000 Tons) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1	(12)	(9)	(21)	(44)	28	(15)	(33)	(37)	12
Genesee	(2)	(2)	(2)	(1)	(2)	(4)	(0)	(4)	(1)	(6)
Central	(41)	(16)	(68)	20	(72)	(33)	(131)	(56)	(48)	(65)
North	(1)	(1)	(2)	(2)	6	2	(0)	1	(4)	(1)
Mohawk Valley	(1)	0	(1)	(1)	0	(2)	(0)	(1)	1	(2)
Capital	(37)	(85)	(48)	(91)	(83)	(120)	(79)	(103)	(116)	(127)
Hudson Valley	184	251	289	327	423	441	450	589	549	477
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(58)	(133)	(181)	(178)	(136)	(116)	12	(209)	(181)	8
Long Island	(7)	31	18	(8)	(28)	(15)	(5)	(9)	(37)	(40)
NYCA Total	40	34	(4)	45	65	182	231	174	124	258

PROJECTED CO2 EMISSION COSTS ($M) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.0	(0.1)	(0.1)	(0.1)	(0.3)	0.2	(0.1)	(0.3)	(0.3)	0.1
Genesee	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)
Central	(0.2)	(0.1)	(0.4)	0.1	(0.5)	(0.3)	(1.1)	(0.5)	(0.5)	(0.7)
North	(0.0)	(0.0)	(0.0)	(0.0)	0.1	0.0	(0.0)	0.0	(0.0)	(0.0)
Mohawk Valley	(0.0)	0.0	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	0.0	(0.0)
Capital	(0.2)	(0.5)	(0.3)	(0.6)	(0.6)	(0.9)	(0.7)	(0.9)	(1.1)	(1.2)
Hudson Valley	0.9	1.4	1.9	2.2	3.1	3.4	3.7	5.3	5.2	4.8
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	(0.2)	(0.8)	(1.1)	(1.1)	(0.9)	(0.8)	0.2	(1.8)	(1.7)	0.2
Long Island	(0.0)	0.1	0.1	(0.1)	(0.2)	(0.1)	(0.1)	(0.1)	(0.3)	(0.4)
NYCA Total	0.3	0.2	0.1	0.4	0.6	1.5	1.9	1.7	1.2	2.6

PROJECTED DEMAND LOSS PAYMENT ($M) | Generic Generation Solution (Study 2: Central East - Knickerbocker - New Scotland)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.1)	0.2	0.3	0.1	0.1	0.4	0.4	0.3	0.4	0.5
Genesee	(0.0)	0.1	0.1	0.0	0.1	0.1	0.2	0.1	0.2	0.2
Central	0.0	(0.0)	(0.0)	0.0	0.1	0.1	0.2	0.1	0.1	0.2
North	(0.0)	0.0	0.1	0.0	(0.0)	0.1	0.0	0.0	0.1	0.1
Mohawk Valley	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Capital	0.0	(0.0)	(0.2)	0.1	0.1	0.0	(0.1)	0.1	(0.0)	0.0
Hudson Valley	(0.0)	(0.2)	(0.3)	(0.1)	(0.3)	(0.3)	(0.5)	(0.4)	(0.4)	(0.5)
Millwood	(0.0)	(0.1)	(0.1)	(0.0)	(0.1)	(0.1)	(0.2)	(0.1)	(0.1)	(0.2)
Dunwoodie	(0.0)	(0.1)	(0.2)	(0.1)	(0.2)	(0.2)	(0.3)	(0.2)	(0.3)	(0.3)
NY City	0.0	(0.9)	(1.7)	(0.5)	(1.3)	(1.8)	(3.1)	(1.5)	(1.8)	(3.1)
Long Island	0.0	(0.5)	(0.8)	(0.2)	(0.5)	(0.7)	(1.2)	(0.8)	(0.7)	(1.1)
NYCA Total	(0.1)	(1.5)	(2.8)	(0.6)	(2.1)	(2.5)	(4.7)	(2.4)	(2.6)	(4.4)

Generic Demand Response Solution (Study 2: Central East)

PROJECTED DEMAND CONGESTION BY ZONE ($M) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

Demand Congestion ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.1)	(0.0)	(1.5)	0.1	0.0	0.1	(0.0)	0.1	(0.0)	(0.0)
Genesee	(0.0)	(0.0)	0.1	0.1	0.0	0.0	0.0	0.0	(0.0)	(0.0)
Central	0.2	(0.1)	(0.2)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.0)	0.0
North	(0.0)	(0.0)	(0.1)	(0.1)	0.0	(0.0)	(0.1)	(0.0)	(0.0)	0.0
Mohawk Valley	0.1	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0
Capital	0.2	0.0	0.1	0.1	(0.2)	(0.0)	0.3	0.0	0.2	0.2
Hudson Valley	(0.2)	(0.3)	(0.6)	(0.4)	(0.4)	0.0	(0.1)	(0.2)	(0.1)	(0.2)
Millwood	(0.0)	(0.1)	(0.1)	(0.1)	(0.1)	(0.0)	0.0	(0.0)	(0.0)	0.0
Dunwoodie	(0.1)	(0.3)	(0.3)	(0.2)	(0.2)	(0.0)	0.0	(0.0)	(0.0)	0.0
NY City	(0.6)	(3.2)	(3.3)	(2.4)	(1.6)	(0.4)	0.4	(2.0)	(1.4)	(1.6)
Long Island	(0.1)	(0.7)	(1.1)	(0.2)	(0.1)	0.1	0.5	(0.1)	0.4	0.2
NYCA Total	(0.6)	(4.8)	(7.0)	(3.3)	(2.5)	(0.3)	1.1	(2.4)	(1.2)	(1.3)

PROJECTED PRODUCTION COST ($M) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

Production Cost ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	1	0	0	(1)	0	0
Genesee	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	0
Central	(0)	0	(0)	0	(0)	(0)	0	(0)	(0)	(0)
North	(0)	0	0	0	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	0	0	(0)	0	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(1)	0	0	0	(0)	(0)
Hudson Valley	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(1)	(1)	(1)	(0)	(1)	(2)	(1)	(0)	(1)	(2)
Long Island	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
NYCA Total	(2)	(1)	(1)	(1)	(2)	(2)	(1)	(2)	(1)	(2)
NYCA Imports	0	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(1)	(0)
NYCA Exports	(0)	0	0	1	0	(0)	0	0	1	(0)
NYCA + Imports - Exports	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	(3)	(2)

PROJECTED NYCA GENERATION (GWh) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(2)	(1)	(2)	(5)	15	1	(1)	(18)	(1)	7
Genesee	(0)	0	0	(0)	0	(0)	(0)	(0)	0	0
Central	(16)	1	(3)	(0)	(5)	(1)	6	(2)	(0)	0
North	1	1	(0)	(0)	(1)	(1)	(4)	(2)	(1)	(1)
Mohawk Valley	(0)	(0)	1	1	(1)	0	(1)	(1)	(1)	(1)
Capital	3	(4)	(5)	(1)	(14)	2	9	2	(4)	(6)
Hudson Valley	(2)	7	(3)	(8)	7	0	(4)	(2)	2	(8)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(36)	(22)	(17)	(2)	(22)	(30)	(13)	(7)	(10)	(38)
Long Island	(1)	2	2	(1)	(6)	2	(2)	(0)	(2)	0
NYCA Total	(53)	(16)	(26)	(17)	(26)	(27)	(9)	(30)	(16)	(45)

PROJECTED NET IMPORTS (GWh) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

Net Imports (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	2	(9)	2	(20)	(14)	(3)	(23)	0	(11)	2
LINDEN VFT	0	(3)	(0)	(3)	(2)	3	(2)	(1)	(7)	3
NEPTUNE	0	0	(0)	(2)	(4)	0	(1)	(5)	(2)	(0)
HTP	4	(1)	(1)	(3)	1	(0)	(0)	(0)	2	2
ISONE - NYISO	10	(8)	(7)	5	10	(9)	5	2	(3)	1
CROSS SOUND CABLE	(1)	(1)	(1)	(1)	4	0	(0)	1	1	0
NORTHPORT NORWALK	(1)	0	(2)	(1)	(2)	(1)	(1)	1	0	(2)
IESO - NYISO	1	(4)	(5)	3	(5)	(4)	(8)	(7)	(3)	(0)
HQ - NYISO CHAT	(0)	0	0	(0)	0	0	(0)	0	0	0
HQ - NYISO CEDARS	(0)	0	0	0	0	0	0	0	0	(0)
TOTAL	15	(24)	(14)	(23)	(13)	(13)	(31)	(9)	(23)	6

PROJECTED GENERATOR PAYMENTS ($M) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

Generator Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(1)	(0)	1	(0)	(0)	(1)	(0)	0
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(1)	0	(1)	(0)	(1)	(0)	(0)	0	(0)	(0)
North	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(1)	(1)	(2)	(1)	(1)	0	(0)	0	(1)	(0)
Hudson Valley	(1)	(0)	(2)	(1)	0	(0)	(1)	(1)	(0)	(0)
Millwood	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NY City	(3)	(4)	(7)	(3)	(2)	(2)	(2)	(2)	(2)	(3)
Long Island	(1)	(1)	(2)	(1)	(0)	0	(0)	(0)	(0)	(0)
NYCA Total	(7)	(6)	(15)	(6)	(4)	(3)	(4)	(4)	(5)	(4)

PROJECTED LOAD PAYMENTS ($M) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

Load Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(1)	(0)	(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Genesee	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Hudson Valley	(1)	(1)	(2)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Millwood	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NY City	(3)	(5)	(10)	(5)	(3)	(2)	(3)	(4)	(5)	(3)
Long Island	(1)	(1)	(4)	(1)	(0)	(0)	(0)	(1)	(0)	0
NYCA Total	(8)	(10)	(23)	(9)	(5)	(4)	(6)	(7)	(8)	(5)

PROJECTED LBMPS ($/MWh) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

Average LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.03)	(0.01)	(0.12)	(0.01)	(0.02)	(0.01)	(0.02)	(0.00)	(0.02)	(0.01)
Genesee	(0.02)	(0.01)	(0.04)	(0.01)	(0.02)	(0.01)	(0.02)	(0.00)	(0.02)	(0.01)
Central	(0.02)	(0.02)	(0.06)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
North	(0.02)	(0.01)	(0.03)	0.01	(0.02)	(0.00)	(0.01)	(0.00)	(0.02)	(0.01)
Mohawk Valley	(0.02)	(0.01)	(0.05)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Capital	(0.01)	(0.01)	(0.05)	(0.01)	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	0.01
Hudson Valley	(0.03)	(0.03)	(0.08)	(0.03)	(0.03)	(0.00)	(0.02)	(0.02)	(0.03)	(0.01)
Millwood	(0.03)	(0.04)	(0.08)	(0.03)	(0.03)	(0.01)	(0.02)	(0.01)	(0.02)	(0.00)
Dunwoodie	(0.03)	(0.04)	(0.08)	(0.04)	(0.03)	(0.01)	(0.02)	(0.01)	(0.02)	(0.00)
NY City	(0.02)	(0.04)	(0.08)	(0.04)	(0.03)	(0.01)	(0.01)	(0.03)	(0.03)	(0.02)
Long Island	(0.02)	(0.03)	(0.08)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	0.00
Average	(0.02)	(0.02)	(0.07)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)

PROJECTED SO2 EMISSIONS (Tons) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

SO_2 Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(0)	(0)	(0)	50	2	0	(46)	(2)	8
Genesee	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	0
Central	(0)	0	(0)	0	(0)	(0)	0	(0)	(0)	0
North	(0)	0	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	0	0	(0)	0	(0)	(0)	(0)	(0)
Capital	0	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(1)	(0)	0	0	0	0	0	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	(0)	(1)	(0)	(0)	0	(0)	(0)	(0)	0
NYCA Total	(1)	(1)	(3)	(0)	50	2	(0)	(46)	(3)	7

PROJECTED SO2 EMISSION COSTS ($M) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(0)	(0)	(0)	0	0	0	(0)	(0)	0
Genesee	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	0
Central	(0)	0	(0)	0	(0)	(0)	0	(0)	(0)	0
North	(0)	0	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	0	0	(0)	0	(0)	(0)	(0)	(0)
Capital	0	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	0	0	0	0	0	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)	0
NYCA Total	(0)	(0)	(0)	(0)	0	0	(0)	(0)	(0)	0

PROJECTED NOX EMISSIONS (Tons) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1	(1)	(0)	(2)	4	1	(0)	(10)	1	8
Genesee	(0)	0	0	0	0	(0)	(0)	(0)	0	0
Central	(1)	(0)	(0)	(0)	(1)	(0)	0	(0)	(0)	0
North	0	0	0	(0)	(0)	(0)	(0)	(0)	0	(0)
Mohawk Valley	(0)	(0)	0	0	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(1)	(0)	(1)	(1)	(1)	(1)	0	(0)	(0)	(1)
Hudson Valley	(2)	(2)	(6)	(7)	1	(0)	(0)	1	(2)	(2)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(16)	(20)	(24)	(13)	(17)	(20)	(19)	(14)	(17)	(25)
Long Island	1	(1)	(2)	(1)	(3)	1	0	(1)	(1)	1
NYCA Total	(20)	(25)	(32)	(24)	(17)	(20)	(20)	(26)	(20)	(19)

PROJECTED NOX EMISSION COSTS ($M) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(0)	(0)	(0)	(0)	0	(0)	(0)	0	0
Genesee	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	0	0
Central	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	0
North	(0)	0	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	0	0	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	0	(0)	(0)	0	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	0	(0)	(0)	(0)	(0)	0	0	(0)	(0)	0
NYCA Total	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

PROJECTED CO2 EMISSIONS (1000 Tons) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1	(0)	(0)	(1)	18	1	0	(18)	(0)	5
Genesee	(0)	0	(0)	(0)	0	(0)	(0)	(0)	0	0
Central	(6)	0	(1)	0	(3)	(0)	2	(1)	(0)	0
North	(0)	0	0	(0)	(0)	(1)	(2)	(1)	(1)	(0)
Mohawk Valley	(0)	(0)	0	0	(0)	0	(0)	(0)	(0)	(0)
Capital	0	(3)	(3)	(1)	(6)	(1)	3	(0)	(2)	(4)
Hudson Valley	(2)	2	(3)	(5)	3	(0)	(3)	(0)	(1)	(4)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(19)	(14)	(13)	(3)	(14)	(19)	(10)	(5)	(7)	(24)
Long Island	(0)	1	1	(0)	(4)	1	(1)	(0)	(1)	0
NYCA Total	(28)	(14)	(20)	(11)	(6)	(18)	(11)	(26)	(13)	(27)

PROJECTED CO2 EMISSION COSTS ($M) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.0	(0.0)	(0.0)	(0.0)	0.1	0.0	0.0	(0.2)	(0.0)	0.1
Genesee	(0.0)	0.0	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	0.0	0.0
Central	(0.0)	0.0	(0.0)	0.0	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)
North	(0.0)	0.0	0.0	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Mohawk Valley	(0.0)	(0.0)	0.0	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Capital	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0	0.0	(0.0)	(0.0)
Hudson Valley	(0.0)	0.0	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	(0.1)	(0.1)	(0.1)	(0.0)	(0.1)	(0.1)	(0.0)	(0.0)	(0.0)	(0.2)
Long Island	(0.0)	0.0	0.0	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)
NYCA Total	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.2)	(0.1)	(0.2)

PROJECTED DEMAND LOSS PAYMENT ($M) | Generic Demand Response Solution (Study 2: Central East - Knickerbocker - New Scotland)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	(0.0)
Genesee	0.0	0.0	0.0	0.0	0.0	(0.0)	0.0	0.0	0.0	(0.0)
Central	(0.0)	(0.0)	(0.0)	(0.0)	0.0	0.0	0.0	0.0	0.0	(0.0)
North	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mohawk Valley	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0
Capital	(0.1)	(0.0)	(0.1)	(0.1)	(0.1)	(0.0)	(0.1)	(0.1)	(0.0)	(0.0)
Hudson Valley	(0.0)	(0.0)	(0.1)	(0.0)	(0.0)	(0.0)	(0.1)	(0.1)	(0.1)	(0.0)
Millwood	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Dunwoodie	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0
NY City	(0.2)	(0.2)	(0.5)	(0.2)	(0.2)	(0.1)	(0.3)	(0.3)	(0.2)	(0.1)
Long Island	(0.1)	(0.1)	(0.2)	(0.1)	(0.1)	(0.0)	(0.1)	(0.1)	(0.1)	0.0
NYCA Total	(0.4)	(0.3)	(0.9)	(0.4)	(0.2)	(0.2)	(0.3)	(0.4)	(0.4)	(0.2)

Generic Energy Efficiency Solution (Study 2: Central East – Knickerbocker – New Scotland)

PROJECTED DEMAND CONGESTION BY ZONE ($M) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

Demand Congestion ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1.7	0.1	2.4	0.6	(0.4)	(0.9)	(0.9)	(0.7)	(1.6)	(0.6)
Genesee	(0.1)	(0.1)	(0.0)	0.3	(0.2)	(0.3)	(0.3)	(0.3)	(0.7)	(0.2)
Central	(0.1)	(0.5)	(0.2)	(0.4)	(0.2)	(0.4)	0.0	(0.7)	(0.4)	(0.2)
North	0.1	0.2	0.3	(0.1)	0.1	0.1	0.2	(0.0)	(0.0)	(0.0)
Mohawk Valley	(0.0)	(0.2)	(0.2)	(0.2)	(0.1)	(0.3)	(0.1)	(0.4)	(0.2)	(0.1)
Capital	(9.5)	(7.9)	(8.6)	(6.9)	(3.9)	(3.6)	(1.4)	(3.1)	(1.9)	(2.5)
Hudson Valley	(7.1)	(6.3)	(7.2)	(6.7)	(4.1)	(2.7)	(1.6)	(3.0)	(1.9)	(2.8)
Millwood	(0.4)	(0.6)	(0.6)	(0.7)	(0.6)	(0.3)	(0.2)	(0.6)	(0.2)	(0.3)
Dunwoodie	(0.9)	(1.2)	(1.3)	(1.6)	(1.2)	(0.6)	(0.3)	(1.2)	(0.4)	(0.6)
NY City	(24.1)	(24.5)	(25.8)	(24.8)	(16.7)	(13.0)	(7.3)	(17.1)	(9.7)	(11.2)
Long Island	2.4	0.8	1.2	0.0	1.1	3.7	5.0	1.3	4.4	3.3
NYCA Total	(38.0)	(40.3)	(40.1)	(40.5)	(26.3)	(18.4)	(6.9)	(25.9)	(12.6)	(15.3)

PROJECTED PRODUCTION COST ($M) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

Production Cost ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(1)	(1)	(1)	(1)	0	(2)	(4)	(4)	(1)
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(5)	(4)	(5)	(5)	(6)	(7)	(11)	(6)	(8)	(9)
North	0	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	0	(0)	0	(0)	(0)	0	(0)
Capital	(26)	(26)	(21)	(23)	(28)	(30)	(29)	(33)	(34)	(37)
Hudson Valley	(7)	(16)	(17)	(22)	(18)	(21)	(19)	(18)	(22)	(22)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(32)	(36)	(32)	(35)	(38)	(35)	(40)	(43)	(42)	(40)
Long Island	(2)	(1)	(3)	(3)	(3)	(2)	(3)	(3)	(2)	(3)
NYCA Total	(72)	(84)	(79)	(88)	(96)	(96)	(104)	(107)	(112)	(112)
NYCA Imports	(12)	(11)	(17)	(19)	(21)	(23)	(29)	(30)	(28)	(34)
NYCA Exports	21	18	25	20	20	25	24	27	30	30
NYCA + Imports - Exports	(104)	(113)	(121)	(127)	(137)	(144)	(157)	(165)	(169)	(175)

PROJECTED NYCA GENERATION (GWh) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	6	(15)	(4)	(15)	(13)	14	(14)	(61)	(44)	(16)
Genesee	(3)	(3)	(4)	(4)	(8)	(5)	(4)	(6)	(4)	(4)
Central	(239)	(171)	(208)	(183)	(204)	(219)	(296)	(157)	(212)	(221)
North	2	(1)	(6)	(3)	(2)	0	0	(4)	(1)	(2)
Mohawk Valley	(1)	0	(2)	(1)	(1)	2	(1)	(3)	0	(3)
Capital	(926)	(826)	(687)	(658)	(751)	(754)	(668)	(709)	(709)	(733)
Hudson Valley	(253)	(503)	(519)	(625)	(463)	(533)	(421)	(378)	(479)	(459)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(1,020)	(1,056)	(918)	(944)	(940)	(807)	(830)	(884)	(806)	(731)
Long Island	(47)	(37)	(66)	(60)	(65)	(40)	(52)	(53)	(45)	(45)
NYCA Total	(2,481)	(2,613)	(2,413)	(2,493)	(2,447)	(2,341)	(2,286)	(2,255)	(2,299)	(2,214)

PROJECTED NET IMPORTS (GWh) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

Net Imports (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	(248)	(295)	(342)	(408)	(349)	(347)	(499)	(434)	(388)	(534)
LINDEN VFT	(94)	(84)	(75)	(64)	(71)	(57)	(60)	(72)	(60)	(63)
NEPTUNE	(32)	(48)	(80)	(56)	(107)	(95)	(82)	(82)	(90)	(72)
HTP	(46)	(23)	(53)	(30)	(21)	(33)	(28)	(40)	(46)	(42)
ISONE - NYISO	(553)	(427)	(537)	(463)	(427)	(545)	(404)	(450)	(478)	(406)
CROSS SOUND CABLE	9	15	36	17	7	18	1	6	(0)	10
NORTHPORT NORWALK	14	21	18	8	5	15	8	12	5	(1)
IESO - NYISO	(61)	(44)	(49)	(2)	(80)	(116)	(139)	(179)	(140)	(178)
HQ - NYISO CHAT	(0)	(0)	(0)	(0)	0	0	0	0	0	0
HQ - NYISO CEDARS	1	(0)	(2)	(0)	0	(0)	0	(0)	(0)	(0)
TOTAL	(1,011)	(887)	(1,082)	(999)	(1,043)	(1,160)	(1,205)	(1,239)	(1,197)	(1,286)

PROJECTED GENERATOR PAYMENTS ($M) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

Generator Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(3)	(3)	(4)	(3)	(3)	(4)	(7)	(6)	(8)	(6)
Genesee	(1)	(1)	(1)	(1)	(1)	(2)	(2)	(1)	(2)	(2)
Central	(5)	(1)	(7)	(8)	(10)	(14)	(19)	(10)	(16)	(15)
North	(2)	(2)	(2)	(2)	(2)	(3)	(3)	(3)	(3)	(3)
Mohawk Valley	(1)	(1)	(1)	(1)	(1)	(1)	(2)	(1)	(2)	(2)
Capital	(34)	(33)	(30)	(30)	(36)	(38)	(38)	(41)	(42)	(43)
Hudson Valley	(8)	(19)	(20)	(25)	(21)	(24)	(23)	(21)	(26)	(25)
Millwood	(7)	(4)	(2)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NY City	(41)	(46)	(46)	(49)	(49)	(47)	(52)	(56)	(55)	(53)
Long Island	(3)	(3)	(5)	(5)	(4)	(3)	(4)	(5)	(5)	(4)
NYCA Total	(104)	(114)	(117)	(124)	(128)	(136)	(150)	(143)	(157)	(151)

PROJECTED LOAD PAYMENTS ($M) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

Load Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(1)	(2)	(0)	(2)	(2)	(3)	(4)	(2)	(4)	(3)
Genesee	(2)	(2)	(2)	(2)	(2)	(3)	(3)	(2)	(3)	(3)
Central	(3)	(3)	(4)	(3)	(3)	(5)	(6)	(5)	(7)	(5)
North	(1)	(1)	(1)	(1)	(1)	(2)	(2)	(1)	(2)	(2)
Mohawk Valley	(2)	(1)	(2)	(2)	(2)	(3)	(3)	(2)	(3)	(2)
Capital	(32)	(34)	(37)	(38)	(39)	(42)	(45)	(47)	(48)	(49)
Hudson Valley	(28)	(30)	(33)	(35)	(37)	(38)	(42)	(43)	(45)	(46)
Millwood	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Dunwoodie	(2)	(2)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
NY City	(76)	(82)	(89)	(93)	(93)	(101)	(107)	(114)	(117)	(117)
Long Island	(3)	(4)	(4)	(5)	(3)	(3)	(4)	(5)	(5)	(4)
NYCA Total	(152)	(164)	(176)	(185)	(186)	(204)	(220)	(226)	(238)	(236)

PROJECTED LBMPS ($/MWh) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

Average LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.09)	(0.14)	(0.05)	(0.12)	(0.15)	(0.23)	(0.27)	(0.18)	(0.26)	(0.23)
Genesee	(0.19)	(0.14)	(0.19)	(0.14)	(0.17)	(0.27)	(0.31)	(0.22)	(0.31)	(0.27)
Central	(0.21)	(0.19)	(0.21)	(0.20)	(0.21)	(0.33)	(0.35)	(0.31)	(0.42)	(0.31)
North	(0.22)	(0.19)	(0.24)	(0.16)	(0.21)	(0.32)	(0.38)	(0.25)	(0.39)	(0.29)
Mohawk Valley	(0.22)	(0.20)	(0.24)	(0.23)	(0.23)	(0.36)	(0.39)	(0.34)	(0.45)	(0.34)
Capital	(0.40)	(0.39)	(0.46)	(0.46)	(0.43)	(0.52)	(0.50)	(0.55)	(0.57)	(0.49)
Hudson Valley	(0.39)	(0.37)	(0.46)	(0.49)	(0.44)	(0.50)	(0.52)	(0.55)	(0.57)	(0.53)
Millwood	(0.36)	(0.36)	(0.43)	(0.45)	(0.40)	(0.47)	(0.47)	(0.50)	(0.52)	(0.47)
Dunwoodie	(0.37)	(0.36)	(0.44)	(0.46)	(0.41)	(0.47)	(0.47)	(0.50)	(0.52)	(0.47)
NY City	(0.43)	(0.43)	(0.49)	(0.50)	(0.44)	(0.54)	(0.53)	(0.58)	(0.59)	(0.52)
Long Island	(0.13)	(0.14)	(0.16)	(0.22)	(0.16)	(0.20)	(0.20)	(0.26)	(0.26)	(0.23)
Average	(0.27)	(0.26)	(0.31)	(0.31)	(0.30)	(0.38)	(0.40)	(0.38)	(0.44)	(0.38)

PROJECTED SO2 EMISSIONS (Tons) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

SO_2 Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(0)	(0)	(0)	21	61	(19)	(121)	(61)	25
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)
North	0	0	(0)	(0)	(0)	0	0	(0)	(0)	(0)
Mohawk Valley	(0)	0	(0)	0	(0)	0	(0)	(0)	0	(0)
Capital	(2)	(2)	(1)	(1)	(1)	(2)	(1)	(1)	(1)	(2)
Hudson Valley	(1)	(1)	(1)	(2)	(1)	(1)	(1)	(1)	(1)	(1)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(3)	(3)	(3)	(3)	(3)	(2)	(2)	(2)	(2)	(2)
Long Island	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	(6)	(7)	(7)	(6)	15	56	(24)	(126)	(66)	19

PROJECTED SO2 EMISSION COSTS ($M) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	0	0	(0)	(0)	(0)	0
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	0	0	(0)	(0)	(0)	0	0	(0)	(0)	(0)
Mohawk Valley	(0)	0	(0)	0	(0)	0	(0)	(0)	0	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	(0)	(0)	(0)	(0)	0	0	(0)	(0)	(0)	0

PROJECTED NOX EMISSIONS (Tons) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(12)	(4)	(10)	(10)	17	(1)	(36)	(26)	0
Genesee	(1)	(1)	(1)	(0)	(1)	(0)	(0)	(1)	(0)	(1)
Central	(13)	(9)	(11)	(10)	(12)	(13)	(18)	(10)	(13)	(15)
North	4	3	2	1	0	4	(3)	7	1	1
Mohawk Valley	(0)	(0)	(0)	0	(0)	0	(0)	(1)	(0)	(1)
Capital	(41)	(38)	(36)	(40)	(49)	(49)	(37)	(43)	(37)	(47)
Hudson Valley	(109)	(73)	(120)	(96)	(96)	(73)	(77)	(61)	(69)	(86)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(196)	(254)	(250)	(270)	(310)	(210)	(247)	(240)	(227)	(205)
Long Island	(15)	(14)	(25)	(18)	(24)	(13)	(13)	(17)	(13)	(13)
NYCA Total	(372)	(399)	(445)	(443)	(501)	(336)	(396)	(401)	(385)	(365)

PROJECTED NOX EMISSION COSTS ($M) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	(0)	0	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)
Mohawk Valley	(0)	0	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

PROJECTED CO2 EMISSIONS (1000 Tons) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(2)	(15)	(9)	(14)	(12)	13	(18)	(62)	(45)	(10)
Genesee	(1)	(1)	(2)	(2)	(4)	(2)	(2)	(3)	(2)	(2)
Central	(98)	(70)	(85)	(74)	(85)	(91)	(123)	(66)	(89)	(93)
North	1	1	(1)	(1)	(1)	0	0	(2)	(0)	(1)
Mohawk Valley	(1)	0	(0)	0	(0)	1	(0)	(1)	0	(1)
Capital	(364)	(329)	(269)	(277)	(297)	(310)	(267)	(295)	(291)	(304)
Hudson Valley	(145)	(233)	(260)	(291)	(224)	(241)	(200)	(173)	(219)	(219)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(505)	(544)	(477)	(489)	(500)	(413)	(436)	(461)	(420)	(376)
Long Island	(28)	(18)	(37)	(33)	(35)	(22)	(28)	(29)	(23)	(23)
NYCA Total	(1,142)	(1,209)	(1,141)	(1,180)	(1,157)	(1,065)	(1,073)	(1,092)	(1,090)	(1,028)

PROJECTED CO2 EMISSION COSTS ($M) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.0)	(0.1)	(0.1)	(0.1)	(0.1)	0.1	(0.2)	(0.6)	(0.5)	(0.1)
Genesee	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Central	(0.5)	(0.4)	(0.5)	(0.5)	(0.6)	(0.7)	(1.0)	(0.6)	(0.8)	(1.0)
North	0.0	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Mohawk Valley	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	(0.0)	0.0	(0.0)
Capital	(1.8)	(1.8)	(1.6)	(1.8)	(2.1)	(2.4)	(2.2)	(2.6)	(2.7)	(3.0)
Hudson Valley	(0.7)	(1.3)	(1.7)	(2.0)	(1.7)	(1.9)	(1.7)	(1.6)	(2.1)	(2.3)
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	(1.9)	(2.9)	(2.8)	(3.1)	(3.4)	(3.0)	(3.4)	(3.8)	(3.8)	(3.6)
Long Island	(0.1)	(0.1)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.3)	(0.2)	(0.2)
NYCA Total	(5.0)	(6.6)	(7.0)	(7.8)	(8.2)	(8.1)	(8.7)	(9.5)	(10.2)	(10.3)

PROJECTED DEMAND LOSS PAYMENT ($M) | Generic Energy Efficiency Solution (Study 2: Central East - Knickerbocker - New Scotland)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.3	0.3	0.5	0.5	0.4	0.5	0.7	0.8	0.7	0.8
Genesee	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Central	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3
North	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Mohawk Valley	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.1)	(0.0)	(0.1)	(0.1)
Capital	(1.5)	(1.7)	(1.8)	(1.9)	(2.0)	(1.6)	(1.9)	(1.9)	(2.0)	(2.0)
Hudson Valley	(1.2)	(1.3)	(1.5)	(1.5)	(1.5)	(1.8)	(1.8)	(1.9)	(2.0)	(2.1)
Millwood	(0.1)	(0.0)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
Dunwoodie	(0.2)	(0.1)	(0.2)	(0.2)	(0.1)	(0.2)	(0.3)	(0.2)	(0.3)	(0.3)
NY City	(3.8)	(3.7)	(4.4)	(4.5)	(4.3)	(5.8)	(6.0)	(6.0)	(6.5)	(7.0)
Long Island	(0.5)	(0.3)	(0.4)	(0.4)	(0.3)	(0.6)	(0.7)	(0.5)	(0.7)	(0.8)
NYCA Total	(6.7)	(6.6)	(7.5)	(7.6)	(7.5)	(9.2)	(9.5)	(9.2)	(10.1)	(10.7)

Study 3: Volney – Scriba

Generic Transmission Solution (Study 3: Volney – Scriba)

PROJECTED DEMAND CONGESTION BY ZONE ($M) | Generic Transmission Solution (Study 3: Volney - Scriba)

Demand Congestion ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.5	0.7	0.3	0.0	0.5	0.5	0.1	0.8	0.4	0.8
Genesee	0.5	0.4	(0.2)	(0.0)	0.3	0.3	0.1	0.4	0.2	0.4
Central	(2.5)	(3.3)	(2.8)	(3.0)	(3.3)	(3.4)	(3.4)	(4.4)	(5.2)	(5.2)
North	0.1	(0.0)	0.0	0.1	0.1	0.2	(0.1)	0.1	0.2	0.1
Mohawk Valley	(0.5)	(0.7)	(0.5)	(0.6)	(0.6)	(0.7)	(0.7)	(0.9)	(1.0)	(1.0)
Capital	0.6	(0.8)	1.0	1.5	(0.0)	0.1	0.1	(0.4)	(0.0)	0.4
Hudson Valley	0.3	(0.1)	0.7	1.1	0.4	0.0	0.0	(0.5)	(0.1)	(0.0)
Millwood	0.1	(0.0)	0.2	0.3	0.1	(0.0)	0.0	(0.2)	(0.0)	0.0
Dunwoodie	0.2	(0.1)	0.4	0.6	0.3	(0.0)	(0.0)	(0.3)	(0.1)	(0.0)
NY City	2.4	0.9	3.8	6.5	2.5	0.3	1.0	(1.3)	(0.3)	0.7
Long Island	1.4	0.1	1.8	3.1	1.1	0.7	0.8	(1.3)	0.6	0.0
NYCA Total	3.1	(2.9)	4.7	9.6	1.3	(2.0)	(2.0)	(8.0)	(5.5)	(3.8)

PROJECTED PRODUCTION COST ($M) | Generic Transmission Solution (Study 3: Volney - Scriba)

Production Cost ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(1)	(1)	(1)	0	0	(0)	(2)	0	1
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)
Central	3	6	5	6	5	4	5	7	6	6
North	(0)	(0)	(0)	0	0	0	(0)	(0)	(0)	0
Mohawk Valley	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)
Capital	(2)	(0)	(1)	(1)	(2)	1	(1)	(1)	(1)	(0)
Hudson Valley	(1)	(2)	(2)	(1)	(2)	(2)	0	1	(1)	(1)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(1)	(3)	(1)	(2)	(1)	(1)	(1)	(2)	(2)	(2)
Long Island	0	(0)	(0)	0	(0)	(0)	(0)	(0)	0	1
NYCA Total	(1)	1	1	1	0	2	2	2	2	5
NYCA Imports	(1)	(1)	(1)	(2)	(1)	(1)	(4)	(3)	(3)	(4)
NYCA Exports	1	3	2	2	2	3	2	2	3	3
NYCA + Imports - Exports	(2)	(3)	(3)	(3)	(3)	(2)	(4)	(3)	(3)	(3)

PROJECTED NYCA GENERATION (GWh) | Generic Transmission Solution (Study 3: Volney - Scriba)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(2)	(22)	(19)	(29)	1	0	24	(34)	7	27
Genesee	(1)	(2)	(2)	(6)	(6)	(2)	(1)	(0)	(0)	(1)
Central	173	304	244	244	217	161	169	219	204	200
North	(2)	0	(4)	3	2	1	(1)	(5)	(1)	3
Mohawk Valley	(3)	(0)	(1)	(1)	(1)	(2)	1	(3)	(2)	(3)
Capital	(54)	(28)	(22)	(48)	(51)	4	(20)	(23)	(34)	(22)
Hudson Valley	(30)	(61)	(58)	(25)	(48)	(36)	2	13	(25)	(20)
Millwood	0	0	0	0	0	0	0	0	0	(0)
Dunwoodie	0	0	0	0	0	0	0	0	0	(0)
NY City	(28)	(80)	(32)	(45)	(33)	(20)	(20)	(48)	(48)	(44)
Long Island	(0)	(3)	(4)	4	(11)	(7)	(6)	(9)	2	12
NYCA Total	52	108	103	97	72	98	147	110	104	152

PROJECTED NET IMPORTS (GWh) | Generic Transmission Solution (Study 3: Volney - Scriba)

Net Imports (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	(19)	(59)	(31)	(64)	(20)	(58)	(90)	(80)	(77)	(87)
LINDEN VFT	3	9	1	4	0	9	(9)	0	4	14
NEPTUNE	(4)	(4)	6	5	2	21	6	10	4	6
HTP	3	(2)	8	1	3	6	(10)	(9)	(4)	(8)
ISONE - NYISO	(12)	(46)	(54)	(18)	(24)	(38)	(17)	(11)	17	(16)
CROSS SOUND CABLE	(5)	2	(2)	(4)	(2)	(2)	(1)	(2)	6	4
NORTHPORT NORWALK	2	3	0	(5)	(0)	(6)	(2)	(1)	(2)	(11)
IESO - NYISO	(19)	(8)	(31)	(15)	(26)	(25)	(24)	(13)	(49)	(49)
HQ - NYISO CHAT	(0)	0	0	(0)	0	(0)	(0)	0	0	0
HQ - NYISO CEDARS	(0)	0	(0)	(0)	0	0	(0)	0	0	(0)
TOTAL	(50)	(105)	(102)	(96)	(68)	(93)	(147)	(106)	(102)	(148)

PROJECTED GENERATOR PAYMENTS ($M) | Generic Transmission Solution (Study 3: Volney - Scriba)

Generator Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(3)	(2)	(3)	(3)	(1)	(1)	(0)	(1)	(0)	0
Genesee	(0)	(0)	(1)	(1)	(1)	(0)	(0)	0	(0)	(0)
Central	40	55	49	53	57	58	57	77	90	91
North	(1)	(0)	(1)	(1)	(1)	(1)	(0)	(0)	(1)	(0)
Mohawk Valley	(1)	(0)	(1)	(1)	(1)	(1)	(1)	(0)	(1)	(1)
Capital	(2)	(2)	(1)	(2)	(3)	(0)	(2)	(1)	(2)	0
Hudson Valley	(1)	(3)	(3)	(1)	(2)	(2)	(0)	0	(2)	(1)
Millwood	(0)	(0)	0	(0)	(0)	(0)	(0)	0	(0)	(0)
Dunwoodie	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)
NY City	(1)	(3)	(3)	(2)	(1)	(2)	(2)	(1)	(3)	(2)
Long Island	0	(0)	(1)	0	(0)	(0)	(0)	(0)	0	0
NYCA Total	32	44	37	42	47	51	51	74	81	87

PROJECTED LOAD PAYMENTS ($M) | Generic Transmission Solution (Study 3: Volney - Scriba)

Load Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	0	(1)	(2)	(1)	(1)	(1)	(0)	(1)	(1)
Genesee	(1)	(1)	(1)	(1)	(1)	(1)	(1)	0	(1)	(1)
Central	(3)	(4)	(4)	(5)	(4)	(4)	(4)	(4)	(6)	(5)
North	(0)	(0)	(0)	(1)	(0)	(0)	(0)	0	(0)	(0)
Mohawk Valley	(1)	(1)	(1)	(2)	(1)	(1)	(1)	(1)	(1)	(1)
Capital	(0)	(1)	(0)	(0)	(1)	(0)	(1)	0	(0)	0
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(1)	0	(0)	(0)
Millwood	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)
Dunwoodie	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)
NY City	(0)	(1)	(2)	(1)	(0)	(2)	(3)	2	(1)	1
Long Island	0	(1)	(1)	0	0	(0)	(1)	(0)	(0)	(0)
NYCA Total	(7)	(8)	(12)	(12)	(9)	(11)	(13)	(1)	(11)	(8)

PROJECTED LBMPS ($/MWh) | Generic Transmission Solution (Study 3: Volney - Scriba)

Average LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.02)	0.03	(0.05)	(0.10)	(0.09)	(0.06)	(0.07)	0.00	(0.04)	(0.06)
Genesee	(0.09)	(0.05)	(0.09)	(0.11)	(0.08)	(0.06)	(0.08)	0.01	(0.04)	(0.06)
Central	(0.19)	(0.19)	(0.24)	(0.29)	(0.25)	(0.23)	(0.26)	(0.20)	(0.32)	(0.31)
North	(0.07)	(0.01)	(0.08)	(0.13)	(0.08)	(0.07)	(0.05)	0.03	(0.07)	(0.04)
Mohawk Valley	(0.12)	(0.10)	(0.15)	(0.20)	(0.15)	(0.12)	(0.16)	(0.06)	(0.16)	(0.14)
Capital	0.00	(0.07)	(0.00)	(0.02)	(0.05)	(0.03)	(0.05)	0.03	(0.03)	0.02
Hudson Valley	(0.01)	(0.03)	(0.01)	(0.02)	(0.02)	(0.03)	(0.06)	0.02	(0.02)	(0.00)
Millwood	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.06)	0.02	(0.02)	0.00
Dunwoodie	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.06)	0.02	(0.03)	0.00
NY City	(0.00)	(0.00)	(0.02)	(0.02)	(0.01)	(0.03)	(0.05)	0.04	(0.02)	0.01
Long Island	0.01	(0.02)	0.00	0.00	(0.01)	(0.00)	(0.03)	0.01	0.00	(0.00)
Average	(0.05)	(0.04)	(0.06)	(0.09)	(0.07)	(0.06)	(0.08)	(0.01)	(0.07)	(0.05)

PROJECTED SO2 EMISSION COSTS ($M) | Generic Transmission Solution (Study 3: Volney - Scriba)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	0	0	0	(0)	0	0
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	0	0	0	0	0	0	0	0	0	0
North	(0)	(0)	(0)	0	0	0	(0)	(0)	(0)	0
Mohawk Valley	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	0	0
NYCA Total	(0)	(0)	0	0	0	0	0	(0)	0	0

PROJECTED NOX EMISSIONS (Tons) | Generic Transmission Solution (Study 3: Volney - Scriba)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(1)	(11)	(8)	(9)	(1)	14	19	(17)	3	18
Genesee	(1)	(0)	(0)	(1)	(1)	(0)	(0)	(0)	(0)	(0)
Central	(0)	3	2	5	4	(1)	(2)	(0)	(1)	(2)
North	(1)	(1)	1	1	0	2	(1)	(1)	(0)	0
Mohawk Valley	(1)	(0)	(1)	(1)	(0)	(1)	0	(1)	(1)	(1)
Capital	(8)	(6)	(4)	(6)	(6)	(5)	(4)	(3)	(3)	(6)
Hudson Valley	(21)	(33)	(33)	(24)	(23)	(15)	(23)	4	(5)	(10)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(7)	(22)	(12)	(9)	(19)	(9)	(17)	(21)	(24)	(12)
Long Island	(0)	(3)	0	4	(4)	(1)	(1)	(5)	1	3
NYCA Total	(40)	(75)	(55)	(39)	(49)	(16)	(29)	(44)	(30)	(10)

PROJECTED NOX EMISSION COSTS ($M) | Generic Transmission Solution (Study 3: Volney - Scriba)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	(0)	0	0	0	0	(0)	(0)	(0)	(0)	(0)
North	(0)	(0)	(0)	(0)	0	(0)	0	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	0	0
NYCA Total	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

PROJECTED CO2 EMISSIONS (1000 Tons) | Generic Transmission Solution (Study 3: Volney - Scriba)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(2)	(10)	(8)	(10)	12	7	27	(31)	8	35
Genesee	(0)	(1)	(1)	(3)	(3)	(1)	(0)	(0)	(0)	(0)
Central	56	106	86	87	77	55	59	79	71	68
North	(1)	(0)	(1)	1	1	1	(1)	(2)	(1)	2
Mohawk Valley	(1)	(1)	(1)	(1)	(1)	(1)	0	(2)	(1)	(1)
Capital	(27)	(16)	(13)	(23)	(24)	(1)	(9)	(14)	(15)	(13)
Hudson Valley	(21)	(39)	(39)	(21)	(29)	(22)	(9)	7	(13)	(12)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(15)	(44)	(16)	(22)	(19)	(11)	(14)	(28)	(29)	(23)
Long Island	0	(1)	(2)	4	(6)	(4)	(3)	(6)	1	8
NYCA Total	(11)	(7)	5	11	9	23	48	2	21	63

PROJECTED CO2 EMISSION COSTS ($M) | Generic Transmission Solution (Study 3: Volney - Scriba)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.0)	(0.1)	(0.1)	(0.1)	0.1	0.0	0.2	(0.3)	0.1	0.3
Genesee	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0	(0.0)	(0.0)
Central	0.3	0.6	0.5	0.6	0.5	0.4	0.5	0.7	0.6	0.7
North	(0.0)	(0.0)	(0.0)	0.0	0.0	0.0	(0.0)	(0.0)	(0.0)	0.0
Mohawk Valley	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)
Capital	(0.1)	(0.1)	(0.1)	(0.2)	(0.2)	0.0	(0.1)	(0.1)	(0.1)	(0.1)
Hudson Valley	(0.1)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)	(0.1)	0.1	(0.1)	(0.1)
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	(0.0)	(0.2)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.2)	(0.3)	(0.2)
Long Island	0.0	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.1)	0.0	0.1
NYCA Total	(0.0)	(0.1)	0.0	0.1	0.0	0.2	0.3	0.0	0.2	0.6

PROJECTED DEMAND LOSS PAYMENT ($M) | Generic Transmission Solution (Study 3: Volney - Scriba)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.2	0.1	0.3	0.4	0.2	0.1	0.1	0.1	0.2	0.1
Genesee	0.0	(0.0)	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Central	(0.0)	(0.1)	(0.1)	(0.0)	(0.1)	(0.0)	(0.0)	(0.1)	(0.0)	(0.0)
North	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Mohawk Valley	0.0	0.0	(0.0)	(0.0)	0.0	0.0	(0.0)	0.0	0.0	0.0
Capital	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2
Hudson Valley	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.2
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Dunwoodie	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
NY City	0.5	1.0	0.4	0.4	0.9	0.6	0.7	1.3	1.1	1.3
Long Island	0.2	0.4	0.2	0.1	0.4	0.3	0.3	0.5	0.4	0.4
NYCA Total	1.2	1.9	1.2	1.3	1.9	1.4	1.5	2.4	2.2	2.4

Generic Generation Solution (Study 3: Volney – Scriba)

PROJECTED DEMAND CONGESTION BY ZONE ($M) | Generic Generation Solution (Study 3: Volney - Scriba)

Demand Congestion ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1.9	3.5	2.3	0.4	(0.5)	(1.3)	(0.5)	(2.5)	(1.4)	(0.8)
Genesee	0.6	(0.3)	0.0	0.1	(0.2)	(0.7)	(0.2)	(1.2)	(0.7)	(0.3)
Central	(2.0)	(1.6)	(2.1)	(2.7)	(2.8)	(2.3)	(2.6)	(3.3)	(4.2)	(4.1)
North	(0.1)	(0.3)	(0.3)	(0.1)	0.1	(0.0)	(0.2)	(0.1)	0.1	0.0
Mohawk Valley	(0.4)	(0.2)	(0.4)	(0.5)	(0.6)	(0.2)	(0.4)	(0.4)	(0.6)	(0.6)
Capital	0.6	6.2	2.9	2.3	2.2	5.3	3.3	5.7	5.6	5.5
Hudson Valley	0.8	4.3	2.9	2.9	2.6	3.6	2.2	3.5	4.4	3.7
Millwood	0.2	1.2	0.8	0.8	0.8	1.0	0.6	1.0	1.1	1.0
Dunwoodie	0.5	2.7	1.8	1.8	1.7	2.1	1.2	2.1	2.1	1.8
NY City	3.0	24.1	20.4	17.7	17.8	22.0	12.6	25.8	23.0	21.6
Long Island	3.2	10.7	6.6	8.1	2.9	12.1	7.5	10.7	9.5	10.2
NYCA Total	8.3	50.2	34.9	30.7	24.0	41.7	23.7	41.4	38.8	37.9

PROJECTED PRODUCTION COST ($M) | Generic Generation Solution (Study 3: Volney - Scriba)

Production Cost ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(1)	(2)	(2)	(3)	(5)	(2)	(5)	(7)	(9)	(8)
Genesee	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(1)
Central	8	20	19	29	38	44	50	54	61	63
North	(0)	(0)	(0)	(0)	(0)	(1)	(1)	(0)	(1)	(0)
Mohawk Valley	(0)	(0)	(0)	(0)	(0)	(1)	(1)	(0)	(0)	(0)
Capital	(1)	(4)	2	(1)	(5)	(7)	(11)	(6)	(10)	(16)
Hudson Valley	(1)	(5)	(6)	(9)	(7)	(10)	(18)	3	(9)	(17)
Millwood	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(12)	(13)	(15)	(7)	(4)	5	(21)	(22)	(13)
Long Island	(0)	4	1	0	(1)	(2)	(0)	(1)	(5)	(4)
NYCA Total	4	0	(0)	1	13	18	19	20	5	5
NYCA Imports	(2)	(6)	(9)	(12)	(18)	(21)	(24)	(23)	(18)	(26)
NYCA Exports	3	3	5	7	15	14	13	21	20	19
NYCA + Imports - Exports	(1)	(9)	(14)	(18)	(20)	(17)	(19)	(24)	(33)	(41)

PROJECTED NYCA GENERATION (GWh) | Generic Generation Solution (Study 3: Volney - Scriba)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(16)	(33)	(48)	(74)	(102)	(14)	(93)	(166)	(157)	(134)
Genesee	(4)	(10)	(10)	(9)	(16)	(11)	(6)	(9)	(7)	(14)
Central	433	941	846	1,205	1,543	1,612	1,708	1,724	1,894	1,952
North	(5)	(6)	(15)	(5)	(7)	(18)	(11)	(4)	(14)	(5)
Mohawk Valley	(6)	(2)	(5)	(4)	(2)	(12)	(8)	(6)	(4)	(7)
Capital	(41)	(212)	(66)	(188)	(172)	(223)	(227)	(226)	(303)	(346)
Hudson Valley	(28)	(159)	(175)	(205)	(169)	(250)	(362)	42	(176)	(354)
Millwood	0	(0)	(0)	(0)	0	(0)	(0)	0	(0)	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(91)	(206)	(165)	(173)	(207)	(186)	(61)	(383)	(336)	12
Long Island	(13)	42	27	2	(19)	(19)	(5)	(16)	(61)	(63)
NYCA Total	228	355	389	549	850	881	935	956	836	1,041

PROJECTED NET IMPORTS (GWh) | Generic Generation Solution (Study 3: Volney - Scriba)

Net Imports (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	(71)	(124)	(148)	(234)	(329)	(418)	(442)	(405)	(316)	(556)
LINDEN VFT	(7)	39	20	16	(12)	9	(21)	0	(28)	(3)
NEPTUNE	15	(0)	(24)	12	(8)	(30)	(67)	(22)	(23)	(17)
HTP	9	9	34	(3)	(8)	19	(15)	(14)	3	16
ISONE - NYISO	(94)	(84)	(157)	(161)	(266)	(266)	(150)	(219)	(196)	(196)
CROSS SOUND CABLE	5	(8)	(19)	(2)	(39)	11	(12)	(22)	(5)	9
NORTHPORT NORWALK	6	7	6	(8)	(5)	(4)	(2)	(3)	2	(4)
IESO - NYISO	(85)	(184)	(101)	(164)	(183)	(197)	(222)	(268)	(272)	(284)
HQ - NYISO CHAT	(0)	(0)	0	(0)	0	(0)	(0)	0	0	0
HQ - NYISO CEDARS	(1)	0	(0)	0	0	(0)	0	0	0	0
TOTAL	(223)	(346)	(388)	(545)	(850)	(876)	(930)	(952)	(834)	(1,036)

PROJECTED GENERATOR PAYMENTS ($M) | Generic Generation Solution (Study 3: Volney - Scriba)

Generator Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(4)	(7)	(9)	(9)	(12)	(10)	(12)	(18)	(19)	(16)
Genesee	(1)	(2)	(3)	(2)	(3)	(4)	(3)	(4)	(4)	(4)
Central	34	52	46	67	82	85	102	114	138	144
North	(1)	(3)	(3)	(3)	(5)	(6)	(4)	(6)	(7)	(6)
Mohawk Valley	(1)	(2)	(2)	(2)	(2)	(3)	(3)	(4)	(4)	(4)
Capital	(4)	(4)	(3)	(5)	(11)	(11)	(15)	(13)	(16)	(19)
Hudson Valley	(2)	(6)	(9)	(10)	(9)	(12)	(20)	1	(10)	(19)
Millwood	(1)	1	(0)	0	(1)	(0)	0	0	1	(0)
Dunwoodie	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NY City	(4)	(9)	(12)	(10)	(8)	(11)	(5)	(26)	(22)	5
Long Island	(1)	3	(2)	0	(1)	(1)	(1)	(1)	(6)	(4)
NYCA Total	14	23	3	26	30	26	39	44	51	78

PROJECTED LOAD PAYMENTS ($M) | Generic Generation Solution (Study 3: Volney - Scriba)

Load Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(2)	(4)	(5)	(6)	(8)	(6)	(7)	(8)	(7)
Genesee	(2)	(4)	(5)	(4)	(5)	(6)	(5)	(6)	(6)	(6)
Central	(4)	(9)	(10)	(9)	(11)	(13)	(11)	(16)	(16)	(14)
North	(0)	(2)	(2)	(2)	(3)	(3)	(2)	(4)	(4)	(3)
Mohawk Valley	(1)	(3)	(4)	(3)	(4)	(5)	(4)	(6)	(6)	(5)
Capital	(1)	1	(3)	(2)	(4)	(3)	(3)	(4)	(3)	(2)
Hudson Valley	(1)	(0)	(2)	(1)	(2)	(3)	(2)	(4)	(2)	(2)
Millwood	(0)	0	(1)	(0)	(1)	(1)	(1)	(1)	(1)	(1)
Dunwoodie	(0)	0	(1)	(0)	(1)	(2)	(1)	(2)	(2)	(1)
NY City	(5)	1	(7)	(2)	(7)	(10)	(11)	(12)	(12)	(8)
Long Island	(0)	1	(5)	(0)	(7)	(1)	(2)	(4)	(4)	(1)
NYCA Total	(16)	(17)	(41)	(28)	(50)	(54)	(47)	(65)	(64)	(49)

PROJECTED LBMPS ($/MWh) | Generic Generation Solution (Study 3: Volney - Scriba)

Average LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.02)	(0.14)	(0.22)	(0.26)	(0.37)	(0.48)	(0.35)	(0.45)	(0.50)	(0.42)
Genesee	(0.18)	(0.34)	(0.38)	(0.31)	(0.44)	(0.57)	(0.43)	(0.57)	(0.61)	(0.52)
Central	(0.24)	(0.47)	(0.51)	(0.48)	(0.65)	(0.79)	(0.64)	(0.93)	(0.97)	(0.83)
North	(0.10)	(0.30)	(0.31)	(0.30)	(0.47)	(0.61)	(0.42)	(0.68)	(0.68)	(0.55)
Mohawk Valley	(0.18)	(0.41)	(0.45)	(0.40)	(0.56)	(0.68)	(0.53)	(0.81)	(0.80)	(0.66)
Capital	(0.07)	0.10	(0.18)	(0.13)	(0.27)	(0.21)	(0.19)	(0.28)	(0.26)	(0.11)
Hudson Valley	(0.05)	0.02	(0.14)	(0.06)	(0.21)	(0.26)	(0.20)	(0.34)	(0.25)	(0.17)
Millwood	(0.05)	0.03	(0.15)	(0.07)	(0.20)	(0.26)	(0.21)	(0.33)	(0.28)	(0.19)
Dunwoodie	(0.04)	0.04	(0.13)	(0.05)	(0.19)	(0.27)	(0.21)	(0.33)	(0.29)	(0.19)
NY City	(0.07)	0.03	(0.08)	(0.03)	(0.15)	(0.22)	(0.19)	(0.23)	(0.23)	(0.14)
Long Island	0.01	0.07	(0.17)	0.01	(0.38)	(0.06)	(0.09)	(0.21)	(0.21)	(0.04)
Average	(0.09)	(0.12)	(0.25)	(0.19)	(0.35)	(0.40)	(0.32)	(0.47)	(0.46)	(0.35)

PROJECTED SO2 EMISSIONS (Tons) | Generic Generation Solution (Study 3: Volney - Scriba)

SO_2 Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	1	(0)	(79)	46	(122)	(357)	(291)	(227)
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	26	45	43	58	90	85	99	92	98	108
North	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(1)	(1)
Hudson Valley	(0)	(0)	(1)	(0)	0	(1)	(1)	0	(0)	(1)
Millwood	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(1)	(1)	(1)	(1)	(0)	(0)	(1)	(1)	(0)
Long Island	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	25	43	42	56	10	129	(24)	(267)	(195)	(121)

PROJECTED SO2 EMISSION COSTS ($M) | Generic Generation Solution (Study 3: Volney - Scriba)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	0	0	0	0	0	0	0	0	0	0
North	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	0	(0)	(0)	0	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0
Long Island	(0)	0	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	0	0	0	0	0	0	(0)	(0)	(0)	(0)

PROJECTED NOX EMISSIONS (Tons) | Generic Generation Solution (Study 3: Volney - Scriba)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(7)	(22)	(28)	(32)	(60)	(2)	(43)	(64)	(50)	(65)
Genesee	(2)	(2)	(1)	(1)	(2)	(1)	(1)	(1)	(1)	(2)
Central	73	134	126	180	270	259	299	281	302	329
North	(1)	(5)	(2)	0	(1)	(6)	(5)	(2)	0	(1)
Mohawk Valley	(0)	(1)	(0)	(1)	(1)	(3)	(1)	(2)	(2)	(2)
Capital	20	(17)	(12)	(22)	17	(20)	(26)	(37)	(28)	(37)
Hudson Valley	(1)	(64)	(80)	(67)	(77)	(60)	(60)	(12)	(61)	(59)
Millwood	0	(0)	(1)	(1)	0	(2)	(1)	0	(2)	1
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(15)	(66)	(47)	(24)	(115)	(57)	25	(88)	(71)	(19)
Long Island	(1)	33	2	5	(15)	(11)	6	(8)	(18)	(12)
NYCA Total	67	(9)	(43)	37	17	97	193	68	70	133

PROJECTED NOX EMISSION COSTS ($M) | Generic Generation Solution (Study 3: Volney - Scriba)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Central	0	0	0	0	0	0	0	0	0	0
North	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	0	0	(0)	(0)	0	(0)	(0)	(0)
Long Island	(0)	(0)	0	0	(0)	(0)	0	0	(0)	(0)
NYCA Total	(0)	(0)	0	(0)	(0)	0	0	0	(0)	(0)

PROJECTED CO2 EMISSIONS (1000 Tons) | Generic Generation Solution (Study 3: Volney - Scriba)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(7)	(25)	(30)	(39)	(80)	(11)	(83)	(161)	(150)	(125)
Genesee	(2)	(5)	(5)	(5)	(8)	(5)	(3)	(5)	(3)	(7)
Central	160	367	331	473	606	638	677	683	750	773
North	(5)	(3)	(5)	(3)	(3)	(8)	(5)	(2)	(6)	(3)
Mohawk Valley	(3)	(1)	(2)	(1)	(1)	(6)	(4)	(3)	(2)	(4)
Capital	(24)	(88)	(36)	(85)	(77)	(97)	(107)	(99)	(132)	(156)
Hudson Valley	(14)	(93)	(109)	(116)	(101)	(124)	(171)	12	(98)	(166)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(39)	(118)	(104)	(103)	(113)	(97)	(2)	(215)	(183)	(4)
Long Island	(8)	37	15	2	(13)	(11)	(3)	(9)	(34)	(33)
NYCA Total	58	74	56	124	211	278	300	201	141	276

PROJECTED CO2 EMISSION COSTS ($M) | Generic Generation Solution (Study 3: Volney - Scriba)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.0)	(0.2)	(0.2)	(0.3)	(0.6)	(0.1)	(0.7)	(1.4)	(1.4)	(1.3)
Genesee	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)
Central	0.8	2.1	2.1	3.3	4.5	5.0	5.6	6.1	7.1	7.8
North	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.0)	(0.0)	(0.1)	(0.0)
Mohawk Valley	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.0)	(0.0)	(0.0)	(0.0)
Capital	(0.1)	(0.5)	(0.2)	(0.6)	(0.5)	(0.7)	(0.9)	(0.9)	(1.2)	(1.6)
Hudson Valley	(0.1)	(0.5)	(0.7)	(0.8)	(0.8)	(1.0)	(1.5)	0.1	(1.0)	(1.8)
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	(0.1)	(0.7)	(0.6)	(0.7)	(0.8)	(0.7)	0.1	(1.9)	(1.7)	0.0
Long Island	(0.1)	0.2	0.1	(0.0)	(0.0)	(0.1)	(0.1)	(0.1)	(0.3)	(0.3)
NYCA Total	0.4	0.4	0.4	0.9	1.6	2.2	2.5	1.9	1.3	2.8

PROJECTED DEMAND LOSS PAYMENT ($M) | Generic Generation Solution (Study 3: Volney - Scriba)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.3	0.9	0.9	0.8	1.4	1.6	1.7	2.3	2.2	2.0
Genesee	0.0	0.1	0.2	0.1	0.3	0.3	0.4	0.7	0.6	0.4
Central	(0.1)	(0.1)	(0.2)	(0.2)	(0.1)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)
North	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.3
Mohawk Valley	(0.0)	(0.0)	(0.0)	0.0	0.0	(0.0)	0.0	(0.0)	(0.0)	0.0
Capital	0.1	0.2	0.1	0.5	0.6	0.4	0.6	0.5	0.6	0.9
Hudson Valley	0.2	0.3	0.2	0.5	0.7	0.6	0.8	0.6	0.9	0.9
Millwood	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3
Dunwoodie	0.1	0.2	0.1	0.3	0.4	0.4	0.5	0.5	0.6	0.6
NY City	1.0	1.3	0.9	2.7	3.8	3.4	4.2	4.3	5.5	5.3
Long Island	0.5	0.5	0.4	1.1	1.4	1.3	1.7	1.5	2.0	2.1
NYCA Total	2.3	3.4	3.0	6.2	8.8	8.2	10.1	10.8	12.7	12.6

Generic Demand Response Solution (Study 3: Volney – Scriba)

PROJECTED DEMAND CONGESTION BY ZONE ($M) | Generic Demand Response Solution (Study 3: Volney - Scriba)

Demand Congestion ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.6	0.4	(0.6)	(0.0)	0.0	0.2	(0.1)	0.0	(0.0)	(0.2)
Genesee	(0.0)	(0.0)	0.1	(0.0)	0.0	0.1	(0.0)	(0.0)	(0.0)	(0.1)
Central	0.1	(0.0)	(0.1)	(0.0)	0.1	(0.1)	0.0	(0.0)	(0.0)	0.0
North	0.0	(0.0)	(0.0)	(0.0)	0.0	0.0	(0.1)	0.0	(0.0)	(0.0)
Mohawk Valley	0.1	(0.0)	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)	0.0
Capital	(0.1)	0.0	0.1	0.0	0.2	(0.4)	0.3	0.0	0.1	0.2
Hudson Valley	(0.2)	(0.2)	(0.2)	(0.2)	(0.0)	(0.2)	(0.1)	(0.2)	(0.1)	(0.3)
Millwood	(0.0)	(0.0)	(0.0)	(0.0)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)
Dunwoodie	(0.1)	(0.0)	(0.0)	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.0)
NY City	(0.4)	(0.1)	(0.4)	(0.2)	0.3	(0.8)	0.5	(0.5)	0.2	0.1
Long Island	0.1	0.2	(0.3)	0.1	0.3	(0.3)	0.4	(0.2)	0.2	0.3
NYCA Total	0.1	0.3	(1.7)	(0.4)	0.9	(1.7)	1.1	(1.1)	0.4	(0.0)

PROJECTED PRODUCTION COST ($M) | Generic Demand Response Solution (Study 3: Volney - Scriba)

Production Cost ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	0	0	0	1	(0)	0	(1)	0	(1)
Genesee	(0)	0	(0)	0	0	0	0	(0)	0	(0)
Central	(0)	0	(0)	0	(0)	(0)	0	(0)	0	(0)
North	(0)	(0)	0	(0)	0	0	(0)	0	(0)	0
Mohawk Valley	(0)	0	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)
Capital	0	(0)	(0)	0	(0)	1	(0)	0	(0)	(0)
Hudson Valley	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	0
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	(0)	0	0	(0)	0	(0)	(0)	(0)	(0)
NYCA Total	(0)	(0)	(1)	(0)	(0)	(0)	(1)	(2)	(1)	(1)
NYCA Imports	(0)	(0)	(0)	(0)	(0)	(0)	(1)	(0)	(0)	(0)
NYCA Exports	0	0	(0)	0	1	0	(0)	(0)	0	0
NYCA + Imports - Exports	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(2)	(1)	(2)

PROJECTED NYCA GENERATION (GWh) | Generic Demand Response Solution (Study 3: Volney - Scriba)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(1)	1	0	(0)	18	(6)	0	(16)	(1)	(13)
Genesee	(0)	(0)	(0)	0	0	(0)	0	(0)	0	(0)
Central	(6)	0	(1)	(0)	(5)	(1)	5	(0)	1	(1)
North	(0)	(0)	1	(1)	1	0	(2)	1	(1)	0
Mohawk Valley	(0)	0	(0)	(0)	(1)	0	(1)	(0)	(0)	(0)
Capital	7	(2)	(2)	1	(9)	11	(2)	(1)	(3)	(1)
Hudson Valley	1	(3)	(4)	(6)	(0)	(4)	(2)	(3)	2	5
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(12)	(7)	(14)	(1)	(2)	(8)	(1)	(2)	(3)	(6)
Long Island	(1)	(0)	3	0	(1)	1	(4)	0	(2)	(1)
NYCA Total	(12)	(11)	(16)	(7)	1	(6)	(5)	(22)	(7)	(17)

PROJECTED NET IMPORTS (GWh) | Generic Demand Response Solution (Study 3: Volney - Scriba)

Net Imports (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	(4)	(3)	7	(6)	(9)	(6)	(2)	(3)	(7)	(1)
LINDEN VFT	(2)	0	2	(1)	(1)	0	(2)	1	(2)	1
NEPTUNE	1	1	0	(2)	(3)	(0)	0	(4)	(2)	2
HTP	(0)	0	0	(0)	3	0	(5)	0	0	1
ISONE - NYISO	2	(4)	(5)	(1)	(2)	(8)	1	6	(4)	(8)
CROSS SOUND CABLE	(1)	(0)	(2)	0	0	0	(1)	1	0	0
NORTHPORT NORWALK	(0)	1	(2)	(1)	(1)	(1)	(1)	1	0	(1)
IESO - NYISO	(4)	(3)	(5)	(2)	(7)	0	(6)	(1)	2	4
HQ - NYISO CHAT	(0)	0	0	0	0	0	(0)	0	0	0
HQ - NYISO CEDARS	0	0	0	0	0	0	0	0	0	(0)
TOTAL	(7)	(9)	(4)	(13)	(21)	(14)	(15)	2	(13)	(3)

PROJECTED GENERATOR PAYMENTS ($M) | Generic Demand Response Solution (Study 3: Volney - Scriba)

Generator Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	1	(0)	(0)	(1)	(0)	(1)
Genesee	(0)	(0)	(0)	(0)	(0)	0	(0)	0	(0)	(0)
Central	(0)	0	(0)	(1)	(1)	1	(1)	0	(0)	(0)
North	(0)	(0)	(0)	(0)	(0)	0	(0)	0	(0)	(0)
Mohawk Valley	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(1)	(1)	(0)	0	(0)	0	(0)	0
Hudson Valley	(0)	(0)	(1)	(1)	0	(0)	(0)	(0)	(0)	0
Millwood	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
NY City	(1)	(1)	(3)	(2)	0	(1)	(1)	(0)	(1)	(1)
Long Island	(0)	(0)	(1)	(0)	0	0	(0)	(0)	(0)	(0)
NYCA Total	(2)	(3)	(8)	(5)	1	0	(4)	(1)	(2)	(2)

PROJECTED LOAD PAYMENTS ($M) | Generic Demand Response Solution (Study 3: Volney - Scriba)

Load Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	1	0	(1)	(0)	(0)	(0)	(0)	0	(0)	0
Genesee	(0)	(0)	(0)	(0)	0	0	(0)	0	(0)	0
Central	0	(0)	(1)	(0)	0	0	(0)	0	(0)	(0)
North	(0)	(0)	(0)	(0)	(0)	0	(0)	0	(0)	(0)
Mohawk Valley	0	(0)	(0)	(0)	(0)	0	(0)	0	(0)	(0)
Capital	(1)	(1)	(1)	(1)	(0)	(1)	(1)	(1)	(1)	(1)
Hudson Valley	(1)	(1)	(1)	(1)	(0)	(1)	(1)	(1)	(1)	(1)
Millwood	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
NY City	(1)	(1)	(4)	(2)	0	(0)	(1)	(0)	(1)	(1)
Long Island	(0)	(0)	(2)	(1)	0	(0)	(0)	(0)	(0)	0
NYCA Total	(2)	(4)	(11)	(7)	0	(1)	(5)	(2)	(4)	(3)

PROJECTED LBMPS ($/MWh) | Generic Demand Response Solution (Study 3: Volney - Scriba)

Average LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.03	0.01	(0.06)	(0.02)	(0.01)	0.00	(0.02)	0.01	(0.01)	0.00
Genesee	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	0.01	(0.02)	0.01	(0.01)	(0.00)
Central	0.00	(0.02)	(0.04)	(0.02)	(0.01)	0.01	(0.03)	0.00	(0.01)	(0.01)
North	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	0.01	(0.02)	0.00	(0.01)	(0.01)
Mohawk Valley	0.00	(0.01)	(0.03)	(0.02)	(0.01)	0.01	(0.03)	0.00	(0.01)	(0.01)
Capital	(0.01)	(0.01)	(0.03)	(0.02)	0.01	(0.01)	(0.01)	(0.00)	(0.01)	0.00
Hudson Valley	(0.02)	(0.02)	(0.03)	(0.02)	0.00	(0.01)	(0.03)	(0.01)	(0.02)	(0.02)
Millwood	(0.01)	(0.01)	(0.03)	(0.02)	0.00	(0.00)	(0.02)	(0.01)	(0.01)	(0.01)
Dunwoodie	(0.01)	(0.01)	(0.03)	(0.02)	0.00	(0.00)	(0.02)	(0.00)	(0.01)	(0.01)
NY City	(0.01)	(0.01)	(0.03)	(0.02)	0.00	(0.00)	(0.02)	(0.01)	(0.01)	(0.01)
Long Island	(0.00)	(0.01)	(0.04)	(0.02)	0.01	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)
Average	(0.00)	(0.01)	(0.03)	(0.02)	(0.00)	0.00	(0.02)	(0.00)	(0.01)	(0.01)

PROJECTED SO2 EMISSIONS (Tons) | Generic Demand Response Solution (Study 3: Volney - Scriba)

SO_2 Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	0	0	0	50	(8)	0	(46)	(2)	(43)
Genesee	(0)	0	(0)	0	0	0	0	(0)	0	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	0	(0)
North	(0)	(0)	0	(0)	0	0	(0)	0	(0)	0
Mohawk Valley	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
Capital	0	(0)	(0)	0	(0)	0	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	0	(0)	0	(0)	0	0
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	0	(1)	0	0	0	(0)	0	(0)	(0)
NYCA Total	(0)	(0)	(2)	(0)	50	(8)	0	(46)	(2)	(43)

PROJECTED SO2 EMISSION COSTS ($M) | Generic Demand Response Solution (Study 3: Volney - Scriba)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	0	0	0	0	(0)	0	(0)	(0)	(0)
Genesee	(0)	0	(0)	0	0	0	0	(0)	0	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	0	(0)
North	(0)	(0)	0	(0)	0	0	(0)	0	(0)	0
Mohawk Valley	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
Capital	0	(0)	(0)	0	(0)	0	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	0	(0)	0	(0)	0	0
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)	(0)	(0)
Long Island	(0)	(0)	(0)	0	0	0	(0)	0	(0)	(0)
NYCA Total	(0)	(0)	(0)	(0)	0	(0)	0	(0)	(0)	(0)

PROJECTED NOX EMISSIONS (Tons) | Generic Demand Response Solution (Study 3: Volney - Scriba)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	0	1	0	6	(5)	(0)	(10)	2	(4)
Genesee	0	0	0	(0)	0	0	0	(0)	0	(0)
Central	(0)	(0)	(0)	0	(1)	(0)	0	(0)	(0)	0
North	(0)	(0)	0	(0)	0	(0)	(0)	0	0	0
Mohawk Valley	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0
Capital	(0)	0	(0)	0	(1)	(1)	(0)	(0)	(0)	(0)
Hudson Valley	(1)	(2)	(3)	(4)	1	0	0	(0)	(2)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(3)	(4)	(11)	(3)	(3)	(4)	(7)	(1)	(3)	(1)
Long Island	0	(1)	1	0	(1)	1	(1)	0	(1)	0
NYCA Total	(3)	(7)	(12)	(7)	2	(9)	(8)	(12)	(4)	(4)

PROJECTED NOX EMISSION COSTS ($M) | Generic Demand Response Solution (Study 3: Volney - Scriba)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	0	0	(0)	(0)	(0)	(0)	0	(0)
Genesee	(0)	0	(0)	0	(0)	0	0	(0)	0	(0)
Central	(0)	(0)	(0)	0	(0)	(0)	(0)	0	(0)	(0)
North	0	(0)	0	(0)	(0)	(0)	(0)	0	(0)	0
Mohawk Valley	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0
Capital	(0)	0	(0)	0	(0)	0	0	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	0	0	(0)	(0)	(0)	0
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	0	(0)	0	0	(0)	0	(0)	0	(0)	0
NYCA Total	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

PROJECTED CO2 EMISSIONS (1000 Tons) | Generic Demand Response Solution (Study 3: Volney - Scriba)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	1	1	0	19	(4)	0	(18)	(0)	(16)
Genesee	(0)	0	(0)	0	0	0	0	(0)	0	(0)
Central	(3)	(0)	(0)	(0)	(2)	(0)	2	(0)	0	(0)
North	(0)	(0)	0	(0)	0	0	(1)	0	(0)	0
Mohawk Valley	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
Capital	2	(1)	(1)	0	(5)	3	(1)	(1)	(2)	(1)
Hudson Valley	0	(2)	(3)	(4)	0	(2)	(1)	(1)	(1)	2
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(6)	(5)	(9)	(1)	(1)	(4)	(1)	(1)	(2)	(4)
Long Island	(1)	(0)	2	0	(1)	1	(3)	0	(1)	(1)
NYCA Total	(7)	(8)	(11)	(5)	10	(6)	(5)	(21)	(6)	(19)

PROJECTED CO2 EMISSION COSTS ($M) | Generic Demand Response Solution (Study 3: Volney - Scriba)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.0)	0.0	0.0	0.0	0.1	(0.0)	0.0	(0.2)	(0.0)	(0.2)
Genesee	(0.0)	0.0	(0.0)	0.0	0.0	0.0	0.0	(0.0)	0.0	(0.0)
Central	(0.0)	0.0	(0.0)	0.0	(0.0)	(0.0)	0.0	(0.0)	0.0	(0.0)
North	(0.0)	(0.0)	0.0	(0.0)	0.0	0.0	(0.0)	0.0	(0.0)	0.0
Mohawk Valley	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0
Capital	0.0	(0.0)	(0.0)	0.0	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)
Hudson Valley	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	(0.0)	(0.0)	(0.1)	(0.0)	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)
Long Island	(0.0)	(0.0)	0.0	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	(0.0)
NYCA Total	(0.0)	(0.0)	(0.1)	(0.0)	0.1	(0.0)	(0.0)	(0.2)	(0.1)	(0.2)

PROJECTED DEMAND LOSS PAYMENT ($M) | Generic Demand Response Solution (Study 3: Volney - Scriba)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.0	0.0	0.0	0.0	0.0	(0.0)	0.1	0.1	0.0	0.1
Genesee	0.0	0.0	(0.0)	(0.0)	0.0	(0.0)	0.0	0.0	0.0	0.0
Central	0.0	(0.0)	(0.0)	(0.0)	0.0	(0.0)	0.0	0.0	0.0	0.0
North	0.0	0.0	0.0	0.0	(0.0)	(0.0)	0.0	(0.0)	0.0	0.0
Mohawk Valley	(0.0)	(0.0)	(0.0)	(0.0)	0.0	0.0	(0.0)	0.0	(0.0)	(0.0)
Capital	(0.0)	(0.0)	(0.1)	(0.1)	(0.1)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)
Hudson Valley	(0.0)	(0.0)	(0.1)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)
Millwood	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)
Dunwoodie	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)
NY City	(0.0)	(0.1)	(0.2)	(0.1)	(0.0)	0.1	(0.1)	(0.0)	(0.0)	(0.1)
Long Island	0.0	(0.0)	(0.1)	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)
NYCA Total	(0.1)	(0.2)	(0.4)	(0.2)	(0.1)	0.1	(0.1)	(0.0)	(0.1)	(0.1)

Generic Energy Efficiency Solution (Study 3: Volney – Scriba)

PROJECTED DEMAND CONGESTION BY ZONE ($M) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

Demand Congestion ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(0)	1	(0)	(0)	(0)	(1)	(0)	(1)	(1)
Genesee	0	0	0	0	(0)	(0)	(0)	(0)	(0)	(0)
Central	(1)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	0	0	0	0	0	0	(0)	0	0	(0)
Mohawk Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(11)	(9)	(7)	(8)	(3)	(3)	(1)	(2)	(2)	(2)
Hudson Valley	(7)	(6)	(6)	(6)	(3)	(3)	(1)	(2)	(2)	(2)
Millwood	(1)	(0)	(0)	(1)	(0)	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(1)	(1)	(0)	(1)	(1)	(1)	(0)	(1)	(0)	(0)
NY City	(8)	(6)	(1)	(9)	(3)	(2)	1	(3)	(1)	3
Long Island	(1)	(1)	2	(2)	1	1	3	0	2	3
NYCA Total	(29)	(25)	(11)	(28)	(10)	(8)	0	(9)	(5)	1

PROJECTED PRODUCTION COST ($M) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

Production Cost ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(1)	(0)	(1)	(0)	0	(1)	(3)	(3)	1
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)
Central	(4)	(2)	(4)	(3)	(4)	(5)	(7)	(3)	(5)	(5)
North	0	0	0	(0)	0	(0)	(0)	(0)	0	(0)
Mohawk Valley	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
Capital	(18)	(17)	(13)	(14)	(17)	(18)	(18)	(19)	(21)	(23)
Hudson Valley	(4)	(9)	(9)	(13)	(10)	(13)	(10)	(10)	(10)	(12)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(9)	(11)	(9)	(12)	(13)	(10)	(13)	(17)	(13)	(11)
Long Island	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
NYCA Total	(35)	(41)	(37)	(43)	(45)	(46)	(50)	(53)	(52)	(50)
NYCA Imports	(6)	(6)	(9)	(8)	(12)	(12)	(15)	(16)	(15)	(21)
NYCA Exports	12	10	15	12	12	13	13	14	17	17
NYCA + Imports - Exports	(53)	(57)	(61)	(64)	(69)	(71)	(78)	(82)	(84)	(88)

PROJECTED NYCA GENERATION (GWh) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

Generation (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	5	(15)	7	(10)	4	3	(18)	(39)	(32)	21
Genesee	(1)	(2)	(1)	(3)	(4)	(3)	(3)	(4)	1	(2)
Central	(148)	(79)	(136)	(93)	(113)	(149)	(188)	(69)	(124)	(106)
North	2	4	(1)	(4)	2	(1)	(3)	(4)	(0)	(1)
Mohawk Valley	(1)	2	(1)	(0)	(2)	1	(2)	(1)	(0)	(2)
Capital	(605)	(510)	(406)	(406)	(443)	(436)	(407)	(399)	(420)	(430)
Hudson Valley	(130)	(287)	(271)	(354)	(243)	(318)	(215)	(216)	(217)	(242)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(302)	(337)	(286)	(337)	(324)	(232)	(260)	(341)	(277)	(205)
Long Island	(17)	(28)	(29)	(31)	(27)	(15)	(18)	(17)	(20)	(15)
NYCA Total	(1,198)	(1,250)	(1,125)	(1,237)	(1,149)	(1,149)	(1,114)	(1,090)	(1,089)	(983)

PROJECTED NET IMPORTS (GWh) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

Net Imports (GWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
PJM - NYISO	(118)	(156)	(186)	(147)	(159)	(165)	(258)	(203)	(214)	(330)
LINDEN VFT	(40)	(31)	(31)	(24)	(27)	(23)	(22)	(20)	(23)	(19)
NEPTUNE	(27)	(31)	(52)	(33)	(63)	(31)	(49)	(55)	(49)	(41)
HTP	(9)	(9)	4	(12)	(13)	(15)	(12)	(17)	(17)	(29)
ISONE - NYISO	(336)	(264)	(360)	(301)	(308)	(324)	(218)	(281)	(287)	(241)
CROSS SOUND CABLE	9	12	19	18	(0)	3	7	4	1	16
NORTHPORT NORWALK	4	22	11	3	(1)	2	3	12	(1)	(10)
IESO - NYISO	(28)	(32)	(26)	(7)	(23)	(41)	(78)	(93)	(66)	(110)
HQ - NYISO CHAT	(0)	(0)	(0)	(0)	0	0	(0)	0	0	0
HQ - NYISO CEDARS	(0)	1	(0)	0	0	(0)	0	0	(0)	(0)
TOTAL	(546)	(490)	(621)	(502)	(594)	(593)	(628)	(652)	(655)	(764)

PROJECTED GENERATOR PAYMENTS ($M) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

Generator Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(1)	(2)	(3)	(1)	(1)	(2)	(4)	(3)	(4)	(3)
Genesee	(0)	(0)	(1)	(0)	(1)	(1)	(1)	(1)	(1)	(1)
Central	1	2	(6)	(2)	(6)	(8)	(12)	(4)	(9)	(11)
North	(0)	(0)	(2)	(1)	(1)	(1)	(2)	(1)	(2)	(2)
Mohawk Valley	(0)	(0)	(1)	(0)	(0)	(0)	(1)	(0)	(1)	(1)
Capital	(23)	(22)	(18)	(20)	(21)	(22)	(24)	(23)	(26)	(28)
Hudson Valley	(4)	(11)	(11)	(15)	(11)	(14)	(12)	(12)	(12)	(14)
Millwood	(3)	(2)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Dunwoodie	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NY City	(12)	(14)	(15)	(18)	(15)	(14)	(18)	(21)	(19)	(17)
Long Island	(1)	(1)	(2)	(2)	(1)	(1)	(2)	(1)	(2)	(2)
NYCA Total	(44)	(50)	(60)	(59)	(57)	(63)	(76)	(66)	(77)	(80)

PROJECTED LOAD PAYMENTS ($M) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

Load Payment ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(2)	(1)	(1)	(1)	(2)	(1)	(2)	(3)
Genesee	(0)	(0)	(2)	(0)	(1)	(1)	(2)	(1)	(2)	(2)
Central	(1)	(1)	(3)	(1)	(1)	(2)	(4)	(2)	(4)	(5)
North	(0)	(0)	(1)	(0)	(1)	(1)	(1)	(1)	(1)	(1)
Mohawk Valley	(0)	(0)	(1)	(1)	(1)	(1)	(2)	(1)	(2)	(2)
Capital	(31)	(33)	(35)	(37)	(37)	(40)	(43)	(44)	(46)	(48)
Hudson Valley	(26)	(29)	(31)	(33)	(35)	(36)	(40)	(41)	(43)	(45)
Millwood	(1)	(0)	(1)	(1)	(0)	(1)	(1)	(1)	(1)	(1)
Dunwoodie	(1)	(1)	(1)	(2)	(1)	(1)	(2)	(1)	(2)	(2)
NY City	(8)	(6)	(11)	(11)	(7)	(9)	(12)	(8)	(13)	(13)
Long Island	(1)	(1)	(2)	(2)	(0)	(2)	(2)	(2)	(3)	(3)
NYCA Total	(69)	(72)	(90)	(88)	(84)	(96)	(110)	(102)	(118)	(125)

PROJECTED LBMPS ($/MWh) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

Average LBMP ($/MWh)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.00)	(0.01)	(0.10)	(0.03)	(0.07)	(0.10)	(0.15)	(0.07)	(0.14)	(0.21)
Genesee	(0.04)	(0.02)	(0.15)	(0.03)	(0.08)	(0.12)	(0.18)	(0.09)	(0.17)	(0.24)
Central	(0.04)	(0.03)	(0.17)	(0.06)	(0.09)	(0.15)	(0.23)	(0.12)	(0.24)	(0.29)
North	(0.02)	(0.01)	(0.19)	(0.05)	(0.12)	(0.13)	(0.22)	(0.11)	(0.22)	(0.26)
Mohawk Valley	(0.04)	(0.03)	(0.19)	(0.07)	(0.11)	(0.16)	(0.24)	(0.14)	(0.26)	(0.31)
Capital	(0.29)	(0.31)	(0.31)	(0.36)	(0.27)	(0.32)	(0.34)	(0.31)	(0.40)	(0.39)
Hudson Valley	(0.21)	(0.21)	(0.27)	(0.28)	(0.21)	(0.27)	(0.32)	(0.28)	(0.36)	(0.38)
Millwood	(0.19)	(0.15)	(0.23)	(0.24)	(0.16)	(0.22)	(0.26)	(0.22)	(0.30)	(0.30)
Dunwoodie	(0.18)	(0.15)	(0.22)	(0.23)	(0.16)	(0.22)	(0.26)	(0.21)	(0.29)	(0.29)
NY City	(0.16)	(0.11)	(0.18)	(0.20)	(0.13)	(0.18)	(0.22)	(0.15)	(0.24)	(0.25)
Long Island	(0.05)	(0.02)	(0.08)	(0.11)	(0.02)	(0.09)	(0.10)	(0.08)	(0.14)	(0.15)
Average	(0.11)	(0.10)	(0.19)	(0.15)	(0.13)	(0.18)	(0.23)	(0.16)	(0.25)	(0.28)

PROJECTED SO2 EMISSIONS (Tons) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

SO_2 Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0	(0)	(0)	(0)	34	41	(14)	(66)	(60)	78
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	(0)	0	0	(0)	0	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
Capital	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Hudson Valley	(1)	(1)	(1)	(1)	(1)	(1)	(0)	(0)	(0)	(1)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Long Island	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	(3)	(3)	(3)	(3)	31	38	(16)	(69)	(63)	76

PROJECTED SO2 EMISSION COSTS ($M) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

SO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	0	0	(0)	(0)	(0)	0
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	(0)	0	0	(0)	0	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	0	(0)	(0)	(0)	0	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
NYCA Total	(0)	(0)	(0)	(0)	0	0	(0)	(0)	(0)	0

PROJECTED NOX EMISSIONS (Tons) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

NO_X Emissions (Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(10)	(4)	(7)	(4)	14	(10)	(20)	(21)	18
Genesee	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)
Central	(9)	(4)	(6)	(7)	(9)	(9)	(11)	(6)	(9)	(9)
North	2	(0)	1	1	(0)	1	(1)	1	1	1
Mohawk Valley	(0)	0	(0)	0	(1)	(0)	(0)	(0)	(0)	(0)
Capital	(29)	(24)	(22)	(26)	(33)	(29)	(23)	(29)	(26)	(28)
Hudson Valley	(54)	(36)	(74)	(57)	(53)	(46)	(48)	(42)	(30)	(55)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(37)	(69)	(62)	(67)	(99)	(47)	(60)	(70)	(65)	(51)
Long Island	(3)	(9)	(9)	(7)	(10)	(2)	(3)	(5)	(4)	(4)
NYCA Total	(131)	(151)	(177)	(172)	(209)	(119)	(157)	(171)	(154)	(127)

PROJECTED NOX EMISSION COSTS ($M) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

NO_X Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Genesee	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0	(0)
Central	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
North	(0)	0	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)
Mohawk Valley	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Capital	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Hudson Valley	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Long Island	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	0
NYCA Total	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

PROJECTED CO2 EMISSIONS (1000 Tons) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

CO_2 Emissions (1000 Tons)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(2)	(12)	(6)	(10)	3	5	(17)	(37)	(37)	21
Genesee	(1)	(1)	(1)	(1)	(2)	(1)	(1)	(2)	0	(1)
Central	(62)	(35)	(57)	(40)	(48)	(62)	(78)	(30)	(53)	(46)
North	(0)	0	0	(1)	1	(0)	(2)	(2)	(0)	(0)
Mohawk Valley	(0)	0	(0)	(0)	(1)	1	(1)	(1)	(0)	(1)
Capital	(248)	(206)	(167)	(168)	(178)	(180)	(164)	(168)	(173)	(181)
Hudson Valley	(75)	(129)	(141)	(166)	(117)	(145)	(106)	(101)	(99)	(120)
Millwood	0	0	0	0	0	0	0	0	0	0
Dunwoodie	0	0	0	0	0	0	0	0	0	0
NY City	(146)	(174)	(141)	(168)	(172)	(115)	(134)	(174)	(142)	(103)
Long Island	(9)	(15)	(16)	(16)	(15)	(7)	(9)	(10)	(10)	(6)
NYCA Total	(544)	(571)	(528)	(571)	(529)	(506)	(511)	(524)	(514)	(436)

PROJECTED CO2 EMISSION COSTS ($M) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

CO_2 Emissions Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	(0.0)	(0.1)	(0.0)	(0.1)	0.0	0.0	(0.1)	(0.3)	(0.4)	0.2
Genesee	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	0.0	(0.0)
Central	(0.3)	(0.2)	(0.4)	(0.3)	(0.4)	(0.5)	(0.7)	(0.3)	(0.5)	(0.5)
North	0.0	0.0	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Mohawk Valley	(0.0)	0.0	(0.0)	(0.0)	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)
Capital	(1.2)	(1.1)	(1.0)	(1.1)	(1.3)	(1.4)	(1.3)	(1.5)	(1.6)	(1.8)
Hudson Valley	(0.4)	(0.7)	(0.9)	(1.1)	(0.9)	(1.2)	(0.9)	(0.9)	(1.0)	(1.3)
Millwood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dunwoodie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NY City	(0.5)	(1.0)	(0.8)	(1.1)	(1.2)	(0.8)	(1.1)	(1.5)	(1.3)	(1.0)
Long Island	(0.0)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
NYCA Total	(2.5)	(3.2)	(3.3)	(3.8)	(3.8)	(3.9)	(4.2)	(4.6)	(4.9)	(4.4)

PROJECTED DEMAND LOSS PAYMENT ($M) | Generic Energy Efficiency Solution (Study 3: Volney - Scriba)

Loss Costs ($M)	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
West	0.1	0.0	0.4	0.2	0.2	0.3	0.6	0.5	0.6	0.7
Genesee	0.1	0.0	0.2	0.1	0.1	0.1	0.3	0.2	0.3	0.3
Central	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
North	0.0	(0.0)	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Mohawk Valley	(0.0)	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Capital	(1.5)	(1.7)	(1.9)	(1.8)	(2.0)	(1.7)	(1.9)	(1.9)	(2.0)	(2.1)
Hudson Valley	(0.9)	(1.1)	(1.3)	(1.2)	(1.3)	(1.5)	(1.5)	(1.6)	(1.7)	(1.8)
Millwood	0.0	0.0	(0.0)	0.0	0.0	0.0	(0.0)	0.0	0.0	(0.0)
Dunwoodie	0.0	0.1	(0.0)	0.1	0.1	0.0	0.0	0.1	0.0	0.0
NY City	0.4	1.0	0.1	0.9	0.9	0.5	0.3	1.2	0.6	0.4
Long Island	0.2	0.4	0.1	0.4	0.4	0.3	0.0	0.4	0.2	0.1
NYCA Total	(1.5)	(1.1)	(2.4)	(1.2)	(1.4)	(1.7)	(2.0)	(0.8)	(1.8)	(2.0)

Appendix I - Scenario Case Results

These results reflect changes in the identified metrics for 2028, only. All dollar values are presented as nominal.

PROJECTED DEMAND CONGESTION CHANGE BY ZONE ($M)

Demand Congestion ($M)	High Load	Low Load	High Fuel	Low Fuel
West	4	(4)	9	(2)
Genesee	1	(2)	5	(1)
Central	(2)	(4)	5	(3)
North	0	(0)	1	(0)
Mohawk Valley	(1)	(1)	2	(1)
Capital	(8)	3	22	(8)
Hudson Valley	(6)	(0)	16	(6)
Millwood	(1)	1	4	(2)
Dunwoodie	(2)	1	9	(3)
NY City	(39)	(22)	97	(31)
Long Island	21	(7)	52	(17)
NYCA Total	(32)	(35)	222	(72)

PROJECTED PRODUCTION COST CHANGE ($M)

Production Cost ($M)	High Load	Low Load	High Fuel	Low Fuel
West	(5)	(52)	81	(24)
Genesee	0	(2)	(1)	(0)
Central	23	(79)	(29)	(16)
North	1	(2)	0	0
Mohawk Valley	(0)	(1)	0	(0)
Capital	59	(154)	112	(52)
Hudson Valley	15	(150)	3	(1)
Millwood	0	(0)	0	0
Dunwoodie	0	0	0	0
NY City	(20)	(192)	230	(110)
Long Island	32	(68)	52	(22)
NYCA Total	105	(701)	448	(224)
NYCA Imports	86	(196)	280	(95)
NYCA Exports	(5)	158	41	(8)
NYCA + Imports - Exports	196	(1,055)	686	(311)

PROJECTED NYCA GENERATION CHANGE (GWh)

Generation (GWh)	High Load	Low Load	High Fuel	Low Fuel
West	(59)	(868)	1,482	(329)
Genesee	(1)	(36)	(28)	4
Central	503	(1,921)	(1,693)	191
North	17	(45)	(6)	13
Mohawk Valley	(4)	(14)	1	(4)
Capital	1,205	(3,134)	(1,225)	491
Hudson Valley	299	(3,208)	(1,614)	911
Millwood	0	(0)	0	0
Dunwoodie	0	0	0	0
NY City	(1)	(3,341)	(1,281)	367
Long Island	560	(1,149)	(691)	376
NYCA Total	2,520	(13,716)	(5,053)	2,021

PROJECTED NET IMPORTS CHANGE (GWh)

Net Imports (GWh)	High Load	Low Load	High Fuel	Low Fuel
PJM - NYISO	425	(2,527)	4,433	(1,575)
LINDEN VFT	44	(341)	499	(123)
NEPTUNE	299	(920)	927	(404)
HTP	114	(49)	347	(113)
ISONE - NYISO	297	(1,814)	(1,036)	385
CROSS SOUND CABLE	383	(281)	(142)	55
NORTHPORT NORWALK	231	(178)	(114)	5
IESO - NYISO	237	(1,115)	251	(275)
HQ - NYISO CHAT	0	0	0	0
HQ - NYISO CEDARS	(0)	0	0	0
TOTAL	2,029	(7,223)	5,166	(2,045)

PROJECTED GENERATOR PAYMENTS CHANGE ($M)

Generator Payment ($M)	High Load	Low Load	High Fuel	Low Fuel
West	9	(96)	200	(79)
Genesee	4	(16)	33	(17)
Central	55	(113)	170	(96)
North	9	(25)	71	(32)
Mohawk Valley	3	(12)	32	(15)
Capital	60	(191)	120	(59)
Hudson Valley	13	(170)	6	(3)
Millwood	0	(1)	5	(2)
Dunwoodie	(0)	(0)	1	(0)
NY City	(13)	(254)	209	(106)
Long Island	43	(88)	62	(28)
NYCA Total	183	(967)	908	(438)

PROJECTED LOAD PAYMENTS CHANGE ($M)

Load Payment ($M)	High Load	Low Load	High Fuel	Low Fuel
West	54	(105)	92	(48)
Genesee	(7)	(114)	67	(34)
Central	6	(161)	128	(59)
North	6	(23)	41	(19)
Mohawk Valley	20	(57)	58	(26)
Capital	30	(106)	126	(55)
Hudson Valley	8	(94)	100	(44)
Millwood	17	(17)	29	(13)
Dunwoodie	31	(36)	60	(26)
NY City	10	(541)	555	(240)
Long Island	132	(193)	234	(100)
NYCA Total	306	(1,446)	1,490	(664)

PROJECTED LBMP CHANGE ($/MWh)

LBMP ($/MWh)	High Load	Low Load	High Fuel	Low Fuel
West	1.00	(2.41)	6.25	(3.21)
Genesee	0.88	(2.82)	6.93	(3.42)
Central	0.95	(2.85)	8.23	(3.80)
North	0.97	(2.37)	7.64	(3.51)
Mohawk Valley	1.06	(2.78)	8.59	(3.88)
Capital	0.49	(1.84)	10.29	(4.43)
Hudson Valley	0.57	(2.27)	10.11	(4.42)
Millwood	0.65	(2.24)	10.11	(4.42)
Dunwoodie	0.64	(2.26)	10.07	(4.41)
NY City	0.58	(2.57)	10.34	(4.46)
Long Island	1.86	(2.50)	11.04	(4.72)

PROJECTED SO_2 EMISSIONS CHANGE (Tons)

SO_2 Emissions (Tons)	High Load	Low Load	High Fuel	Low Fuel
West	(311)	(1,767)	4,245	(1,317)
Genesee	(0)	(0)	(0)	0
Central	1	(4)	(4)	0
North	0	(0)	(0)	0
Mohawk Valley	(0)	(0)	0	(0)
Capital	2	(7)	(3)	1
Hudson Valley	1	(7)	(4)	2
Millwood	0	(0)	0	0
Dunwoodie	0	0	0	0
NY City	(1)	(10)	(4)	1
Long Island	2	(3)	(2)	1
NYCA Total	(306)	(1,798)	4,229	(1,311)

PROJECTED SO_2 EMISSION COSTS CHANGE ($M)

SO_2 Emissions Costs ($M)	High Load	Low Load	High Fuel	Low Fuel
West	(0)	(0)	0	(0)
Genesee	(0)	(0)	(0)	0
Central	0	(0)	(0)	0
North	0	(0)	(0)	0
Mohawk Valley	(0)	(0)	0	(0)
Capital	0	(0)	(0)	0
Hudson Valley	0	(0)	(0)	0
Millwood	0	0	0	0
Dunwoodie	0	0	0	0
NY City	(0)	(0)	(0)	0
Long Island	0	(0)	(0)	0
NYCA Total	(0)	(0)	0	(0)

PROJECTED NO_X EMISSIONS CHANGE (Tons)

NO_X Emissions (Tons)	High Load	Low Load	High Fuel	Low Fuel
West	(66)	(469)	766	(218)
Genesee	(0)	(4)	(3)	1
Central	27	(123)	(99)	23
North	5	(9)	(4)	4
Mohawk Valley	(2)	(3)	1	(1)
Capital	21	(225)	(131)	19
Hudson Valley	12	(498)	(449)	264
Millwood	1	(1)	0	0
Dunwoodie	0	0	0	0
NY City	(341)	(1,301)	(433)	145
Long Island	158	(330)	(211)	119
NYCA Total	(184)	(2,964)	(563)	355

PROJECTED NO_X EMISSION COSTS CHANGE ($M)

NO_X Emissions Costs ($M)	High Load	Low Load	High Fuel	Low Fuel
West	(0)	(0)	0	(0)
Genesee	(0)	(0)	(0)	0
Central	0	(0)	(0)	0
North	(0)	(0)	(0)	0
Mohawk Valley	(0)	(0)	0	0
Capital	0	(0)	(0)	0
Hudson Valley	0	(0)	(0)	0
Millwood	0	0	0	0
Dunwoodie	0	0	0	0
NY City	(0)	(0)	(0)	0
Long Island	0	(0)	(0)	0
NYCA Total	0	(0)	(0)	0

PROJECTED CO_2 EMISSIONS CHANGE (1000 Tons)

CO_2 Emissions (1000 Tons)	High Load	Low Load	High Fuel	Low Fuel
West	(104)	(858)	1,627	(460)
Genesee	(1)	(17)	(13)	2
Central	206	(801)	(702)	88
North	9	(22)	(3)	7
Mohawk Valley	(2)	(7)	1	(2)
Capital	457	(1,288)	(556)	224
Hudson Valley	122	(1,473)	(826)	476
Millwood	0	0	0	0
Dunwoodie	0	0	0	0
NY City	(115)	(1,837)	(706)	218
Long Island	310	(653)	(395)	225
NYCA Total	882	(6,956)	(1,572)	779

PROJECTED CO_2 EMISSION COSTS CHANGE ($M)

CO_2 Emissions Costs ($M)	High Load	Low Load	High Fuel	Low Fuel
West	(1)	(9)	16	(5)
Genesee	(0)	(0)	(0)	0
Central	2	(8)	(7)	1
North	0	(0)	(0)	0
Mohawk Valley	(0)	(0)	0	(0)
Capital	4	(13)	(6)	2
Hudson Valley	1	(16)	(9)	5
Millwood	0	0	0	0
Dunwoodie	0	0	0	0
NY City	(1)	(18)	(7)	2
Long Island	3	(7)	(4)	2
NYCA Total	8	(71)	(16)	8

PROJECTED DEMAND LOSS PAYMENT CHANGE ($M)

Loss Costs ($M)	High Load	Low Load	High Fuel	Low Fuel
West	1	0	(21)	6
Genesee	(0)	(3)	(8)	2
Central	(0)	(4)	(3)	1
North	(0)	1	(2)	1
Mohawk Valley	1	(2)	1	(0)
Capital	1	(2)	5	(2)
Hudson Valley	1	(4)	4	(2)
Millwood	1	(1)	1	(1)
Dunwoodie	2	(2)	3	(1)
NY City	1	(33)	30	(13)
Long Island	9	(12)	15	(6)
NYCA Total	15	(61)	26	(15)

Appendix J – Tie Line Import & Export

The 2028 annual net export energy, by individual NYISO tie line is provided in Figure 68 below. Results are presented for the base case and four scenarios.

Figure 68: Annual Net Export Energy by Tie Line

Annual Flow(GWh)	Description	From ISO	To ISO	Base Case	Scenario Load Relaxed	Scenario Load Constrained	Base Load Relaxed	Base Load Constrained
WEST/CENTRAL to PEN	PJM West AC Ties	NYISO	PJM	(3,471)	4,359	2,646	4,986	2,946
HUDSON to JCP&L	Ramapo Line	NYISO	PJM	(3,472)	(3,207)	68	(3,247)	195
HUDSON to PSEG	Waldwick PARS (J & K)	NYISO	PJM	(1,023)	5,199	436	5,007	469
HUDSON to RECO	RECO Ties	NYISO	PJM	1,493	1,491	1,491	1,491	1,490
NYC to PSEG	VFT + A-PAR + HTP	NYISO	PJM	(1,531)	(1,786)	1,568	(1,838)	1,274
L ISLAND to JCP&L	Neptune	NYISO	PJM	(4,234)	(576)	(1,763)	(403)	(1,847)
PJM Net Imports				12,239	(5,480)	(4,446)	(5,997)	(4,526)

Annual Flow(GWh)	Description	From ISO	To ISO	Base Case	Scenario Load Relaxed	Scenario Load Constrained	Base Load Relaxed	Base Load Constrained
WEST to ONNI	Niagara Ties	NYISO	IESO	2,810	5,394	5,661	5,874	6,089
NORTH to ONEAST	St Lawrence PARs	NYISO	IESO	53	156	154	155	158
IESO Net imports				(2,862)	(5,550)	(5,815)	(6,030)	(6,247)

Annual Flow(GWh)	Description	From ISO	To ISO	Base Case	Scenario Load Relaxed	Scenario Load Constrained	Base Load Relaxed	Base Load Constrained
NORTH to VT	PV20	NYISO	ISONE	967	665	650	657	636
CAPITAL to VT/WMA and HUDSON to CT	AC Freeflow Ties	NYISO	ISONE	1,646	6,048	6,379	5,242	5,240
L ISLAND to CT	Cross Sound Cable	NYISO	ISONE	(1,638)	(109)	(910)	(226)	(970)
L ISLAND to NOR	1385 Line	NYISO	ISONE	(439)	1,188	300	1,038	166
ISONE Net imports				(536)	(7,791)	(6,419)	(6,710)	(5,072)

Annual Flow(GWh)	Description	From ISO	To ISO	Base Case	Scenario Load Relaxed	Scenario Load Constrained	Base Load Relaxed	Base Load Constrained
NORTH to HQ	Cedars	NYISO	HQ	(1,009)	(1,293)	(1,268)	(1,277)	(1,275)
NORTH to HQ	Chateaugay	NYISO	HQ	(10,555)	(10,497)	(10,495)	(10,491)	(10,482)
NYC to HQ	NYC HVDC Tie	NYISO	HQ	0	(8,012)	(8,012)	(8,012)	(8,012)
HQ Net imports				11,564	19,803	19,775	19,780	19,769

Appendix K - Annualized Growth Rates for the Base, Low and High Loads

These values represent the annualized-growth rates for energy and non-coincident peaks for each NYCA Load Zone from 2017 to 2026 for the "Business as Usual" case as well as the Low and High scenarios. The energy growth rates are presented as well for the New York Control Area.

Figure 69: Load Growth Rates for Base, Low, and High Scenarios

Zones	Energy			Non-Coincident Peak		
	Low	Base	High	Low	Base	High
West	-2.17%	-0.71%	0.06%	-2.92%	-0.82%	-0.66%
Genesee	-2.58%	-0.32%	-0.22%	-3.04%	-0.26%	-0.65%
Central	-2.68%	-0.57%	-0.31%	-3.06%	-0.78%	-0.66%
North	0.10%	1.08%	0.77%	-1.21%	1.56%	-0.53%
Mohawk Valley	-3.42%	-1.07%	-0.26%	-3.52%	-1.37%	-0.31%
Capital	-2.78%	-0.76%	0.08%	-3.07%	-1.09%	-0.20%
Hudson Valley	-2.84%	-0.29%	0.05%	-3.34%	-0.38%	-0.41%
Millwood	-1.40%	0.27%	0.99%	-1.26%	-0.05%	1.16%
Dunwoodie	-1.33%	-0.03%	0.59%	-0.64%	-0.02%	1.33%
NY City	-1.76%	-0.03%	0.04%	-2.60%	-0.02%	-0.78%
Long Island	-2.46%	-0.57%	0.33%	-3.21%	-1.13%	-0.40%
NYCA	-2.16%	-0.32%	0.08%	N/A	N/A	N/A

Appendix L – 70x30 Scenario Cases

In addition to the standard scenario simulations involving changes in natural gas and energy demand forecasts, a scenario evaluating the New York "70x30" target was performed. Within this scenario, three individual sensitivities were simulated to investigate the impacts of storage, nuclear retirements, and reduced export energy. This appendix provides additional detail for the 70x30 scenario and sensitivities.

Targeted Investigation of Energy Storage Resources

State policies, including the CLCPA, support the installation of 3,000 MW of Energy Storage Resources (ESR) in New York by 2030. As a sensitivity to the constrained scenario cases, which do not include incremental ESR, two different ESR dispatch models were used to study 3,000 MW as a distributed resource within MAPS. An additional limited case examined the inclusion of a smaller amount of ESR capacity in the generation pockets in order to minimize RE curtailment from individual collocated RE generators within the Scenario Load Constrained case.

GE-MAPS software allows ESRs (*e.g.*, pumped hydro storage) to be modeled entirely within the MAPS simulations. This method, hereby known as the pumped storage hydro or PSH method, provides ESR dispatches optimizing arbitrage amongst the generators included within an initial commitment pass across each week of the simulation. The supply cost curve of these set of NYCA units and the ESR parameters were used to compute the optimal dispatch for resources in each NYCA zone. ESR in this approach were modeled as distributed resources in MAPS, and distributed to the load busses according to the ratio of annual zonal load to bus load, similar to the distributed modeling approach employed to model BTM-PV.

To augment the capabilities of the MAPS internal ESR model used in the PSH method, an external ESR dispatch optimization algorithm was implemented using MATLAB's Optimization Toolbox and leveraging MAPS hourly resource modifier (HRM) models. This technique for analyzing ESR is hereby labeled the HRM method. Potential benefits of this approach include flexibility and controllability in modeling ESR to target various objectives. As an initial comparison to the MAPS internal model, an external optimization was developed with the objective of minimizing the daily net load (*i.e.*, Gross Load – RE_{input}) deviation on a zonal basis. Input to the optimization are the zonal gross load and aggregate renewable energy profiles, and the ESR power, energy, and efficiency constraints. Resulting optimal dispatches were included in the MAPS simulations as distributed hourly resource modifiers, just as currently done with BTM-PV. MAPS may curtail ESR discharges into the transmission network if it is the most effective resource to resolve low LBMPs due to transmission constraints.

In both the PSH and HRM methods, all ESR are assumed to be four-hour duration with 85% round trip

charge to discharge efficiency. The full power and energy capacity are available to the ESR for charging and discharging. The efficiency constraint is preserved upon charging by appropriately reducing the energy state of charge of the ESR. Self-discharge and other degradation losses are ignored. Results of the modeling study conducted for the NYSERDA Energy Storage Roadmap[11] were used to inform the zonal capacity levels of storage included in the ESR and HRM storage cases.

Figure 70: Assumed ESR Zonal Power Capacity

Nameplate Capacity Distribution (MW)												
	A	B	C	D	E	F	G	H	I	J	K	NYCA
ESR	150	90	120	180	120	240	100	100	100	1,320	480	3,000

An additional examination of ESR focused on using ESR to capture RE curtailments in generation pockets. Five RE generators were selected from one generation pocket, and an ESR unit was collocated with each RE unit. A dispatch profile was created for each ESR using the hourly curtailment data of each RE unit from the Scenario Load Constrained case with no ESR in the system. This approach was based on the principle that ESRs will charge whenever there is any curtailment and discharge when there is no curtailment, while respecting the power, energy, and efficiency constraints of the ESR itself. The power rating of the ESR was selected to capture approximately 75th and 50th percentile of the hourly curtailments of each RE unit. The total hours of available storage were chosen such as the curtailment of each RE unit was reduced to approximately 5% of the total input renewable energy. Resulting ESR dispatches are included in the MAPS simulations as hourly resource modifiers collocated with the associated RE unit.

Several considerations should be take into account when reviewing results and methods utilized in the ESR sensitivity cases. These include:

- ESR models based on arbitrage of energy or costs are significant simplifications of complex, co-optimization bidding strategies and market opportunities which may be available to ESRs (*e.g.*, provision for regulation, reserves, dual-market participation, etc.) and are a function of the assumed zonal capacity distribution.
- Results of distributed methods ignore potential locational benefits provided or anticipated for particular siting locations (*e.g.*, ESRs awarded contracts may be utilized for local rather than bulk power system needs).
- ESR dispatch must be integrated into MAPS optimization to expose the impact of operations on the surrounding power system.

[11] documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={2A1BFBC9-85B4-4DAE-BCAE-164B21B0DC3D}

- Targeted application of ESR is labor intensive and iterative process that will require further understanding and methodological development to reliably include ESR in modeling studies going forward.

For the ESR sensitivity, the NYISO examined two distributed models for storage resources in MAPS and made an initial investigation targeting RE generation curtailment at collocated generators within a generation pocket. The methodologies and differences in approaches are outlined in the assumptions section of the CARIS report. This section compares the results of the distributed MAPS internal ESR and external HRM approach is provided. Separately, results also describe the analysis of ESRs located in generation pockets.

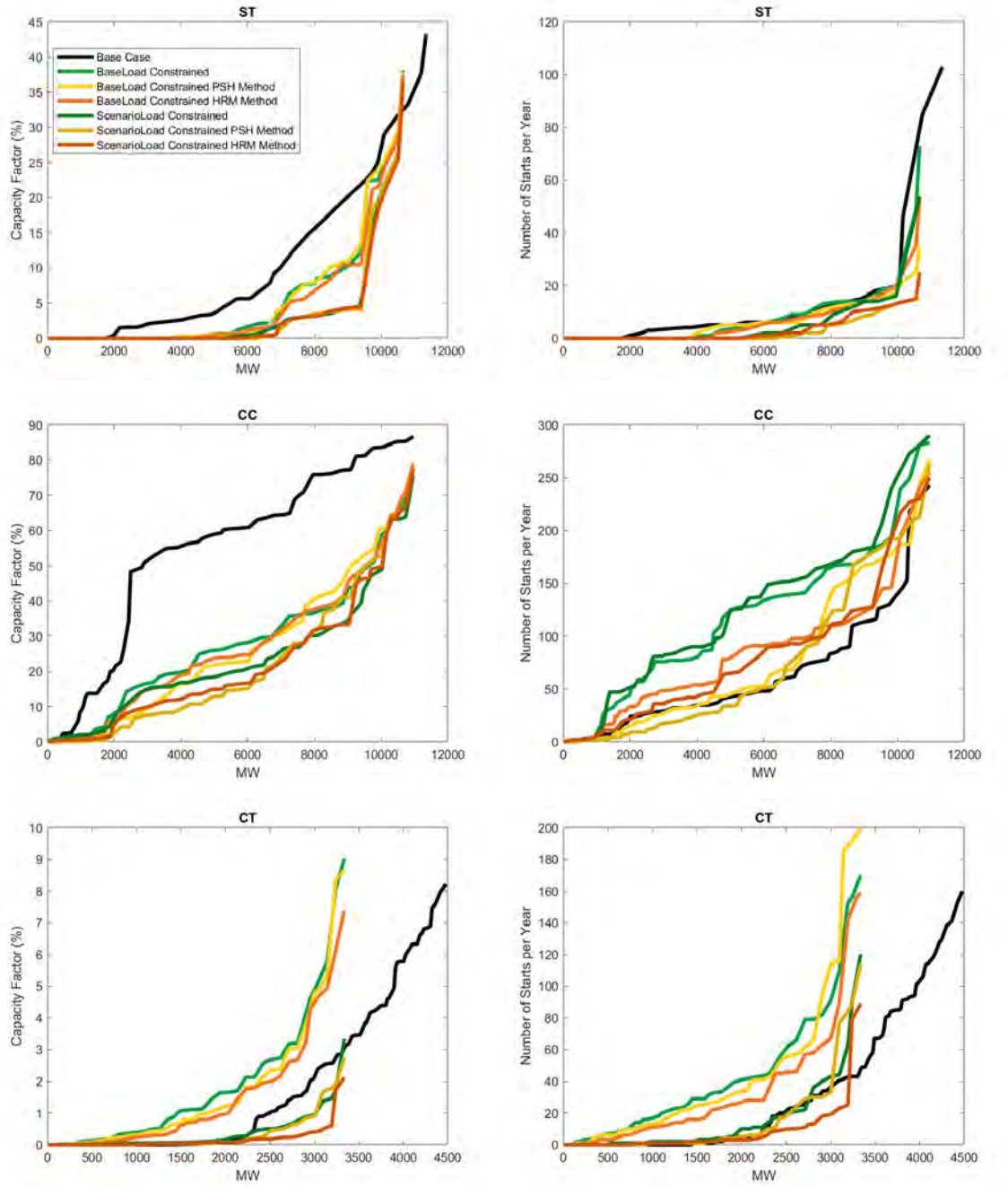
Direct comparison between the two distributed methods for modeling ESR, the first based on utilization of MAPS' internal ESR dispatch ("PSH Method") and the second based on an external dispatch optimization developed by NYISO staff ("HRM Method"), is possible because both incorporate the same amount of storage in the same locations across all cases. Figure 71 displays the annual energy composition of generation, net imports, curtailments, and gross load. Storage resources in the table are shown as net generation values (*i.e.*, net generation = discharge – charge), similar to the calculation of net generation for Pumped Storage resources. The primary impact of including ESR as a distributed resource in MAPS is a reduction in fossil generation, exports, and curtailments, with an observed increase in RE generation. Impacts of distributed ESR models are directionally consistent. The external optimization included as an HRM, however, shows slightly more pronounced changes from the constrained cases without ESR. It should also be noted that including ESR as internally modeled resources in MAPS will impact the output of the Pumped Storage generators more as they use the same internal ESR model approach in MAPS, which places Pumped Storage generators in direct competition with incremental ESR modeled internal to MAPS. These effects together with the zonal daily balancing of the HRM external dispatches explain the increased utilization of the HRM Method resources across these cases.

Figure 71: Energy Storage Resource Sensitivity Case Results Energy Results

Energy (GWh)	ScenarioLoad Constrained	ScenarioLoad Constrained PSH Method	ScenarioLoad Constrained HRM Method	BaseLoad Constrained	BaseLoad Constrained PSH Method	BaseLoad Constrained HRM Method
Nuclear	27,433	27,434	27,434	27,433	27,434	27,435
Other	2,110	2,130	2,126	2,102	2,115	2,117
Fossil	28,185	26,290	26,294	35,181	33,667	33,603
Hydro	28,050	28,123	28,114	28,020	28,084	28,091
Hydro Imports	19,775	19,820	19,808	19,769	19,802	19,808
LBW	13,290	13,515	13,532	17,117	17,322	17,376
OSW	21,625	21,682	21,743	21,592	21,656	21,821
UPV	12,666	13,234	13,124	17,982	18,256	18,350
BTM-PV	9,266	9,287	9,288	9,327	9,332	9,329
Pumped Storage	(822)	(514)	(630)	(868)	(562)	(671)
Storage	-	(613)	(693)	-	(604)	(756)
IESO Net Imports	(5,817)	(5,788)	(5,755)	(6,250)	(6,136)	(6,145)
ISONE Net Imports	(6,418)	(5,902)	(5,847)	(5,073)	(4,695)	(4,723)
PJM Net Imports	(4,446)	(3,798)	(3,648)	(4,528)	(3,859)	(3,838)
Renewable Generation	104,672	105,661	105,609	113,808	114,452	114,775
Curtailment	10,151	9,174	9,266	14,020	13,369	13,097
Non-Renewable Generation	57,728	55,853	55,853	64,717	63,215	63,155
GrossLoad	144,897	144,897	144,888	161,807	161,811	161,797

Figure 72 displays the impact that the two distributed storage resource models, MAPS internal PSH method and HRM external dispatch method, have on fossil fleet operations. The curves show the capacity factor and number of starts per year for each unit across the NYCA fossil fleet broken out by type. Comparison of the curves for the constrained, PSH Method, and HRM Method cases at the same load level allows the impact of the storage models to be assessed. The curves clearly show that the inclusion of ESR has the least operational impacts upon the steam turbine fleet as these resources have less operational flexibility than other fossil generators. Both ESR models lead to a more efficient utilization of the fossil fleet, particularly the combined cycle fleet. This is observed in the combined cycle capacity factor graph as the PSH and HRM Method lines cross over the constrained case curves as unit utilization increases. As each of these ESR models have different approaches and objectives, it is not surprising that they result in different dispatch patterns over the course of the year and therefore have different impact on the operation of the fossil fleet.

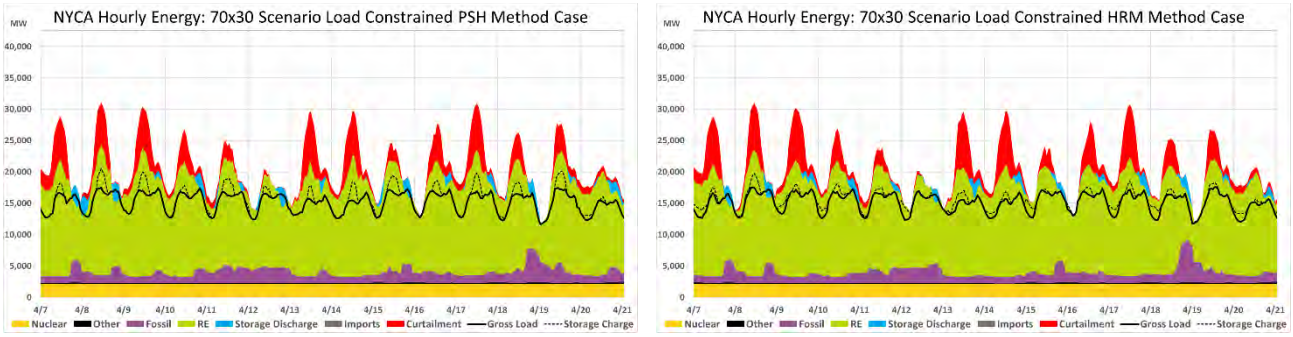
Figure 72: Energy Storage Resource Sensitivity Cases Fossil Fleet Cumulative Capacity Curves



Graphs over two week sample periods, as shown in Figure 73, display the impacts of different distributed ESR models on fossil, renewable, imports, and curtailments on an hourly granularity. The MAPS internal PSH Method results in more coherent charging (increase in load indicate by dotted lines) and discharging (blue fill) patterns than the HRM Method as a result of the different approaches to model storage. The PSH Method objective has all the storage resources optimizing across the NYCA load and initial thermal generation commitments on a weekly basis. In contrast, the HRM Method results shown is

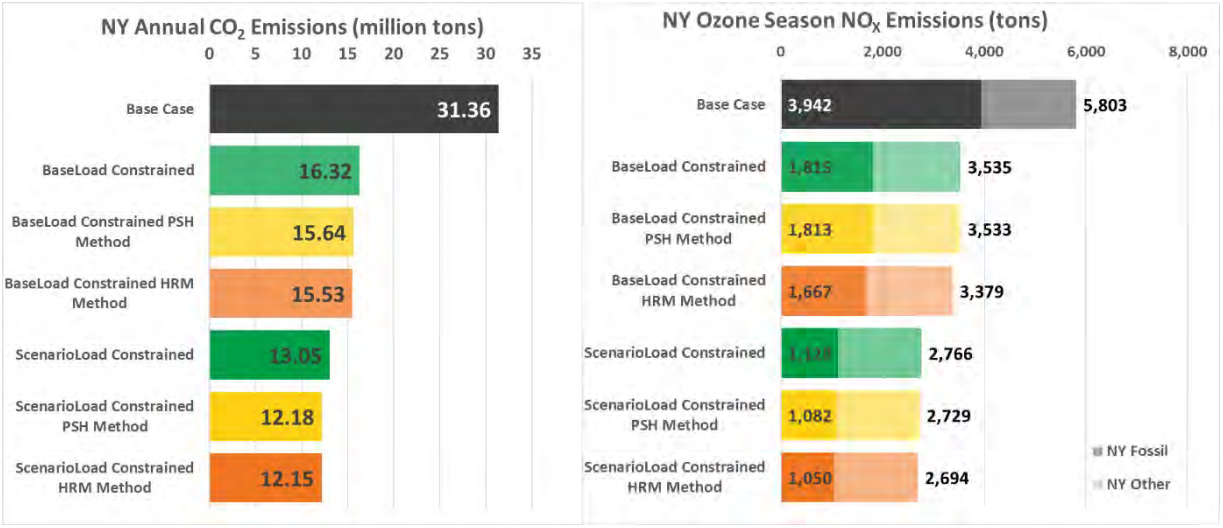
actually the aggregate result of 11 individual optimizations on the zonal daily basis as described above. This result is observable as more uniform dispatches in the HRM cases which tend to spread the ESR utilization across more hours in a day compared to the PSH Method results where they appear to aggregate into a certain subset of hours. Another observation visible in Figure 73 is that the PSH Method targets peak load hours absorbing excess RE generation and dispatching primarily during the evening down ramp hours. By comparison, the HRM Method results tends to absorb excess RE in low load and high load hours and discharges most often during the evening down ramp hours but other hours as well. It can also be observed that across the year the PSH Method provides for smoother fossil fleet output profiles than the HRM Method, indicating generally lower ramping demand. This is due to the PSH Method targeting the initial cost commitment curve to define the ESR dispatch while HRM looks at net load explicitly. Both methods show less fossil generation during low net load periods compared to a case without ESR, as ESR typically reduces peak fossil demand levels. It was also observed for both methods that some (mostly winter) ESR were charging during hours when NYCA was a net importer. This implies that the increased charging demand could increase imports relative to a case without ESR in some hours. Hourly results across each two week period is presented at the end of the 70x30 section appendix.

Figure 73: Energy Storage Resource Hourly Results across a Spring Low Net Load Period



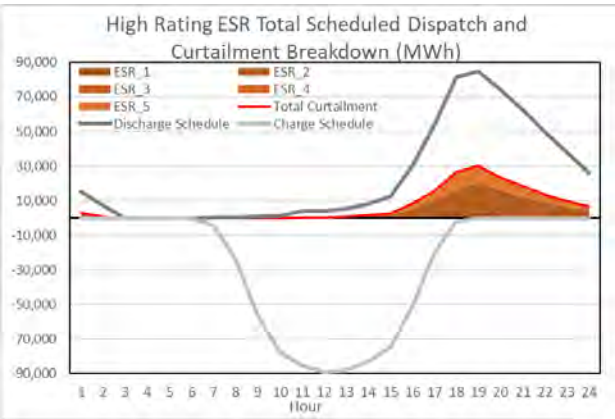
The introduction of ESR does not inherently result in a reduction in emissions or output of fossil generators because on net ESR increase energy demand and this could be associated with increased emissions if not correctly implemented. Figure 74 shows the CO_2 and NO_X emissions of generators located in New York across the Scenario cases and the Base Case. Emissions across all scenario cases decrease substantially from the Base Case results. The additional reduction from both distributed storage models at both load levels are also shown to be relatively small, but non negligible. Again, slightly more pronounced changes occur for the HRM Method cases due to their increased utilization compared the PSH Method case results.

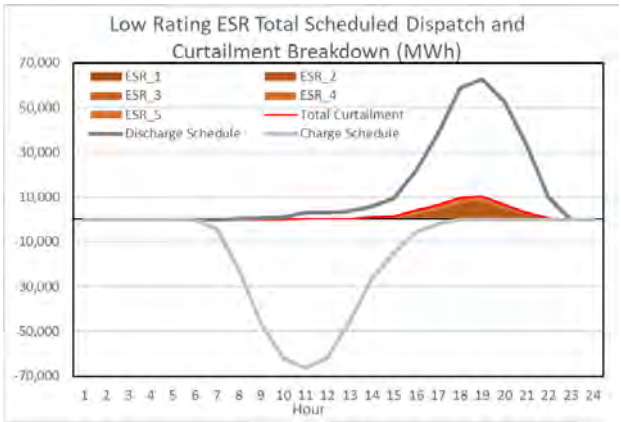
Figure 74: Energy Storage Resource Sensitivity Case CO_2 and Ozone Season NO_X Emissions Projections



The NYISO also performed a limited targeted investigation of the capability of collocated pocket bound ESR to mitigate curtailments, and determine the amount of curtailment that can not be resolved due to inherent limitations in the existing lower voltage transmission network. Based on stakeholder feedback additional information related to the diurnal profile of pocket bound ESR input dispatch and curtailments were aggregated across each hour of the day for the entire modeled year. Input dispatches aggregated across the five ESR units and the individual aggregate curtailments are displayed in Figure 75 in both graphical and tabular form. The High Rating represents 8 hour duration storage with a power capacity approximating the 75th percentile of hourly curtailments while the Low Rating represents 4 hour duration with a power capacity approximately equal to the 50th percentile of hourly curtailment values as described in the body of the report.

Figure 75: Pocket Bound Energy Storage Resource Sensitivity Hourly Aggregate Dispatch and Curtailment





Hour	High Rating							
	ESR Schedule		ESR Curtailmement					
	Charge	Discharge	ESR_1	ESR_2	ESR_3	ESR_4	ESR_5	Total
1	0	15,266	163	2,091	0	5	816	3,075
2	0	7,107	4	657	0	0	133	794
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	-132	0	0	0	0	0	0	0
7	-4,453	54	0	0	0	0	0	0
8	-23,974	354	0	0	0	0	0	0
9	-55,975	655	0	0	0	0	0	0
10	-77,793	1,100	0	0	0	0	0	0
11	-85,799	3,849	0	320	0	0	101	421
12	-89,203	3,958	0	77	0	125	93	295
13	-88,376	5,317	112	318	0	161	112	703
14	-83,389	7,757	27	937	0	212	492	1,668
15	-74,612	12,398	211	1,453	0	362	690	2,716
16	-51,293	30,079	607	3,939	37	1,391	2,249	8,224
17	-20,139	53,760	1,640	7,714	0	1,843	4,356	15,552
18	-1,853	81,642	2,790	13,101	161	1,887	8,834	26,774
19	0	84,706	2,793	17,615	405	952	8,474	30,239
20	0	74,250	1,918	13,984	155	525	6,800	23,383
21	0	62,275	1,517	10,914	0	389	5,423	18,243
22	0	49,860	845	8,066	92	256	4,197	13,457
23	0	37,901	730	5,787	0	115	3,004	9,636
24	0	26,139	794	3,660	0	23	1,911	6,388

Hour	Low Rating							
	ESR Schedule		ESR Curtailmement					
	Charge	Discharge	ESR_1	ESR_2	ESR_3	ESR_4	ESR_5	Total
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	-132	0	0	0	0	0	0	0
7	-4,441	54	0	0	0	0	0	0
8	-22,322	349	0	0	0	0	0	0
9	-46,923	528	0	0	0	0	0	0
10	-61,976	923	0	0	0	0	0	0
11	-66,452	3,148	0	205	0	0	78	283
12	-61,933	3,052	0	49	0	20	82	151
13	-45,355	3,925	0	182	0	55	45	282
14	-26,683	5,973	0	605	0	50	211	866
15	-15,124	9,290	59	877	0	79	294	1,308
16	-5,636	21,824	84	2,508	0	394	989	3,975
17	-1,884	38,228	132	4,246	0	305	1,701	6,383
18	-117	58,757	161	7,102	0	240	2,329	9,832
19	0	62,799	128	8,100	0	8	2,189	10,425
20	0	52,567	327	4,680	41	18	1,637	6,703
21	0	33,594	248	1,843	23	38	1,059	3,211
22	0	10,109	10	310	0	0	417	737
23	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0

Nuclear Sensitivity Result Details

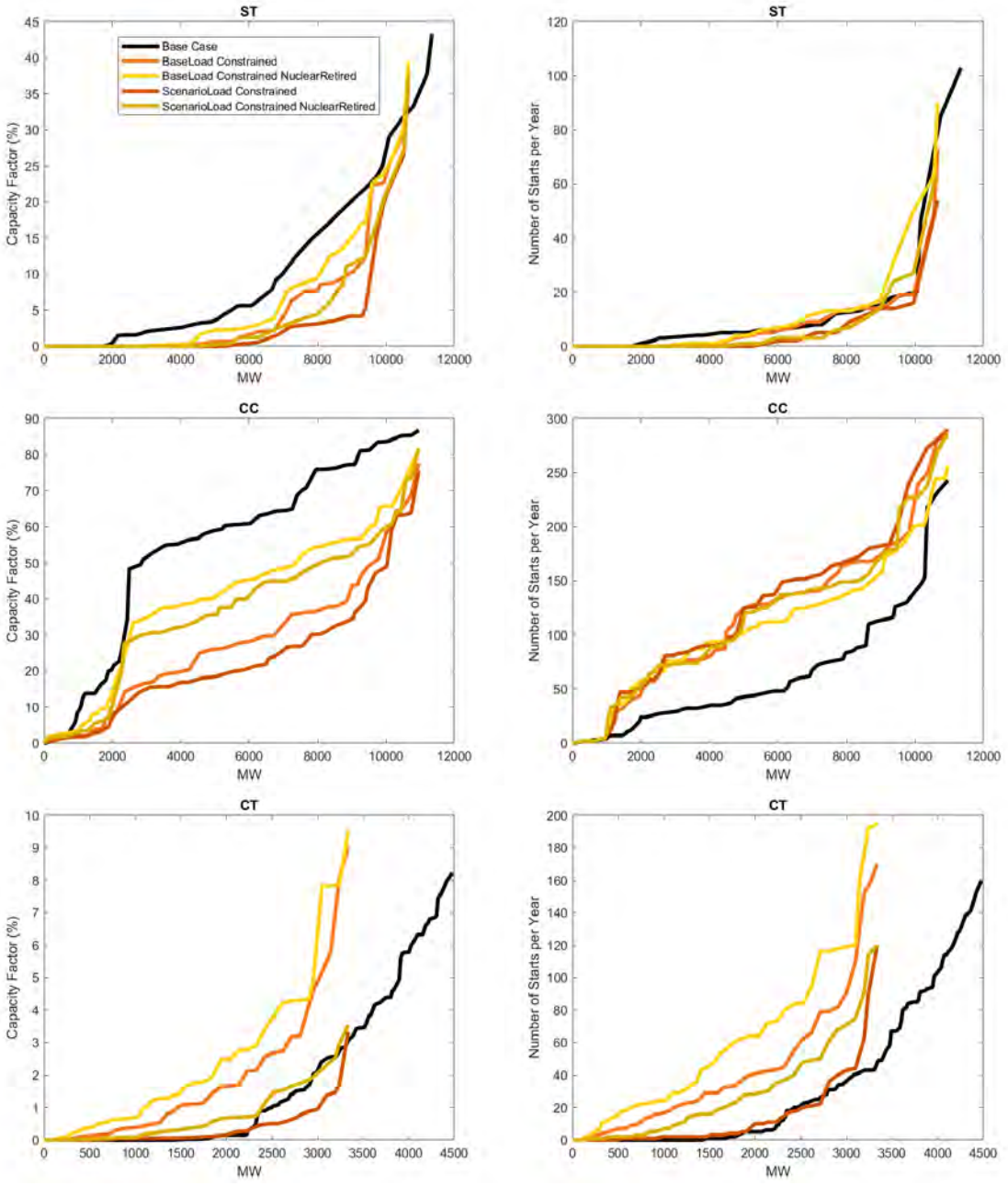
Distinctions between fossil fuel operation in cases with and without nuclear generation can be further studied from the cumulative capacity curves shown below in Figure 76. Steam turbine capacity factors are lower in scenario cases compared to the Base Case even though the number of starts remains consistent across all cases. This result can be attributed to; (i) steam units fulfilling contract and local reliability requirements by remaining on at minimum generation levels, (ii) the location of the nuclear units upstate while the majority of operating steam turbines are located downstate, and (iii) steam turbine generators' lower relative flexibility compared to other fossil generators.

Combined cycle units, which offer more flexibility in operation compared to steam turbine units, have more starts in all scenario cases. Moreover, combined cycle units operate at higher capacity factors across the board when the upstate nuclear fleet is retired. Combined cycle resources operate as marginal units filling in between renewable energy resources in the absence of nuclear generation, which produces a pronounced gap in the cumulative curves between the sensitivity cases.

Combustion turbines offer rapid response to net load variability in cases with high renewable penetration. These units have shorter minimum run time and minimum down time characteristics, which allows for very flexible operation. Similar to other fossil units, these units operate at higher capacity factors in cases with nuclear generation retired.

Across all unit types, capacity factors are higher for Base load cases compared to Scenario load cases because of the higher load levels.

Figure 76: Nuclear Retirement Sensitivity Cases Fossil Fleet Cumulative Capacity Curves



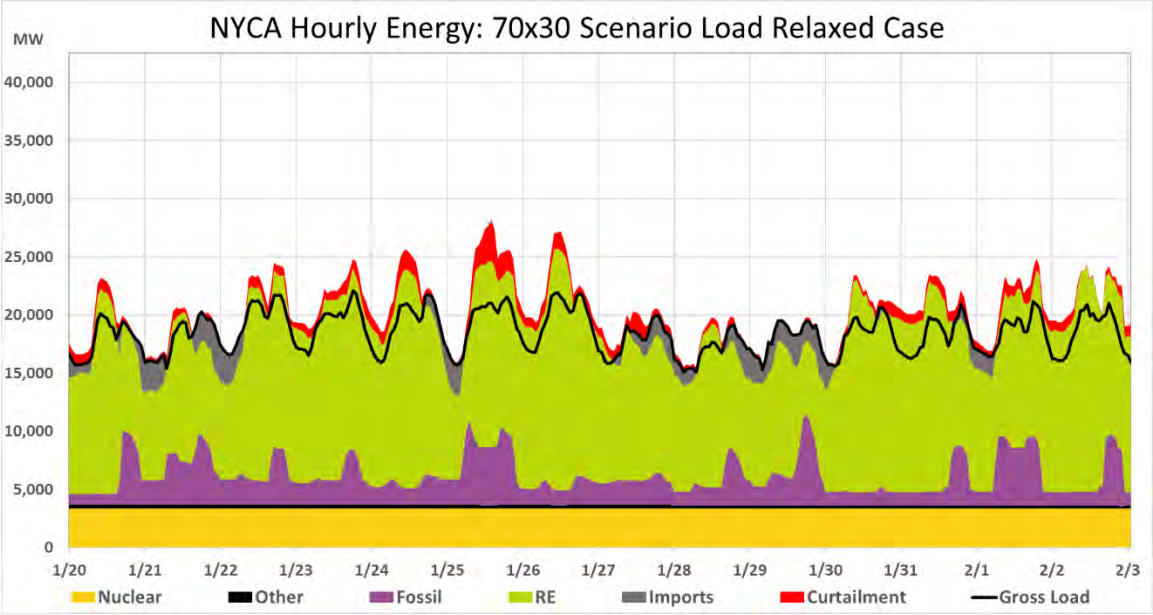
Sample Interval Hourly Examples

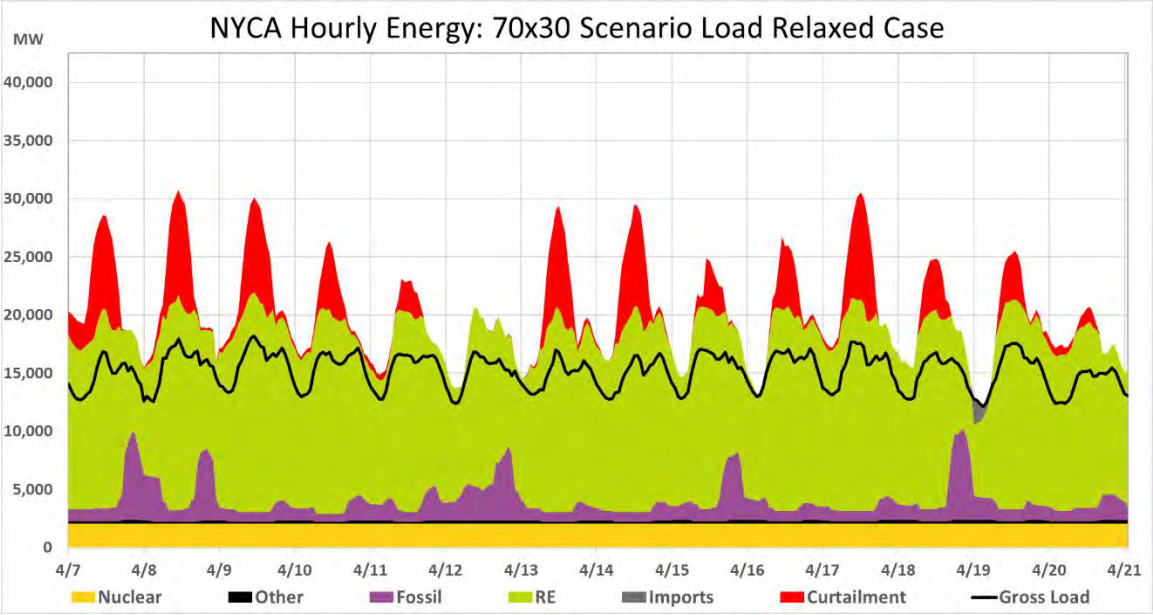
In order to examine the system condition more closely, four two-week periods across the annual hourly simulations were reviewed that are representative of combinations of RE generation and load levels:

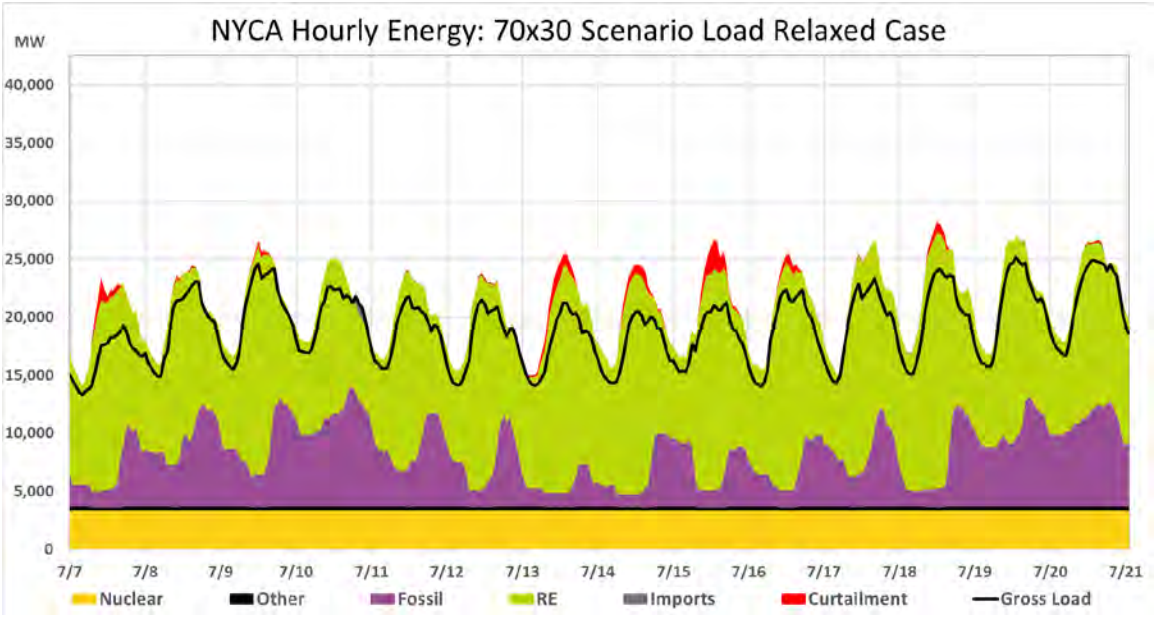
- January: during winter peak load and low renewable generation period
- April: during spring low net load period (high renewable generation during low load)
- July: during summer peak load period
- October: during fall low load and low renewable generation period

The following figures display results during these periods in the relaxed, constrained, nuclear retired, ESR, and HRM cases for both the Scenario and Base Load cases.

Figure 77: Sample Interval Hourly Examples: Scenario Load Relaxed Case






NYCA Hourly Energy: 70x30 Scenario Load Relaxed Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
7/16
7/17
7/18
7/19
7/20
7/21
Nuclear
Other
Fossil
RE
Imports
Curtailment
Gross Load

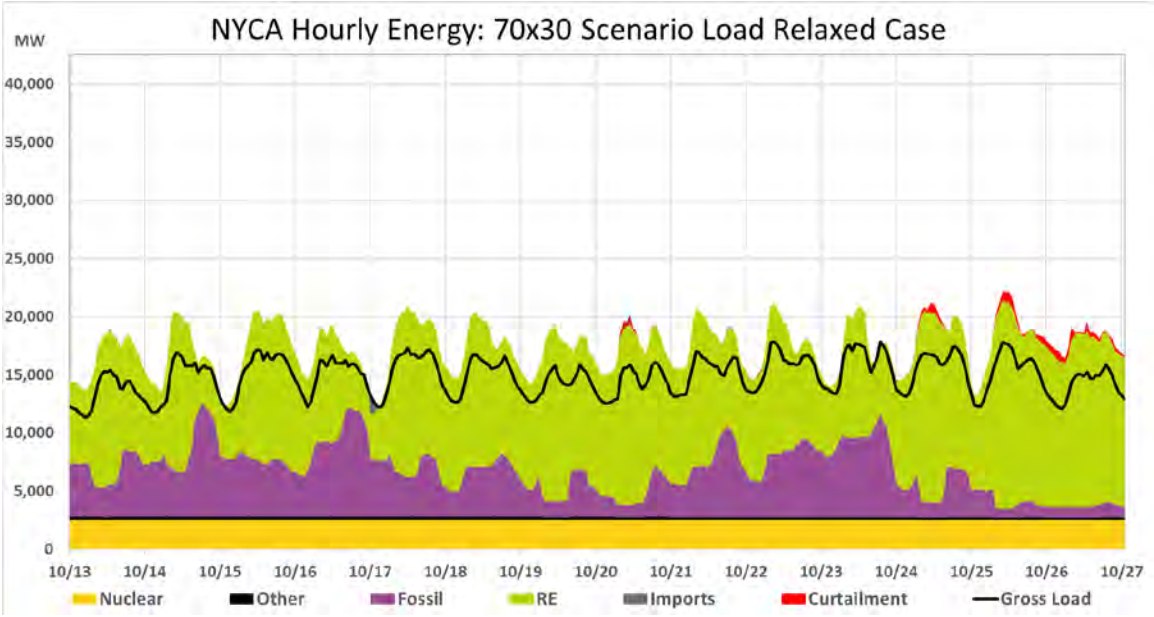
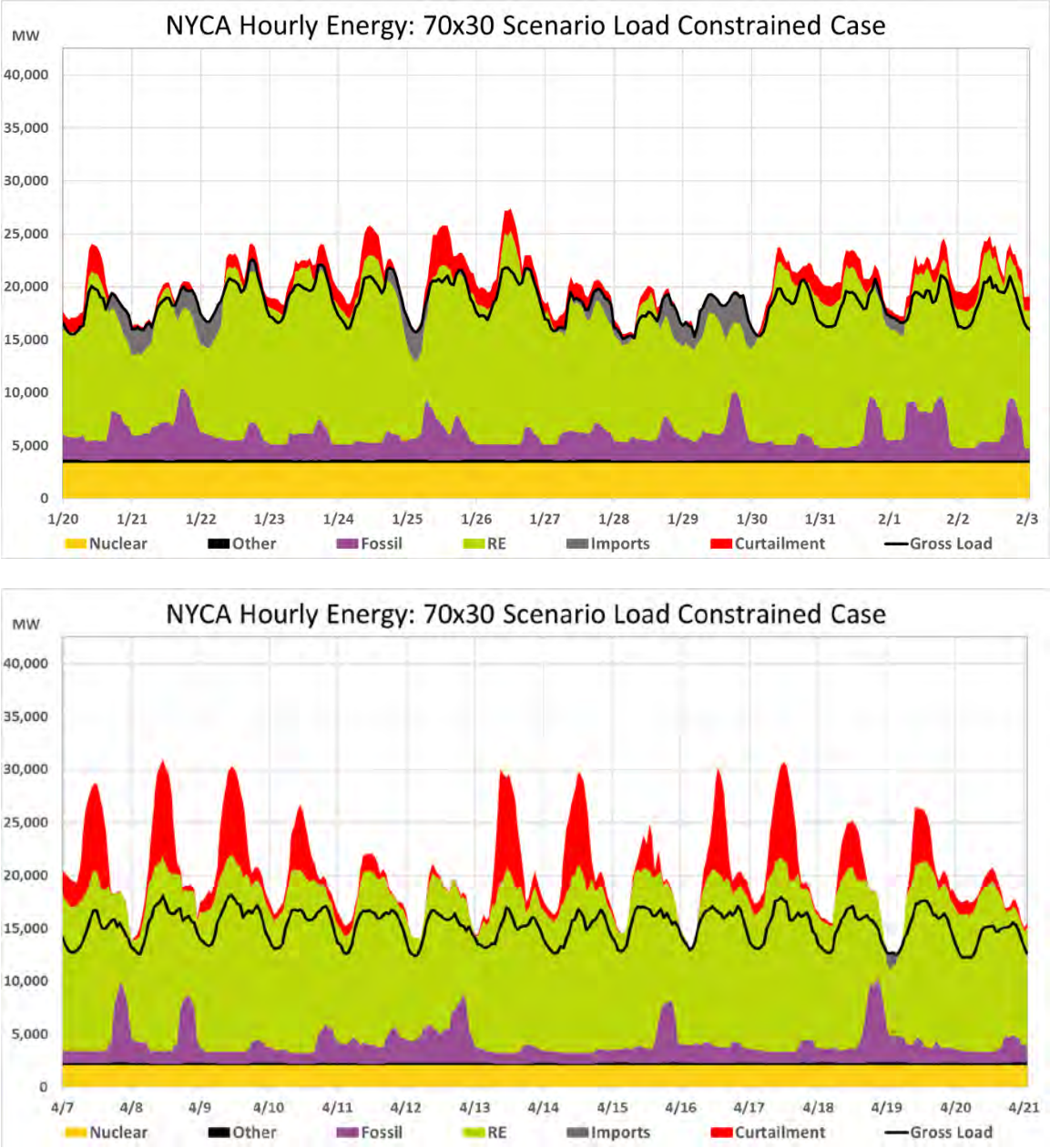
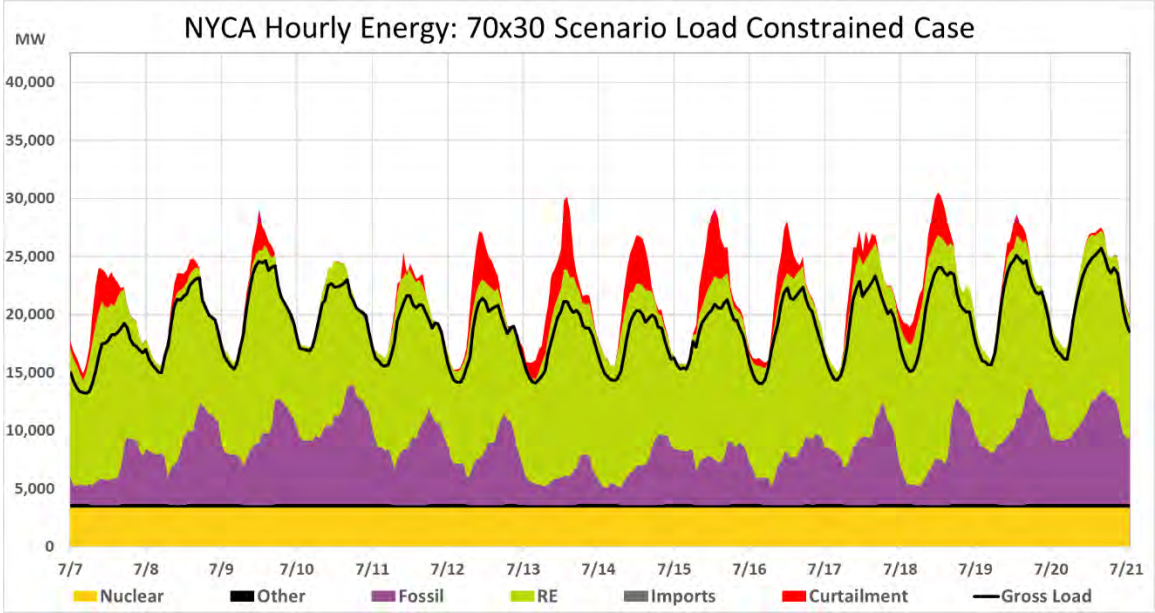

NYCA Hourly Energy: 70x30 Scenario Load Relaxed Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
10/13
10/14
10/15
10/16
10/17
10/18
10/19
10/20
10/21
10/22
10/23
10/24
10/25
10/26
10/27
Nuclear
Other
Fossil
RE
Imports
Curtailment
Gross Load

Figure 78: Sample Interval Hourly Examples: Scenario Load Constrained Case




NYCA Hourly Energy: 70x30 Scenario Load Constrained Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
7/16
7/17
7/18
7/19
7/20
7/21
Nuclear
Other
Fossil
RE
Imports
Curtailment
Gross Load

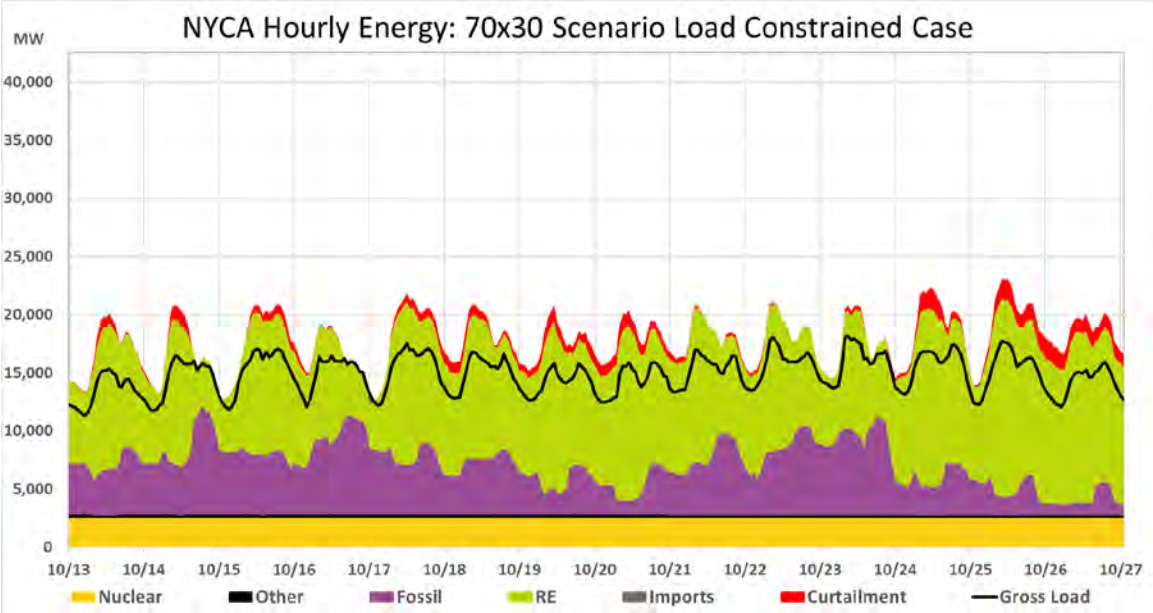
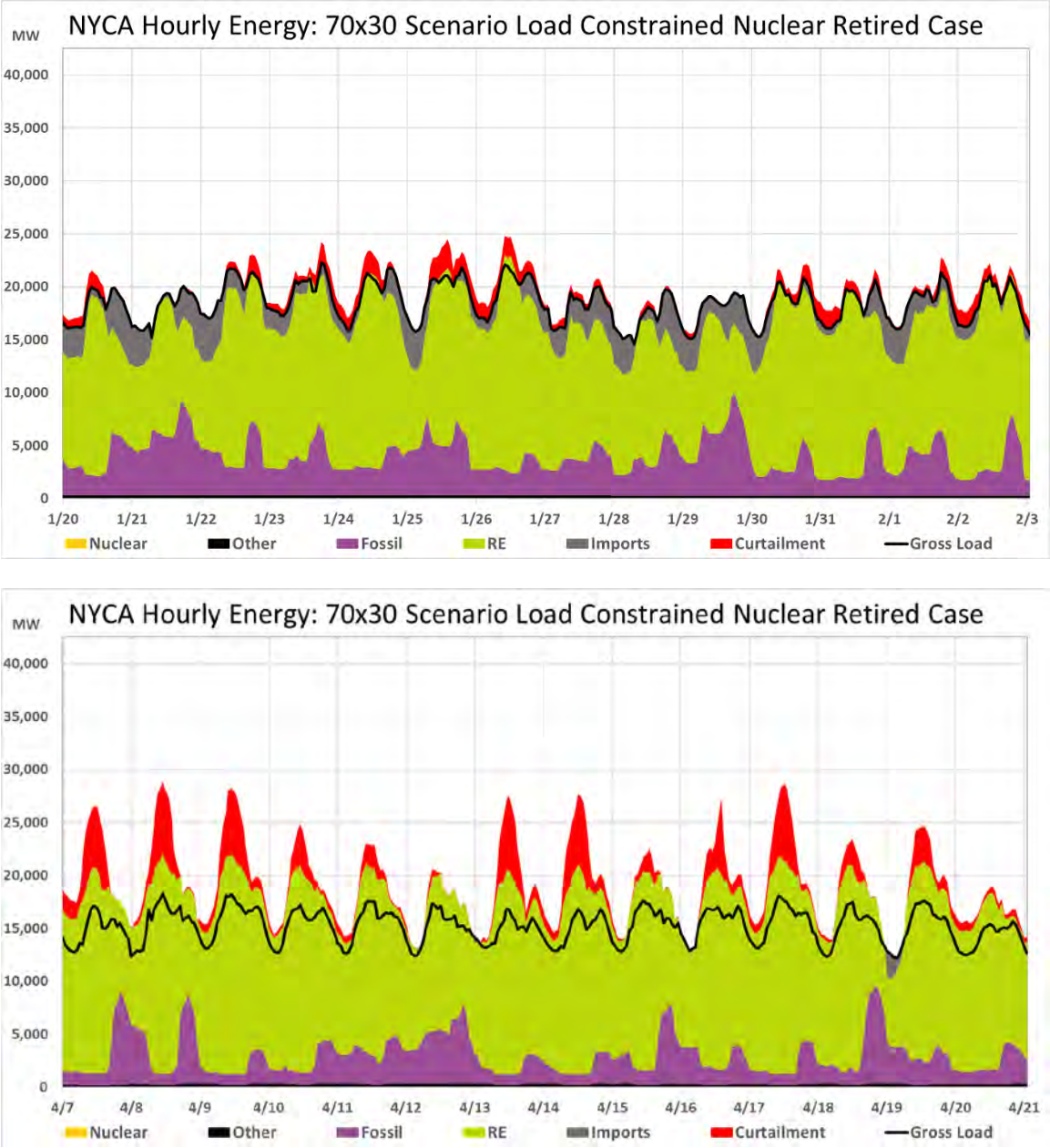
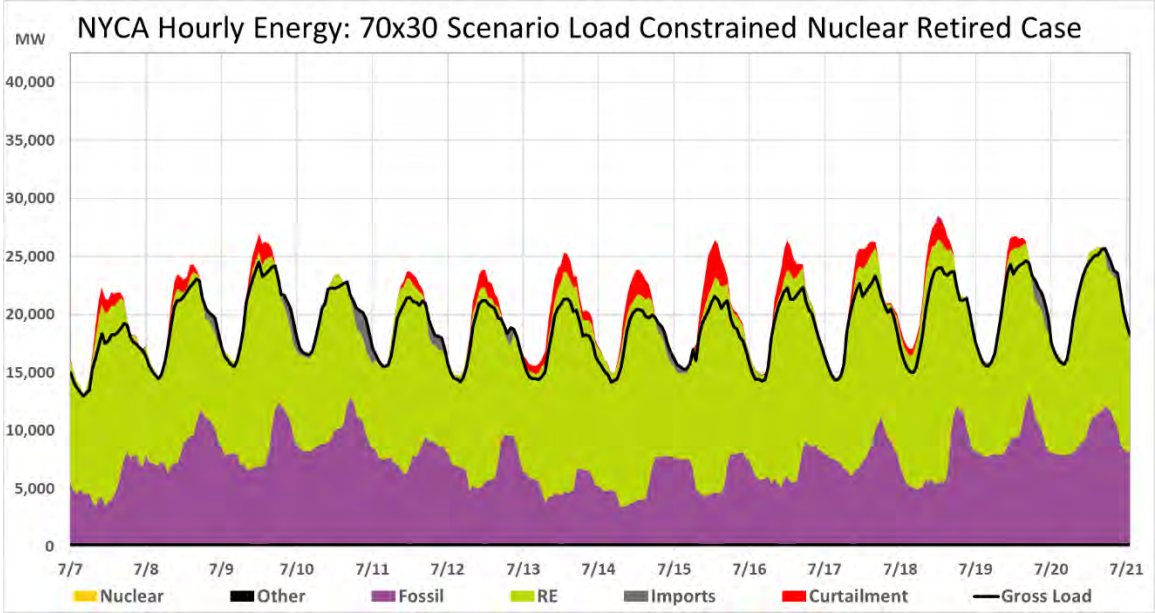

NYCA Hourly Energy: 70x30 Scenario Load Constrained Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
10/13
10/14
10/15
10/16
10/17
10/18
10/19
10/20
10/21
10/22
10/23
10/24
10/25
10/26
10/27
Nuclear
Other
Fossil
RE
Imports
Curtailment
Gross Load

Figure 79: Sample Interval Hourly Examples: Scenario Load Nuclear Retired Case




NYCA Hourly Energy: 70x30 Scenario Load Constrained Nuclear Retired Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
7/16
7/17
7/18
7/19
7/20
7/21
Nuclear
Other
Fossil
RE
Imports
Curtailment
Gross Load

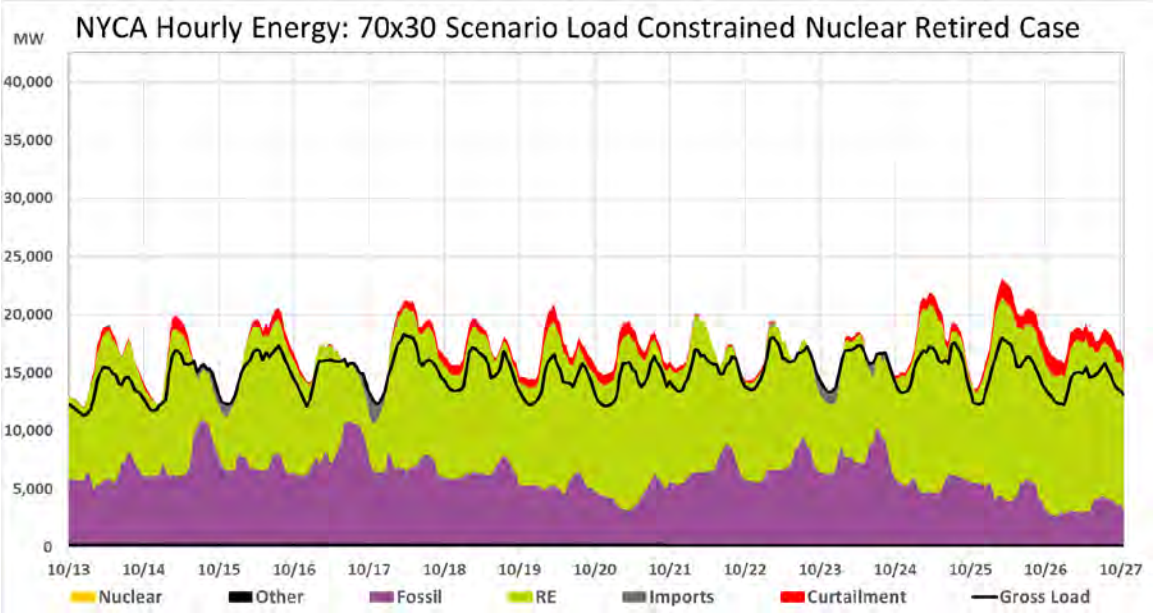
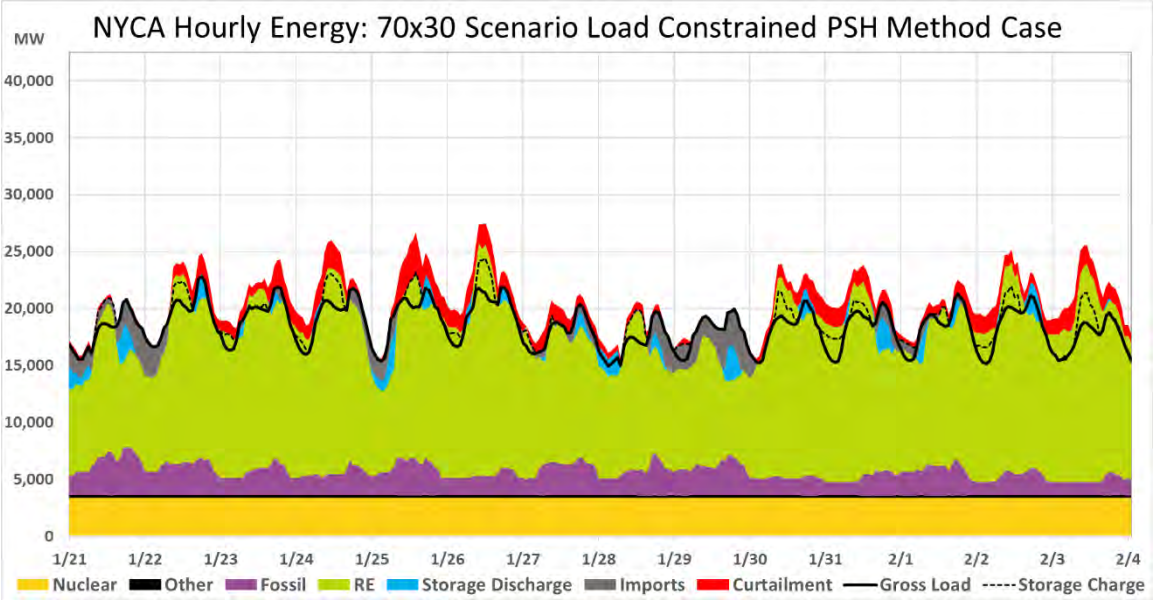
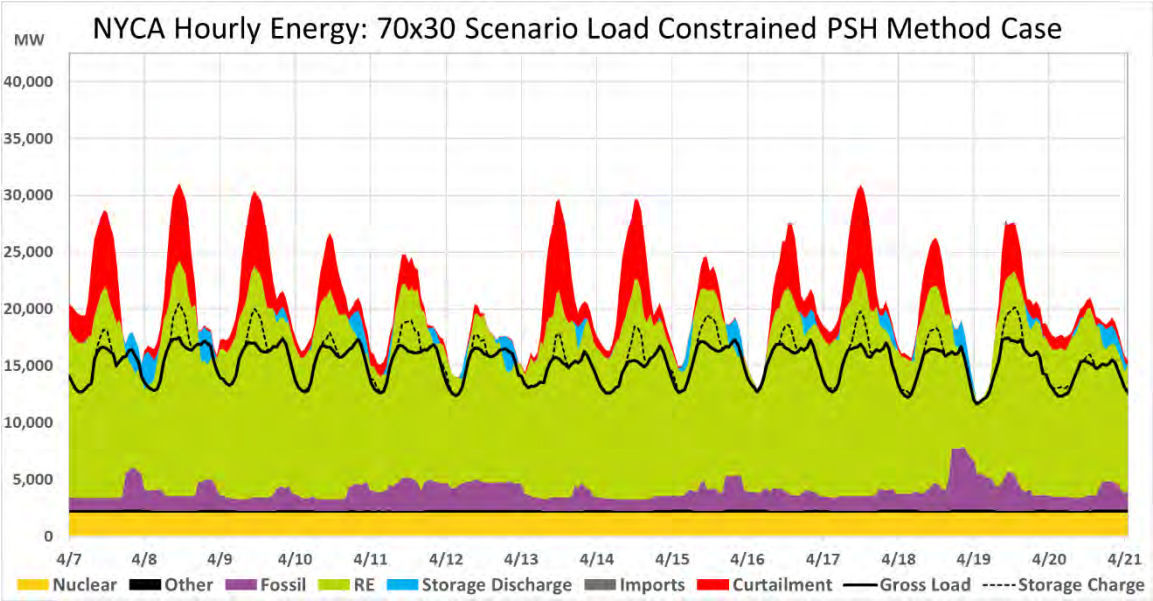
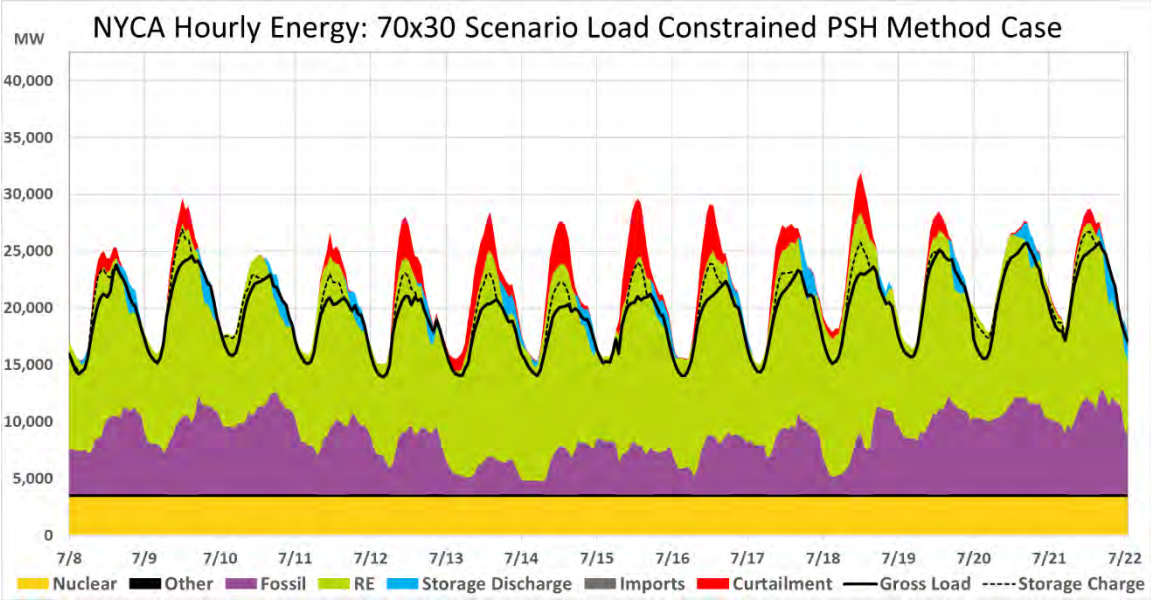

NYCA Hourly Energy: 70x30 Scenario Load Constrained Nuclear Retired Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
10/13
10/14
10/15
10/16
10/17
10/18
10/19
10/20
10/21
10/22
10/23
10/24
10/25
10/26
10/27
Nuclear
Other
Fossil
RE
Imports
Curtailment
Gross Load

Figure 80: Sample Interval Hourly Examples: Scenario Load PSH Method Case






NYCA Hourly Energy: 70x30 Scenario Load Constrained PSH Method Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
7/16
7/17
7/18
7/19
7/20
7/21
7/22
Nuclear
Other
Fossil
RE
Storage Discharge
Imports
Curtailment
Gross Load
Storage Charge

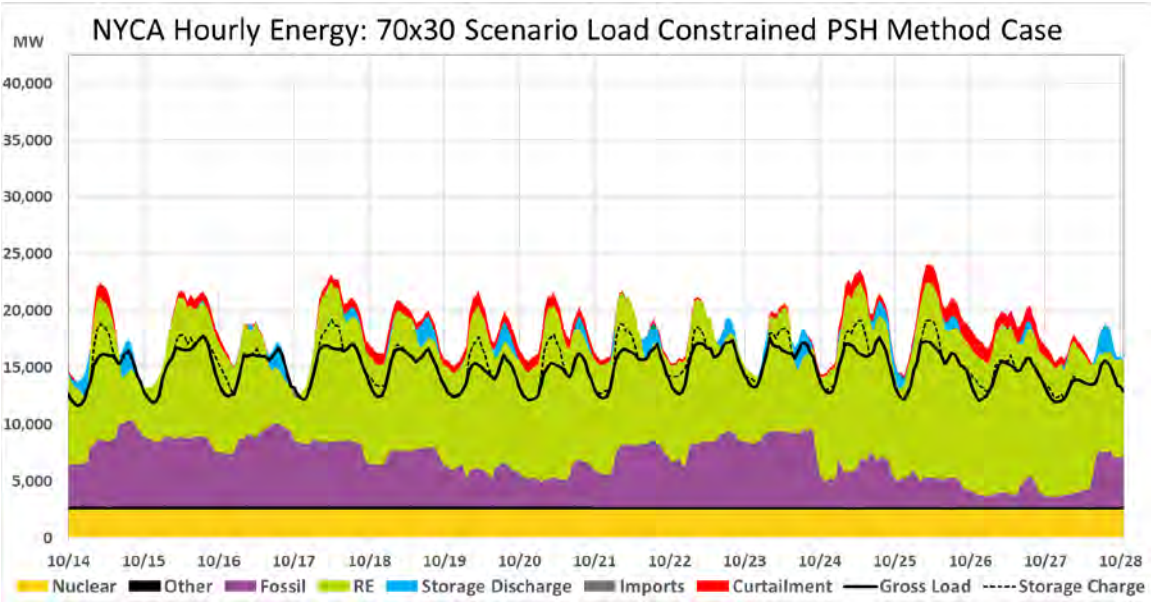
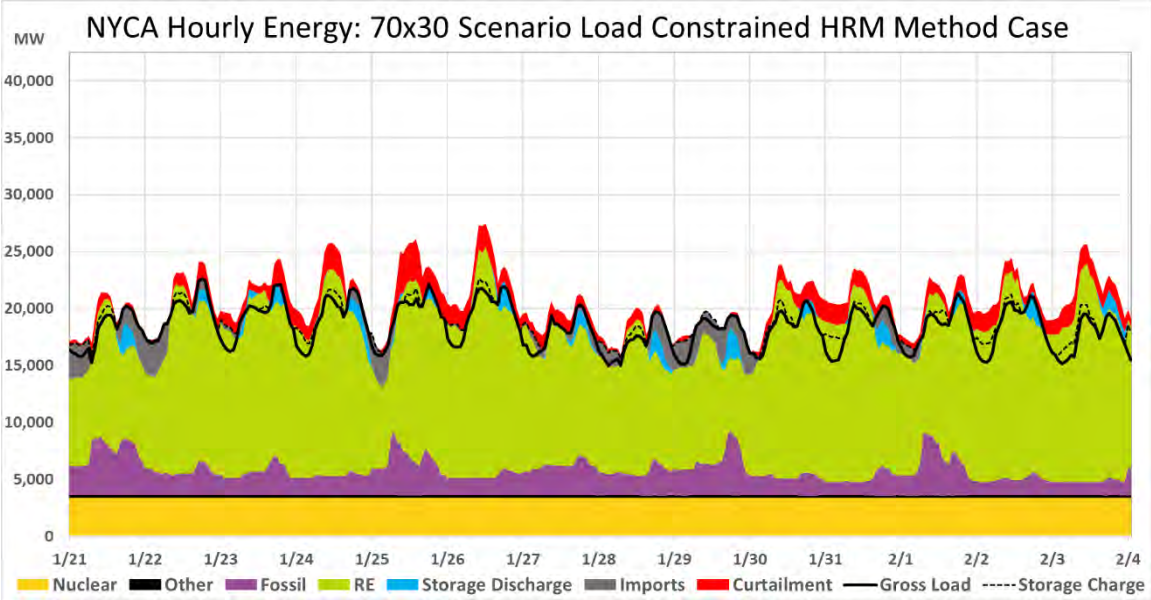
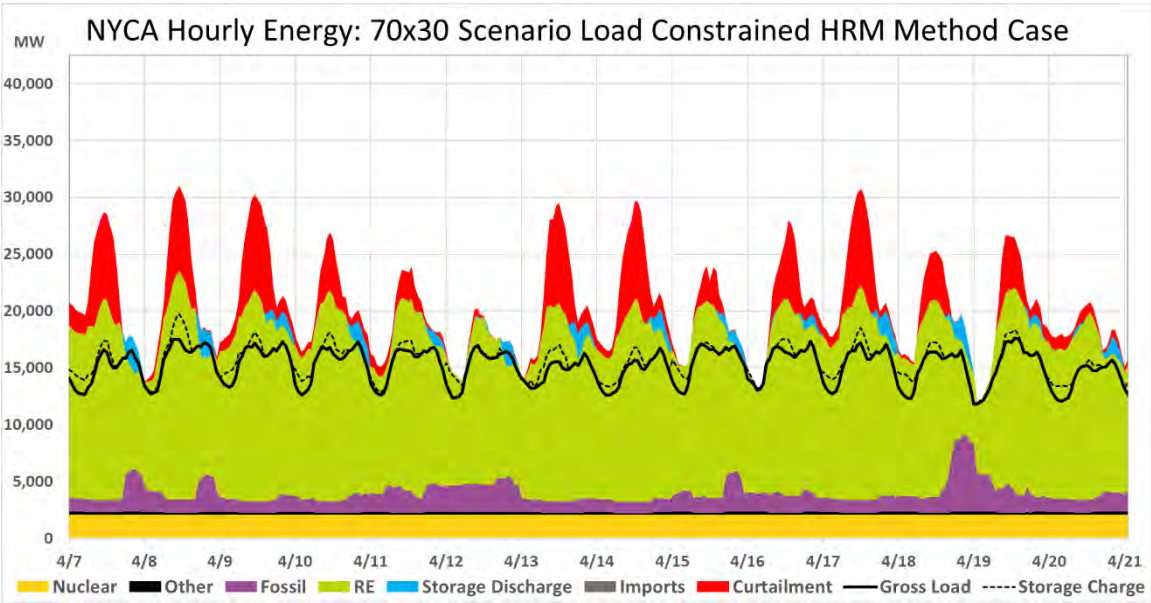
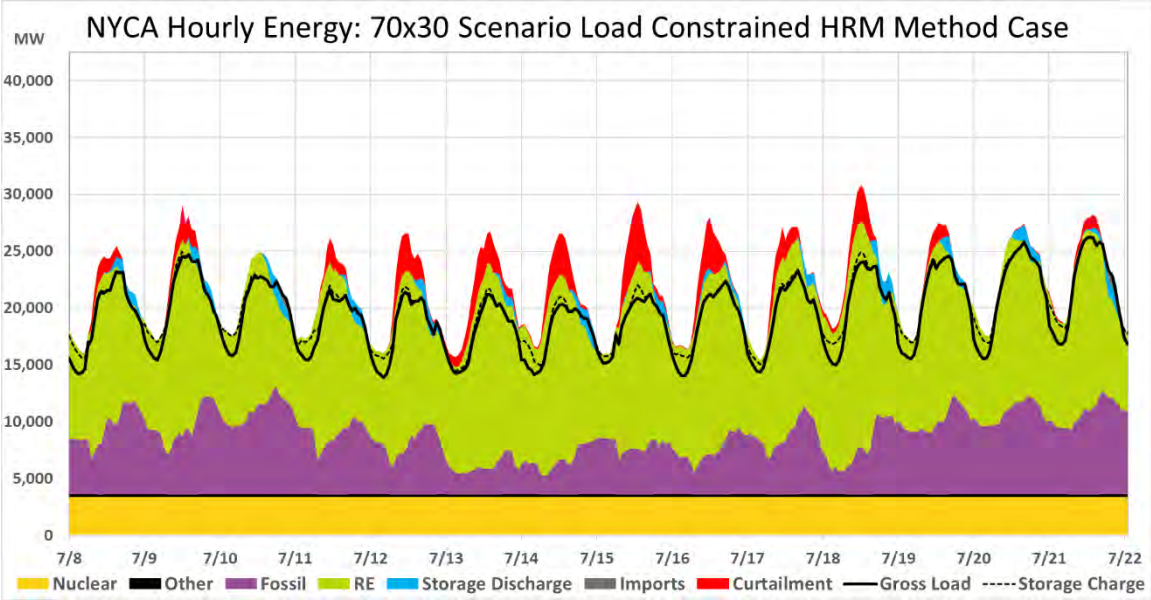

NYCA Hourly Energy: 70x30 Scenario Load Constrained PSH Method Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
10/14
10/15
10/16
10/17
10/18
10/19
10/20
10/21
10/22
10/23
10/24
10/25
10/26
10/27
10/28
Nuclear
Other
Fossil
RE
Storage Discharge
Imports
Curtailment
Gross Load
Storage Charge

Figure 81: Sample Interval Hourly Examples: Scenario Load HRM Method Case






NYCA Hourly Energy: 70x30 Scenario Load Constrained HRM Method Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
7/16
7/17
7/18
7/19
7/20
7/21
7/22
Nuclear
Other
Fossil
RE
Storage Discharge
Imports
Curtailment
Gross Load
Storage Charge

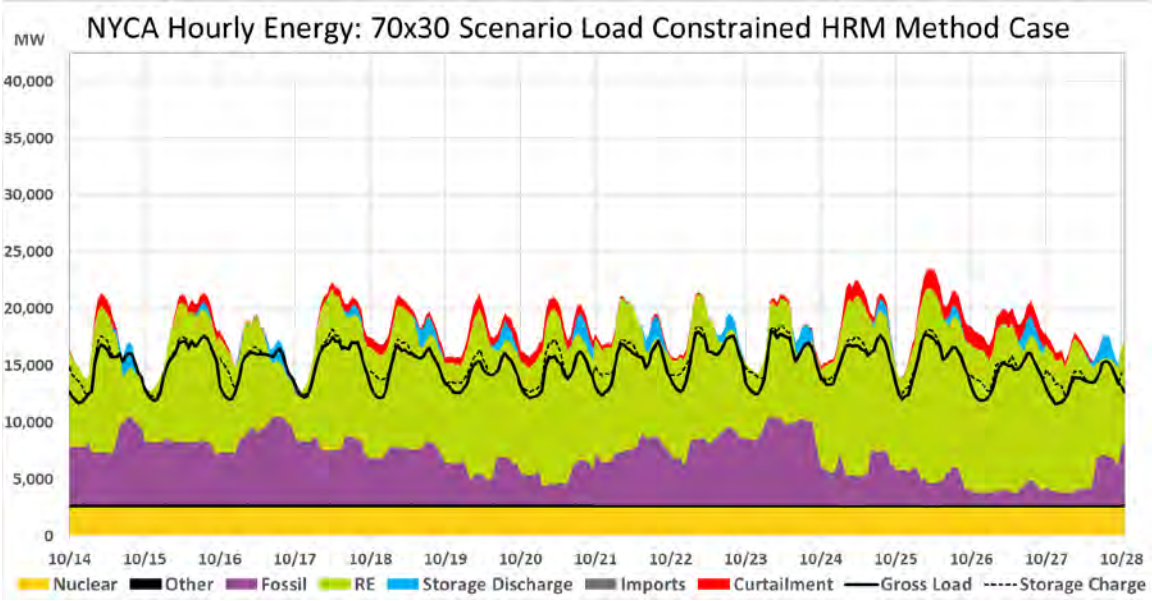
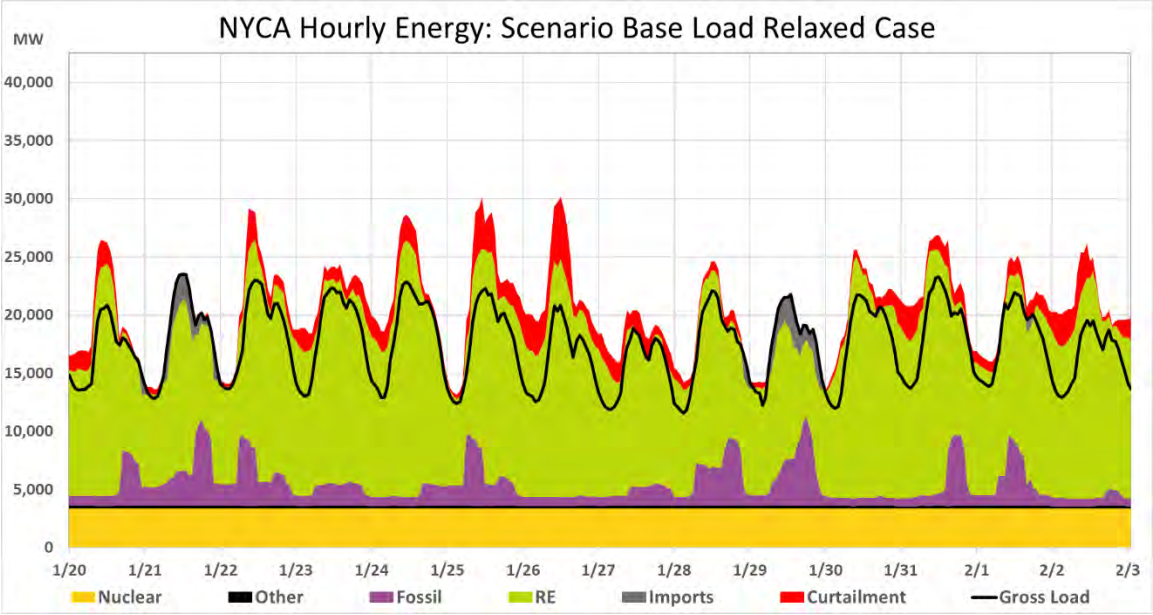
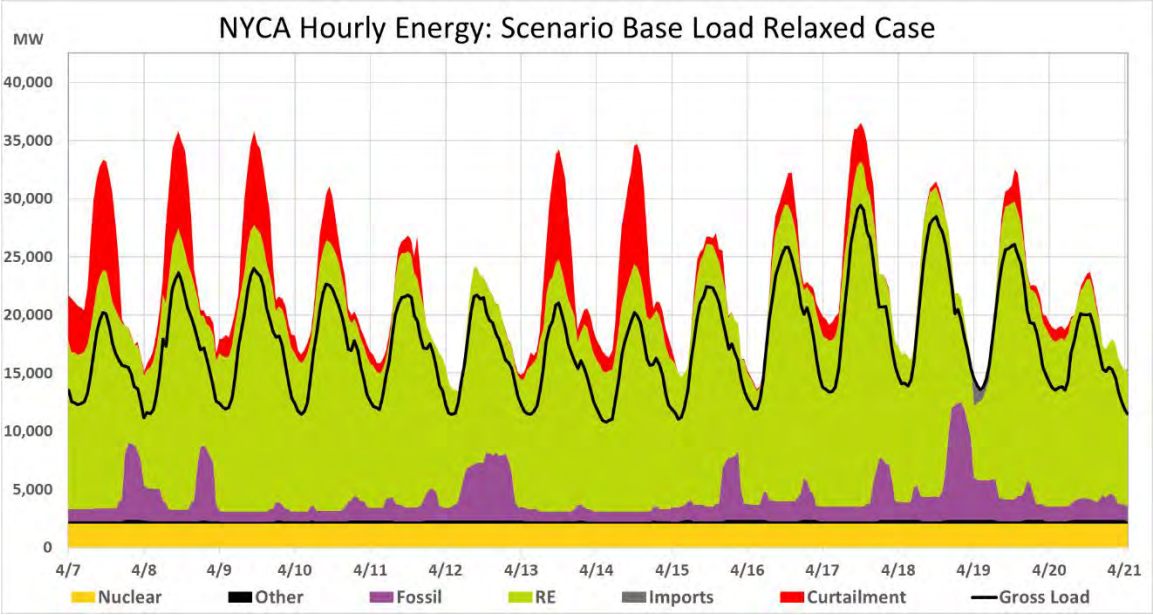
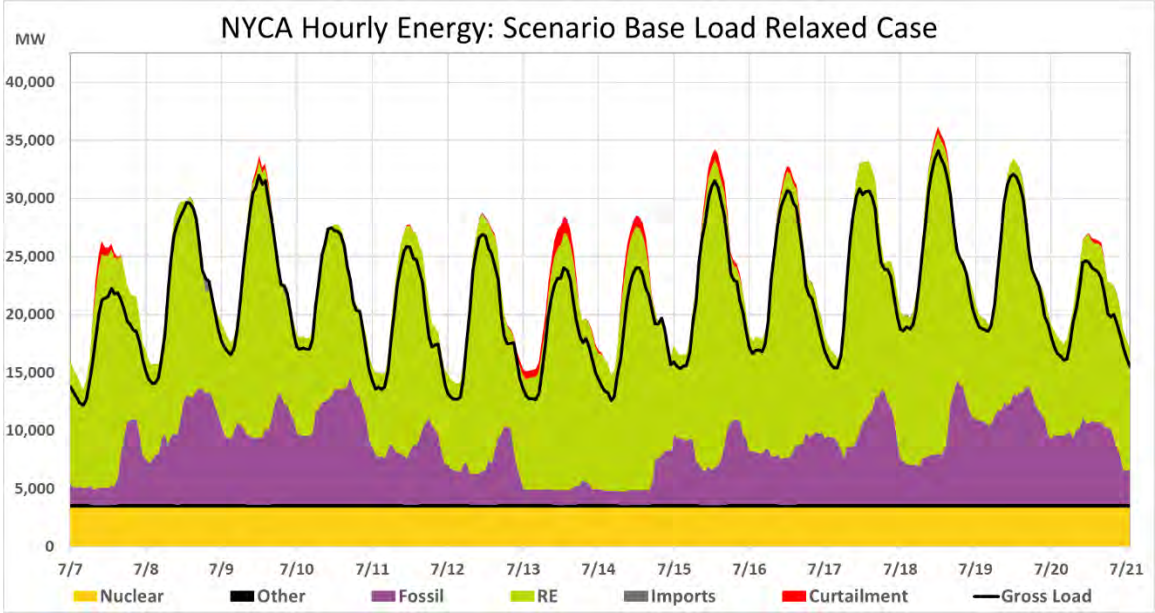

NYCA Hourly Energy: 70x30 Scenario Load Constrained HRM Method Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
10/14
10/15
10/16
10/17
10/18
10/19
10/20
10/21
10/22
10/23
10/24
10/25
10/26
10/27
10/28
Nuclear
Other
Fossil
RE
Storage Discharge
Imports
Curtailment
Gross Load
Storage Charge

Figure 82: Sample Interval Hourly Examples: Base Load Relaxed Case






NYCA Hourly Energy: Scenario Base Load Relaxed Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
7/16
7/17
7/18
7/19
7/20
7/21
Nuclear
Other
Fossil
RE
Imports
Curtailment
Gross Load

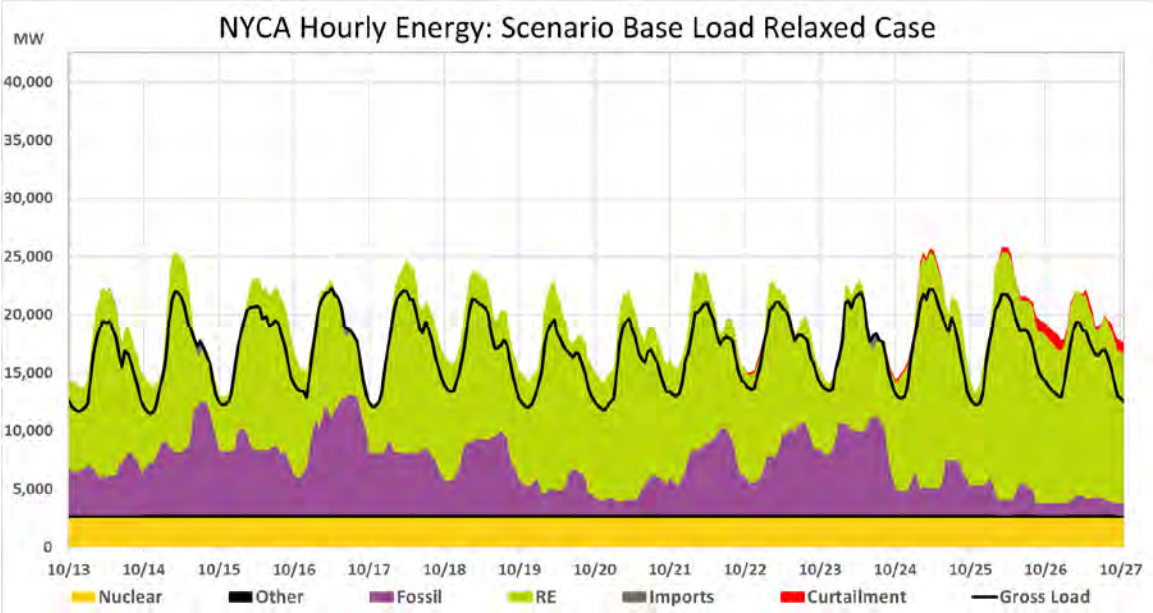
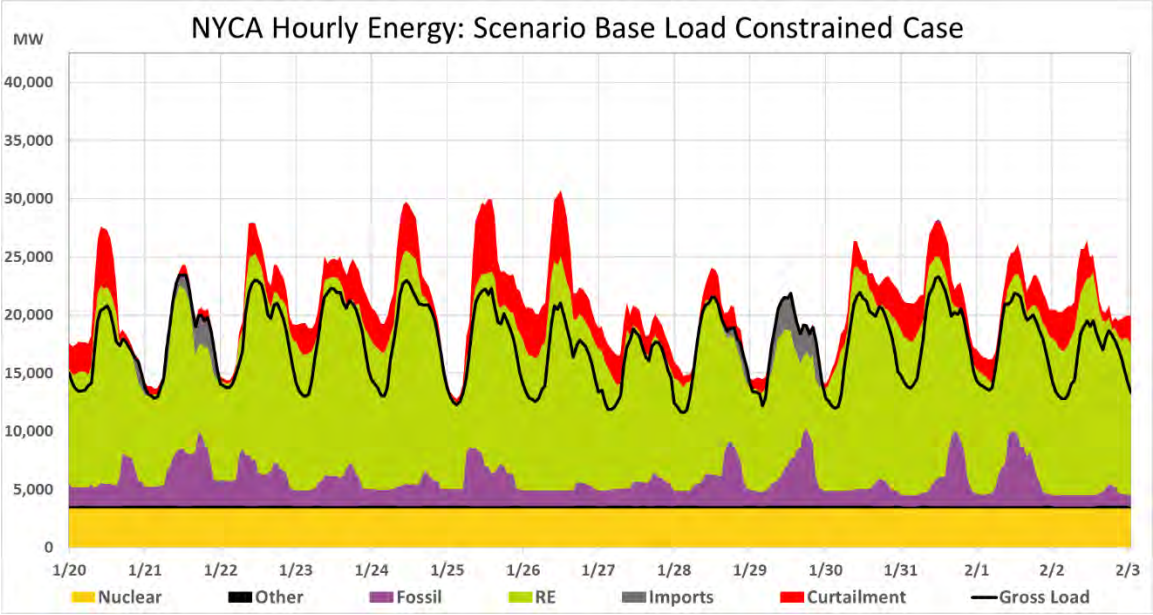
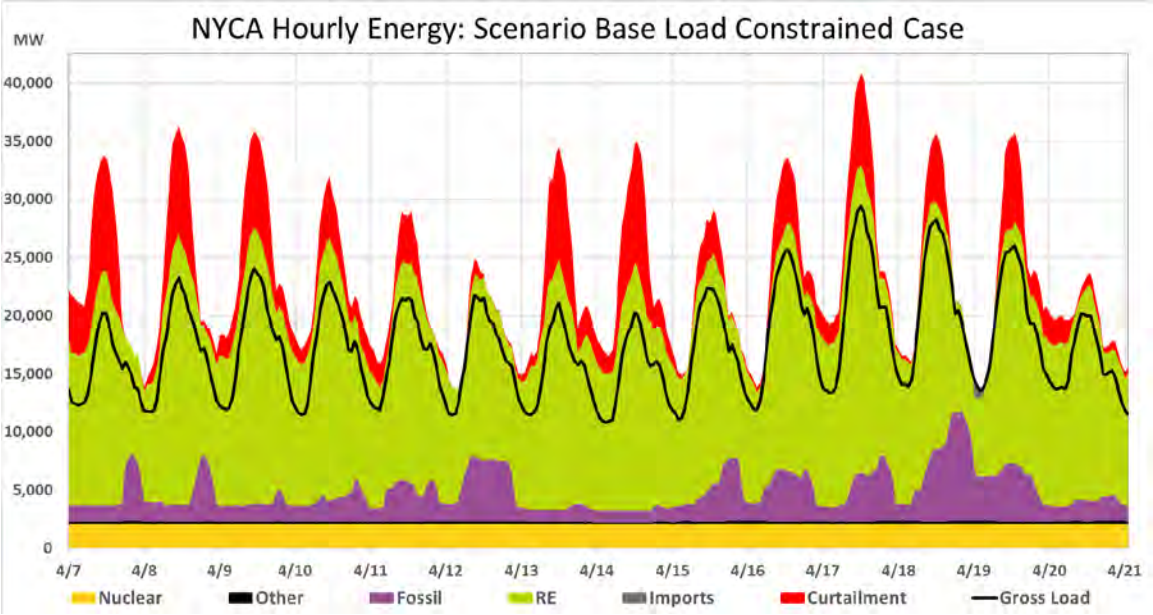
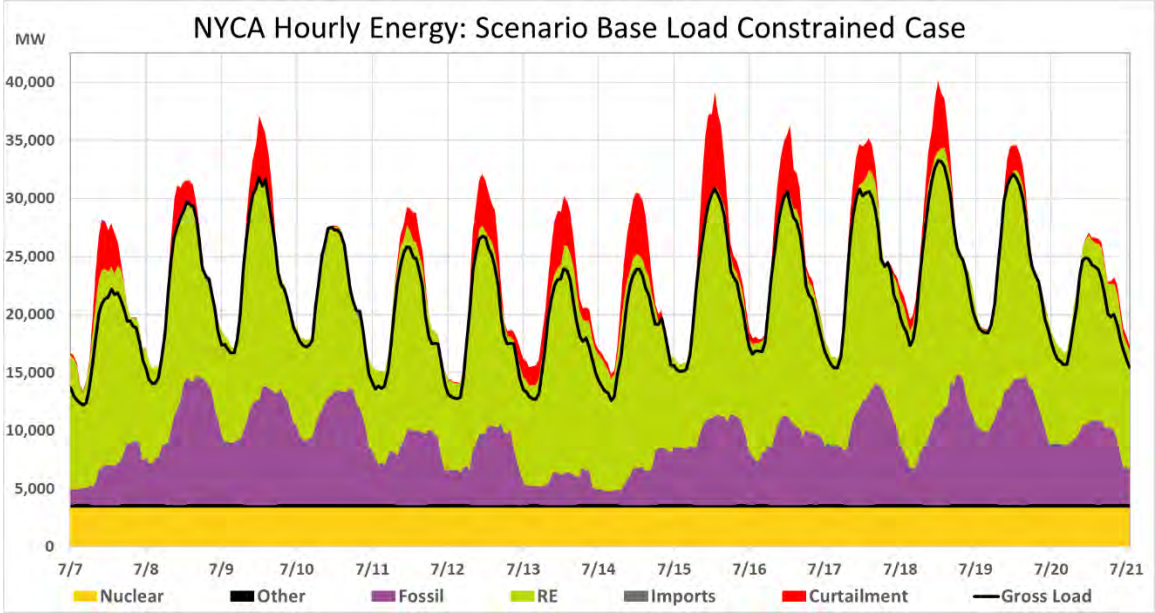

NYCA Hourly Energy: Scenario Base Load Relaxed Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
10/13
10/14
10/15
10/16
10/17
10/18
10/19
10/20
10/21
10/22
10/23
10/24
10/25
10/26
10/27
Nuclear
Other
Fossil
RE
Imports
Curtailment
Gross Load

Figure 83: Sample Interval Hourly Examples: Base Load Constrained Case






NYCA Hourly Energy: Scenario Base Load Constrained Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
7/16
7/17
7/18
7/19
7/20
7/21
Nuclear
Other
Fossil
RE
Imports
Curtailment
Gross Load

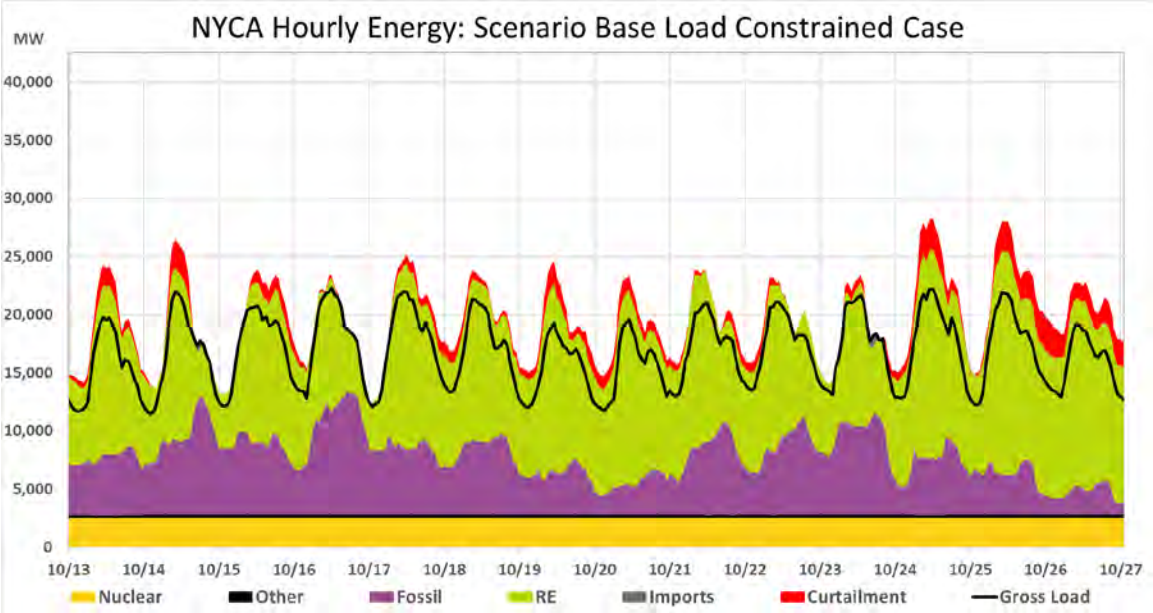
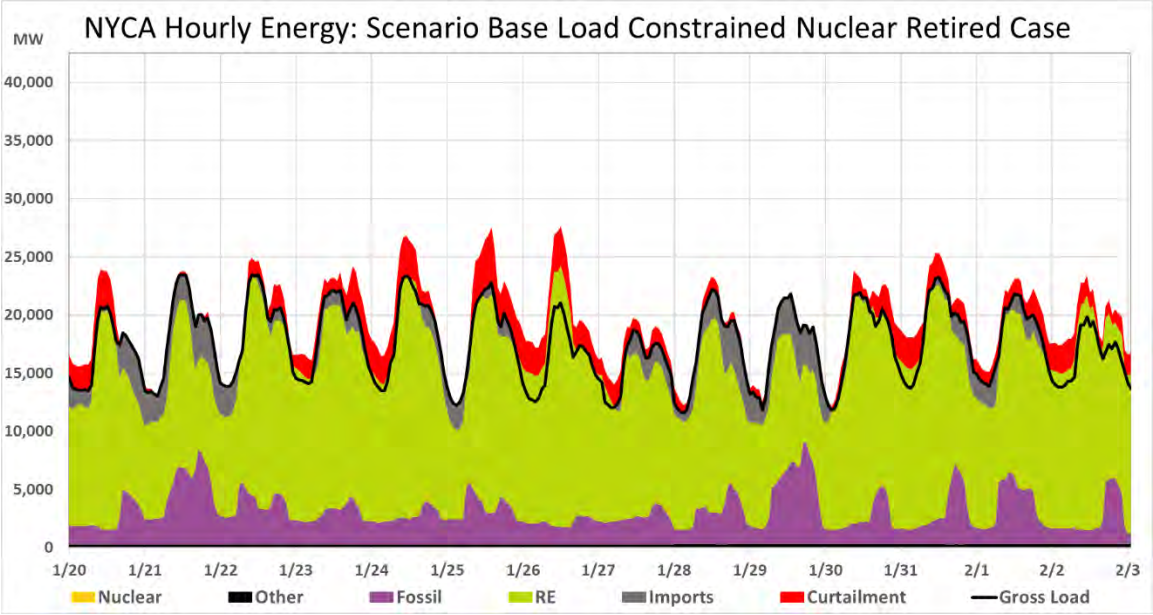
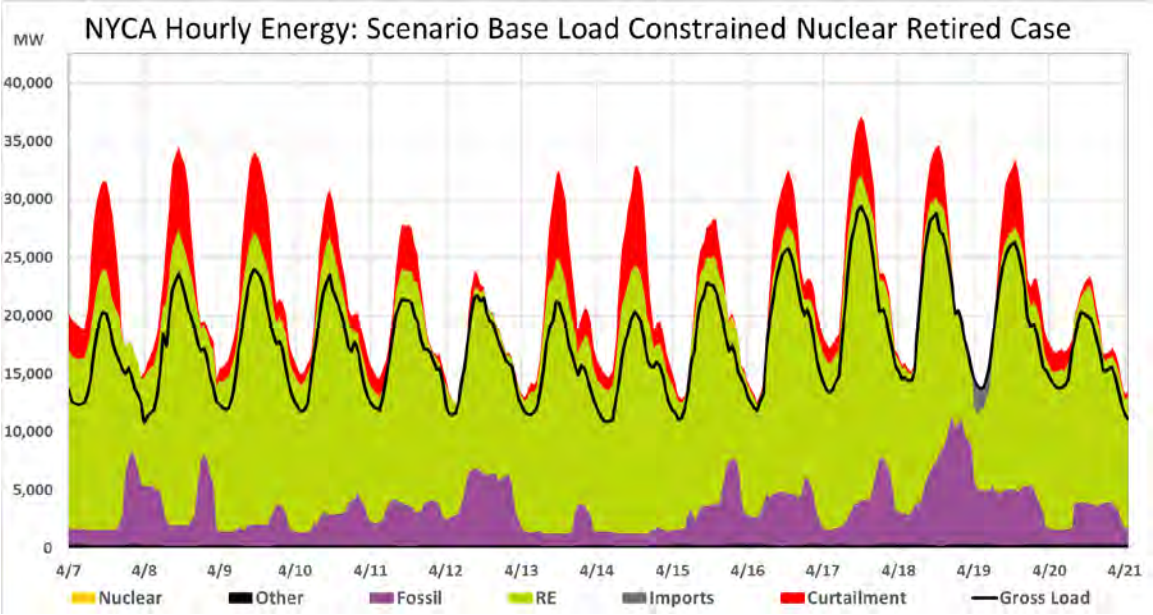
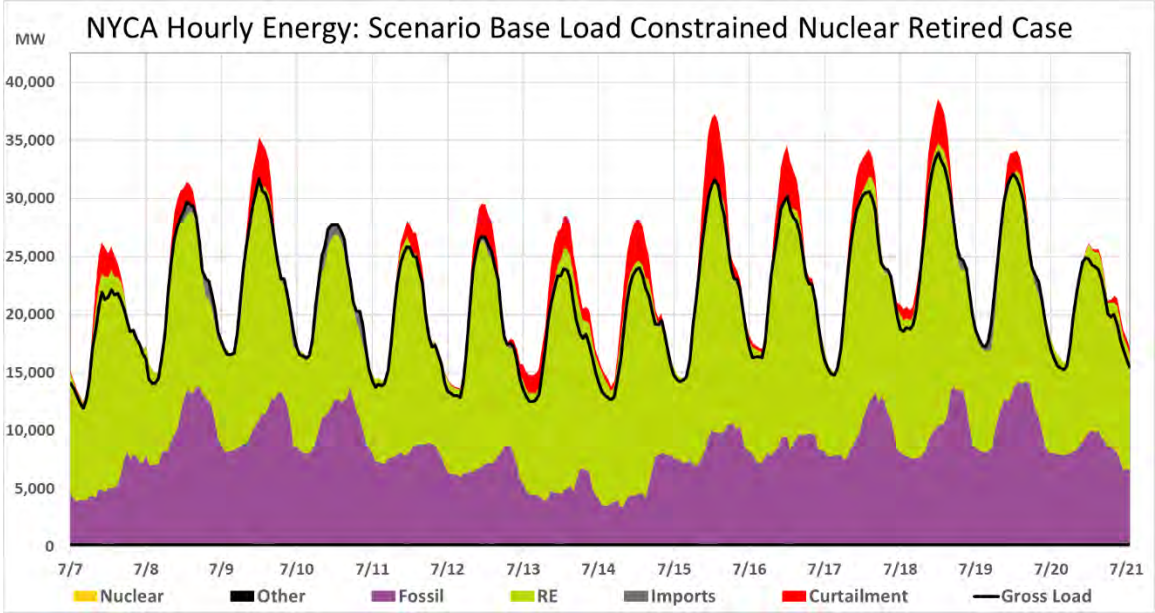

NYCA Hourly Energy: Scenario Base Load Constrained Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
10/13
10/14
10/15
10/16
10/17
10/18
10/19
10/20
10/21
10/22
10/23
10/24
10/25
10/26
10/27
Nuclear
Other
Fossil
RE
Imports
Curtailment
Gross Load

Figure 84: Sample Interval Hourly Examples: Base Load Nuclear Retired Case






NYCA Hourly Energy: Scenario Base Load Constrained Nuclear Retired Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
7/16
7/17
7/18
7/19
7/20
7/21
Nuclear
Other
Fossil
RE
Imports
Curtailment
Gross Load

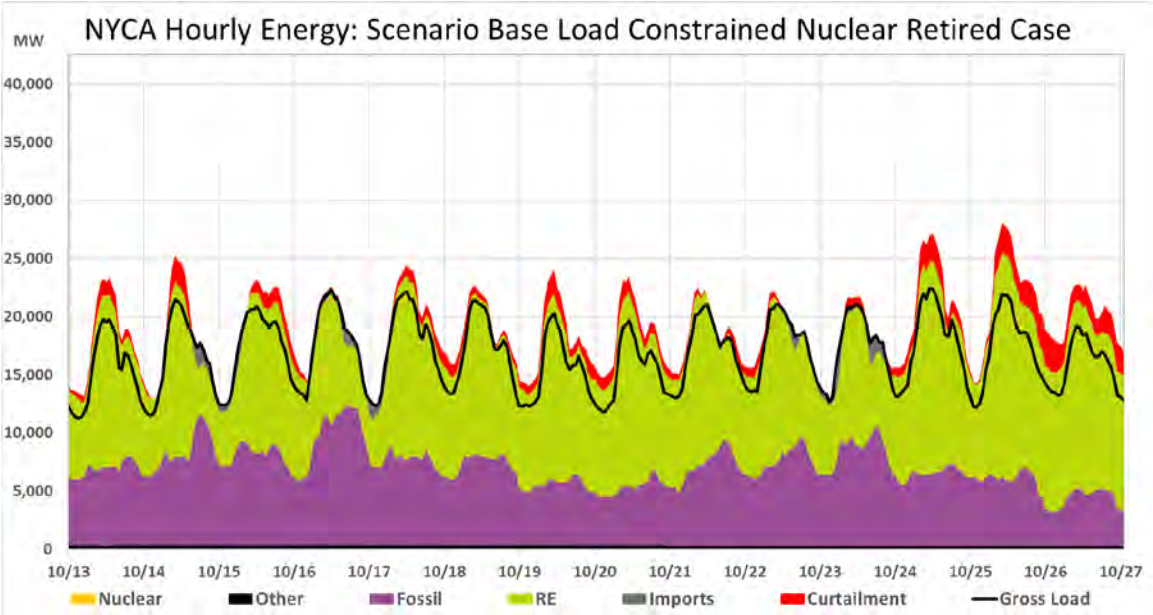
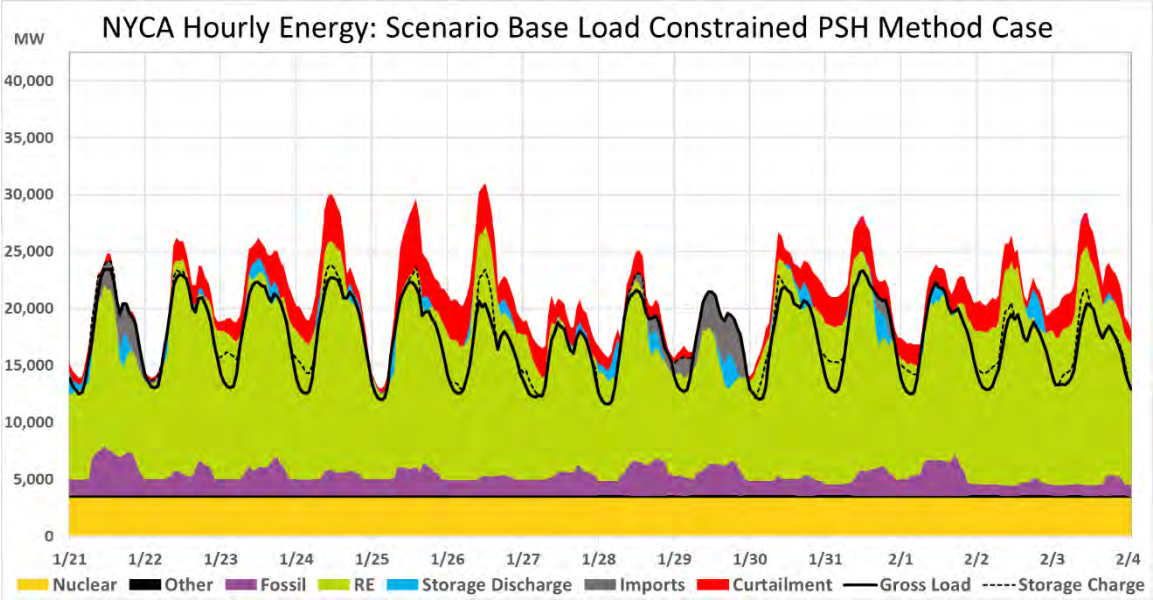
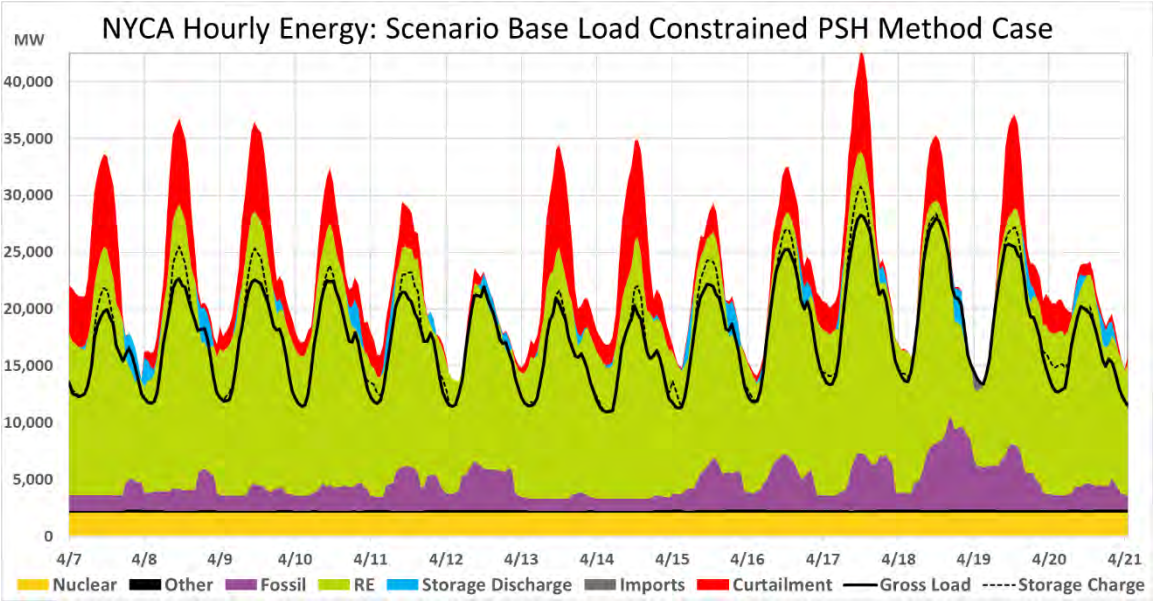
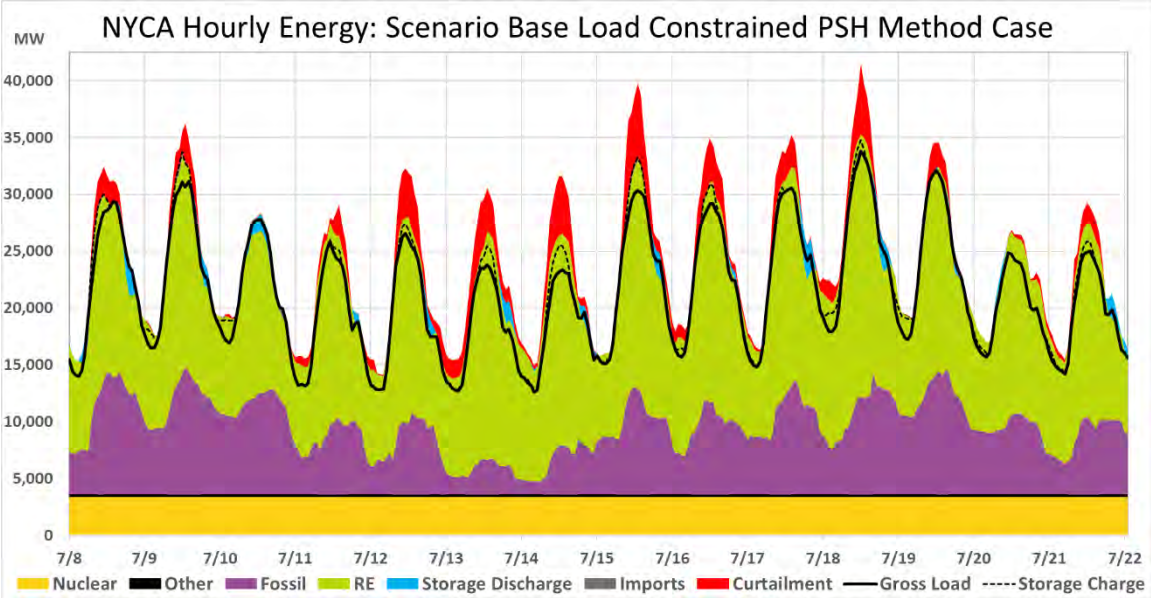

NYCA Hourly Energy: Scenario Base Load Constrained Nuclear Retired Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
10/13
10/14
10/15
10/16
10/17
10/18
10/19
10/20
10/21
10/22
10/23
10/24
10/25
10/26
10/27
Nuclear
Other
Fossil
RE
Imports
Curtailment
Gross Load

Figure 85: Sample Interval Hourly Examples: Base Load PSH Method Case






NYCA Hourly Energy: Scenario Base Load Constrained PSH Method Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
7/16
7/17
7/18
7/19
7/20
7/21
7/22
Nuclear
Other
Fossil
RE
Storage Discharge
Imports
Curtailment
Gross Load
Storage Charge

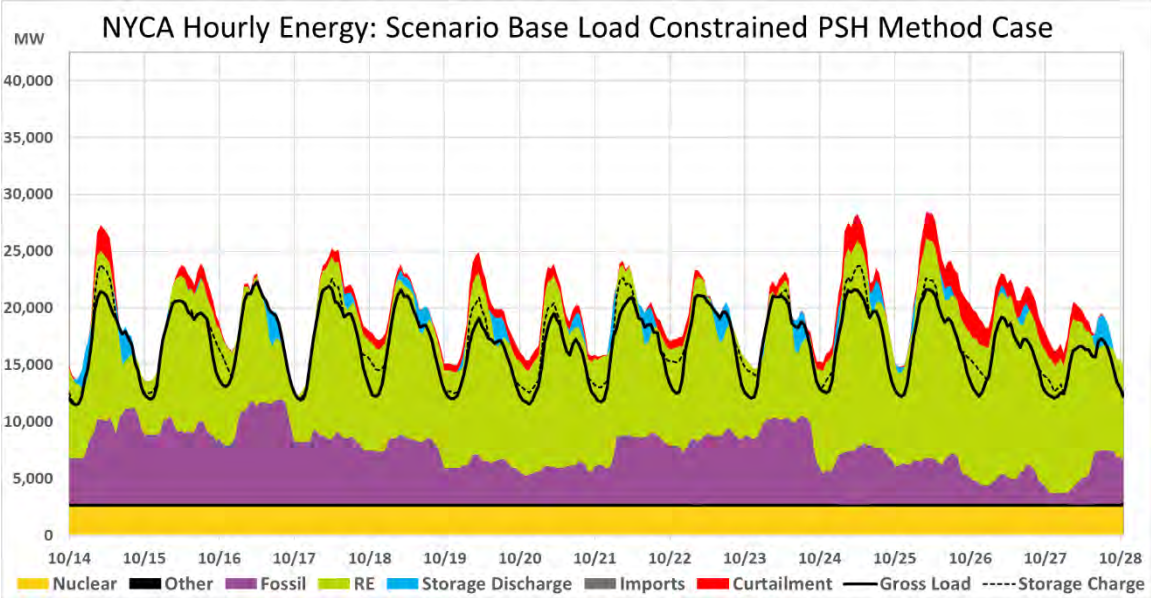
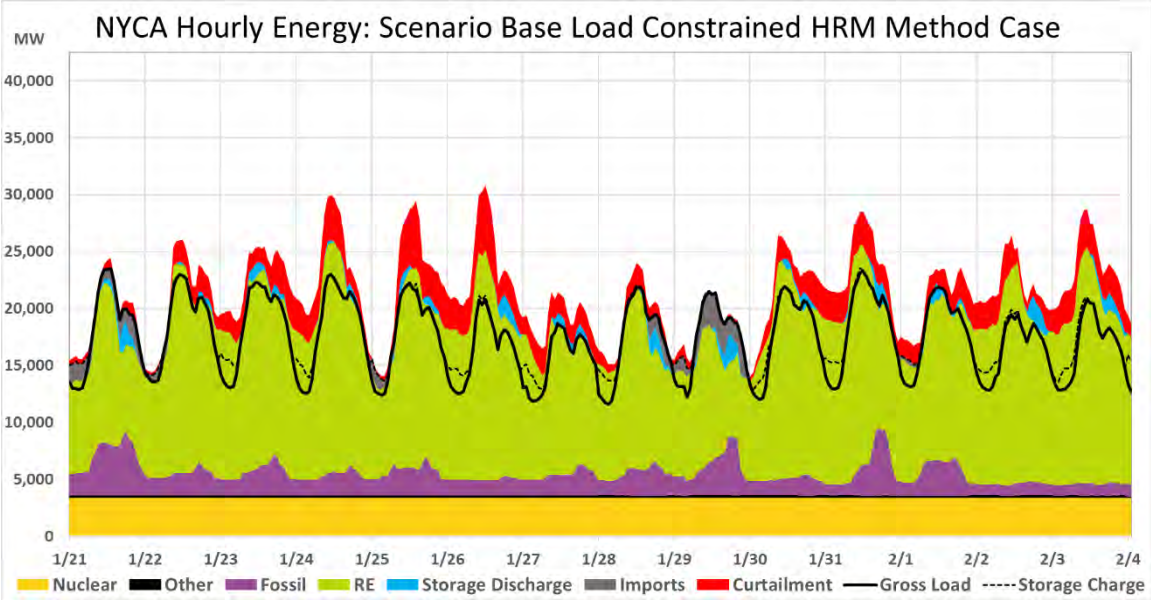
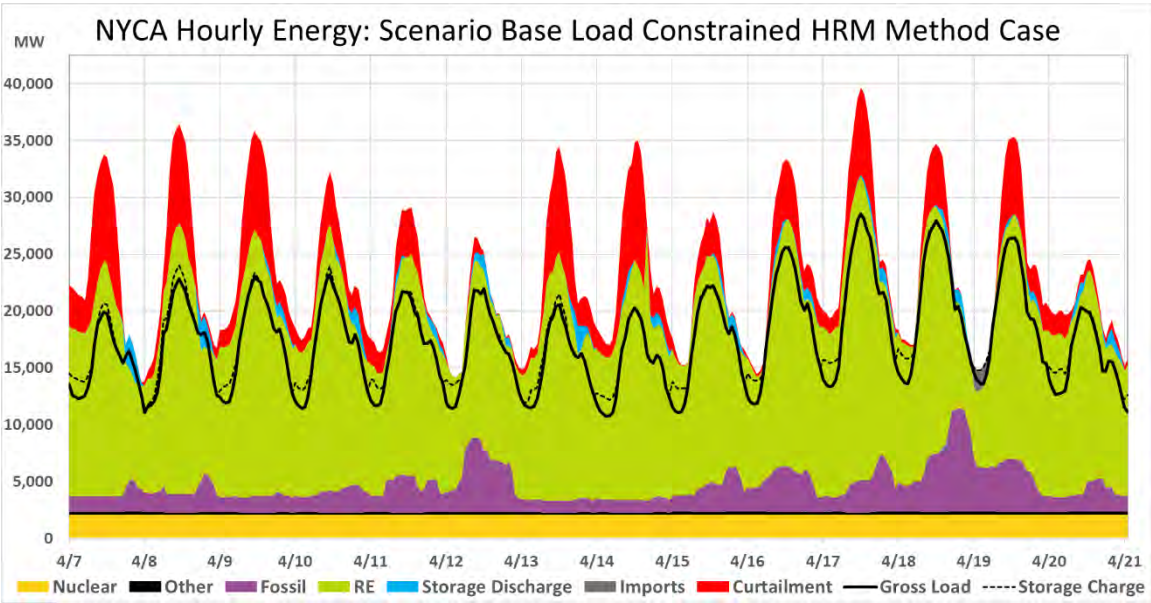
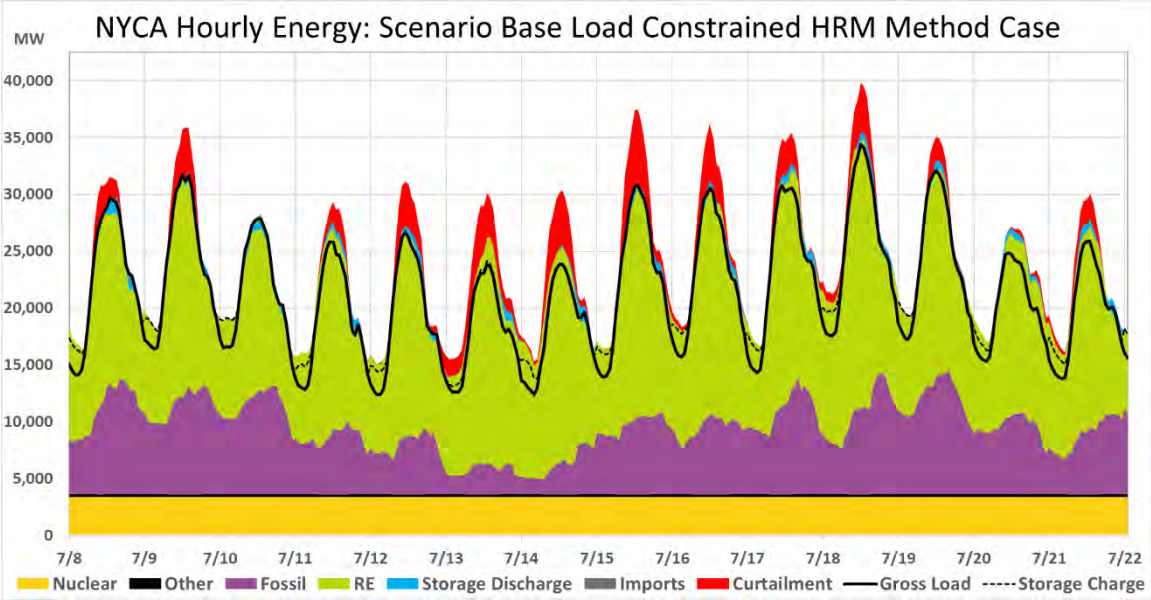
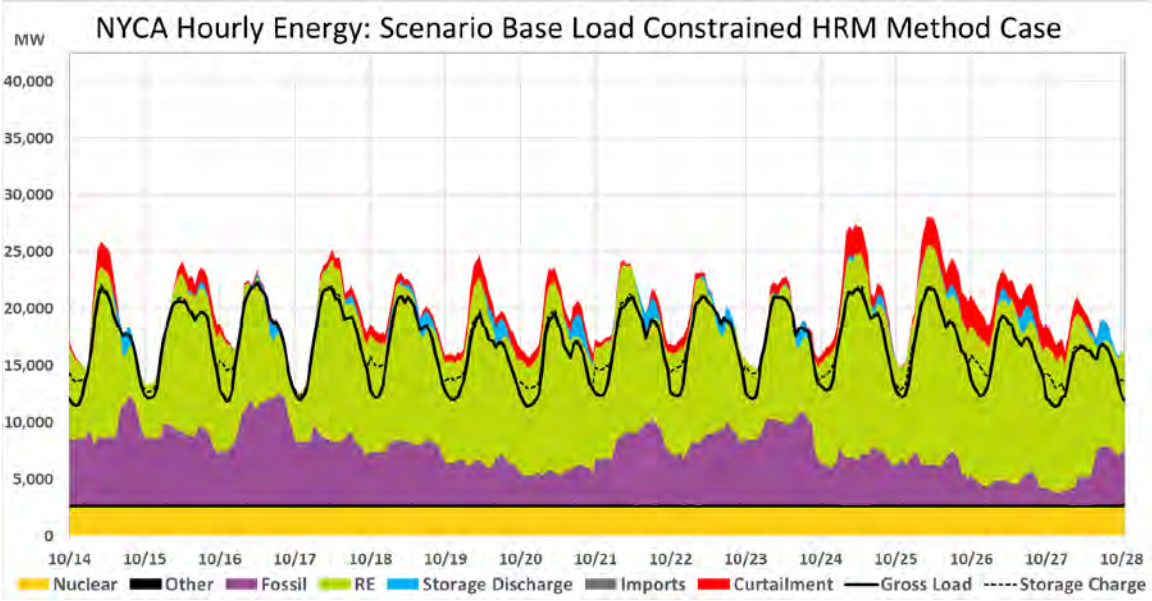

NYCA Hourly Energy: Scenario Base Load Constrained PSH Method Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
10/14
10/15
10/16
10/17
10/18
10/19
10/20
10/21
10/22
10/23
10/24
10/25
10/26
10/27
10/28
Nuclear
Other
Fossil
RE
Storage Discharge
Imports
Curtailment
Gross Load
Storage Charge

Figure 86: Sample Interval Hourly Examples: Base Load HRM Method Case






NYCA Hourly Energy: Scenario Base Load Constrained HRM Method Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
7/16
7/17
7/18
7/19
7/20
7/21
7/22
Nuclear
Other
Fossil
RE
Storage Discharge
Imports
Curtailment
Gross Load
Storage Charge


NYCA Hourly Energy: Scenario Base Load Constrained HRM Method Case
MW
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
10/14
10/15
10/16
10/17
10/18
10/19
10/20
10/21
10/22
10/23
10/24
10/25
10/26
10/27
10/28
Nuclear
Other
Fossil
RE
Storage Discharge
Imports
Curtailment
Gross Load
Storage Charge

Renewable Fleet Output Comparison

Cumulative capacity factor curves, described on the 70x30 Section of the report and presented in this section of the appendix, provided output metrics for the fossil fuel-fired generators. Similar quantification allows the variation in RE resource output across cases to be examined in more detail. Figure 87 shows the output capacity factor of the hydro, LBW, OSW, and UPV generators modeled across the 70x30 Scenario cases. Relative shifts in the curve down and to the right in these graphs indicate increased curtailments. The RE fleet modeling was consistent across cases at the same load level as described in the 70x30 Section of the report. Principle observations from these charts show that:

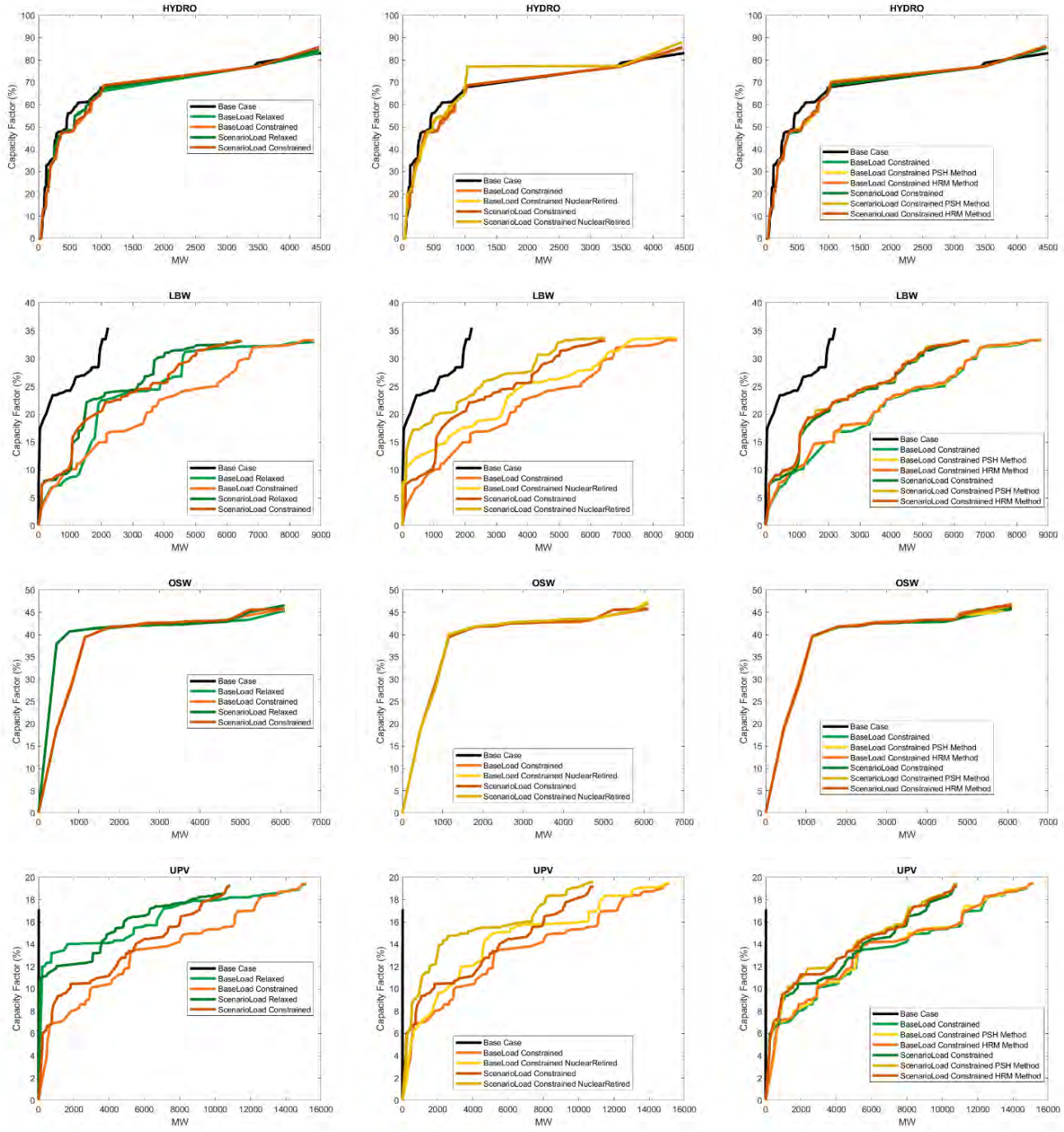
1. Relaxation of internal transmission constraints increases RE output rates, indicating that curtailments are reduced under relaxed conditions,

2. Retirement of the nuclear fleet increases RE output rates as the upstate fleet flexibility increases with the removal of base loaded nuclear generators,

3. Distributed ESR additions increase RE output rates to a lesser extent than either the relaxation of transmission constraints or the retirement of the nuclear fleet, and

4. OSW is only significantly impacted for a subset of generators in the relaxation sensitivity owing to local transmission constraints in the assumed interconnection points for the affected generators in New York City and Long Island.

Figure 87: Renewable Fleet Cumulative Capacity Factor Curves



Appendix M – CARIS Public Data File Directory

Throughout the CARIS study and stakeholder process, various data files have been published on the NYISO public website. The full set of available data files and descriptions of each have been tabulated below.

March 16, 2020

- Monthly Case Energy Output MWh – Updated April 6, 2020
- 70x30 Build Out Scenario Load

April 6, 2020

- Case Output By Type and By Zone – Updated April 23, 2020
- Monthly Case Type Energy MWh – Updated April 23, 2020
- 70x30 RE Buildout Base Load
- Preliminary 70x30 Scenario Pocket Map

April 23, 2020

- Case Output By Type and By Zone – Annual NYCA metrics by generator type, by Zone
- Case Output By Type and By Pocket – Annual NYCA metrics by generator type, by Generation Pocket
- Monthly Case Type Energy MWh – Monthly NYCA energy metrics by generator type, imports an exports by pool, RE curtailment, and gross load
- Monthly Average Zonal LBMP – Monthly Zonal average LBMP across all hours, on-peak, and off-peak hour windows
- Hourly Information By Pocket – Hourly input total RE generation, total RE curtailment, and congestion flag for each generation pocket.

May 22, 2020

- Hourly Wind Solar Curtailment By Pocket – Hourly wind and solar generation and curtailment for each generation pocket.
- Hourly Zonal Net Load – Hourly zonal net load profiles for the Base Load and Scenario Load forecasts
- Fuel Forecast

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