Public Policy Transmission Needs Study: Transmission Constrained Renewable Generation Pockets

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Overview

- The first step in the Public Policy Transmission Planning Process involves the identification of transmission needs driven by Public Policy Requirements for which the NYISO should solicit and evaluate transmission solutions.
    - A Public Policy Requirement is a federal, state or local law or regulation, including an order of the New York State Public Service Commission issued after public notice and comment, that drives the need for transmission in New York State.
- On August 1, 2018 the NYISO will initiate its Public Policy Transmission Planning Process for the 2018-2019 transmission planning cycle by issuing a solicitation to Market Participants and all interested parties over a 60-day period to submit to the NYISO their proposals on Public Policy Requirements that may drive to Public Policy Transmission Needs.

Overview

- This assessment was conducted by the NYISO pursuant to a request by the New York State Department of Public Service (DPS), and is intended to provide some insights on possible public policy transmission needs.
- NYISO conducted a transmission constraint assessment related to the significant injection of renewable generation resources into various locations in the New York Control Area ("NYCA") to satisfy the 50-by-30 goal of the State's Clean Energy Standard ("CES").
- Two "snapshot" conditions were evaluated as representative of expected common operating states in a given year. The goal of this assessment is to identify if transmission upgrades may be needed to facilitate achievement of CES.

Considerations Outside the Scope of Assessment

- This is NOT an interconnection study. System and substation specific upgrades will be identified based on project proposals in the interconnection process.
- The assessment did not review:
  i. N-1-1 contingencies,
  ii. voltage or stability impacts,
  iii. year-round deliverability of energy or capacity to loads,
  iv. impact to the New York system reserve margin

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Proposed Assumptions and Methodology

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Study Methodology

- Conduct screening analysis on the system with projected renewable resource additions to satisfy the CES 50-by-30 goal. The results from N-1 contingency analysis were used to identify the potential thermal constraints on the NYCA transmission system 115 kV and above.
- Contingencies on the BPTF statewide were analyzed, along with the local transmission system contingencies in the service territories of National Grid, NYSEG and Central Hudson. Local circuit switching was not considered as a measure to relieve local transmission constraints.
- The generation pockets with overloaded transmission lines resulting from renewable generation injections were identified, as well as the MW levels of curtailments of the renewable generation that would be required to mitigate these overloads.

Study Methodology (cont.)

- Two projected load conditions for year 2028 were developed and analyzed to provide a probable outcome. The resulting constraints serve as indicative potential transmission bottlenecks.
- The transmission security assessment, including N-0 and N-1 thermal analysis, was performed using the PowerGEM TARA software. Monitored elements included all 115 kV and above facilities in the service territories of National Grid, NYSEG/RGE, and Central Hudson.
- N-1 analysis was performed using the optimization feature of TARA to identify potential curtailment of renewable resources.
- The thermal violations were grouped into “pockets” to identify the transmission constrained renewable generation.

Assumptions

- Transmission upgrades: The bulk power transmission system was updated to include the following projects:
  - NextEra Western New York PPTN project
  - Generic AC Transmission PPTN projects: generic projects that increase the transfer limits of Central East by 350 MW and UPNY-SENY by 900 MW
  - NYPA's proposed rebuild of Moses-Adirondack 230 kV circuits.
- Projected renewable resource addition: Resources were added to satisfy CES at the direction of DPS. The MW amount of each resource type, such as grid-connected solar and wind, and the zonal allocations are included in the next slide.
- Increased net imports from Ontario by 454 MW to satisfy CES, also provided by DPS.

Assumptions re: Additional Renewables

Zone	Land based wind (MW)	Solar (MW)	Off-shore Wind (MW)	Total Addition (MW)
A	1,645	213	-	1,858
B	-	102	-	102
C	958	186	-	1,144
D	325	170	-	495
E	835	700	-	1,535
F	120	1,000	-	1,120
G	-	400	-	400
H	-	6	-	6
I	-	0	-	-
J/K	-	-	2,400	2,400
K	-	328	-	328
Total	3,883	3,105	2,400	9,388

Note: There are multiple combinations of resources that could fulfill the CES. The combination analyzed in this assessment represents one possible approach. This total addition includes firm/planned renewables.

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Assumptions: Points of Interconnection

- **Utilized NYISO's interconnection queue to identify interconnection points and distribution of generation installations**
- **Injection points are assumed to be the closest existing substations**
- **Study assumptions:**
  - Solar: 71 sites, injecting at various voltage levels from 115 kV - 34.5 kV, rating between 140 MW and 6 MW
  - Land-based wind: 23 sites, injecting at various voltage levels from 345 kV - 46 kV, rating between 275 MW and 26 MW
  - Off-shore wind: 2 sites, injecting at 345 kV (zone J) and 138 kV (Zone K), each one rated at 1,200 MW

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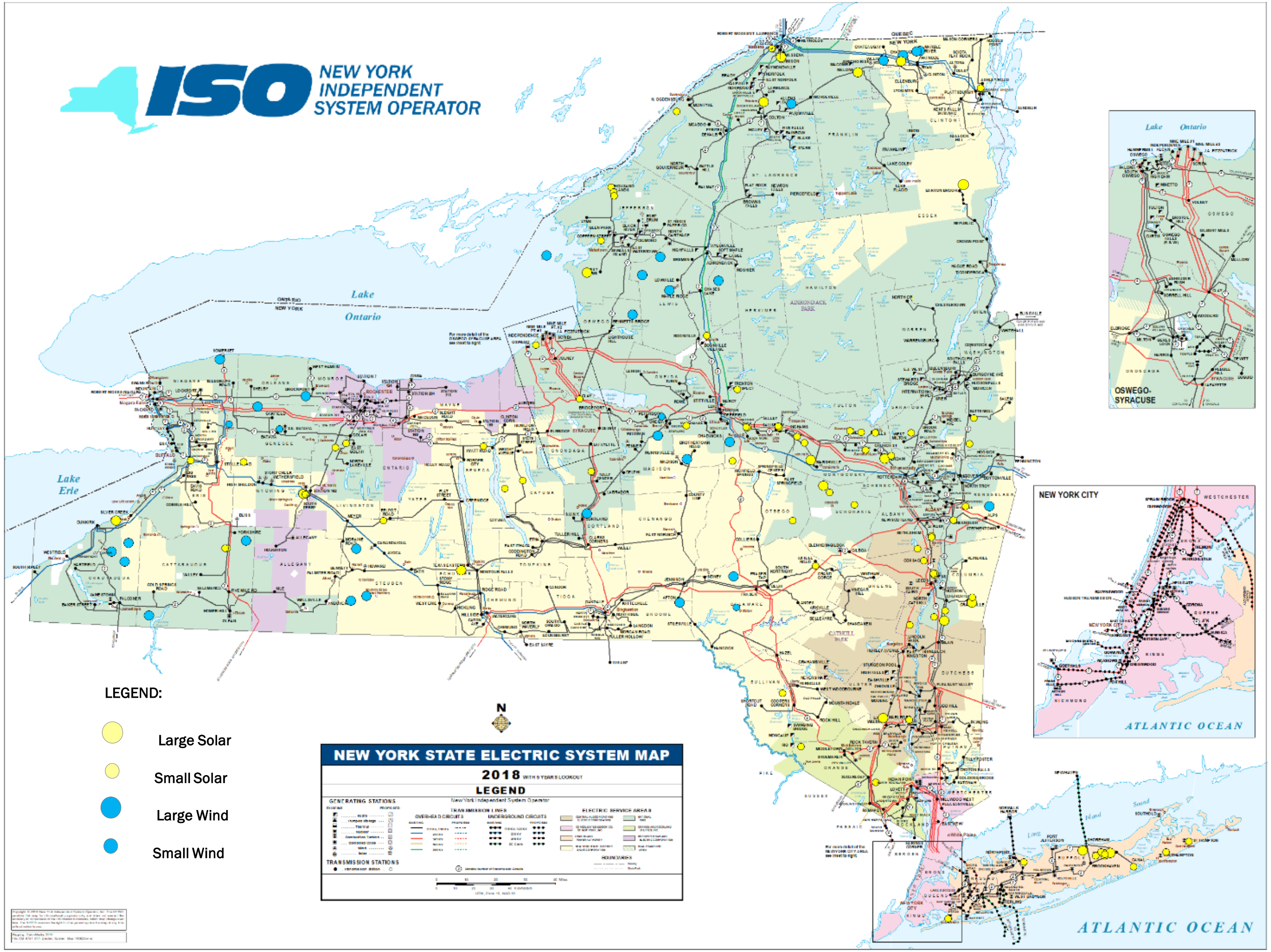
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NEW YORK STATE ELECTRIC SYSTEM MAP
2018 WITH 5 YEARS LOOKOUT
LEGEND
Lake Ontario
Lake Erie
NEW YORK CITY
OSWEGO-SYRACUSE
ATLANTIC OCEAN
LEGEND:
Large Solar
Small Solar
Large Wind
Small Wind

Generation Assumptions

Zone	Existing and Firm Renewables (MW)				Additional Renewables (MW)			Total Renewables (MW)
	Hydro	Wind	PV	Total	Wind	PV	Total(1)	
A	2,439	343	0	2782	1,058	214	1,273	4,054
B	53	6	0	59	390	48	438	497
C	90	665	0	755	995	288	1,283	2,038
D	912	678	0	1590	324	430	746	2,262
E	372	521	0	893	789	389	1,176	2,069
F	246	0	0	246	120	1,150	1,298	1,544
G	85	0	0	85	0	264	264	348
H	0	0	0	0	0	0	0	0
I	0	0	0	0	0	0	0	0
J	0	0	0	0	1,200	0	1,200	1,200
K	0	0	51	51	1,200	327	1,527	1,578
Total	4,197(2)	2,213	51	6467	6,077	3,110	9,205	15,590

1. Total addition to the 2028 power flow case: The MW numbers for Zones A, B and C vary to account for 1) the wind farms not in-service yet but already included in the case, and 2) points of injection.
2. Pumped storage facilities can be either generating or pumping, so the capacity was added separately.

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Assumptions: Generation Dispatch

- In consultation with the DPS staff, the NYISO staff compiled and recommended a list of frequently-committed units that would unlikely be displaced by renewable generation. These units include the existing renewable generating units, nuclear units (except Indian Point Energy Center which was assumed deactivated in the analysis), and several steam and combined cycle plants.

Assumptions: Frequently Committed Generators

- Units committed based on NYISO operating experience as the starting point
  - Peak load: historical August peak hours
  - Light load: historical March loads @~20,000 MW during the day
- Dispatch: Pmax based on the 2018 DMNC, Pmin based on 30% for combined cycle plants and 20% for steam stations

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Assumptions: Load Conditions

- **Two load conditions were developed to represent possible system conditions and load-generation balance: summer peak load and summer light load conditions.**
  - More severe transmission constraints could occur when the NYCA load is very high, or they might occur when the NYCA load is lower but combined with higher renewable generation (during windy and sunny days), and the transmission facilities are at lower summer ratings to transfer power
  - Summer peak load: approximately 33,300 MW load including losses
    - 2018 NYISO forecast for 2028 plus additional losses resulting from transferring power from upstate to downstate
  - Summer light load: approximately 20,000 MW load including losses

Assumptions: Summer Light Load Conditions

- **Summer ratings for transmission facilities**
- **Load Profile:**
  - NYISO operating experience as the starting point
  - NYISO surveyed sunny and windy days in early summer
  - Load duration curves for summer 2014 and 2017 were developed to identify midpoint: NYCA load was approximately 18,000 MW or higher for 50% of the summer hours
  - Zonal load distribution on May 1, 2018 at HR 14 was used as a proxy for scaling up and down

Assumptions: Resource – Load Balance

		Summer Peak	Summer Light
Load	NYCA load+losses	33,294	20,048
Resources for NYCA consumption	Total Renewables	15,594	15,594
	Pmin from frequently committed units	7,499	5,729
	Import from NE	0	-1,400
	Import from ONT	454	-484
	Import from HQ	1,110	0
	Import from PJM	162	0
	HTP	0	0
	Neptune HVDC	660	0
	Pumping Units	0	0
Resources - Load (MW)[note]		-7,815	-609

Note:

- positive total MW balance implies a surplus of generation, and negative numbers implies frequently committed units would be dispatched above Pmin.

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Study cases

- **Summer Peak Cases, total NYCA load at ~33,300 MW:**
  - Case A: Reference FERC 2028 summer peak case with the transmission upgrades. All 6,467 MW of existing (in the case) baseline renewable generation was set at their full output
  - Case B: Similar to Case A, but with all future additional renewable generation added and set at full output

- **Summer Light Load Cases, total NYCA load at ~20,000 MW:**
  - Case C: Similar to Case A, with existing baseline renewable generation but with a summer light load profile
  - Case D: Similar to Case B, with all future additional renewable generation added but a summer light load profile

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Results and Discussion

Baseline N-1 Thermal Assessment: Firm/Existing Renewables at full output

<u>Case A</u> – Summer peak case with baseline renewables at full output: (N-0)/(N-1) was performed, and no curtailment of existing baseline renewables was allowed. Certain 230 kV lines in Zone D (North zone) were found to be overloaded in the vicinity of high wind generation. The identification of these transmission constraints is consistent with NYISO's current operating experience.

<u>Case C</u> – Summer light load case with baseline renewables at full output: (N-0)/(N-1) was performed, and no curtailment of existing baseline renewables was allowed. Some 230 and115 kV lines in Zone D and Zone E were overloaded. The identification of these transmission constraints is consistent with NYISO's current operating experience.

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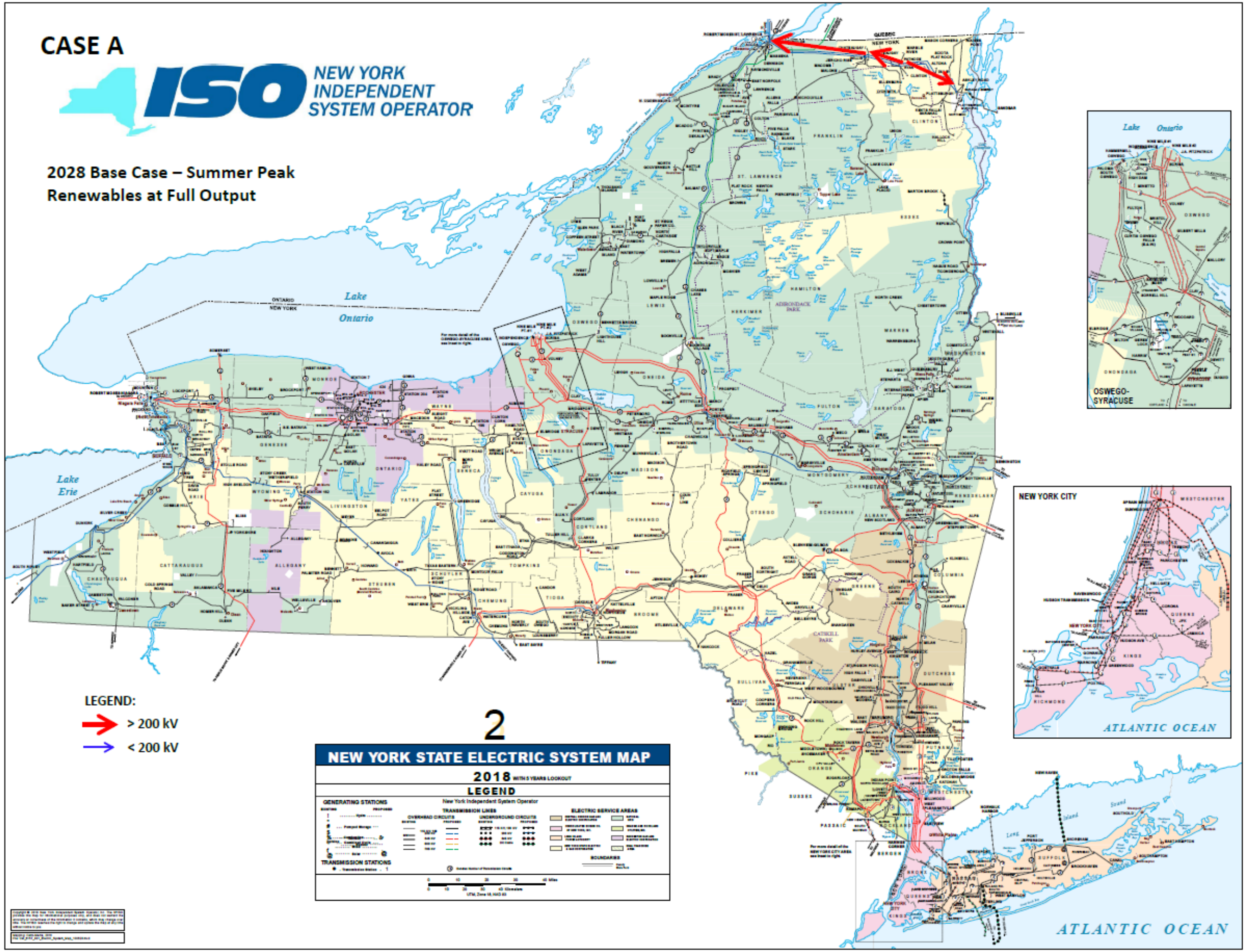
CASE A

2028 Base Case – Summer Peak
Renewables at Full Output



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LEGEND:
- > 200 kV
- < 200 kV

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CASE C

2028 Base Case – Summer Light Load
Renewables at Full Output

LEGEND:

- > 200 kV (red arrow)
- < 200 kV (blue arrow)

Note: Constraints not previously observed in the studied peak load conditions are highlighted in yellow.

CES N-1 Thermal Assessment: Additional Renewables at Full Output

<u>Case B</u> – Summer peak case with baseline and additional renewables at full output: Numerous thermal violations were identified through the state for both N-0 and N-1 conditions. Heavy loop flows through PJM from Zone A to Zone C were observed.

<u>Case D</u> – Summer light load case with baseline and additional renewables at full output: Numerous thermal violations were identified through the state under N-0 and N-1 conditions. The constraints were largely similar to the ones observed in peak load cases. Heavy loop flows through PJM from Zone A to Zone C were also observed.

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Curtailment Analysis

- Renewable generation, both existing and additional, was curtailed to relieve thermal violations. This analysis focuses on unbottling constraints in the study area.
  - The potential system impacts of injecting the assumed amounts of off-shore wind in Zones J and K were not further analyzed.
- The MW of additional renewables that had to be curtailed at a zonal level during summer peak and light load conditions are shown in the next slide.

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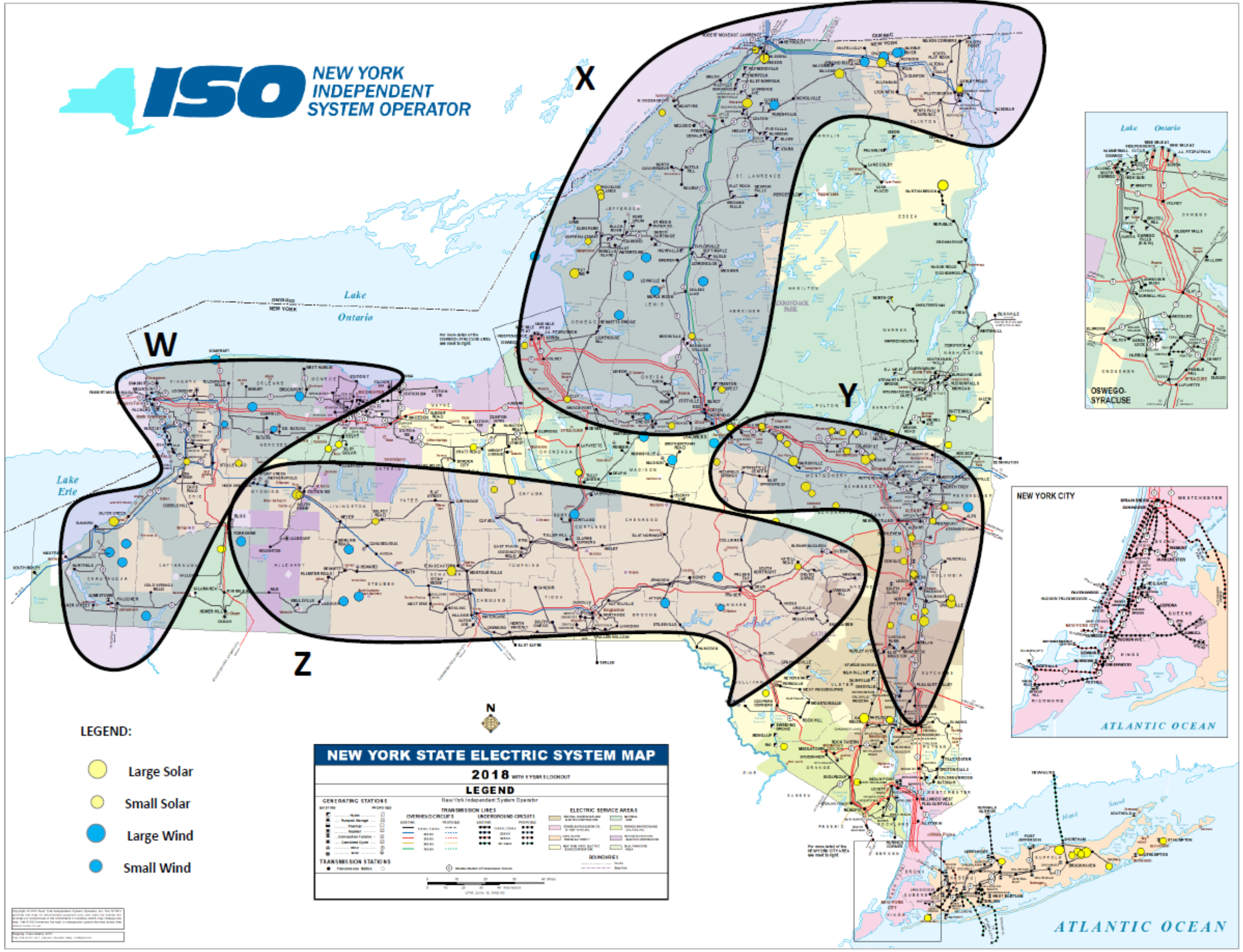
Curtailment Analysis (cont.)

- Groups of overloads ("pockets") were found from study scenarios with renewable generation turned on at their maximum outputs. These overloads were organized into groups:
  - Pocket W: Western NY Overloads
    - Niagara – Rochester (115 kV)
    - PJM-NY AC Ties (115 kV)
    - Niagara – Gardenville – Stolle Rd (115 kV)
  - Pocket X: Northern NY Overloads
    - Zone D Wind Generation Corridor (230 & 115 kV)
    - North to South Moses South Transfer path (230 & 115 kV)
    - Jefferson & Lewis Counties (115 kV)
  - Pocket Y: Eastern NY Overloads
    - Mohawk Valley Corridor (115 kV)
    - Hudson Valley Corridor (115 kV)
  - Pocket Z: Southern Tier Overloads
    - Finger Lakes Region Wind & Solar (115 kV)
    - Southern Tier Transmission Corridor (345 & 115 kV)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W
X
Y
Z
Lake Ontario
Lake Erie
ATLANTIC OCEAN
NEW YORK CITY
OSWEGO-SYRACUSE
LEGEND:
Large Solar
Small Solar
Large Wind
Small Wind
NEW YORK STATE ELECTRIC SYSTEM MAP
2018
LEGEND

Potential unbottling of curtailed renewable generation

Pocket	Description	Renewable Generation Unbottling Range (MW)
W	Western NY 115 kV	25 - 125
X'	Northern NY 230 kV Only	400 - 425
X	Northern NY 230 and 115 kV	975 – 1,050
Y	Eastern NY 115 kV	400 - 500
Z	Southern Tier 345 and 115 kV	875 - 925
W + Z	Western + Southern Tier	1,000 – 1,150

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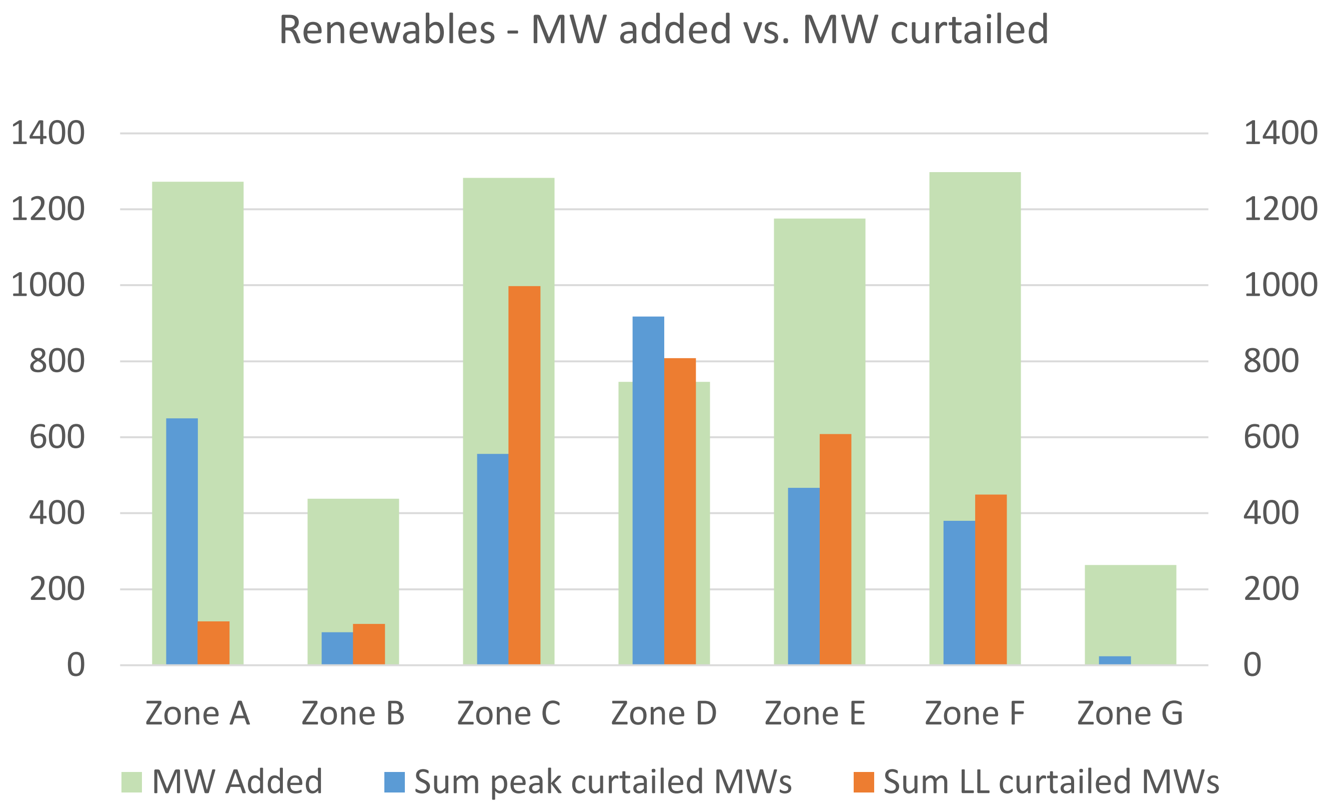

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Conclusions

- The study reveals that under both the studied summer peak and summer light load conditions, the addition of significant amounts of renewable generation causes stresses and certain violations on the NY transmission system at both the backbone (> 200 kV) as well as the underlying (100 – 200 kV) system.
- Under the studied “snapshot” system conditions, a substantial amount of additional renewable generation in these zones may need to be curtailed to prevent overloading transmission facilities.
- The study indicates a need for transmission upgrades in order to transmit the full power from the renewable generation pockets to NYCA load to achieve the CES.

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Questions?

We are here to help. Let us know if we can add anything.

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

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