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Independent System Operator

2019 CARIS 70x30 Scenario: Preliminary Constraint Modeling, Nuclear Sensitivity and Additional Results

Benjamin Cohen
Sr. Planning Environmental Engineer

Chen Yang
Sr. Planning Engineer

Electric System Planning Working Group

March 16, 2020

Agenda

- Scenario Background, Approach, and Assumptions
- Preliminary Relaxed and Constrained Case Results
- Preliminary Nuclear Sensitivity Results
- Generation Pocket Analysis and Congestion Summary
- Fossil Fleet Operations
- Next Steps

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Scenario Background, Approach, and Assumptions

Background

- **Previously presented at ESPWG**
  - September 11, 2019
    - CARIS Preliminary 70 x 30 Scenario Development
  - October 4, 2019
    - CARIS Scenario Load Forecast Development
    - CARIS 1 70x30 Scenario ESR Modeling
  - October 23, 2019
    - CARIS 70x30 Scenario Assumptions and Calculation
  - November 18, 2019
    - Preliminary Scenario Results (High/Low Gas Prices and Loads)
  - February 27, 2020
    - Review of Assumptions and Resource Mix

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“70 by 30” Scenario

- The study will identify opportunities for transmission investment to un-bottle renewable energy to enable the state’s renewable energy production goals.
- The Climate Leadership and Community Protection Act (CLCPA) requires that a minimum of 70% of New York end-use electrical energy requirements shall be generated by renewable energy systems in 2030.

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Scenario Study Approach

- **Develop assumptions for the major drivers that could impact transmission congestion patterns**
  - Develop 70x30 Scenario Load Forecast for comparison with the Base Case Forecast
  - Add renewable generation to approximate achievement of 70% renewable energy target for each load forecast, considering renewable energy "spillage" (*i.e.*, generation exceeds load)
- **Evaluate system production under "relaxed" conditions**
  - Model the resulting resource mix in GE-MAPS without internal NYCA transmission system constraints to establish a baseline of what the system "wants to do" when there are no transmission constraints
- **Evaluate the impact of transmission constraints on renewable energy production for the assumed renewable resource mix**
  - Identify transmission constraints that cause renewable curtailments (*i.e.*, renewable generation pockets)
  - Quantify the magnitude and frequency of the curtailments for each assumed resource mix
- **Sensitivity analysis to understand impact to system production and transmission constraints**
  - Sensitivity analysis of retirement of the entire nuclear fleet
  - Sensitivity analysis of 3,000 MW of Energy Storage Resources (ESR)

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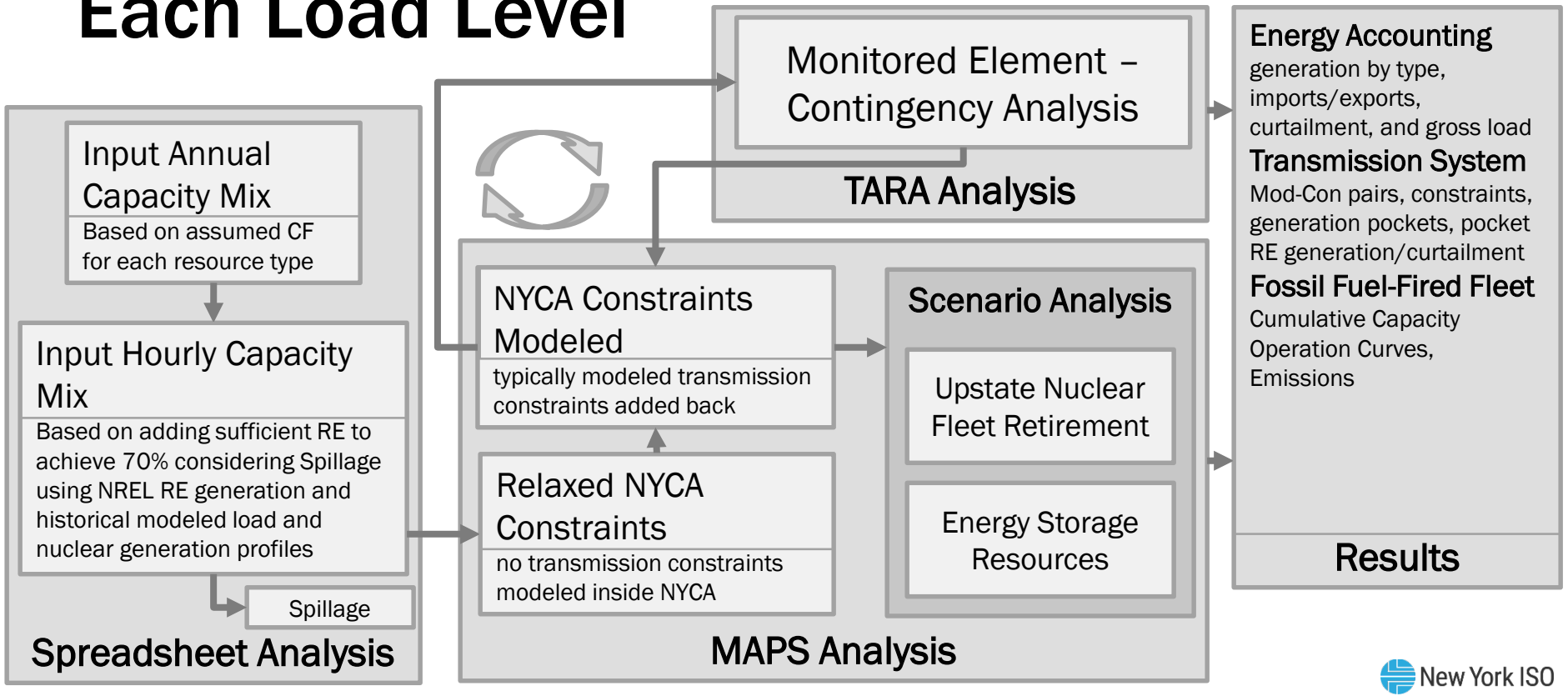
Scenario Study Approach Diagram For Each Load Level



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70x30 Scenario Load Forecast Assumptions

	Base Case Load Forecast	70x30 Scenario Load Forecast
EV	1.3 million Light-duty vehicles by 2030	2.2 million Light-duty vehicles by 2030
Space Heating Electrification	None	2015 estimate of 13,600 GWh in 2015 grows by 50% by 2030 for NYCA
PV	3,000 MWDC behind-the-meter by 2023	6,000 MWDC behind-the-meter by 2025
EE	23,500 GWh of incremental savings by 2030 beyond the 11,000 GWh achieved by 2014	Additional 30,000 GWh* of savings by 2025 beyond 2014 achievements plus around 2,000 GWh/year** for 2026-30
* This target is based on the retail sales of investor-owned utilities implied by the 2015 Gold Book forecast for the year 2025.		
** This is based on the targets expressed in the Clean Energy Fund documents.		

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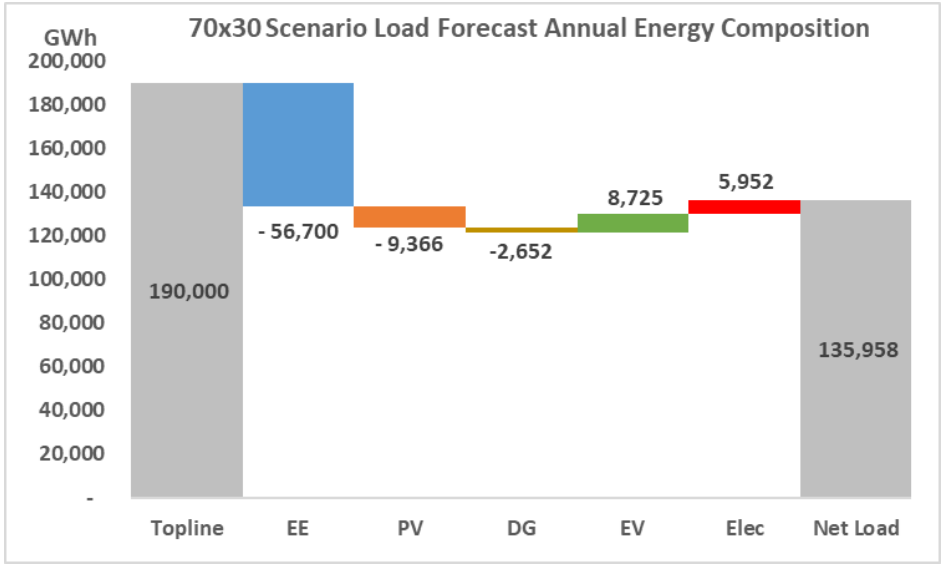
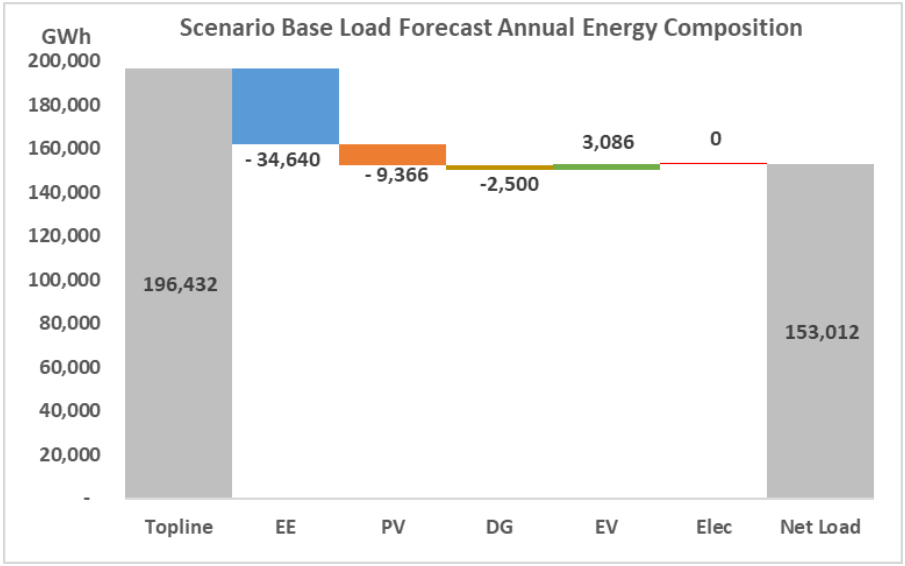
70x30 Scenario Load Forecasts





The net load in 2030 is assumed to be approximately 136,000 GWh resulting from the cumulative impacts of EE (56.7 TWh), BTM-PV (9.4 TWh), DG (2.7 TWh) and EV (8.7 TWh) plus an incremental 6 TWh due to electrification of space heating (Elec).

Annual Load (GWh)	A	B	C	D	E	F	G	H	I	J	K	NYCA
Base Case Load	14,590	9,695	15,394	5,337	7,095	11,312	9,544	2,807	5,881	51,749	19,608	153,012
70x30 Scenario Load	13,034	7,757	12,626	5,101	5,694	9,654	7,911	2,848	5,952	46,354	19,026	135,958

Renewable Addition Locations

- **Injection points are assumed to be the closest existing substations based on interconnection points from the NYISO Interconnection Queue**
- **Study Assumptions:**
  - UPV: 73 sites, injecting at various voltage levels from 345 kV – 115 kV
  - LBW: 30 sites, injecting at various voltage levels from 345 kV – 115 kV
  - OSW: 7 sites, injecting at 345 kV in Zone J and 138 kV – 69 kV in Zone K
  - Hydro imports: 1 site, injecting at 345 kV in Zone J (generic 1,310 MW HVDC)
- **Excel file containing modeled project details included with today's meeting materials**

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Zonal Wind and Solar Total 2030 Capacity (MW)

70x30 Scenario Load

2030 MW	OSW	LBW	UPV	BTM-PV
A		1,640	3,162	995
B		207	361	298
C		1,765	1,972	836
D		1,383		76
E		1,482	1,247	901
F			2,563	1,131
G			1,450	961
H				89
I				130
J	4,320			950
K	1,778		77	1,176
NYCA	6,098	6,476	10,831	7,542

Base Load

2030 MW	OSW	LBW	UPV	BTM-PV
A		2,286	4,432	995
B		314	505	298
C		2,411	2,765	836
D		1,762		76
E		2,000	1,747	901
F			3,592	1,131
G			2,032	961
H				89
I				130
J	4,320			950
K	1,778		77	1,176
NYCA	6,098	8,772	15,150	7,542

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Preliminary Case Results: Scenario Load Relaxed/Constrained

Annual Case Overview MAPS Output for 70x30 Scenario Load Cases: Relaxed vs. Constrained

Energy (GWh)	Base Case	ScenarioLoad Relaxed	ScenarioLoad Constrained	ScenarioLoad Constrained NukeRetired
Nuclear	27,091	27,435	27,433	-
Other	2,368	2,164	2,110	2,270
Fossil	69,028	26,390	28,185	42,924
Hydro	28,832	28,082	28,050	28,448
Hydro Imports	11,564	19,803	19,775	19,897
LBW	5,038	13,960	13,290	14,879
OSW	-	22,775	21,625	21,714
UPV	115	14,764	12,666	14,527
BTM-PV	4,988	9,269	9,266	9,356
Pumped Storage	(447)	(878)	(822)	(988)
Storage	-	-	-	-
IESO Net Imports	(2,862)	(5,550)	(5,817)	(4,090)
ISONE Net Imports	(535)	(7,791)	(6,418)	(4,385)
PJM Net Imports	12,239	(5,479)	(4,446)	287
Renewable Generation	50,537	108,653	104,672	108,821
Curtailment	0	6,239	10,151	6,069
GrossLoad	157,418	144,948	144,897	144,838

- Comparison of case energy generation, net imports, curtailment, and load
- Compare Base Case to Scenario Load Relaxed and Constrained (nuclear sensitivity) cases
- Monthly values posted with today's meeting materials as excel files

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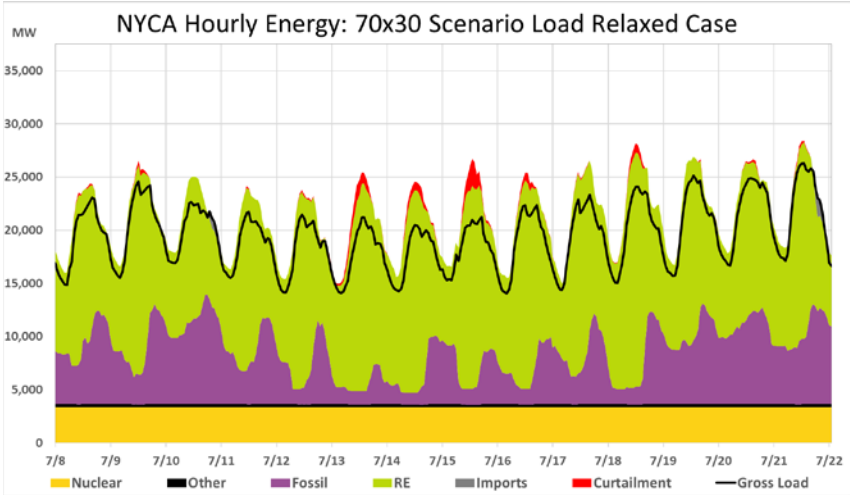
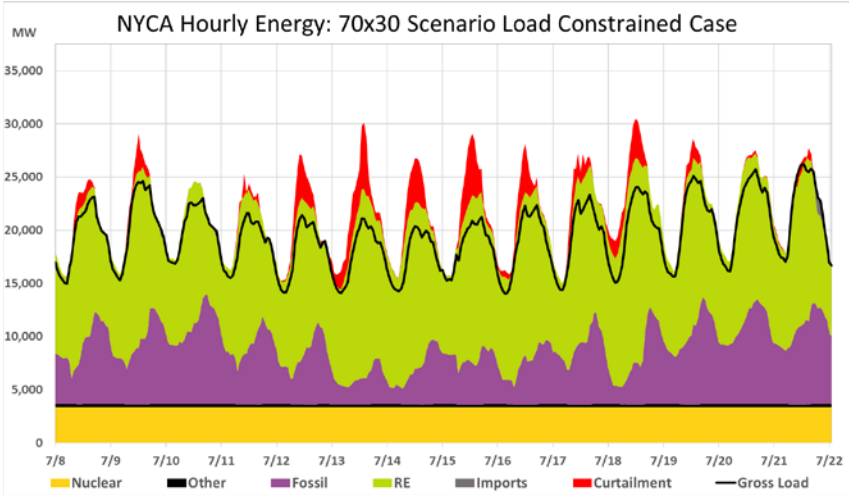
Relaxed/Constrained Scenario Output Profiles: Peak Loads





"Other" includes Methane (Biogas), Refuse (Solid Waste), and Wood fuel-fired generators
"Imports" includes imports from IESO, ISO-NE, and PJM

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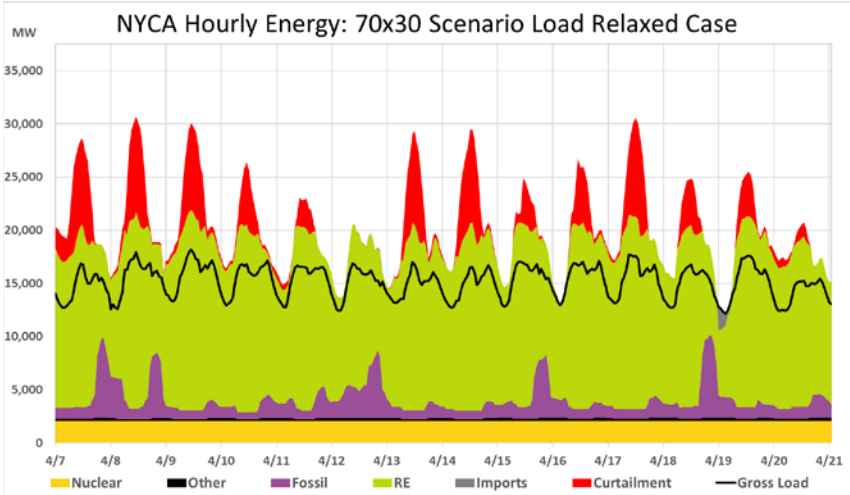
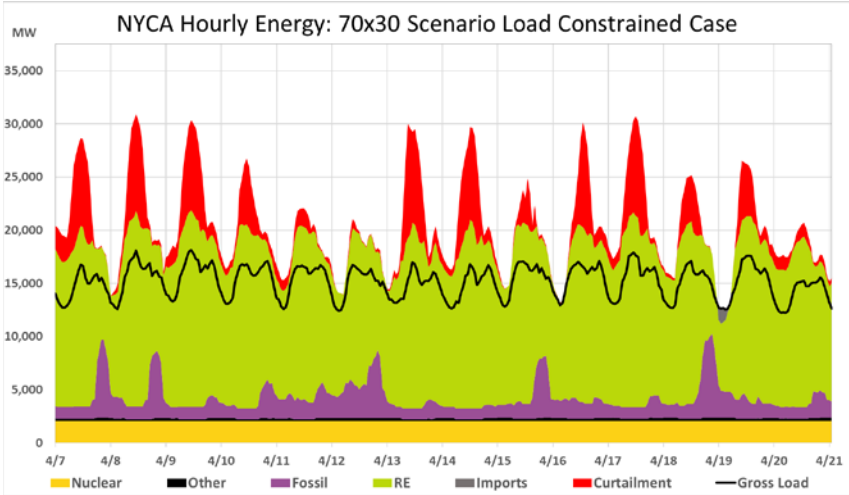
Relaxed/Constrained Scenario Output Profiles: Low Net Loads





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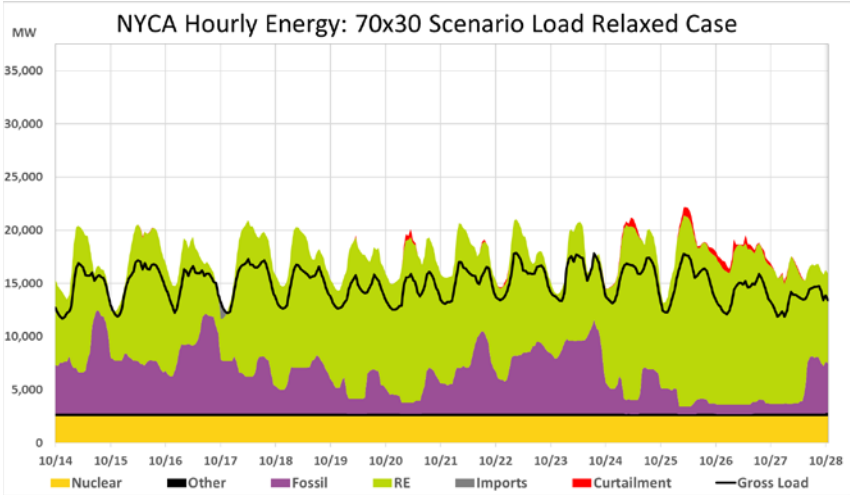
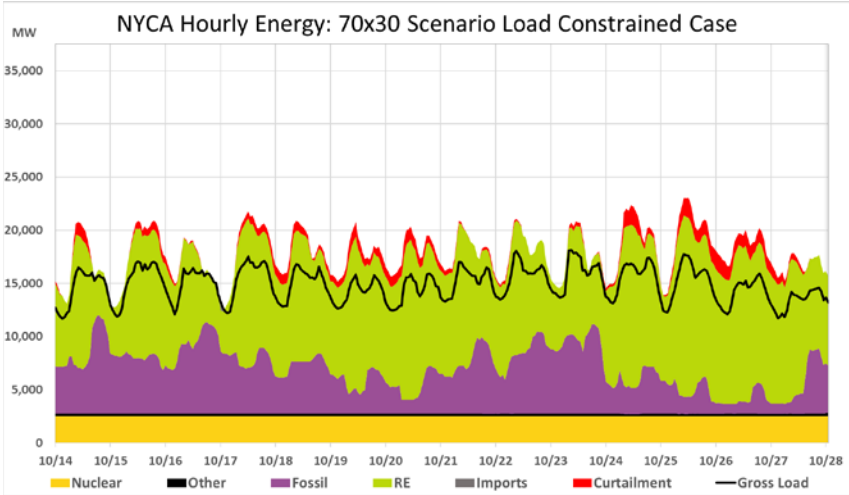
Relaxed/Constrained Scenario Output Profiles: Low Renewable Generation





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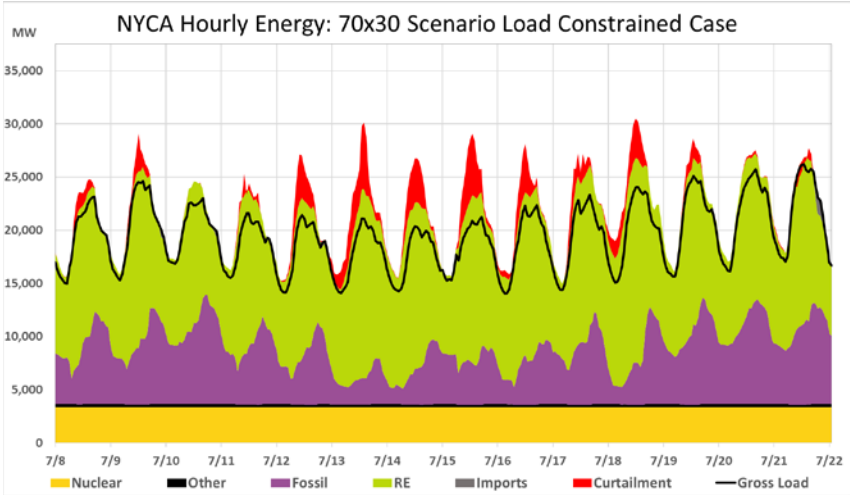
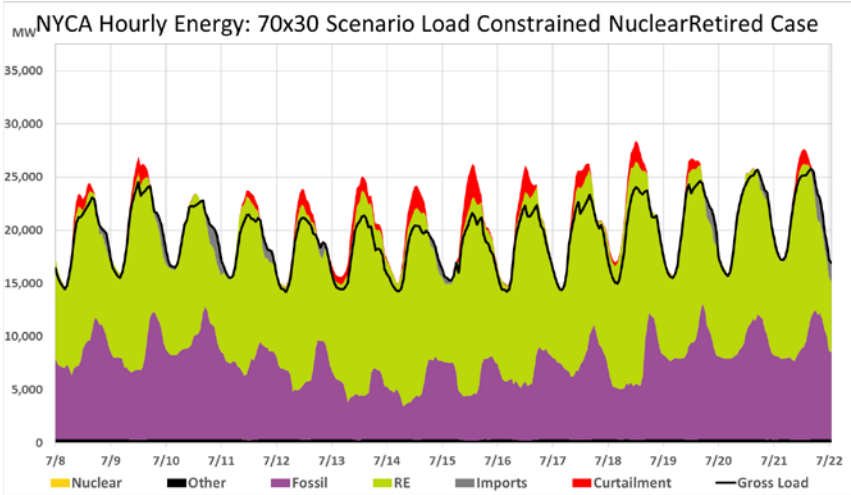
Preliminary Case Results: Scenario Load Constrained Nuclear Retirement Sensitivity

Constrained Nuclear Retirement Sensitivity Output Profiles: Peak Loads





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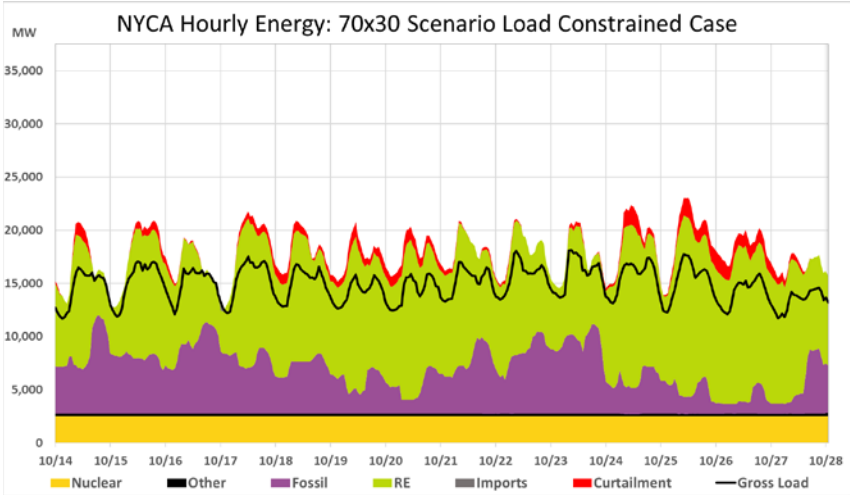
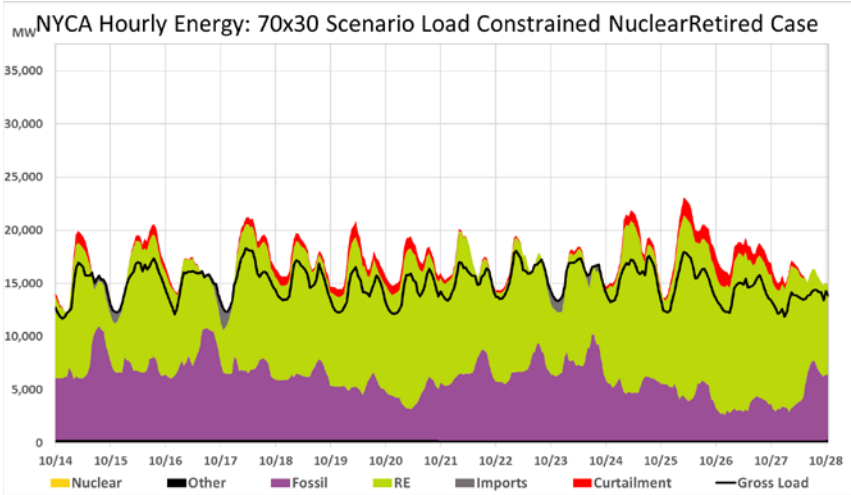
Constrained Nuclear Retirement Sensitivity Output Profiles : Low Renewable Generation





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"Imports" includes imports from IESO, ISO-NE, and PJM

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Transmission System Modeling of Generation Pockets

RE Pocket Study Methodology

- The generation pockets with constrained transmission lines resulting from renewable generation injections were identified, as well as the MW levels of curtailments of the renewable generation.
- The binding constraints were grouped into “pockets” to identify the transmission constrained renewable generation.
- Two projected load conditions for year 2030 were simulated and analyzed to provide a probable outcome. The resulting constraints serve as indicative potential transmission bottlenecks.

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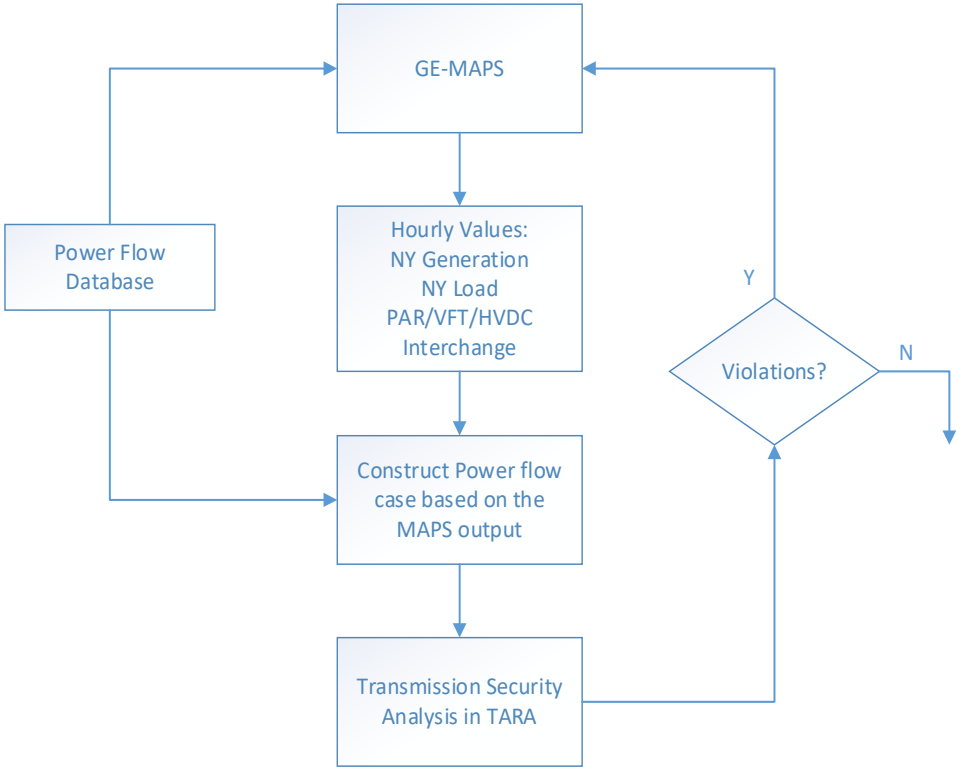
Roundtrip MAPS/TARA Analysis



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Roundtrip MAPS/TARA Analysis

- **N-1 Transmission security analysis in TARA**
  - Monitored elements included 115 kV and above facilities in NYCA
  - Contingencies on the bulk transmission system were analyzed, along with local transmission system contingencies
- **Reported additional constraint overloads in TARA to be added into GE MAPS**
  - Contingency pairs from TARA analysis added into GE MAPS
- **GE MAPS output results iteratively interact with TARA analysis until all the overloaded constraints in TARA are exhaustively modeled in production cost database**

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Preliminary Constrained Case Results: Congestion Summary

Preliminary Constrained Case Congestion Summary

- Preliminary results are only for scenario load level, base load level result assessment are still in progress
- BPTF level constraints: No new significant inter-zonal constraints identified, though some existing constraints could be more congested due to resource shift.
- Potential new constraints: mostly at 115kV levels due to resource additions at the lower kV level. Pockets are identified based on their relative geographical locations for illustration purpose.
- Renewable Generation Pocket Assignment will be discussed in future ESPWG meetings

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Preliminary Constrained Case Bulk Level Congestion Summary

Congested Hours	Base Case	Scenario Load
CENTRAL EAST	878	1,947
TIE-LINES: NORTH -VT	5,756	8,113
NorthTie: OH-NY	3,563	8,751
NEW SCOTLAND KNCKRBOC	28	611
DUNWOODIE TO LONG ISLAND	6,953	5,998
ISONE-NYISO	1,102	2,519
PRNCTWN NEW SCOTLAND	-	342
SUGARLOAF 138 RAMAPO 138	-	906
GREENWOOD	4,471	5,122
PJM-NYISO	2,045	4,417
EGRDNCTY 138 VALLYSTR 138 1	5,074	5,300
DYSINGER STOLLE	5,455	4,525
RAINEY VERNON	421	2,382
MOTTHAVEN RAINEY	275	116
FARRAGUT GOWANUS	-	2,273
DUNWOODIE MOTTHAVEN	2,349	154
E179THST HELLGT ASTORIAE	1,285	1,031
CRICKET VALLEY PLSNTVLY	1,056	38

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Curtailment Analysis: Pockets

- **Pocket X: Northern NY Constraints**
  - X1: North Area Wind (mainly 230 kV in Clinton County)
  - X2: Mohawk Area Wind & Solar(mainly 115 kV in Lewis County)
  - X3: Mohawk Area Wind & Solar (115 kV in Jefferson & Oswego Counties)
- **Pocket Y: Eastern NY Constraints**
  - Y1: Capital Region Solar Generation(115 kV in Montgomery County)
  - Y2: Hudson Valley Corridor (115 kV)
- **Pocket Z: Southern Tier Constraints**
  - Z1: Finger Lakes Region Wind & Solar (115 kV)
  - Z2: Southern Tier Transmission Corridor(115kV)
- **Pocket W: Western NY Constraints**
  - W1: Niagara-Orleans-Rochester Wind (115 kV)
  - W2: Buffalo Erie region Wind & Solar(115 kV)
  - W3: Chautauqua Wind & Solar(115kV)
- **NYC Constraints**
  - Offshore Wind Generation in Staten Island Load Pockets
- **LI Constraints**
  - Offshore Wind Generation in Holbrook Area

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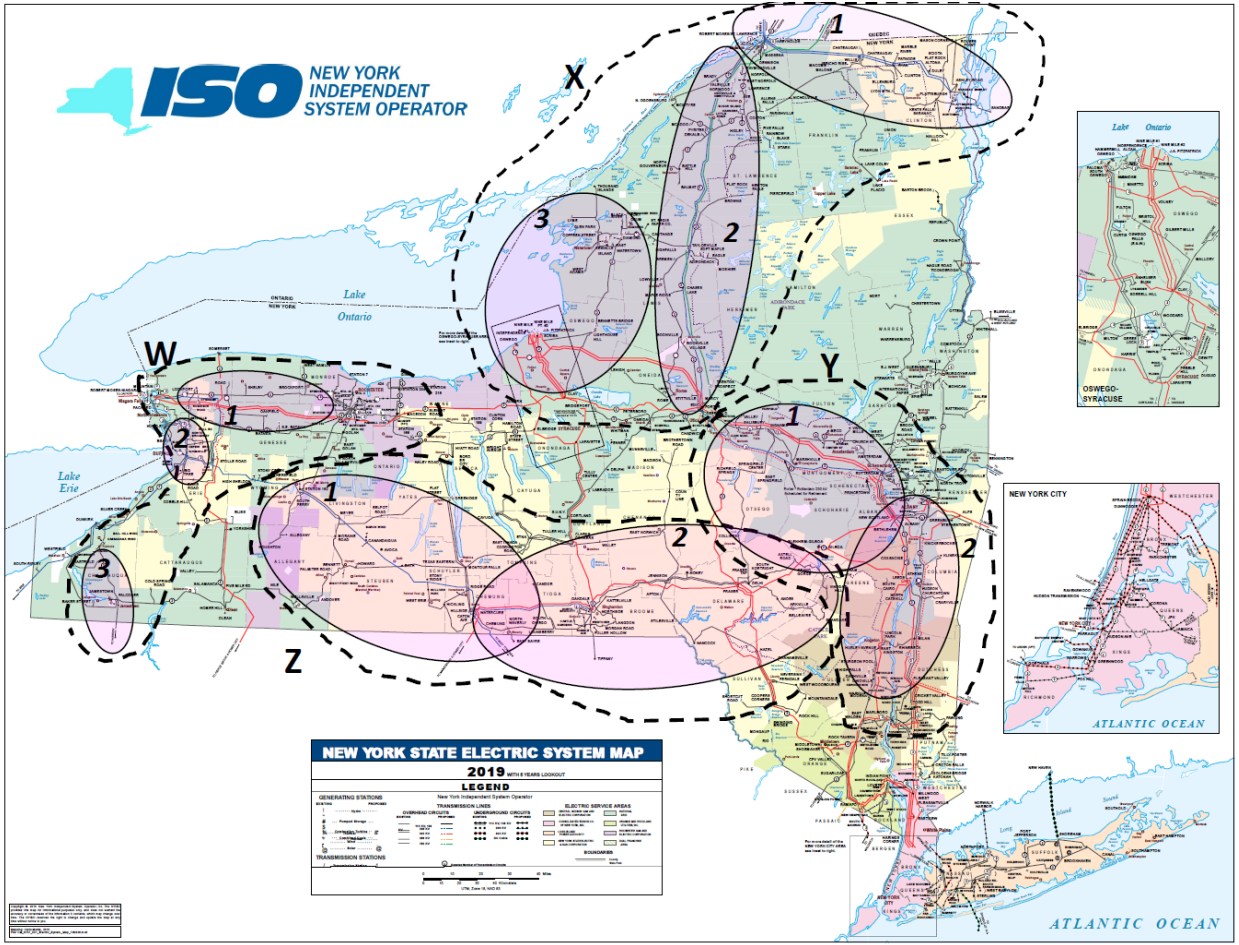
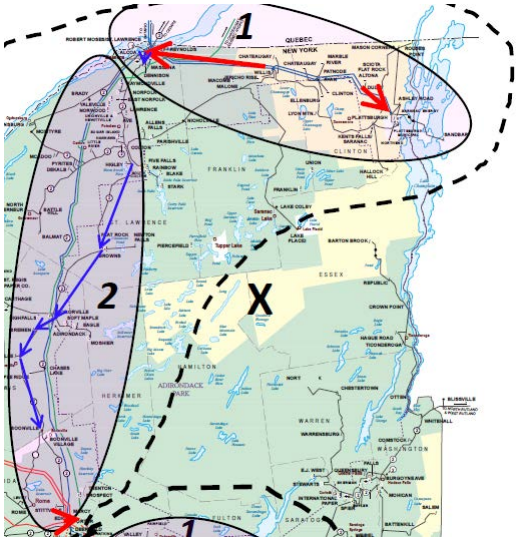


Pocket X1 and X2 Congestion Summary



Constraints	Pocket	Congested Hour
ALCOA-NM 115.00-ALCOA N 115.00	Pocket X1	839
ALCOA-NM 115.00-DENNISON 115.00	Pocket X1	387
DULEY 230.00-PLAT T#1 230.00	Pocket X1	217
MOSES W 230.00-WILLIS E 230.00	Pocket X1	19

Constraints	Pocket	Congested Hour
BREMEN 115.00-BU+LY+MO 115.00	Pocket X2	1,025
LOWVILLE 115.00-BOONVL 115.00	Pocket X2	633
BRNS FLS 115.00-T AYLORVL 115.00	Pocket X2	170
BRNS FLS 115.00-HIGLEY 115.00	Pocket X2	63
NICHOLVL 115.00-PARISHVL 115.00	Pocket X2	33
EDIC 345.00-PORT ER 2 230.00	Pocket X2	11

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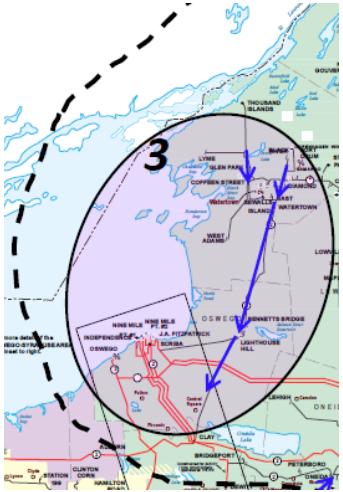
Pocket X3 Congestion Summary



Constraints			Pocket	Congested Hour
HTHSE HL	115.00-MALLORY	115.00	Pocket X3	2,530
COFFEEN	115.00-GLEN PRK	115.00	Pocket X3	706
COFFEEN	115.00-E WTRTWN	115.00	Pocket X3	535
HMMRMILL	115.00-WINE CRK	115.00	Pocket X3	457
HTHSE HL	115.00-COPEN_PO	115.00	Pocket X3	18

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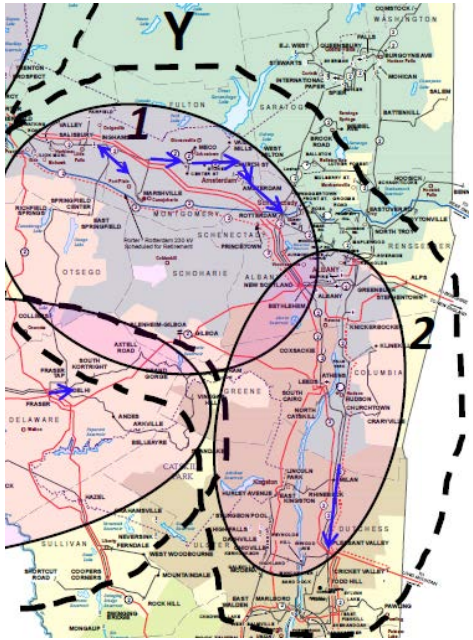
Pocket Y1 and Y2 Congestion Summary



Constraints		Pocket	Congested Hour
RTRDM1	115.00-AMST 115 115.00	Pocket Y1	2,392
STONER	115.00-VAIL TAP 115.00	Pocket Y1	2,036
CHURCH-W	115.00-VAIL TAP 115.00	Pocket Y1	1,034
INGHAM-E	115.00-ST JOHNS 115.00	Pocket Y1	508
CLINTON	115.00-TAP T79 115.00	Pocket Y1	293
CHURCH-E	115.00-MAPLEAV1 115.00	Pocket Y1	293
AMST 115	115.00-CHURCH-E 115.00	Pocket Y1	149
EVERETT	115.00-WOLF RD 115.00	Pocket Y1	149
CENTER-N	115.00-MECO 115 115.00	Pocket Y1	20

Constraints		Pocket	Congested Hour
N.CAT. 1	115.00-CHURCHTO 115.00	Pocket Y2	2,079
MILAN	115.00-PL.VAL 1 115.00	Pocket Y2	1,913
OW CRN E	115.00-BOC 7T 115.00	Pocket Y2	151

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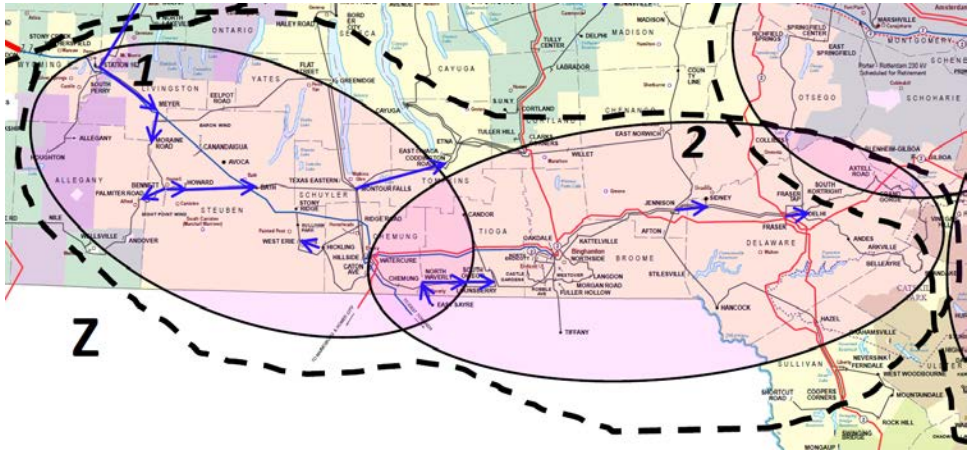
Pocket Z1 and Z2 Congestion Summary



Constraints	Pocket	Congested Hour
HICK 115 115.00-WERIE115 115.00	Pocket Z1	1,966
BENET 115 115.00-PALMT 115 115.00	Pocket Z1	1,456
BATH 115 115.00-HOWARD11 115.00	Pocket Z1	1,438
MEYER115 115.00-S.PER115 115.00	Pocket Z1	1,371
MEYER115 115.00-MORAI115 115.00	Pocket Z1	611
BENET 115 115.00-HOWARD11 115.00	Pocket Z1	346
STA 162 115.00-STA 158S 115.00	Pocket Z1	304

Constraints	Pocket	Congested Hour
N.WAV115 115.00-26E.SAYR 115.00	Pocket Z2	3,595
WHITMAN 115.00-ONEIDA 115.00	Pocket Z2	1,816
DELHI115 115.00-DEL T 115 115.00	Pocket Z2	994
N.WAV115 115.00-LOUNS115 115.00	Pocket Z2	805
JENN 115 115.00-SIDNT 115 115.00	Pocket Z2	575
WHITMAN 115.00-FEN-WIND 115.00	Pocket Z2	290
CORTLAND 115.00-LABRADOR 115.00	Pocket Z2	75
LOUNS115 115.00-STAGECOA 115.00	Pocket Z2	54

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Pocket W1 Congestion Summary

Constraints	Pocket	Congested Hour
Q545A_DY 345.00-Q545A_DY 345.00	Pocket W1	4,525
Q545A_ES 345.00-5MILE345 345.00	Pocket W1	541
HINMN115 115.00-LOCKPORT 115.00	Pocket W1	199
HINMN115 115.00-HARIS115 115.00	Pocket W1	86
MORTIMER 115.00-SWDN-113 115.00	Pocket W1	19
S135 115.00-S230 115 115.00	Pocket W1	3,222
STA89 115.00-PTSFD-25 115.00	Pocket W1	301
PANNELLI 115.00-PTSFD-24 115.00	Pocket W1	184
NIAGAR2W 230.00-NIAG115E 115.00	Pocket W1	71

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Pocket W2 and W3 Congestion Summary

Constraints			Pocket	Congested Hour
STOLE115	115.00-GIRD115	115.00	Pocket W2	594
DEPEW115	115.00-ERIE 115	115.00	Pocket W2	227
STOLE115	115.00-STOLE345	345.00	Pocket W2	124
CLSP-181	115.00-YNG-181	115.00	Pocket W2	50
ERIE 115	115.00-PAVMT 115	115.00	Pocket W2	15

Constraints			Pocket	Congested Hour
FALCONER	115.00-MOON-161	115.00	Pocket W3	718
EDNK-161	115.00-ARKWRIGH	115.00	Pocket W3	270
SLVRC141	115.00-DUNKIRK1	115.00	Pocket W3	29
EDNK-162	115.00-ARKWRIGH	115.00	Pocket W3	15

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Pocket NYC and LI OSW Congestion Summary

Constraints			Pocket	Congested Hour
WILOWBK2	138.00-FRESH KI	138.00	NYC_OSW	3,774
FARRAGUT	345.00-GOWANUS	345.00	NYC_OSW	2,273
E13ST 45	345.00-FARRAGUT	345.00	NYC_OSW	211
WILOWBK1	138.00-FRESH KI	138.00	NYC_OSW	116
RAINEY W	345.00-FARRAGUT	345.00	NYC_OSW	23

Constraints			Pocket	Congested Hour
HOLBROOK	138.00-RONKONK	138.00	LI_OSW	2,032
NEWBRGE	138.00-RULND RD	138.00	LI_OSW	236

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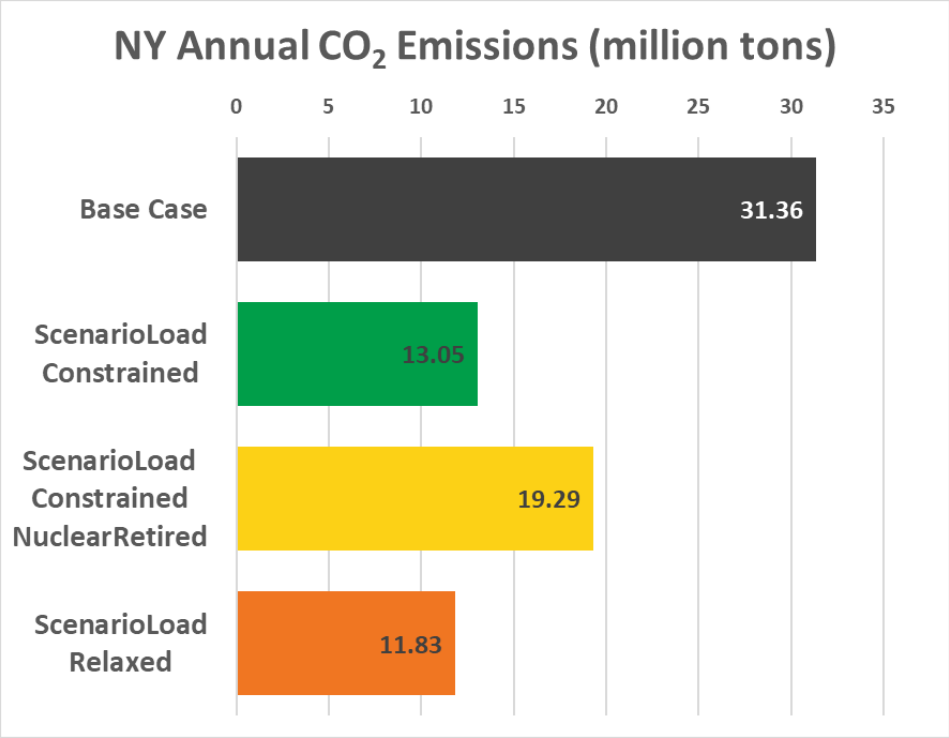
Fossil Fleet Operations

NY CO_2 Emissions



- CO_2 emissions decrease in scenario load cases due to lower loads, increased RE output, and corresponding decreased fossil fleet operations relative to the Base Case

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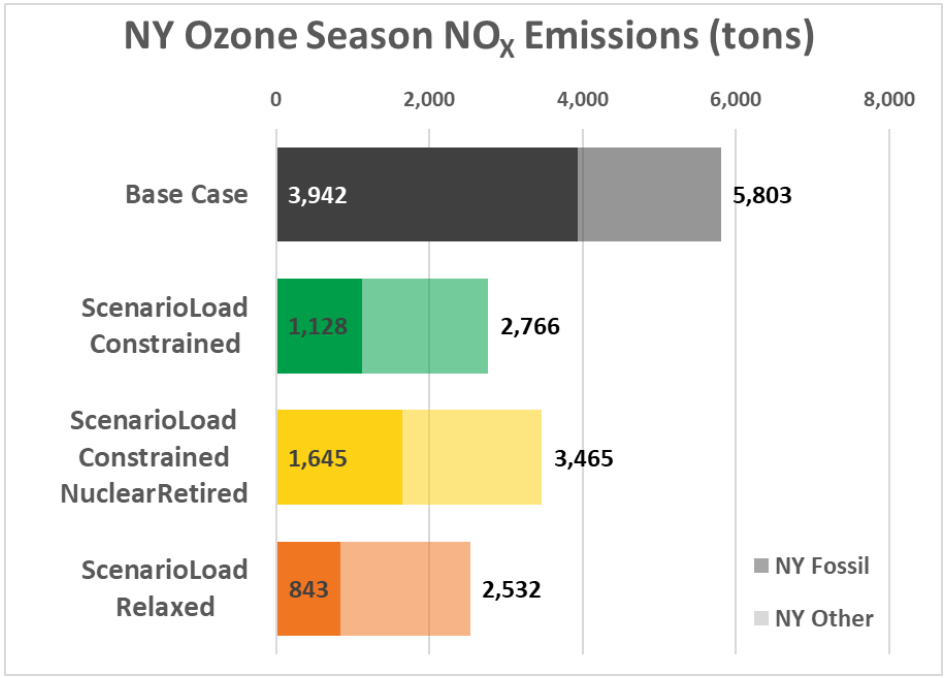
NY Ozone Season NO_X Emissions



- **Emissions of Fossil (program) and Other generators reported separately**
  - NO_X emissions from the Other fleet become an increasing portion of NY ozone season NO_X emissions (no assumed modeling change for Other units in the 70x30 Scenario)
- **Current NY ozone season NO_X Budget ~5,135 tons**
  - Ozone season NO_X emissions of the fossil fleet is comparable to the Budget, generally Other units are not included under the cap and emissions are not costed
  - Ozone season defined as May – September each year

"Other" includes Methane (Biogas), Refuse (Solid Waste), and Wood fuel-fired generators

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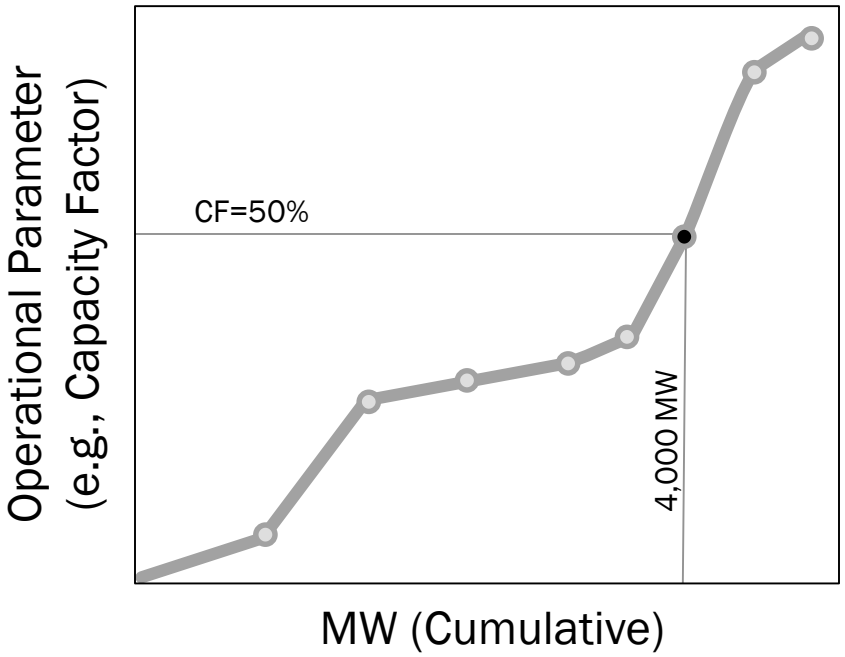
Cumulative Capacity Curve: Example



- Cumulative capacity curves show amount of capacity that operated below a given operational parameter
- Each point on the curve represents one unit's annual operation
- In this example 4,000 MW of capacity operated below an annual capacity factor of 50%

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Cumulative Capacity Curve: Parameters Examined

- Capacity Factor (CF) is a measure of a generator's energy output to potential maximum energy output over a given time period, *e.g.*, CF = MWh/(MW*8760) over a year
- Number of starts per year

- Fossil Fleet operational considerations not modeled in MAPS:
  - Ramp rates and real-time sub-hourly variations
  - Energy and Ancillary Service co-optimization
  - Fuel availability or gas system constraints

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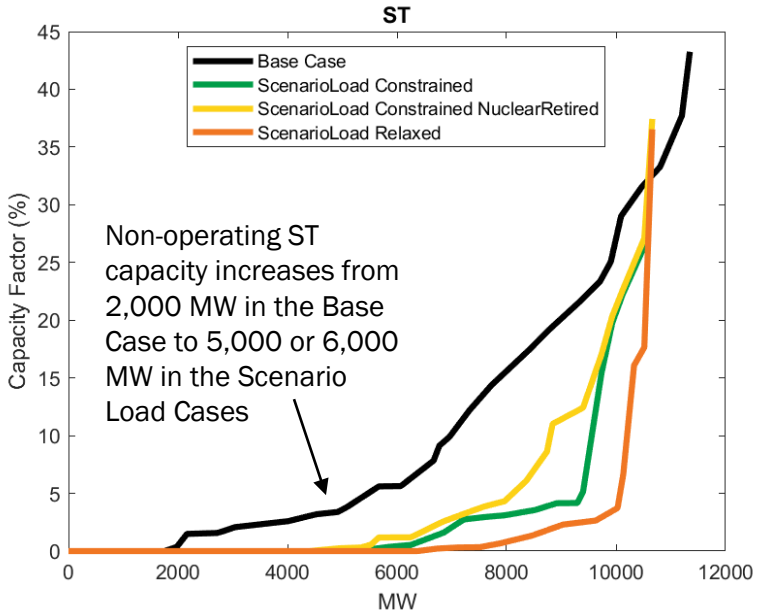
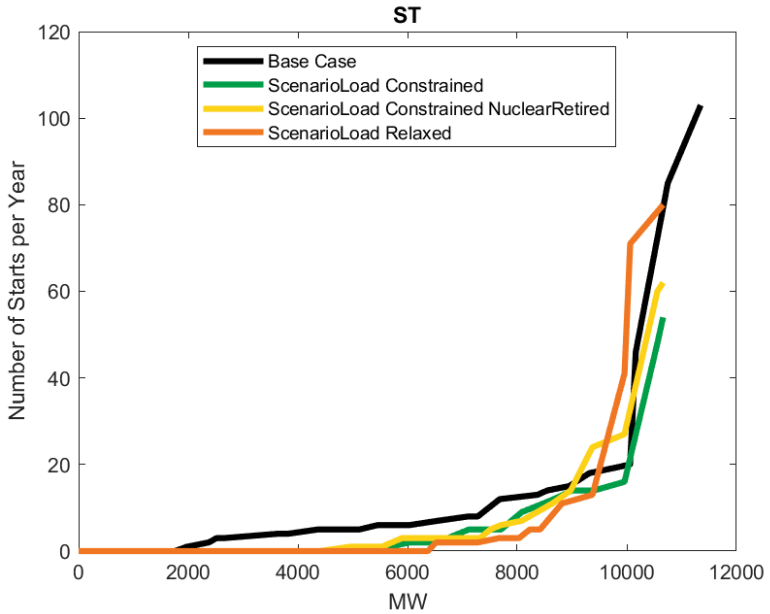
Cumulative Capacity Curve: NYCA Steam Turbine Fleet Operations





- Output is reduced in Scenario Load cases relative to the Base Case
- Decreased number of starts in Scenario Load cases relative to the Base Case
- Reduced capacity result of Coal Rule assumption in Scenario Load cases

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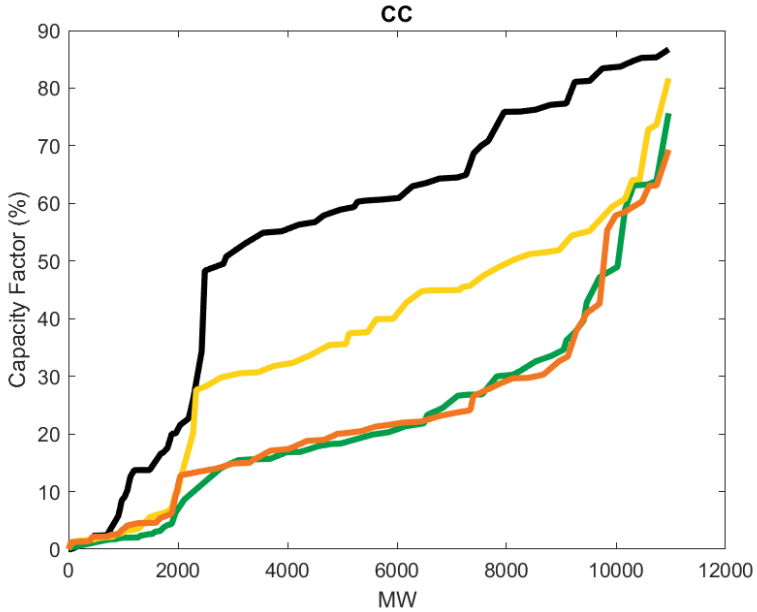
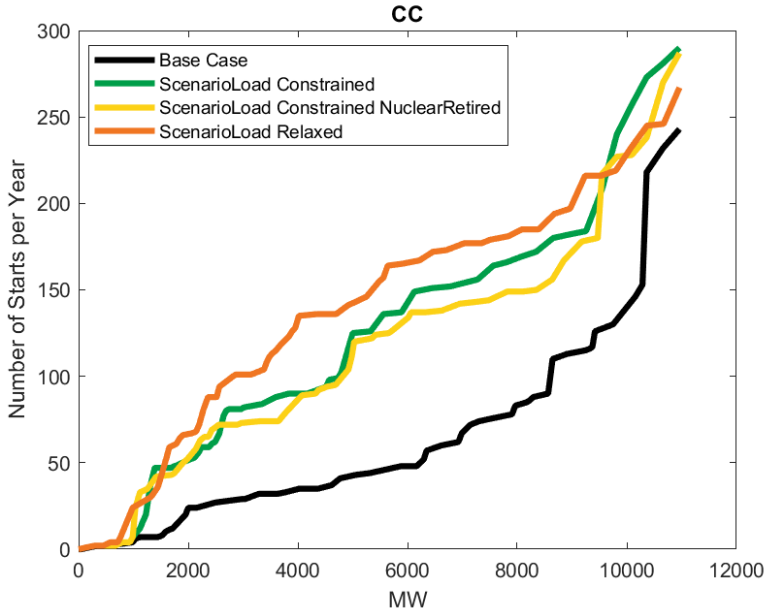
Cumulative Capacity Curve: NYCA Combined Cycle Fleet Operations





- Output is reduced in Scenario Load cases relative to the Base Case
- Increase in number of starts in Scenario Load cases relative to the Base Case
- Combined Cycle fleets modeled consistent between Base and Scenario Load cases

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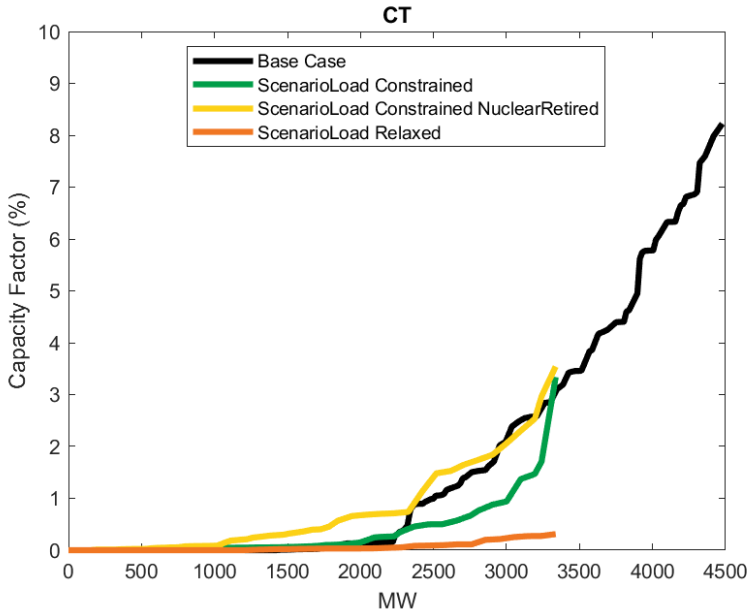
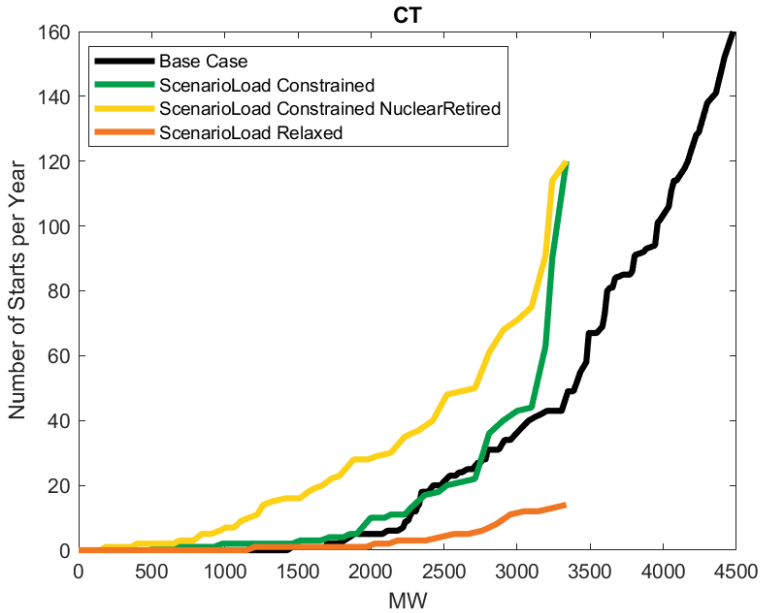
Cumulative Capacity Curve: NYCA Gas Turbine Fleet Operations





- Output is reduced in Scenario Load cases relative to the Base Case
- Number of starts per year increase in Constrained cases and decrease in Relaxed case
- Reduced capacity result of Peaker Rule assumption in Scenario Load cases

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Appendix: Nuclear Retirement Sensitivity Preliminary Congestion Results

Bulk Level Congestion Summary

Congested Hours	Scenario_Load_Nuke_Retired
CENTRAL EAST	113
NorthTie: OH-NY	8,720
NEW SCOTLAND KNCKRBOC	17
DUNWOODIE TO LONG ISLAND	5,222
ISONE-NYISO	1,691
PRNCTWN NEW SCOTLAND	-
SUGARLOAF 138 RAMAPO 138	521
GREENWOOD	4,991
PJM-NYISO	2,557
EGRDNCTY 138 VALLYSTR 138 1	5,778
DYSINGER STOLLE	2,096
RAINEY VERNON	1,517
MOTTHAVEN RAINEY	284
FARRAGUT GOWANUS	2,682
DUNWOODIE MOTTHAVEN	74
E179THST HELLGT ASTORIAE	1,194
CRICKET VALLEY PLSNTVLY	163

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Pocket X1, X2 and X3 Congestion Summary

Constraints	Pocket	Congested Hour
ALCOA-NM 115.00-ALCOA N 115.00	Pocket X1	1,336
DULEY 230.00-PLAT T#1 230.00	Pocket X1	1,009
ALCOA-NM 115.00-DENNISON 115.00	Pocket X1	361
MOSES W 230.00-WILLIS E 230.00	Pocket X1	119

Constraints	Pocket	Congested Hour
BREMEN 115.00-BU+LY+MO 115.00	Pocket X2	638
BRNS FLS 115.00-TAYLORVL 115.00	Pocket X2	523
LOWVILLE 115.00-BOONVL 115.00	Pocket X2	380
BRNS FLS 115.00-HIGLEY 115.00	Pocket X2	285
EDIC 345.00-PORTER 2 230.00	Pocket X2	71
NICHOLVL 115.00-PARISHVL 115.00	Pocket X2	20

Constraints	Pocket	Congested Hour
HTHSE HL 115.00-MALLORY 115.00	Pocket X3	4,131
COFFEEN 115.00-GLEN PRK 115.00	Pocket X3	1,261
HMMRMILL 115.00-WINE CRK 115.00	Pocket X3	601
COFFEEN 115.00-E WTRTWN 115.00	Pocket X3	425
HTHSE HL 115.00-COPEN_PO 115.00	Pocket X3	304

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Pocket Y1 and Y2 Congestion Summary

Constraints			Pocket	Congested Hour
RTRDM1	115.00-AMST 115	115.00	Pocket Y1	2,512
INGHAM-E	115.00-ST JOHNS	115.00	Pocket Y1	1,531
STONER	115.00-VAIL TAP	115.00	Pocket Y1	1,144
CLINTON	115.00-TAP T79	115.00	Pocket Y1	868
CHURCH-W	115.00-VAIL TAP	115.00	Pocket Y1	844
CHURCH-E	115.00-MAPLEAV1	115.00	Pocket Y1	522
CENTER-N	115.00-MECO 115	115.00	Pocket Y1	267
AMST 115	115.00-CHURCH-E	115.00	Pocket Y1	189
EVERETT	115.00-WOLF RD	115.00	Pocket Y1	26

Constraints			Pocket	Congested Hour
N.CAT. 1	115.00-CHURCHTO	115.00	Pocket Y2	2,232
MILAN	115.00-PL.VAL 1	115.00	Pocket Y2	1,340
OW CRN E	115.00-BOC 7T	115.00	Pocket Y2	459

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Pocket Z1 and Z2 Congestion Summary

Constraints	Pocket	Congested Hour
HICK 115 115.00-WERIE115 115.00	Pocket Z1	1,934
BATH 115 115.00-HOWARD11 115.00	Pocket Z1	1,592
MEYER115 115.00-S.PER115 115.00	Pocket Z1	1,305
BENET115 115.00-PALMT115 115.00	Pocket Z1	1,276
STA162 115.00-STA158S 115.00	Pocket Z1	1,238
MEYER115 115.00-MORAI115 115.00	Pocket Z1	702
CODNT115 115.00-MONTR115 115.00	Pocket Z1	345
BENET115 115.00-HOWARD11 115.00	Pocket Z1	323

Constraints	Pocket	Congested Hour
N.WAV115 115.00-26E.SAYR 115.00	Pocket Z2	5,388
WHITMAN 115.00-ONEIDA 115.00	Pocket Z2	1,910
N.WAV115 115.00-LOUNS115 115.00	Pocket Z2	656
WHITMAN 115.00-FEN-WIND 115.00	Pocket Z2	299
DELHI115 115.00-DEL T115 115.00	Pocket Z2	230
JENN 115 115.00-SIDNT115 115.00	Pocket Z2	189
LOUNS115 115.00-STAGECOA 115.00	Pocket Z2	183
CORTLAND 115.00-LABRADOR 115.00	Pocket Z2	180

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Pocket W1, W2 and W3 Congestion Summary

Constraints	Pocket	Congested Hour
Q545A_DY 345.00-Q545A_DY 345.00	Pocket W1	2,103
Q545A_ES 345.00-5MILE345 345.00	Pocket W1	470
HINMN115 115.00-LOCKPORT 115.00	Pocket W1	342
MORTIMER 115.00-SWDN-113 115.00	Pocket W1	159
HINMN115 115.00-HARIS115 115.00	Pocket W1	106

Constraints	Pocket	Congested Hour
DEPEW115 115.00-ERIE 115 115.00	Pocket W2	610
STOLE115 115.00-GIRD115 115.00	Pocket W2	578
CLSP-181 115.00-YNG-181 115.00	Pocket W2	51
STOLE115 115.00-STOLE345 345.00	Pocket W2	23
ERIE 115 115.00-PAVMT115 115.00	Pocket W2	5

Constraints	Pocket	Congested Hour
FALCONER 115.00-MOON-161 115.00	Pocket W3	907
EDNK-161 115.00-ARKWRIGH 115.00	Pocket W3	247
SLVRC141 115.00-DUNKIRK1 115.00	Pocket W3	28
EDNK-162 115.00-ARKWRIGH 115.00	Pocket W3	28

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Next Steps

- Review additional sensitivity analysis of nuclear retirements and energy storage
- Continue identification of transmission constraints that cause renewable curtailments (*i.e.*, renewable generation pockets)
- For each pocket, quantify the magnitude and frequency of the curtailments for each assumed resource mix

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Questions?

Our mission, in collaboration with our stakeholders, is to serve the public interest and provide benefit to consumers by:

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

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