New York ISO
Independent System Operator

Appendix J

2021-2040 System & Resource Outlook (The Outlook)

A Report from the New York Independent System Operator

September 22, 2022

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Appendix J: Detailed Contract and Policy Case Renewable Generation Pockets

This appendix section discusses in detail the congested hours for transmission constraints and deliverability of energy from renewable resources from the pockets identified in the Contract and Policy Cases for simulation years 2030 and 2035. Previous pocket analysis performed for the 2019 CARIS 1 70 x 30 study focused on the 2030 year as it represents the year by which set policy goals for 70% renewable generation are to be achieved. Since The Outlook expands the study horizon and includes additional policy goals that allow for different buildouts of renewable resources over different years, 2035 was also studied for Policy Case scenarios S1 and S2 to examine the effects of expanded large-scale renewables on localized transmission networks.

Renewable Generation Pocket Overview

Consistent with the renewable generation pockets identified in the 2019 CARIS Phase 1 70 x 30 Scenario, the renewable generation pockets are defined below. Each pocket (W, X, Y and Z), along with corresponding sub-pockets (W1, X2, Y1, etc.), depicts a geographic grouping of renewable generation and the transmission constraints in a local area.

- **Western NY (Pocket W)**: Western NY constraints, mainly 115 kV in Buffalo and Rochester areas:
    1) **W1**: Orleans-Rochester Wind (115 kV)
    2) **W2**: Buffalo Erie region Wind & Solar (115 kV)
    3) **W3**: Chautauqua Wind & Solar (115kV)
- **North Country (Pocket X)**: Northern NY constraints, including the 230 kV and 115 kV facilities in the North Country:
    1) **X1:** North Area Wind (mainly 230 kV in Clinton County)
    2) **X2**: Tug Hill Plateau Wind & Solar (mainly 115 kV in Lewis County)
    3) **X3**: Watertown Wind & Solar (115 kV in Jefferson & Oswego Counties)
- **Capital Region (Pocket Y)**: Eastern NY constraints, mainly the 115 kV facilities in the Capital Region:
    1) **Y1**: Capital Region Solar Generation (115 kV in Montgomery County)
    2) **Y2**: Hudson Valley Corridor (115 kV)
- **Southern Tier (Pocket Z)**: Southern Tier constraints, mainly the 115 kV constraints in the Finger Lakes area:
    1) **Z1**: Finger Lakes Region Wind & Solar (115 kV)

2) **Z2**: Southern Tier Transmission Corridor (115kV)
3) **Z3**: Central and Mohawk Area Wind and Solar (115kV)

- **Offshore Wind:** offshore wind generation connected to New York City (Zone J) and Long Island (Zone K)

The renewable generation pocket analysis performed using the aforementioned pocket definitions is based on the grouping of congested lines and generators which are likely to be curtailed within a localized area. The pocket definitions and locations are the same between the Contract and Policy Cases. With the addition of new Policy Case resources resulting from capacity expansion simulations for scenarios Scenario 1 and Scenario 2, significantly more renewable energy resources are added to the system in the Policy Cases compared to the Baseline and Contract Cases.

An analysis for 2030 and 2035 was conducted with a detailed transmission representation to capture the constraints at various voltage levels. In the transition to an emission-free grid, the Policy Case analysis for 2040 assumes sufficient transmission expansion occurs between 2035 and 2040 to relieve transmission constraints at lower voltage levels, recognizing that the transmission owners are actively developing local transmission & distribution expansion plans to meet CLCPA[1]. By doing so, the full impact to the bulk constraints due to new resources becomes more pronounced and highlights the bulk transmission expansions that will still be necessary to efficiently deliver energy to consumers.

The new resource additions from the capacity expansion simulations were placed at available buses identified in the NYISO Interconnection Queue for new wind and solar facilities. These locations represent the probable sites for new resource additions and provide likely interconnection points on the existing system. Most of the additional resources are located inside the general pocket locations identified in the Contract Case. A study of local congestion within these pockets illustrates expected obstacles in the transmission system to transmit power out of the pockets to serve loads elsewhere.

The two figures below provide an overview of the locations of new resources added to the Contract and Policy Case scenarios in years 2030 and 2035, respectively. The location of renewable generation pockets in relation to the new resources is also depicted.

[1] Case 20-E-0197, Proceeding on Motion of the Commission to Implement Transmission Planning Pursuant to the Accelerated Renewable Energy Growth and Community Benefit Act

Figure 235: 2030 Renewable Generation Pocket Map

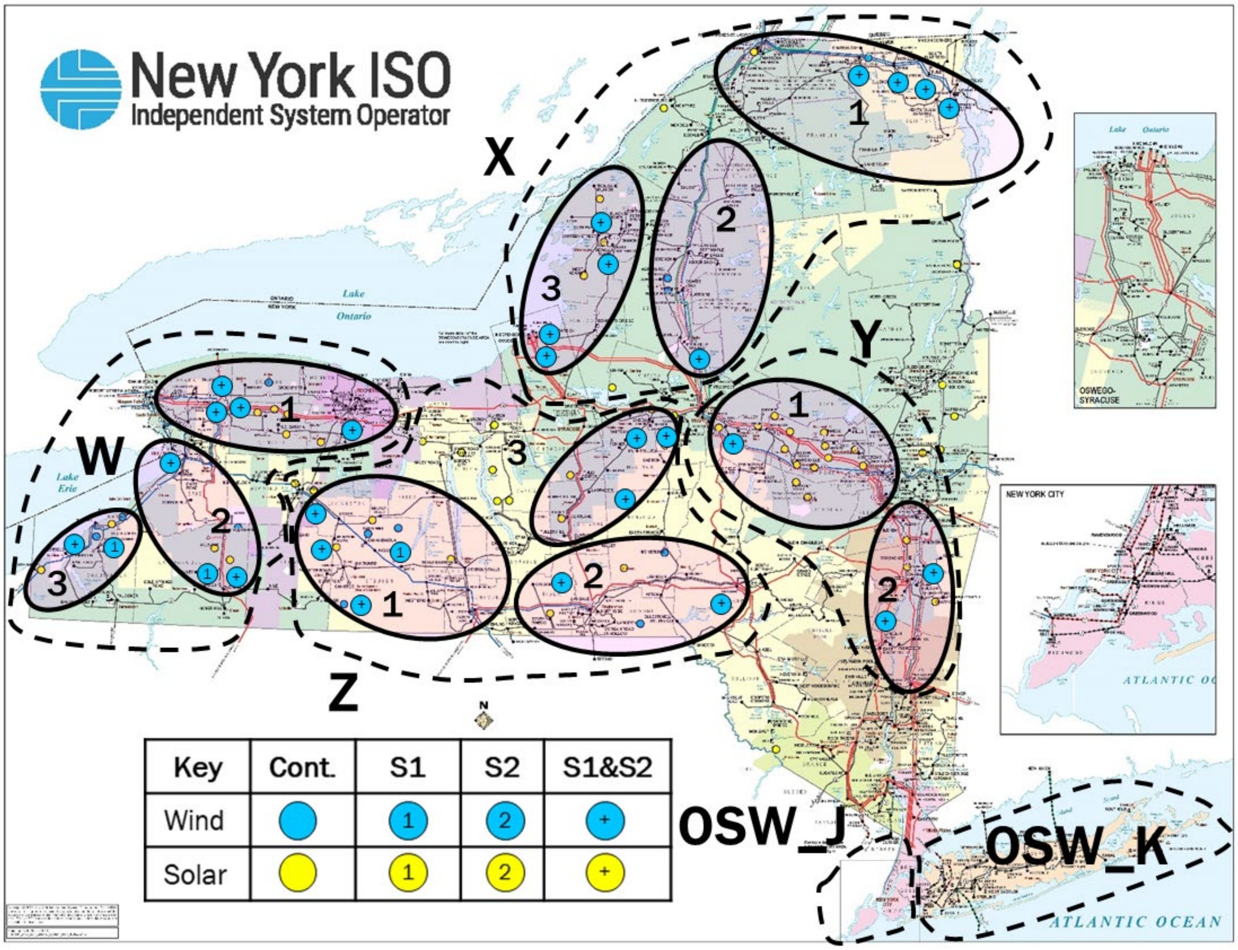
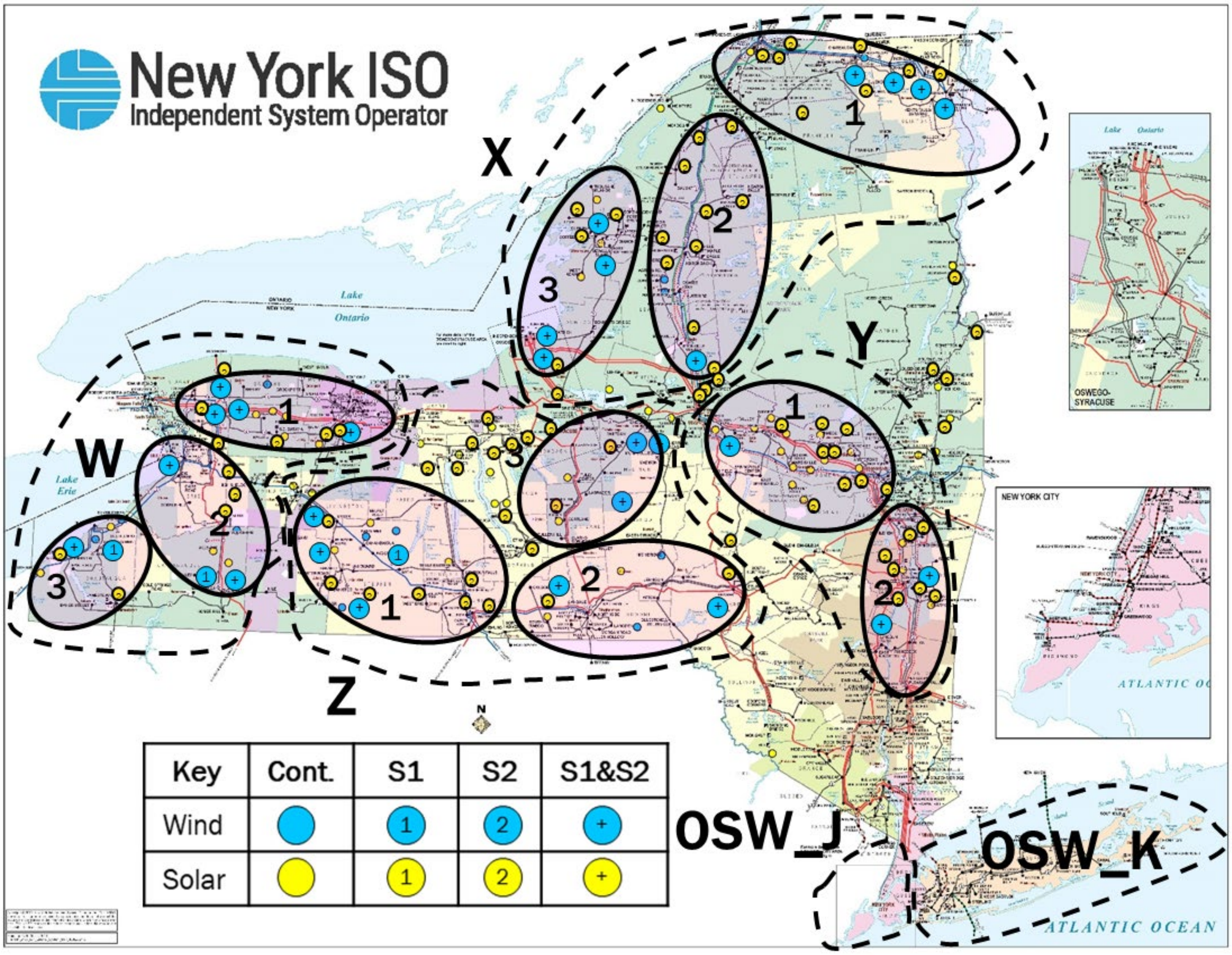


Figure 236: 2035 Renewable Generation Pocket Map



In Figure 235 and Figure 236, the blue and yellow colored circles show approximate locations of new renewables (wind and solar generation respectively) that are not included in the Baseline Case.

In 2030, a vast majority of new capacity in both Policy scenarios is land-based wind. The new wind projects are above and beyond what has already been included in the Contract Case, where over four GW of solar and four GW of offshore wind is added. Projects are concentrated in the W, X, and Z pockets. Transmission constraints in the X3, Z1, Z2, and OSW_K pockets result in lower energy deliverability levels in 2030.

Between 2030 and 2035, each scenario includes an increased amount of offshore wind to meet the 9 GW by 2035 policy target as compared to the Contract Case. Scenario 1 includes several more land-based wind projects in the X and Z pockets, which help to meet energy demand and policy objectives. Scenario 2 builds an increased number of solar projects scattered throughout all of the upstate pockets.

The congested paths that create each pocket are generally on the lower voltage networks and electrically close to new renewable generators added in each case. Congestion on lines around the pocket could cause curtailment of generators within the pocket. While higher voltage bulk level constraints typically limit the flow of energy across the state, lower voltage constraints tend to become congested first, limiting the amount of energy that can flow out of the generation pocket and onto the bulk system.

Almost all of the renewable generation (99%) is located within a pocket. Offshore wind makes up the majority of renewable generation added in New York City and Long Island (Zones J and K). Upstate renewable generation is a mix of utility-scale solar and land-based wind resources. The existing Hydro-Québec (HQ) imports into Northern New York (Zone D) are considered qualifying renewable generation injecting into the X1 pocket.

Each renewable generator is associated with an hourly generation profile in the production cost simulation. Owing to load, renewable scheduled generation, local transmission topology, and system conditions, a portion of potential renewable generator output may be curtailed. Curtailment of scheduled generation usually results when a generator locates upstream of a transmission bottleneck or in localized pockets with limited transmission export capabilities.

The sections below describe each individual pocket and sub-pockets identified for both 2030 and 2035 study years and provide metrics for comparing congestion and energy deliverability across three different cases – Contract Case, Policy Case Scenario S1 and Scenario S2. These pocket locations were identified as part of the 2019 CARIS 1 70 x 30 study. Naming conventions of pockets and sub-pockets are consistent with the prior CARIS study.

Western New York (Pocket W)

The Western New York pocket contains large existing hydro units as well as a mix of new utility-scale solar (UPV) and Land Based Wind (LBW) units. UPV units, which are mostly derived from the Contract Case, are located in this region, particularly in sub-pocket W1 along the Dysinger-Rochester path. There is also a considerable amount of LBW resources built in this area with about 36% of the total contracted wind capacity located in this pocket. With lower amounts of imports from IESO, as identified in both the Baseline and Contract Cases, this region shows less congestion than that observed in prior studies.

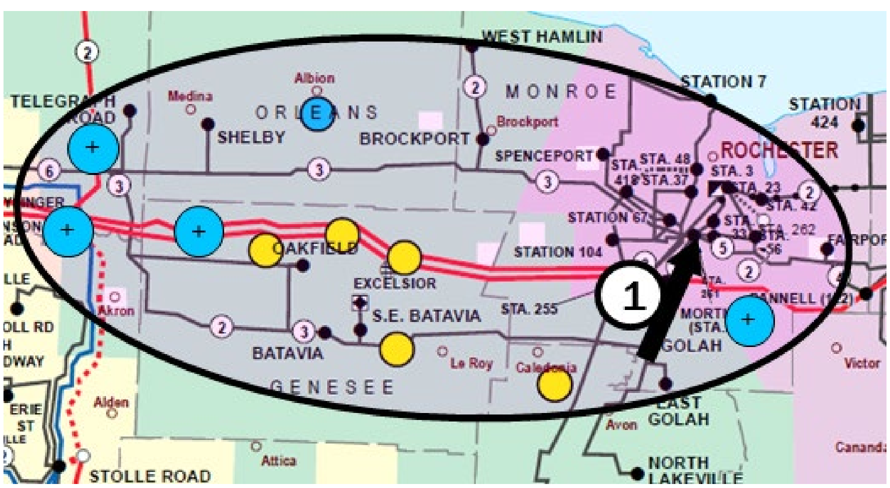
Pocket W1

W1 - 2030 Pocket Analysis

Pocket W1 is located in Niagara-Orleans-Rochester area. For year 2030, UPV units in this sub-pocket are all contracted units which experience minimal curtailment in all three Cases. LBW units, which are mostly connected to higher kV buses, experience no curtailment.

The only congested element which meets a threshold of greater than 100 hours congested[2] to be included in the pocket is ‘Golah 115-Mortimer 115’ which is a 115 kV line feeding power into the Rochester area. This line is congested for about 800-1000 hours in 2030 in all three cases.

Figure 237: Pocket W1 Congestion and Energy Deliverability Summary (2030)



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2 A threshold of 100 constrained hours per year per transmission path, in any of the three cases evaluated, was used to filter results to be reported in the pocket analysis. All additional transmission constraints with less than 100 hours of transmission congestion were not reported for simplification purposes.

ID	Constraint	Contract	Policy S1	Policy S2
1	GOLAH 115-MORTIMER 115	845	979	983

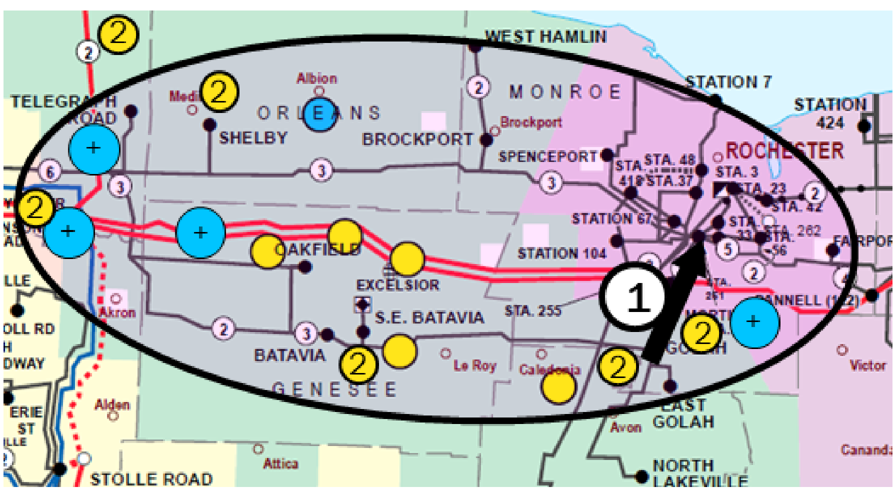
Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Wind	200	1,543	735	100%	100%	100%
Solar	1,130	1,130	1,130	99%	98%	99%

W1 - 2035 Pocket Analysis

W1 contains additional UPV units built in S2 compared to S1 which does not have any additional UPV units other than the contracted units. These new UPV units are indicated in the pocket map below by the yellow circle with '2' inside indicating this unit is only included in the S2 case. The number of congested hours decreases in 2035 compared to 2030 as UPV resources are added downstream of the constraint. Load increases elsewhere in the system might also divert flows away from congested paths.

With the addition of UPV units in S2 in 2035 in the 115 kV and 345 kV system, the curtailment increases for pocket W1. Additional wind units in 2035 are still deliverable in both cases.

Figure 238: Pocket W1 Congestion and Energy Deliverability Summary (2035)



ID	Constraint	Policy S1	Policy S2
1	GOLAH 115-MORTIMER 115	793	458

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Solar	1,130	2,092	95%	98%
Wind	1,621	1,375	100%	100%

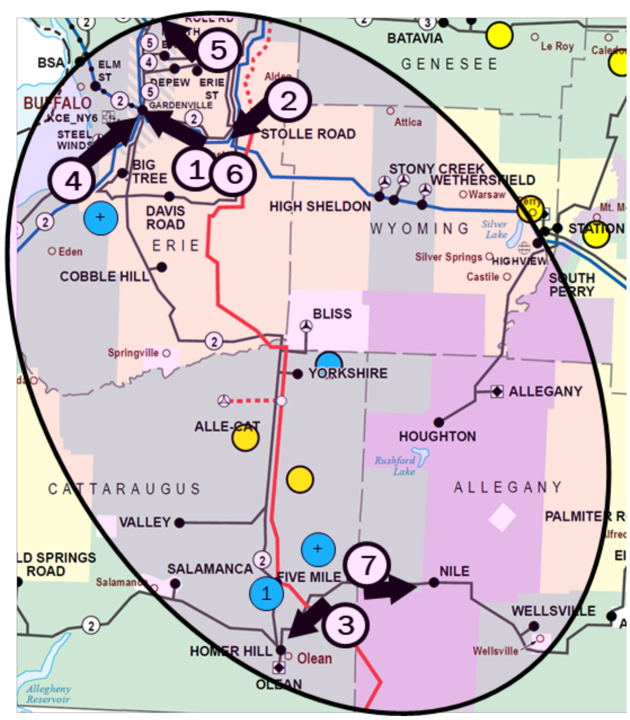
Pocket W2

W2 - 2030 Pocket Analysis

Pocket W2 is located in the Buffalo-Erie area which contains mostly LBW resources along the 345 kV corridor from Stolle Road to Five Mile substation. Most binding constraints are on the 115 kV level within Buffalo around Stolle 115 kV Bus.

Contracted UPV units within the pocket are curtailed slightly in 2030 in both the policy cases but the magnitude of curtailment is small. LBW resources have lower energy deliverability (higher curtailment) in S1 compared to S2 due to larger buildout in the same region.

Figure 239: Pocket W2 Congestion and Energy Deliverability Summary (2030)



ID	Constraint	Contract	Policy S1	Policy S2
1	**STOLE 115-GIRD 115**	3,816	1,442	2,975
2	**STOLE 115-STOLE 345**	2,040	1,215	1,885
3	**DUGN-157 115-HOMERHIL 115**	8	2,833	722
4	**BETH-149 115-GRDNVL1 115**	0	827	0
5	**CLSP-181 115-URBN-922 115**	12	199	34
6	**GARDV 115-GIRD 115**	0	158	24
7	**DUGN-157 115-NILE 115**	0	116	2

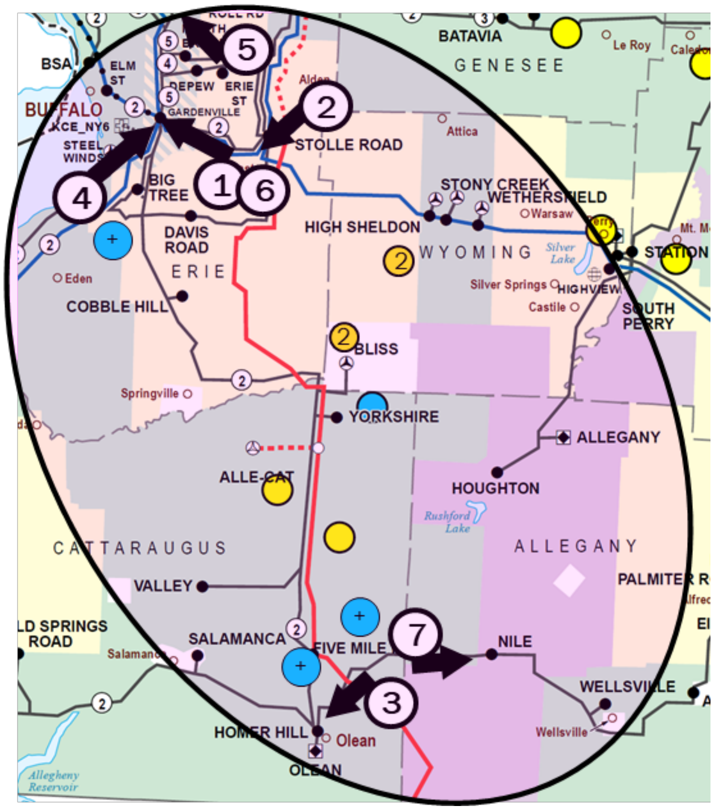
Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Wind	813	1,491	1,074	100%	94%	99%
Solar	60	60	60	100%	89%	96%

W2 - 2035 Pocket Analysis

Additions of incremental UPV and LBW resources in 2035 cause congestion to increase in the elements within the pocket as seen in the congested hour by constraint table below. The Dugan Road 115 kV to Homerhill 115 kV line congestion increases significantly in both cases as additional resources are added upstream of this constraint.

Increased congestion on lines due to incremental resources in the same area causes the energy deliverability metric of the resources within the pocket to reduce. LBW energy deliverability is lower compared to 2030 as incremental additions are placed at the same locations.

Figure 240: Pocket W2 Congestion and Energy Deliverability Summary (2035)



ID	Constraint	Policy S1	Policy S2
1	STOLE 115-GIRD 115	1,642	1,438
2	STOLE 115-STOLE 345	1,266	2,456
3	DUGN-157 115-HOMERHIL 115	3,634	3,933
4	BETH-149 115-GRDNVL1 115	1,340	1,330
5	CLSP-181 115-URBN-922 115	461	396
6	GARDV 115-GIRD 115	83	183
7	DUGN-157 115-NILE 115	110	304

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Solar	60	349	83%	95%
Wind	1,633	1,633	88%	88%

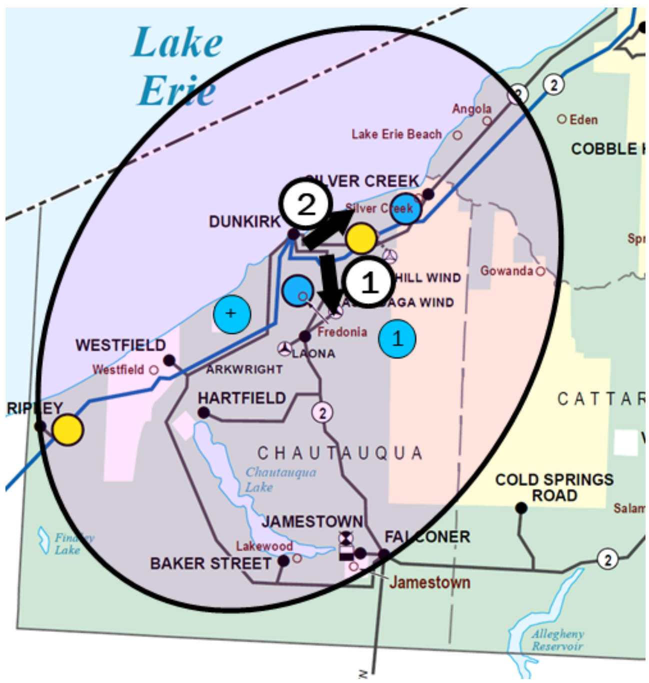
Pocket W3

W3-2030 Pocket Analysis

Pocket W3 is located in Chautauqua County along the 230 kV line from Silver Creek- Dunkirk-Ripley. This pocket contains significant LBW resources connected to the 115 kV and 230 kV circuits around the Dunkirk 230 kV substation, which supply power to load centers further north in the Buffalo area. The 115 kV path from Dunkirk to Silver Creek is highly congested in S1 compared to the other two cases due to increased LBW capacity buildout upstream of the constraint.

The energy deliverability metric results shows that higher amounts of renewable energy resources built within this sub-pocket in S1 causes increased curtailments.

Figure 241: Pocket W3 Congestion and Energy Deliverability Summary (2030)



ID	Constraint	Contract	Policy S1	Policy S2
1	EDNK-161 115-ARKWRIGH 115	297	106	139
2	SLVRC141 115-DUNKIRK1 115	13	2,270	387

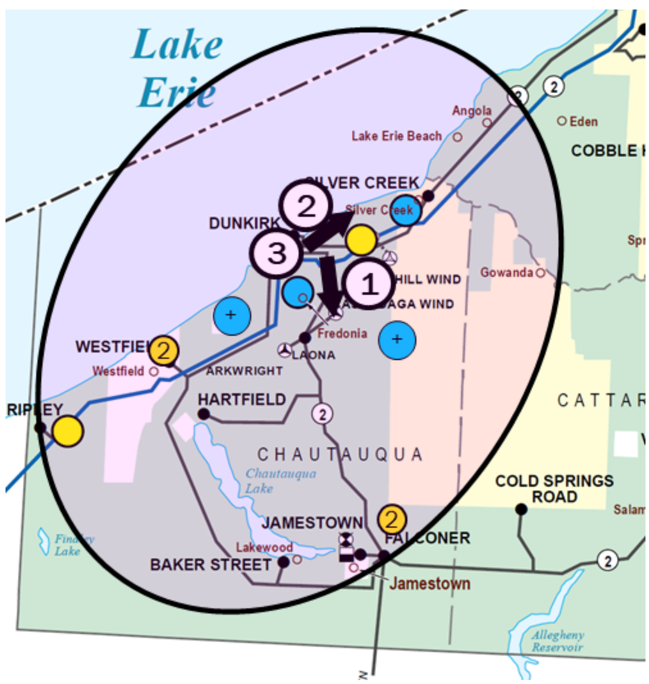
Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Wind	305	916	576	100%	93%	99%
Solar	290	290	290	100%	94%	100%

W3-2035 Pocket Analysis

W3 pocket congestion increases in year 2035 because of resource additions in both cases. S2 has additional UPV units added in 2035 which increases congestion on the 115 kV path from Dunkirk to Silver Creek. However, due to an additional unit added downstream of East Dunkirk 115 kV to Arkwright 115 kV line on Falconer 115 kV bus, the congestion on this line decreases in 2035. This new unit might still experience some curtailment due to congestion on lines outside of this pocket. A new constraint ('DUNKIRK 230-DUNKIRK1 115') meets the threshold of greater than 100 hours congested in 2035 due to additional LBW capacity added on the Dunkirk 230 kV bus.

As a result of limited transmission paths and large renewable capacity within pocket W3, energy deliverability is lowest for both LBW and UPV in Pocket W.

Figure 242: Pocket W3 Congestion and Energy Deliverability Summary (2035)



ID	Constraint	Policy S1	Policy S2
1	EDNK-161 115-ARKWRIGH 115*	92	64
2	SLVRC141 115-DUNKIRK1 115	2,757	3,060
3	DUNKIRK 230-DUNKIRK1 115	289	187

*met >100 hours threshold in 2030

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Solar	290	574	87%	83%
Wind	1,012	1,012	88%	89%

Northern New York (Pocket X)

Northern New York Pocket located in Zone D (North) and Zone E (Mohawk Valley) consists of large-scale LBW units, Hydro, few UPV units in the Contract and S1 cases and some large UPV additions which are in-service in 2035 in S2. With existing scheduled imports from HQ into Zone D (HQ-Chateaugay and HQ-Cedars), which are assumed to count as qualified renewable energy injections, Pocket X is one of the most resource rich areas in terms of renewable energy in the system.

The Policy Cases include upgrades to the existing Adirondack-Chases Lake and Adirondack-Porter 230 kV path as well as upgrades to Moses-Willis-Patnode and Willis-Ryan 230 kV circuits as part of the Northern New York Priority Transmission project ('Smart Path Connect Project', a priority transmission project approved by the New York Public Service Commission under New York's Accelerated Renewable Energy Growth and Community Benefit Act). Upgrades to the transmission system along this path increases transfer capability by approximately 1,000 MW.

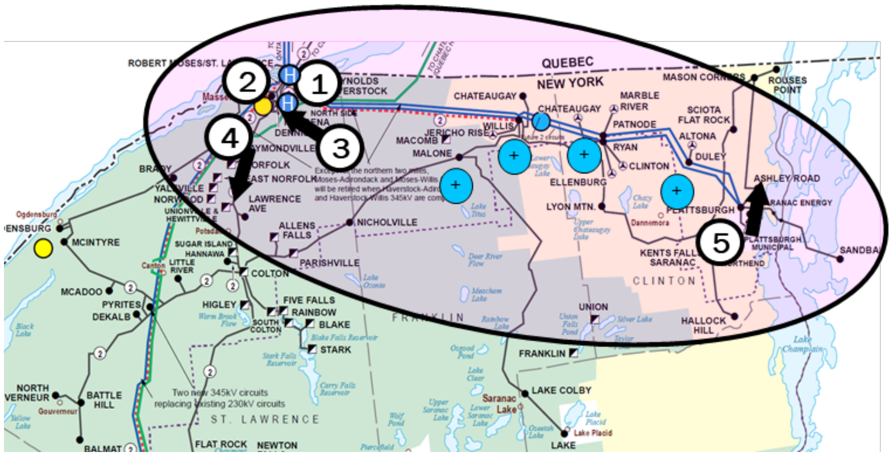
Pocket X1

X1 – 2030 Pocket Analysis

Pocket X1 is located in Zone D along the 230 kV path from Moses to Plattsburgh. This region contains existing LBW resources and incremental LBW resources in the Policy Cases in year 2030. The primary transmission constraints in the area are on the 115 kV system including the Phase Angle Regulators (PARs) connecting NY to the Ontario system. This path is highly utilized to transact power from New York into Ontario and is congested almost all hours of the year. The Dennison-Alcoa 115 kV path is congested around 10% of the year which serves load at the Alcoa bus.

There is slight curtailment of LBW resources. However, due to upgrades to the bulk system in the area energy deliverability from resources in this pocket is high in 2030.

Figure 243: Pocket X1 Congestion and Energy Deliverability Summary (2030)



ID	Constraint	Contract	Policy S1	Policy S2
1	**North Tie: OH-NY**	7,678	8,098	7,978
2	**ALCOA-NM 115-ALCOA N 115**	926	967	847
3	**ALCOA-NM 115-DENNISON 115**	782	859	805
4	**LWRNCE-B 115-SANDST-5 115**	0	146	158
5	**NOEND115 115-PLAT 115**	128	94	64

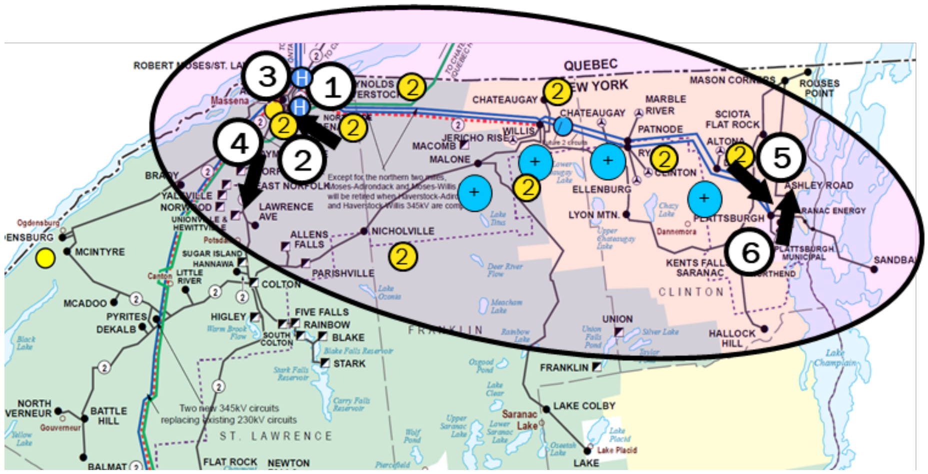
Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Hydro	1,049	1,049	1,007	100%	100%	100%
HQImport	1,930	1,930	1,930	100%	98%	99%
Wind	678	876	778	100%	98%	99%
Solar	180	180	180	100%	100%	100%

X1 – 2035 Pocket Analysis

Congestion patterns in 2035 remain similar to those seen in 2030 for pocket X1. There are UPV additions in S2 which are primarily on the 230 kV level. The Duley 230 kV to Plattsburgh 230 kV constraint meets the threshold for inclusion due to increased wind and solar penetration along the 230 kV corridor from West to East towards Plattsburgh. Congestion around the Alcoa substation is slightly lower due to additional resources connecting upstream of congested paths around the Moses 230 kV bus.

Energy deliverability of resources from within the pocket decreases slightly due to increased resource capacity in the system in 2035. Additional constraints outside of the pocket may also cause curtailment of resources in the pocket if local constraints are not encountered.

Figure 244: Pocket X1 Congestion and Energy Deliverability Summary (2035)



ID	Constraint	Policy S1	Policy S2
1	North Tie: OH-NY	8,024	7,972
2	ALCOA-NM 115-DENNISON 115	738	696
3	ALCOA-NM 115-ALCOA N 115	591	444
4	LWRNCE-B 115-SANDST-5 115	137	120
5	DULEY 230-PLAT T#1 230	4	176
6	NOEND115 115-PLAT 115	113	50

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Hydro	1,068	1,068	94%	97%
HQImport	1,930	1,930	92%	95%
Solar	180	355	97%	99%
Wind	1,274	1,274	93%	96%

Pocket X2

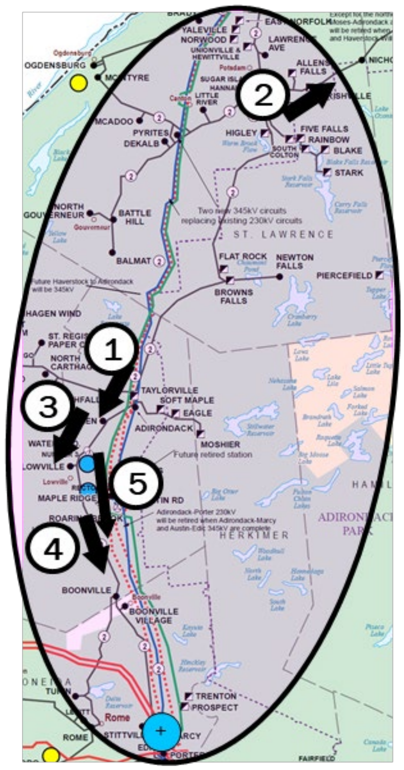
X2 – 2030 Pocket Analysis

Pocket X2 is located in Zones D and E along the Moses-Adirondack-Porter path that connects upstream of Central East interface. A parallel 115 kV path also runs alongside the higher kV system from Colton - Browns Falls – Taylorville – Lowville – Boonville – Stittville. This pocket contains primarily hydro and LBW resources connected along the 115 kV path in 2030.

The most binding constraint in this pocket is the line from Q531 POI 115 kV to Burrows 115 kV bus which is binding for about 15-25% of the year. This constraint is directly downstream of Number 3 Wind interconnection point that is serving load at the Burrows 115 kV bus. The contingency securing this line with loss of parallel path on Q531 – Lowville 115 kV causes congestion for a high number of hours.

Policy S1 case resources have slightly less energy deliverability compared to the S2 and Contract cases owing to an assumed higher resource buildout in pocket X.

Figure 245: Pocket X2 Congestion and Energy Deliverability Summary (2030)



ID	Constraint	Contract	Policy S1	Policy S2
1	BREMEN 115-Q531_POI 115	182	24	7
2	NICHOLVL 115-PARISHVL 115	515	183	664
3	LOWVILLE 115-Q531_POI 115	434	132	92
4	BOONVL 115-LOWVILLE 115	96	0	0
5	Q531_POI 115-BU+LY+MO 115	0	1,994	1,262

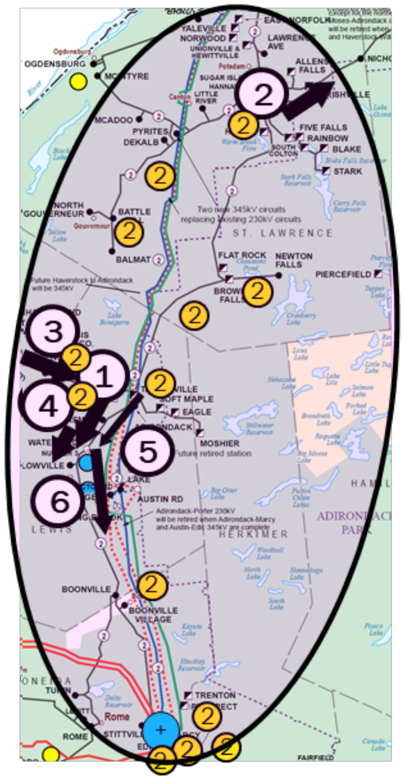
Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Hydro	250	250	240	100%	95%	99%
Wind	505	598	552	100%	99%	99%
Solar	35	35	35	96%	84%	91%

X2 -2035 Pocket Analysis

Pocket X2 contains additional UPV units in S2 in 2035 that are upstream of most constraints within the pocket. This leads to the number of hours congested for constraints to increase compared to the 2030 case. Some additional constraints such as the Deferiet to Taylorville 115 kv line meet the threshold for inclusion in 2035. This line is connected to sub-pocket X3 which has increased resource additions in 2035.

Energy deliverability from resources in X2 in the S1 case is lower than 2030 as a result of incremental resource additions in the pocket and the system. Existing hydro resources, which are mostly upstream of the constrained paths, are curtailed about 13% of the year. Even though S2 has very high capacity of UPV resources added to this pocket, energy deliverability from these units remains high at around 98%. Most of the larger UPV projects are connected to the higher kV bulk system with few smaller UPV projects with interconnections to 115 kV level circuits.

Figure 246: Pocket X2 Congestion and Energy Deliverability Summary (2035)



ID	Constraint	Policy S1	Policy S2
1	BREMEN 115-Q531_POI 115	17	161
2	NICHOLVL 115-PARISHVL 115	163	489
3	DEFERIET 115-TAYLORVL 115	195	178
4	LOWVILLE 115-Q531_POI 115	178	287
5	TAYLORVL-Q531_POI_115	951	816
6	Q531_POI 115-BU+LY+MO 115	2,099	2,546

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Hydro	249	249	87%	89%
Solar	35	1,043	75%	98%
Wind	785	785	95%	98%

Pocket X3

X3-2030 Pocket Analysis

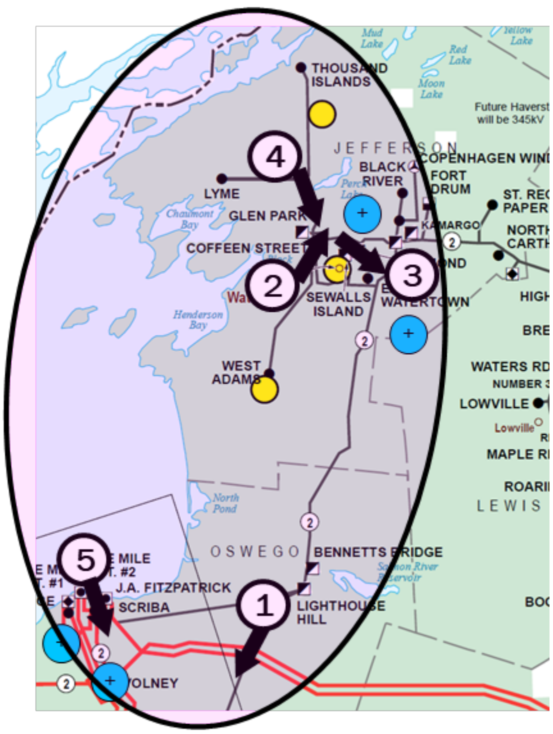
Pocket X3 is located in Jefferson and Oswego counties in Zone C and E. It consists of a mostly 115 kV system around Watertown and a 115 kV path down from Watertown to Lighthouse Hill 115 kV substation. Some constraints are also observed in the Oswego area on the 115 kV system.

2030-year resources consist of existing wind and hydro resources along with contracted UPV in the Contract Case. Policy Cases S1 and S2 include new LBW projects with S1 having a larger buildout of capacity at the same locations compared to S2.

Contracted UPV resources in the pocket experience curtailment due to local congestion on 115 kV lines flowing out of the pocket. The 115 kV line from Lighthouse Hill to Mallory, which is exporting power out of the pocket, is consistently congested across the cases and is proportional to the magnitude of resource capacity in each case.

Energy deliverability from UPV and hydro resources are impacted by congestion on the lower kV circuits. LBW units connected further downstream of congested elements are less impacted and have high energy deliverability across all cases.

Figure 247: Pocket X3 Congestion and Energy Deliverability Summary (2030)



ID	Constraint	Contract	Policy S1	Policy S2
1	HTHSE HL 115-MALLORY 115	591	2,495	1,217
2	COFFEEN 115-GLEN PRK 115	1,119	1,152	1,168
3	COFFEEN 115-E WTRTWN 115	748	223	376
4	COFFEEN 115-LYMETP 115	0	117	115
5	HMMRMILL 115-WINE CRK 115	0	190	0

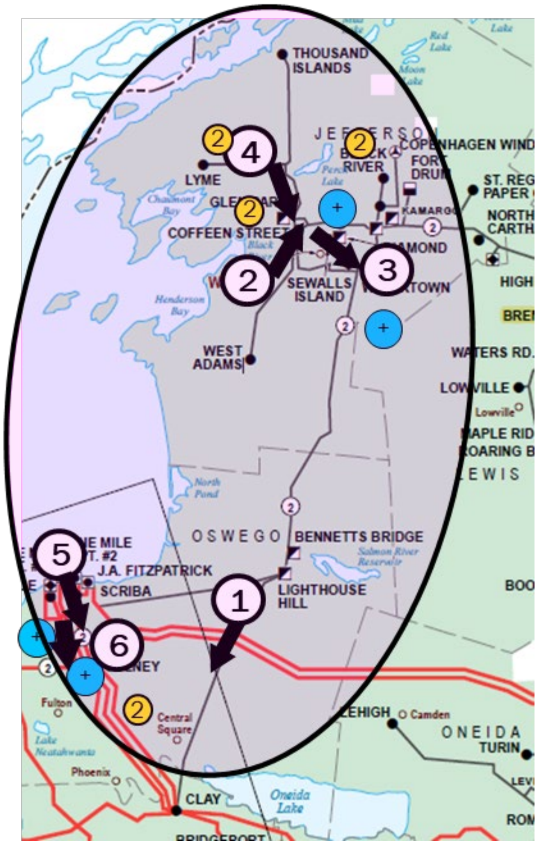
Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Hydro	155	155	152	99%	85%	94%
Wind	80	790	417	100%	98%	99%
Solar	369	369	369	90%	75%	81%

X3-2035 Pocket Analysis

Constraints identified in 2030 have increased congested hours in 2035 in Pocket X3 with addition of UPV and LBW resources. Some constraints, such as on the Coffeen to Lyme 115 kV line, may experience less congestion due to resources being added downstream of the constraint. The 115 kV line from Lighthouse Hill to Mallory remains the most congested element as it exports power out of the pocket towards the Clay 115 kV bus. Constraints in the Oswego area also experience increased congestion as a result of incremental resource additions.

Due to higher congestion on lines and increased renewable capacity in the pocket, curtailment rates are higher in 2035 for all resources across all cases.

Figure 248: Pocket X3 Congestion and Energy Deliverability Summary (2035)



ID	Constraint	Policy S1	Policy S2
1	HTHSE HL 115-MALLORY 115	3,497	3,290
2	COFFEEN 115-GLEN PRK 115	1,047	1,686
3	COFFEEN 115-E WTRTWN 115	352	154
4	COFFEEN 115-LYMETP 115*	36	0
5	HMMRMILL 115-WINE CRK 115	1,469	1,512
6	SCRIBA 345-VOLNEY 345	859	879

*met >100 hours threshold in 2030

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Hydro	156	156	67%	70%
Solar	369	686	64%	59%
Wind	1,313	1,313	94%	94%

Capital Region (Pocket Y)

The Capital Region pocket (Pocket Y) includes areas in the Mohawk Valley and upper Hudson Valley regions and is centered around the Albany metropolitan area. Large amounts of UPV generation are modeled in this pocket mainly on the 115 kV path in Montgomery and Herkimer counties. Bulk level transmission constraints such as Central East and New Scotland-Knickerbocker, which are historically congested paths, are also within this pocket. Since this area is downstream of major interfaces carrying power from upstate to downstate, this pocket experiences high levels of congestion with the addition of resources in the upstate region.

Pocket Y1

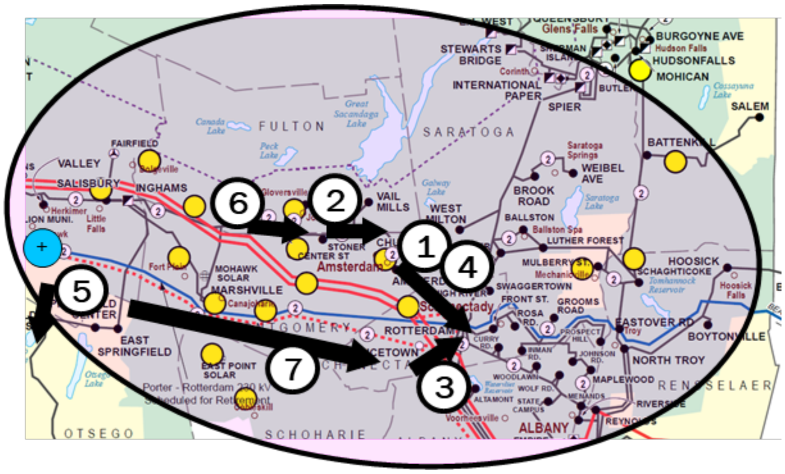
Y1-2030 Pocket Analysis

Pocket Y1 contains mostly contracted UPV units in the 2030 case. Policy Case S1 and S2 have one LBW resource that is within the pocket boundaries. The primary congested transmission corridor is from West to East along the 115 kV path from Inghams 115 kV bus, which is directly downstream of Central East, to the Rotterdam 115 kV bus in the Capital Region. There is significant amount of contracted UPV capacity along this corridor which is injecting power into the Albany metropolitan area down to pocket Y2 in the Hudson Valley region. Central East, which is historically one of the most congested bulk transmission interfaces in the New York system, runs directly through this pocket. Central East carries much of the power from upstate zones to downstate loads and is heavily congested in Policy Case scenarios with high renewable penetration.

Congestion on the bulk as well as the lower kV system can be seen in the Contract Case. Some new constrained elements are identified in the S1 and S2 cases with added resources in the pocket and in upstate zones. Existing constrained paths have more congested hours due to added pressure on lines from increased resource capacity upstream of the path.

Energy deliverability numbers are proportional to the capacity of resources added to each case with higher resource additions causing greater congestion and hence greater amounts of curtailment. Competition between resource types may cause differences in curtailment owing to differences in REC prices assigned to each unit or unit type.

Figure 249: Pocket Y1 Congestion and Energy Deliverability Summary (2030)



ID	Constraint	Contract	Policy S1	Policy S2
1	RTRDM1 115-Q638POI 115	1,200	1,265	1,424
2	STONER 115-VAIL TAP 115	882	1,666	1,275
3	ROTTERDA 345-ROTRDM.2 230	61	1,299	967
4	AMST 115-Q638POI 115	302	604	730
5	COLER 115-RICHF 115	0	278	205
6	CENTER-N 115-MECO 115	0	210	0
7	CENTRAL EAST	234	2480	2281

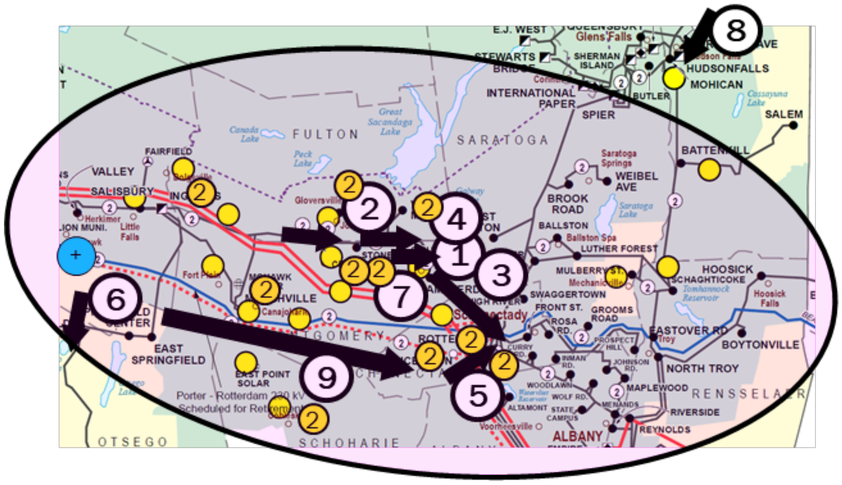
Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Hydro	30	30	30	100%	98%	99%
Wind	74	101	86	97%	90%	94%
Solar	961	961	961	96%	91%	93%

Y1 – 2035 Pocket Analysis

An increased amount of congestion is seen in the 2035 case in both Policy Cases with the addition of renewable energy resources upstream of the constraints identified in 2030. Additional constraints along the 115 kV path that meet the inclusion criteria are also included in the congested hour table below. The S2 case has higher number of congested hours for the same constrained element compared to S1 due to increased UPV capacity additions along the 115 kV corridor. Bulk level constraints such as Rotterdam 345 kV-Rotterdam 230 kV transformer and Central East have increased congestion hours in both S1 and S2.

Energy deliverability numbers reflect that incremental capacity additions, such as those for UPV in S2, cause increases in curtailment rates due to excess congestion around interconnection points.

Figure 250: Pocket Y1 Congestion and Energy Deliverability Summary (2035)



ID	Constraint	Policy S1	Policy S2
1	RTRDM1 115-Q638POI 115	1,216	2,014
2	STONER 115-VAIL TAP 115	1,503	2,533
3	AMST 115-Q638POI 115	546	1,583
4	CHURCH-E 115-MAPLEAV1 115	0	154
5	ROTTERDA 345-ROTRDM.2 230	2,107	2,208
6	COLER 115-RICHF 115	316	277
7	CHURCH-W 115-VAIL TAP 115	17	1,992
8	COMSTOCK 115-MOHICAN 115	24	283
9	CENTRAL EAST	2,280	2,064

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Hydro	30	30	94%	97%
Solar	961	2,162	88%	77%
Wind	120	120	88%	88%

Pocket Y2

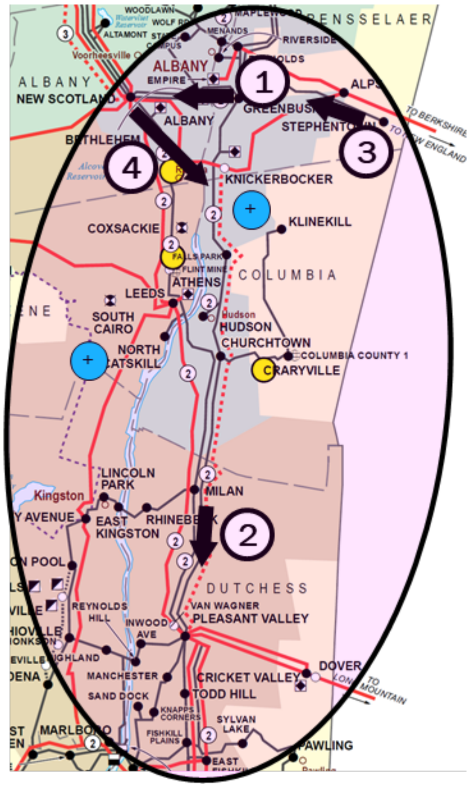
Y2-2030 Pocket Analysis

Pocket Y2 is located south of the Albany metro area in the upper Hudson Valley. This pocket is primarily composed of high capacity 345 kV lines carrying power from the Capital Region into the Hudson Valley and eventually down to load centers in New York City and Long Island.

There are several constraints on the 115 kV level system that experience congestion in all three cases but the numbers of hours limited are low. Due to assumed retirements of fossil resources in the Capital Region, congestion is affected on the bulk as well as the 115 kV system is affected.

Energy deliverability of resources within this pocket remains high due to limited capacity built within the pocket and low congestion on transmission paths.

Figure 251: Pocket Y2 Congestion and Energy Deliverability Summary (2030)



ID	Constraint	Contract	Policy S1	Policy S2
1	JMC2+9TP 115-OC W +MG 115	702	0	0
2	MILAN 115-BLSTR E 115	11	119	15
3	STEPH 115-GBSH+LGE 115	1	134	139
4	NEW SCOTLAND 345-KNICKB 345	511	303	249

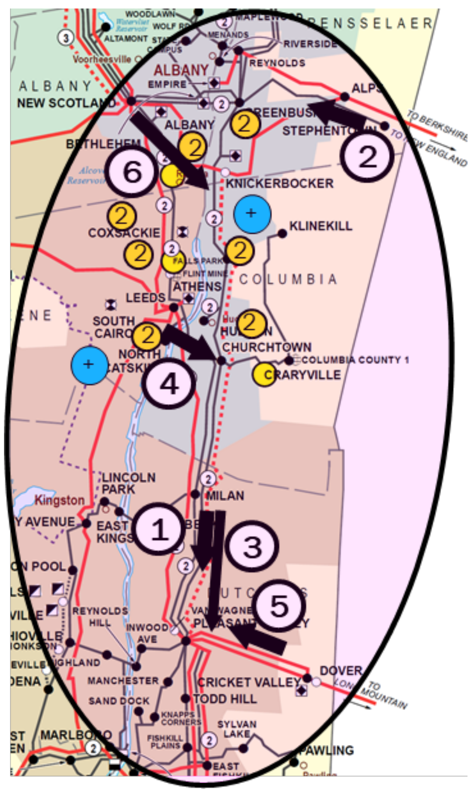
Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Wind		255	123		100%	100%
Solar	250	250	250	100%	99%	99%

Y2-2035 Pocket Analysis

2035-year case includes UPV and LBW additions to pocket Y2 in S1 and S2. UPV additions in S2 are concentrated on the 115 kV path along Bethlehem to Leeds west of the Hudson River and along Greenbush to Churchtown to the east. This introduces additional elements to congest which did not meet the threshold of greater than 100 hours congested in 2030. Of note is North Catskill 115 kV to Churchtown 115 kV line which is downstream of new UPV units in S2. There is also congestion on the Tie-lines which connect to the New-England ISO (NEISO) system – constraints '2' and '5' below.

S2 with higher UPV capacity has lower energy deliverability compared to S1. Overall, energy deliverability from resources within this pocket remains high compared to other pockets.

Figure 252: Pocket Y2 Congestion and Energy Deliverability Summary (2035)



ID	Constraint	Policy S1	Policy S2
1	MILAN 115-BLSTR E 115	322	1,255
2	STEPH 115-GBSH+LGE 115	636	564
3	MILAN 115-PLVAL 1 115	6	159
4	N.CAT. 1 115-CHURCHTO 115	1,939	1,992
5	PLTVLLEY 345-CRICKET 345	186	131
6	NEW SCOTLAND 345-KNICKB 345	169	439

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Solar	250	626	93%	88%
Wind	618	618	94%	96%

Southern Tier (Pocket Z)

Pocket Z is located along the southern NY border in zones C and E. Large amounts of LBW and UPV resources are located within the three sub-pockets in Pocket Z. This pocket contains both bulk level and lower kV transmission network connecting resources in Western NY and the Finger Lakes region to bulk level transmission that connect to other major interfaces such as Central East and Marcy-South that deliver power to the rest of the state.

Pocket Z1

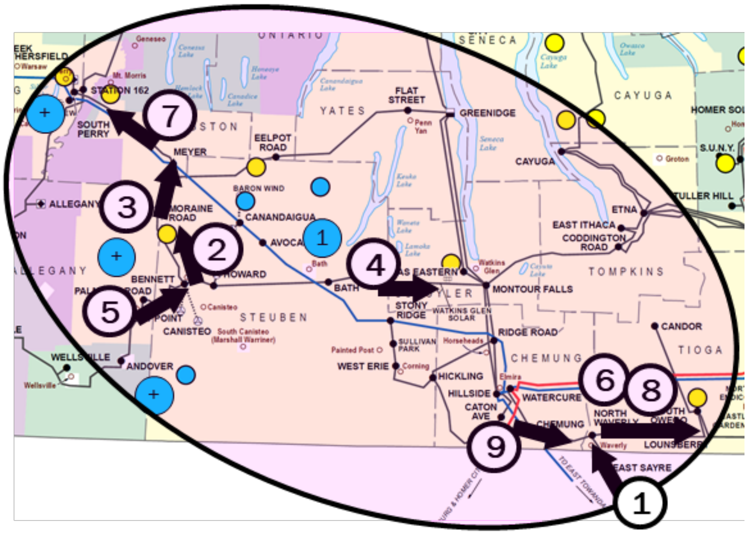
Z1-2030 Pocket Analysis

Pocket Z1 is located along the 230 kV path from South Perry to Hillside, the 115 kV circuits around Bennett substation, 115 kV circuit from Hillside to North Waverly, and the Watercure 345 kV bus. This large sub-pocket includes multiple counties and includes varied transmission paths for resources to interconnect.

The 115 kV lines around Bennet are heavily congested due to large scale LBW projects connected to transmission lines with saturated flows. Addition of Policy Case LBW resources in S1 and S2 to areas with already large capacity of contracted resources causes additional pressure on lines that are not designed to handle so much capacity. Addition of resources with Pocket Z1 pushes back on import flows from PJM along the East Sayre-North Waverly 115 kV tie line, hence the congestion is less in the Policy S1 and S2 cases compared to the Contract Case.

Policy Case S1, which has significant LBW capacity added to Pocket Z1 in 2030, has the low energy deliverability for wind resources compared to other cases. S2, which adds some LBW capacity to Pocket Z1 is closer in energy deliverability metric to the Contract Case.

Figure 253: Pocket Z1 Congestion and Energy Deliverability Summary (2030)



ID	Constraint	Contract	Policy S1	Policy S2
1	N.WAV 115-26E.SAYR 115	3,225	1,249	1,276
2	MORAINE 115-BENET 115	0	2,246	925
3	MEYER 115-MORAINE 115	0	1,825	1,045
4	BATH 115-MONTR 115	5	1,986	572
5	BENET 115-PALMT 115	0	1,906	159
6	LOUNS 115-STAGECOA 115	170	366	201
7	MEYER 115-S.PER 115	12	179	176
8	N.WAV 115-LOUNS 115	95	84	91
9	N.WAV 115-CHEMUNG 115	0	147	26

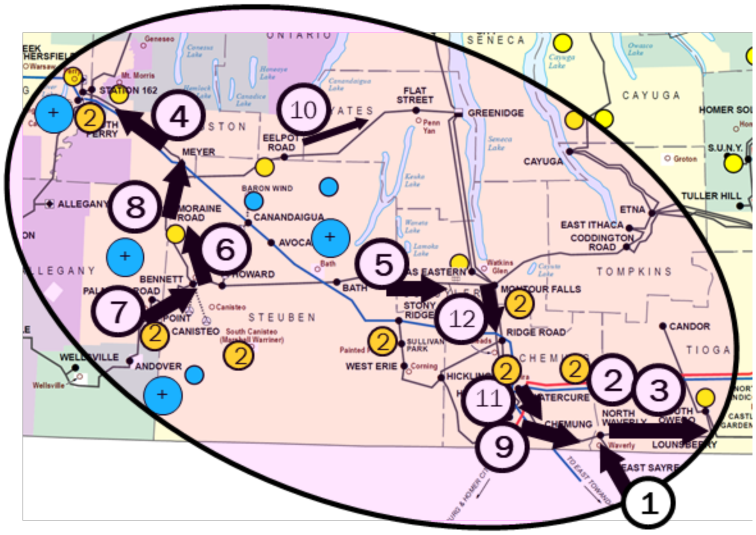
Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Wind	720	1,495	1,119	100%	83%	96%
Solar	405	405	405	100%	93%	97%

Z1-2035 Pocket Analysis

With the addition of incremental resources in both Policy Cases, additional constrained paths are identified in the 2035 case. All constraints are on the 115 kV level and restrict power to flow into the bulk system. Policy Case S2 has UPV builds which are more than twice the capacity of contracted UPV in the pocket in S1 and the Contract Case. This leads to increased congestion in S2 compared to S1.

Energy deliverability of LBW units are lower in both S1 and S2 cases compared to 2030 as incremental capacity is built on the same locations as 2030 where curtailments were occurring. UPV builds in S2 are more spread out across the pocket and some units connect to higher kV buses. Hence energy deliverability numbers are comparable between S1 and S2 for UPV resources.

Figure 254: Pocket Z1 Congestion and Energy Deliverability Summary (2035)



ID	Constraint	Policy S1	Policy S2
1	N.WAV 115-26E.SAYR 115	1,100	855
2	LOUNS 115-STAGECOA 115	212	216
3	N.WAV 115-LOUNS 115	41	201
4	MEYER 115-S.PER 115	668	650
5	BATH 115-MONTR 115	1,811	1,422
6	MORAINE 115-BENET 115	6	3,542
7	BENET 115-PALMT 115	1,814	1,785
8	MEYER 115-MORAI 115	2,062	1,746
9	N.WAV 115-CHEMUNG 115	196	413
10	EELPO 115-FLATS 115	554	629
11	HILLSIDE 115-CHEMUNG 115	43	231
12	MONTR 115-RIDGT 115	6	247

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Solar	405	1,037	85%	87%
Wind	2,160	2,160	74%	74%

Pocket Z2

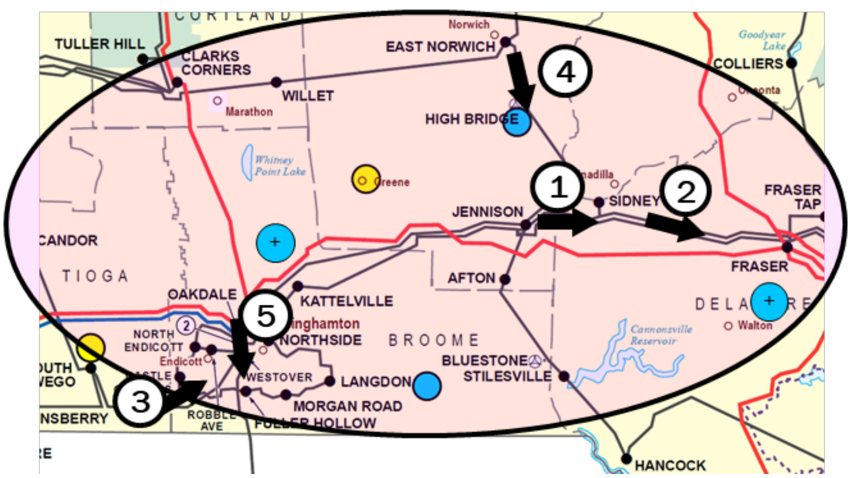
Z2-2030 Pocket Analysis

Pocket Z2 is located along the 345/115 kV corridor from Oakdale to Fraser substation. It also contains the 115 kV section from East Norwich to Jennison. This sub-pocket contains mostly contracted LBW and UPV resources with the Policy Case containing additional LBW resources connecting at the 345 kV and 230 kV buses at Fraser and Oakdale, respectively.

In 2030, constrained elements within the pocket are more congested in the Policy Cases S1 and S2 compared to the Contract Case. These constrained paths are downstream of sub-pockets Z1 and Z3, so resources added in the Policy Case in surrounding sub-pockets affect the congestion in Z2. The Jennison-Sidney-Delhi 115 kV path remains consistently congested across the three cases studied with the number of congested hours increasing in the Policy Case scenarios.

Energy deliverability for resources are relatively high for Contract and S2 cases but S1 experiences increased curtailment of contracted UPV resources in the sub-pocket due to increased congestion on 115 kV paths.

Figure 255: Pocket Z2 Congestion and Energy Deliverability Summary (2030)



ID	Constraint	Contract	Policy S1	Policy S2
1	JENNISON 115-SIDNEY 115	542	3,459	1,357
2	FRASER 115-SIDNEY 115	0	242	155
3	S.OWEGO 115-GOUDEY8- 115	0	167	169
4	E.NORWICH 115-JENNISON 115	0	193	58
5	OAKDALE 230-OAKDALE 115	0	119	0

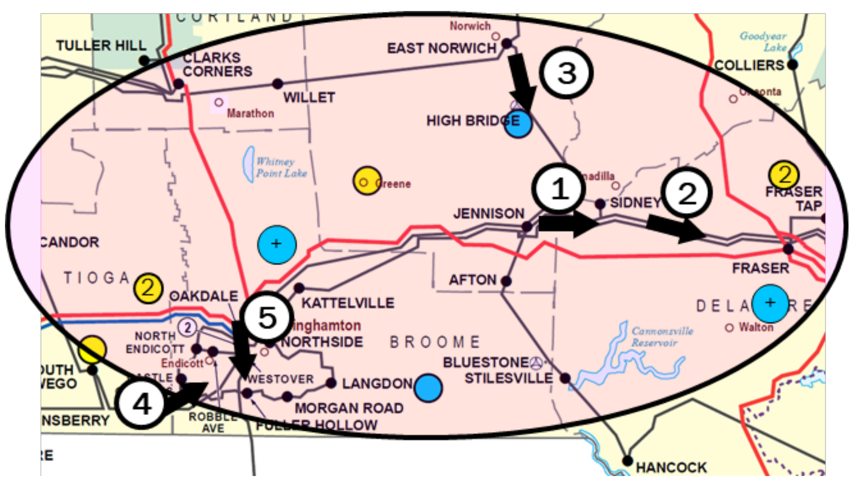
Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Wind	213	803	512	99%	92%	97%
Solar	60	60	60	100%	78%	91%

Z2-2035 Pocket Analysis

As a result of additional resources being added to the cases, 115 kV lines that are downstream of resources within the sub-pocket or downstream of neighboring sub-pockets experience increased congestion in 2035. The Jennison-Sidney 115 kV line remains one of the most binding elements in Z2 as it connects the 115 kV lines to 345 kV system at Fraser substation. The East Norwich-Jennison 115 kV path also gets congested more as additional resources are added to pocket Z3 which is directly upstream of the constraint.

Energy deliverability of resources within the pocket is lower overall as a result of increased congestion. S2 has additional UPV resources that connect to higher kV buses and have higher energy deliverability compared to S1.

Figure 256: Pocket Z2 Congestion and Energy Deliverability Summary (2035)



ID	Constraint	Policy S1	Policy S2
1	JENNISON 115-SIDNEY 115	3,768	4,015
2	FRASER 115-SIDNEY 115	169	49
3	E.NORWICH 115-JENNISON 115	1,240	705
4	S.OWEGO 115-GOUDEY8- 115	92	307
5	OAKDALE 230-OAKDALE 115	1,056	1,419

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Solar	60	443	74%	87%
Wind	1,257	1,257	91%	91%

Pocket Z3

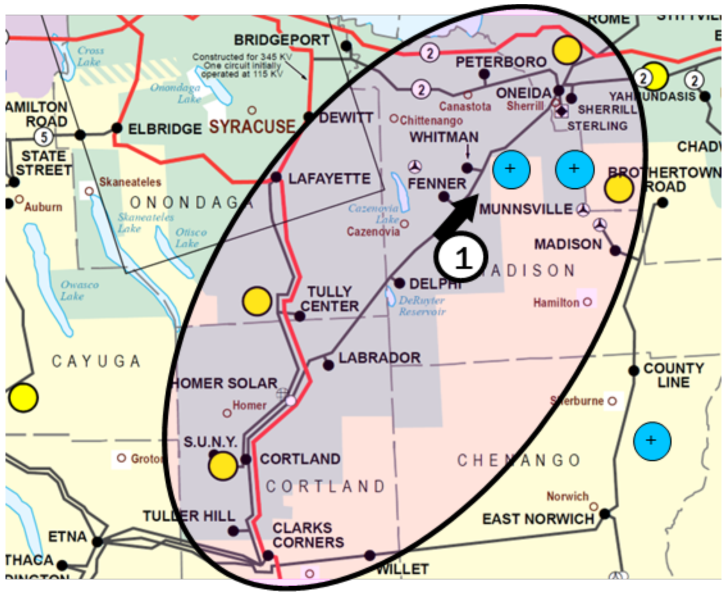
Z3-2030 Pocket Analysis

Pocket Z3 is located along the 345/115 kV corridor from Lafayette-Clarks Corners substation and 115 kV circuit from Clarks Corners to Oneida substation. Resources in this pocket are mostly contracted UPV and LBW units with few LBW additions in the Policy Cases.

In 2030, the 115 kV line from Fenner-Whitman substation is the only element identified as a constraining element within the pocket. This constraint meets the criteria for inclusion only in the Policy S1 Case.

Energy deliverability is high from resources within this pocket with only LBW units experiencing some curtailment in the Policy Cases.

Figure 257: Pocket Z3 Congestion and Energy Deliverability Summary (2030)



ID	Constraint	Contract	Policy S1	Policy S2
1	WHITMAN 115-FEN-WIND 115	0	128	7

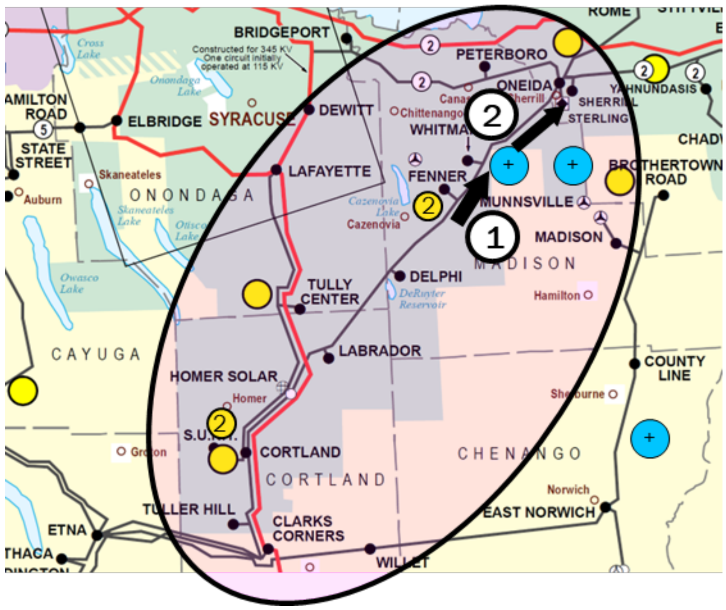
Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Wind	76	265	173	100%	95%	99%
Solar	150	150	150	100%	96%	99%

Z3-2035 Pocket Analysis

An additional constraint from Whitman-Sterling 115 kV is identified for the 2035 Policy Cases as additional resources are added on the 115 kV path upstream of the constraints. Congested hours for S2 increased as the capacity of resources added in S2 is greater than that in S1.

Energy deliverability of resources decreases in 2035 in both S1 and S2 Cases as a result of increased congestion on constraints within the pocket and further downstream in adjacent pockets.

Figure 258: Pocket Z3 Congestion and Energy Deliverability Summary (2035)



ID	Constraint	Policy S1	Policy S2
1	WHITMAN 115-FEN-WIND 115	530	783
2	WHITMAN 115-STERLING 115	1,142	1,862

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Solar	150	303	87%	81%
Wind	413	413	92%	91%

Offshore Wind Zone J Pocket (OSW J)

Offshore Wind Zone J Pocket consists of almost all of Zone J with OSW injections at higher kV buses throughout the zone. The Contract Case consists of two OSW projects injecting at Gowanus 345 kV and Astoria East 138 kV bus. The Policy Cases S1 and S2 have additional OSW projects modeled and interconnected to buses identified from the current interconnection queue. These new interconnections are all on the higher kV buses spread across the city. The Champlain-Hudson Power Express ("CHPE") Project is modeled as a fixed injection of 1,250 MW at Astoria 345 kV substation only in the Policy Cases. Due to retirement of older fossil units and addition of new resources within the pocket, congestion patterns on lines may change and new constrained elements might show up.

OSW J - 2030 Pocket Analysis

Constraints identified in the 2030 pocket analysis for OSW J are mostly on the 138 kV level and are downstream of OSW interconnection points. Congestion in the Contract Case is primarily due to existing system conditions and generation. These paths do get congested more in the Policy Case with additional OSW resources modeled in the system.

The Zone J bulk level system allows all of the OSW energy to be dispatched in 2030 when interconnected to 345 kV buses as modeled in the Contract and Policy Cases. Even with increased congestion in the 138 kV system, there exists alternate routes and enough generation redispatch capability to accommodate all of the OSW energy.

Figure 259: Pocket OSW J Congestion and Energy Deliverability Summary (2030)

ID	Constraint	Contract	Policy S1	Policy S2
1	E179 ST 138-HG 4 138	4,726	5,519	5,775
2	ASTE-ERG 138-CORONA-S 138	1,327	1,888	1,418
3	ASTANNEX 345 E13ST 345	786	6,724	5,555
4	FRESH KI 138-WILOWBK1 138	339	343	229
5	RAINEY8W 138-VERNON-W 138	299	3,044	4,202
6	HG 5 138-ASTORIA 138	210	222	2
7	GOWNUSR1 138-GRENWOOD 138	105	225	840
8	RAINEY8E 138-VERNON-E 138	16	661	610

Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Offshore Wind	2,046	2,046	5,166	100%	100%	100%
HQImport		1,250	1,250		100%	100%

OSW J - 2035 Pocket Analysis

Additional constrained paths are identified for both Policy Cases in 2035 as a result of resources being added and assumed fossil capacity retirements. Overall, an increase in congested hours for constrained elements is observed, which indicates that added pressure on the 138 kV system can be expected with a new resource mix in Zone J.

OSW units are still highly deliverable with the system redispatching capacity to accommodate all of the OSW energy into the system. This can also be attributed to the high REC price received by OSW projects relative to other types of renewable resources. The import from HQ through the CHPE line does experience slight curtailment in 2035 but is still highly deliverable.

Figure 260: Pocket OSW J Congestion and Energy Deliverability Summary (2035)

ID	Constraint	Policy S1	Policy S2
1	E179 ST 138-HG 4 138	5,368	5,716
2	ASTE-ERG 138-CORONA-S 138	1,545	1,974
3	ASTANNEX 345 E13ST 345	6,193	7,038
4	FRESH KI 138-WILOWBK1 138	1,002	163
5	RAINEY8W 138-VERNON-W 138	4,633	7,270
6	HG 5 138-ASTORIA 138	240	0
7	GOWNUSR1 138-GRENWOOD 138	228	1,806
8	RAINEY8E 138-VERNON-E 138	409	499
9	DUNWOODI 345-MOTTHAVEN 345	116	148
10	GREENWOOD 138 - VERNON 138	20	233
11	MOTTHAVN 345-RAINEY 345	190	296

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Offshore Wind	4,571	5,166	100%	100%
HQ Import	1,250	1,250	96%	98%

Offshore Wind Zone K Pocket (OSW K)

The Long Island electric system is primarily comprised of 138 kV lines with local distribution at 69 kV and lower voltage levels. With considerable amounts of OSW projects looking to interconnect into the Long Island system, large amounts of congestion can be expected on lines that are not designed to handle large injections of power. Local constraints that are directly downstream of interconnection points or radial lines that connect the interconnection bus to the rest of the system may limit the amount of energy that can be utilized based on the thermal limits of the line.

The NYISO is currently evaluating the viable and sufficient project proposals to the Long Island Offshore Wind Export Public Policy Transmission Need ("Long Island PPTN"), based on the Order issued by the New York Public Service Commission ("PSC") on March 19, 2021. If a more efficient or cost-effective solution is selected to meet the Long Island PPTN, the observed congestion is expected to be reduced significantly.

OSW K - 2030 Pocket Analysis

The 2030 case includes contracted OSW projects interconnecting at Barrett 138 kV, Holbrook 138 kV, and East Hampton 69 kV buses. Policy Case S1 includes additional OSW units that are placed at seven additional locations indicated in the map below. The most binding constraint in all three cases that directly impacts the energy deliverability of a particular OSW project is the line from Barrett 138 kV to Valley Stream 138 kV. This constraint is consistently binding in all three cases for more than 50% of the year. Other bulk level constraints also impact energy deliverability of resources within the pocket or ability of resources outside of the pocket to serve load in Zone K.

Due to high congestion on the Barrett-Valley Stream 138 kV line and other surrounding constraints, the energy deliverability of OSW projects is highly impacted.

Figure 261: Pocket OSW K Congestion and Energy Deliverability Summary (2030)

ID	Constraint	Contract	Policy S1	Policy S2
1	Cross Sound Cable	6,305	6,049	6,166
2	BARRETT2 138-VLYSTRM 138	4,768	4,922	4,741
3	DUNWOODI 345-SHORE RD 345 (Y50)	3,991	4,362	5,347
4	REACBUS 345-DVNPT NK 345 (Y49)	3,278	2,909	3,559
5	HAUPAGUE 138-C.ISLIP 138	3,066	3,223	3,271
6	Neptune HVDC	2,472	3,125	3,655
7	NRTHPRT1 138-NRTHPRT2 138	1,776	2,114	1,839
8	HOLBROOK 138-RONKONK 138	681	248	754
9	CARLE PL 138-E.G.C. 138	477	680	245
10	NEWBRGE 138-RULND RD 138	436	630	802
11	E.G.C.-2 138-NEWBRGE 138	269	370	292
12	VLY STRM 138-E.G.C.-2 138	264	248	230
13	HAUPAGUE 138-PILGRM P 138	224	190	191
14	BUELL 69-EHAMP 69	158	186	160
15	L SUCS 138-SHORE RD 138	0	207	2

Type	Capacity (MW)			Energy Deliverability (%)		
	Contract	Policy S1	Policy S2	Contract	Policy S1	Policy S2
Offshore Wind	2,270	2,990	2,270	77%	83%	77%
Solar	99	99	99	100%	96%	93%

OSW K - 2035 Pocket Analysis

Additional constrained paths are identified in the 2035 case for both S1 and S2. Overall, the congested hours for constrained paths increase in comparison to 2030. In 2035, both S1 and S2 have additional OSW units added with slightly more capacity in S1. These new OSW additions introduce congestion of lines within the pocket and also on tie lines connecting Zone K to other areas.

Energy deliverability for resources in the pocket is lower in comparison to the 2030 case due to increased congestion on lines and additional capacity added to the system.

Figure 262: Pocket OSW K Congestion and Energy Deliverability Summary (2035)

ID	Constraint	Policy S1	Policy S2
1	Cross Sound Cable	5,756	5,687
2	BARRETT2 138-VLY STRM 138	4,955	4,925
3	DUNWOODI 345-SHORE RD 345 (Y50)	4,090	4,798
4	REACBUS 345-DVNPT NK 345 (Y49)	2,610	2,192
5	HAUPAGUE 138-C.ISLIP 138	2,382	2,518
6	Neptune HVDC	3,748	3,392
7	NRTHPRT1 138-NRTHPRT2 138	2,206	1,977
8	HOLBROOK 138-RONKONK 138	351	944
9	CARLE PL 138-E.G.C. 138	1,344	714
10	NEWBRGE 138-RULND RD 138	380	710
11	E.G.C.-2 138-NEWBRGE 138	1,186	390
12	VLY STRM 138-E.G.C.-2 138	637	410
13	HAUPAGUE 138-PILGRM P 138	403	125
14	BUELL 69-EHAMP 69*	84	18
15	L SUCS 138-SHORE RD 138	1,037	655
16	HOLBROOK 138-HOLBRK2 69	862	299

*met >100 hours threshold in 2030

Type	Capacity (MW)		Energy Deliverability (%)	
	Policy S1	Policy S2	Policy S1	Policy S2
Offshore Wind	4,430	3,835	88%	87%
Solar	99	99	85%	94%