New York ISO
Independent System Operator

System & Resource Outlook Update

Economic Planning Department

Electric System Planning Working Group (ESPWG)

February 9th, 2022

Agenda

- Outlook Study Status
- Congestion & Constraint Relaxation Analysis
- Contract Case Results Update
- Policy Case Follow-Up
  - Topology Clarification
  - Review scenario feedback
  - Capacity expansion model updates
- Next Steps

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Outlook Study Status

- September – October 2021: Finalize reference case assumptions*
- November - December 2021: Conduct simulations and analysis*
- January - March 2022 : Conduct Policy case simulations and analysis, issue draft report*
- April-May 2022: Finalize draft report, seek Business Issues Committee and Management Committee review and approval
- June 2022: Seek Board of Directors review and approval

* Collaborate with ESPWG and seek stakeholder input

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Requests from last ESPWG

- **Adjustments to Base & Contract Case charts**
  - Include percentages for generation by type, emissions change, and curtailment
  - Include table for generation by type
  - Present additional constraints for Contract Case
  - Updated results presented in separate slide deck posted to ESPWG
- **Re-present Policy Case scenario request slide and include stakeholder requests for scenarios**
- **Add clarifications for Policy Case network diagram**

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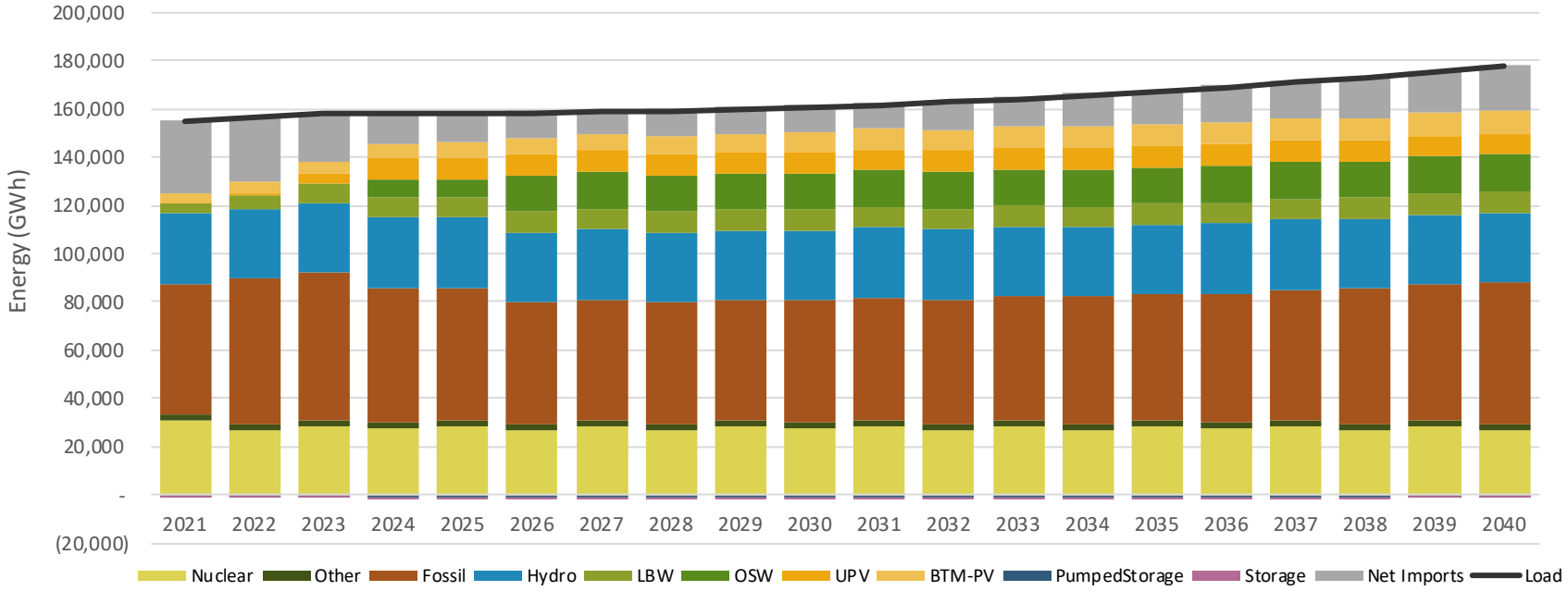
Contract Case Follow-Up

Contract Case: Projected NYCA Generation and Net Imports (GWh)



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DRAFT – FOR DISCUSSION PURPOSES ONLY

Contract Case: Projected NYCA Generation and Net Imports (GWh)

Generation Type	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
BTM-PV	3,541	4,382	5,176	5,986	6,435	6,808	7,152	7,494	7,760	8,010	8,238	8,451	8,645	8,823	8,969	9,093	9,166	9,238	9,313	9,375
Fossil	54,158	60,106	61,496	55,797	55,110	50,504	49,912	50,257	49,841	50,633	51,045	51,571	51,233	52,571	52,349	53,551	54,454	56,182	56,174	58,603
Hydro	28,974	28,974	28,974	28,970	28,963	28,963	28,963	28,963	28,962	28,961	28,963	28,964	28,964	28,964	28,964	28,964	28,965	28,966	28,965	28,965
LBW	4,527	5,247	7,587	8,572	8,523	8,537	8,555	8,606	8,537	8,538	8,520	8,585	8,584	8,584	8,539	8,558	8,538	8,562	8,589	8,625
Nuclear	30,917	26,993	28,323	27,511	28,319	26,997	28,751	27,080	28,322	27,428	28,318	27,080	28,755	27,001	28,323	27,512	28,323	27,001	28,756	27,082
OSW	0	0	0	7,334	7,307	15,150	15,096	15,184	15,134	15,181	15,193	15,202	15,164	15,151	15,171	15,264	15,212	15,170	15,203	15,243
Other	2,416	2,433	2,442	2,436	2,424	2,420	2,420	2,435	2,423	2,426	2,424	2,437	2,432	2,434	2,434	2,441	2,437	2,437	2,437	2,437
UPV	220	1,486	4,221	8,818	8,849	8,842	8,848	8,868	8,836	8,839	8,835	8,857	8,846	8,851	8,848	8,858	8,848	8,863	8,859	8,872
Net Imports	30,557	27,515	20,491	13,295	12,897	11,004	9,926	11,219	10,781	11,475	10,970	12,438	12,265	13,868	14,266	15,377	15,543	17,026	17,472	18,847

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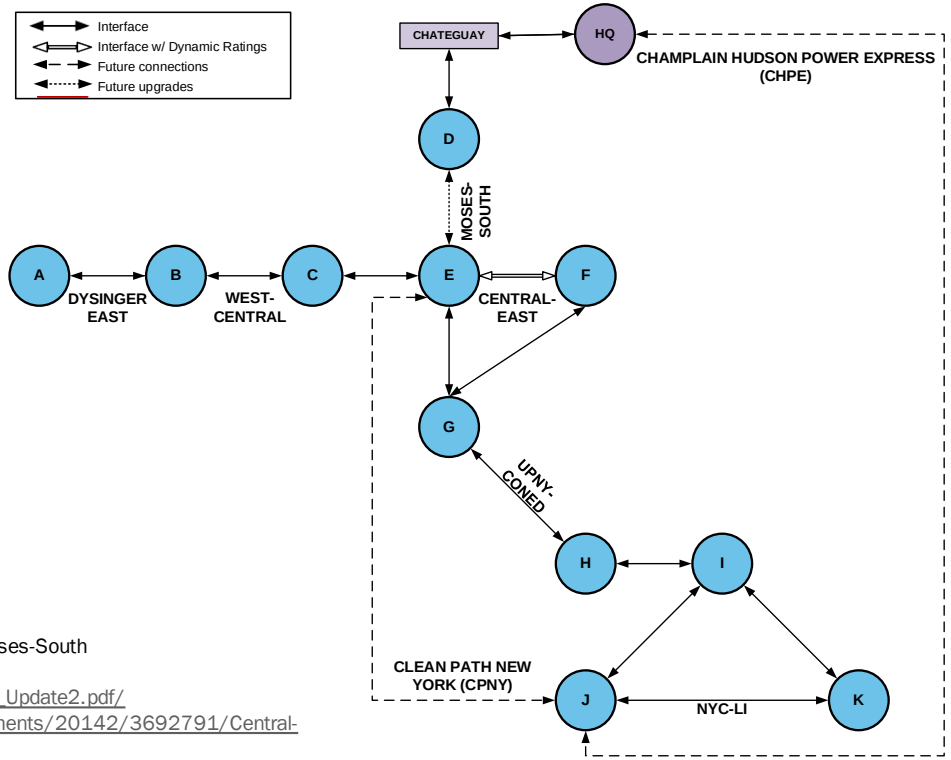
Policy Case Update

Pipe & Bubble Representation for Capacity Expansion Model

Years	Interface/Interzonal Pipes	+ Limit (MW)	- Limit (MW)	Source
All	DYSINGER EAST	3,050	*	10/2021 Ops study stability limit [1]
All	WEST-CENTRAL	*	*	
All	MOSES-SOUTH	4,050	-1,500	1/2015 Ops study stability limit [1,2]
2021-2023	CENTRAL-EAST (summer)	2,380	-2,380	Operational nomogram [3]
2021-2023	CENTRAL-EAST (winter)	2,615	-2,615	Operational nomogram [3]
2024-2040	CENTRAL-EAST (summer)	3,255	-3,255	Operational nomogram [3]
2024-2040	CENTRAL-EAST (winter)	3,490	-3,490	Operational nomogram [3]
2021-2023	UPNY-CONED	6,150	*	2021 CRP limit
2024-2040	UPNY-CONED	6,525	*	2021 CRP limit
All	DUNWOODI-NYC	*	*	
All	DUNWOODI-LI	*	*	
All	NYC-LI	0	-350	Wheel contract
2027-2040	CLEAN PATH NEW YORK	1,300	-1,300	Tier 4 contracts [4]
2025-2040	CHAMPLAIN HUDSON POWER EXPRESS	1,250	-1,250	Tier 4 contracts [4]

*Limit is defined by sum of normal limits of the lines making up the interface



1: See "Interface Limits & Ops Studies" here: https://www.nyiso.com/reports-information/
2: Northern New York Smart Path Transmission Project will increase transfer capability to Moses-South by ~1000 MW and is reflected in the limit noted above: https://www.nyiso.com/documents/20142/27019028/ESPWG_System_Resource_Outlook_Update2.pdf/
3: Max Limit Applied Proportionally to Operational Nomogram: https://www.nyiso.com/documents/20142/3692791/Central-East%20Voltage-Collapse-Limit-Evaluation-FINAL.pdf/
4: See Case Number Case Number 15-E-0302 for additional information on Tier 4 contracts: https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=15-e-0302&CaseSearch=Search

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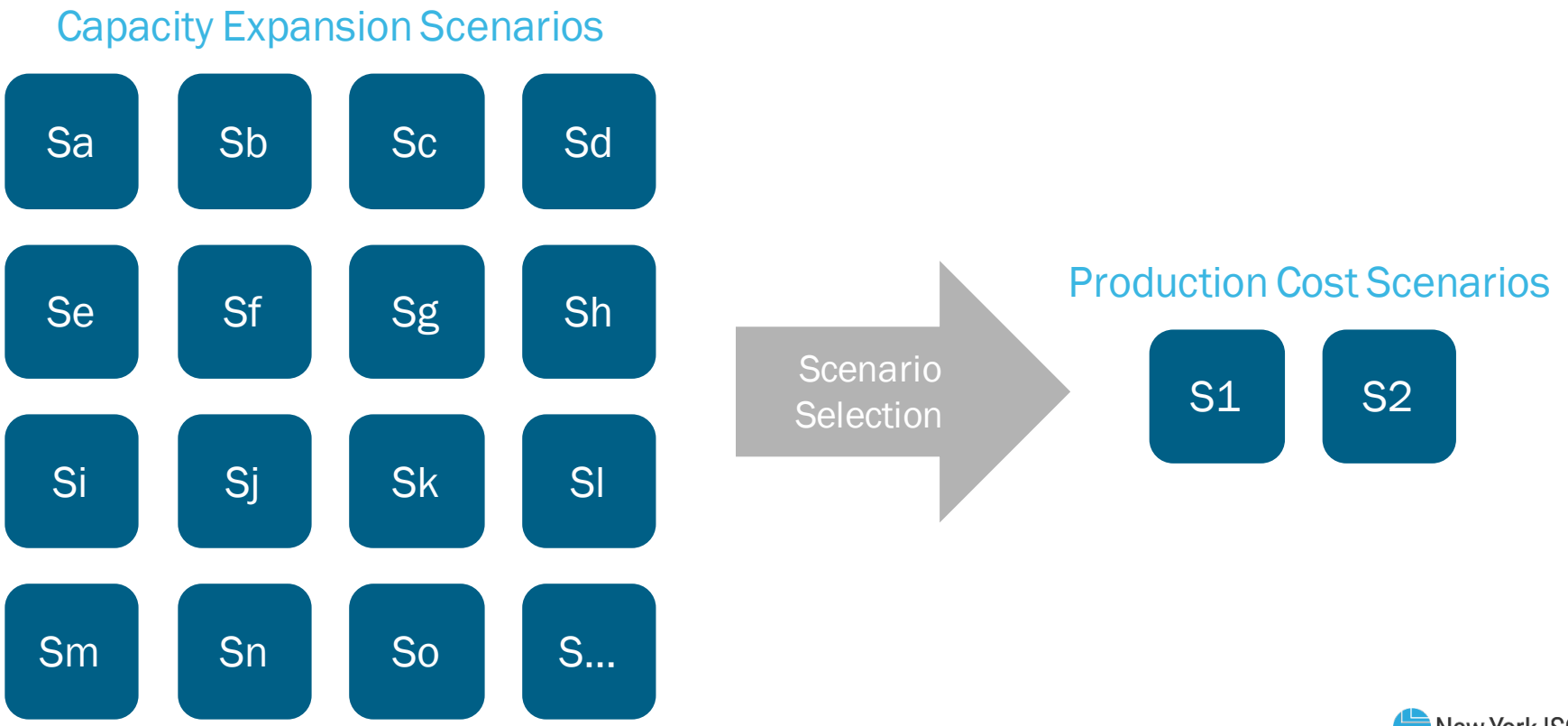
Proposed Capacity Expansion Methodology



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Potential Capacity Expansion Scenarios

- Candidate technologies available
- Nuclear re-licensing/retirement
- High/low renewable technology cost
- High/low/alternative load forecasts
- High/low gas prices
- High/low emission prices
- Enable/disable/accelerate retirements
- Include/exclude max capacity builds
- Relax/accelerate CLCPA targets
- Reduced hydroelectric energy output
- **Fixed capacity value curves**

Scenario suggestions from stakeholders

- Zone J remove all SCR Emergency Response Capacity
- Zone J retire any generator over 40 years old
- Transmission expansion
- NYSERDA Integration Analysis: Scenario 2 load forecast
- $0 REC bidding
- Distribution of OSW capacity between Zones J and K

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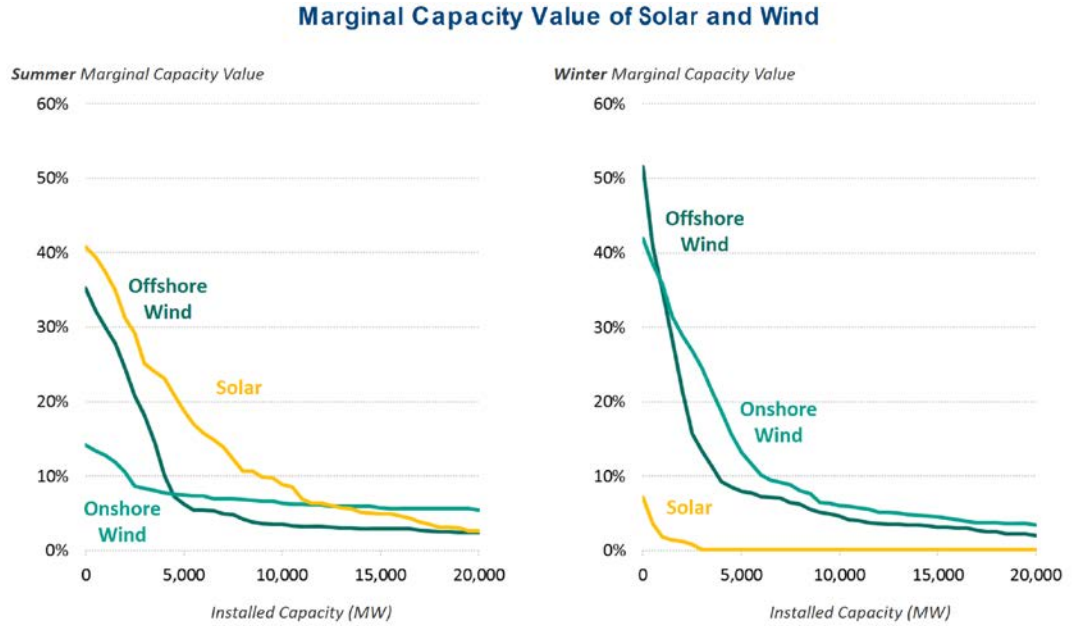
Capacity Expansion Model: Marginal Capacity Value Curves

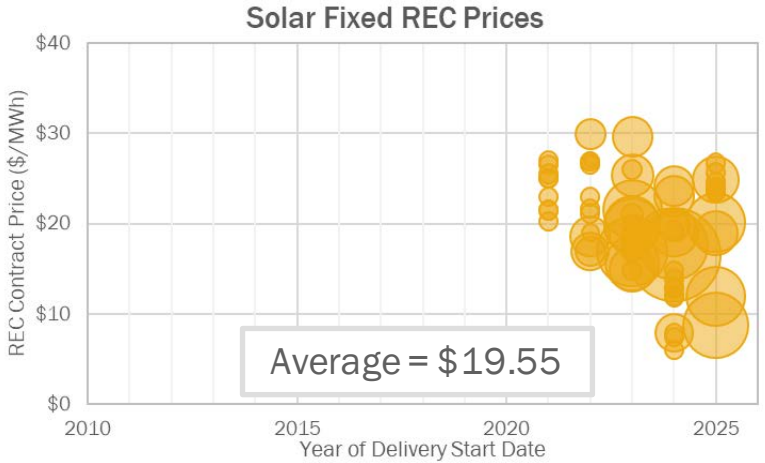
- Implementing marginal capacity value curves from 2020 Grid in Evolution study into capacity expansion model for wind, solar, & energy storage

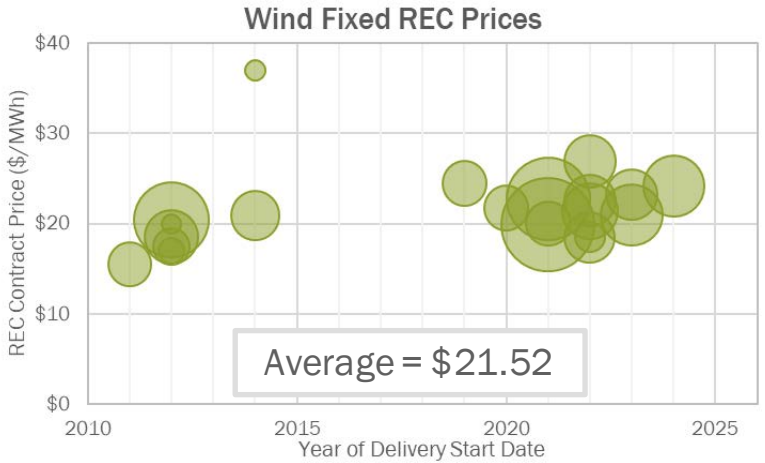


Note: Declining capacity value of solar, wind, and energy storage resources is a function of load and operational profiles of the resources, which may not be consistent across studies but provides a reasonable approximation for this study

Future REC Prices

- **Proposal:** in production cost simulation model future renewable generation REC prices as average of fixed REC prices by technology





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Congestion & Constraint Relaxation Analysis

Background

- **Congestion analysis** reviews in greater detail historic and projected congestion
- **Constraint relaxation** analysis uses results from simulations with transmission constraints “relaxed” (limit removed) to quantify impact of congestion

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Metric Definitions

- Base Case – Base Case simulation as part of Reference Case set
- Relaxed Case – Simulation w/ specific transmission congestion removed
- Flow = MW transaction
- Limit = Transmission line or interface limit based on normal/contingency and summer/winter technical specifications
- Manual defined metrics:
  - Demand congestion
  - Limiting hours
- Additional metrics:
  - Utilization % = $Flow_h / Limit_h \times 100$
  - Freed Energy = $\sum_{h=1}^{8760} [Max(Relax\ Case\ Flow)_h - Max(Base\ Case\ Flow)_h]$

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Historic & Base Case Congestion (Nominal $M)

Demand Congestion ($M)	Historic					Projected																			
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
CENTRAL EAST	641	598	540	516	402	609	286	122	25	4	1	1	4	1	2	1	1	2	6	3	5	6	7	2	1
DUNWOODIE TO LONG ISLAND	164	88	133	82	98	56	40	29	26	27	27	29	27	30	32	38	39	47	46	58	53	57	62	72	75
N.WAV-E.SAYR_115	-	-	-	-	-	25	29	18	12	15	17	18	18	20	20	21	21	23	21	23	26	29	30	34	36
ELWOOD-PULASKI_69	-	-	-	-	-	24	24	14	8	5	4	1	1	6	8	9	12	13	15	18	21	26	27	31	37
EDIC MARCY	32	125	107	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
VOLNEY SCRIBA	0	1	1	3	1	6	6	7	6	7	8	6	8	9	9	10	10	12	11	15	12	15	15	17	18
DUNWOODIE MOTTHAVEN	2	30	65	28	4	3	3	0	1	1	3	3	1	2	2	3	5	4	2	3	5	6	5	3	19
LEEDS PLEASANT VALLEY	63	101	9	20	1	3	1	0	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	0	0
GREENWOOD	31	18	62	25	22	7	7	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
UPNY-ConEd	-	4	-	0	3	-	-	0	2	2	2	1	3	6	5	5	4	4	5	4	6	19	19	27	42
CHESTR-SHOEMAKR_138	-	-	-	19	10	31	27	26	2	1	1	1	2	3	2	1	1	4	2	5	4	3	4	4	6
PACKARD HUNTLEY	54	30	41	9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEW SCOTLAND KNCKRBOC	-	-	-	-	-	-	-	-	20	8	3	5	13	7	8	9	8	7	12	11	4	4	3	3	1
SGRLF-RAMAPO_138	-	-	-	-	-	-	-	-	8	5	4	5	5	5	4	6	7	6	7	10	7	16	14	9	7
NORTHPORT PILGRIM	-	-	-	-	-	7	8	5	4	2	2	1	1	3	4	4	4	4	4	6	7	7	8	9	11
GREENBSH-STEPHTWN_115	0	0	0	0	0	0	0	0	5	5	5	4	5	5	5	5	5	6	6	7	7	8	8	9	9

*Congested elements evaluated further in congestion & constraint relaxation analysis

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Historic & Base Case Congestion (2021 $M*)

Demand Congestion (2021 $M)	Historic					Projected																		
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
CENTRAL EAST	932	812	686	612	445	630	277	110	21	3	1	1	3	0	1	1	1	1	3	1	2	2	2	1	0
DUNWOODIE TO LONG ISLAND	239	120	168	97	109	58	38	27	22	21	20	20	18	18	18	20	19	21	20	23	20	20	20	22	21
EDIC MARCY	46	170	136	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-
LEEDS PLEASANT VALLEY	92	138	12	24	1	3	1	0	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	0	0
N.WAV-E.SAYR_115	-	-	-	-	-	26	28	17	10	12	13	12	11	12	11	11	10	11	9	9	10	10	10	10	10
GREENWOOD	45	24	79	30	25	7	7	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DUNWOODIE MOTTHAVEN	4	41	82	33	4	3	2	0	1	1	2	2	1	1	1	2	3	2	1	1	2	2	2	1	5
PACKARD HUNTLEY	79	40	52	10	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ELWOOD-PULASKI_69	-	-	-	-	-	25	23	13	7	4	3	1	1	4	5	5	6	6	6	7	8	9	9	9	10
CHESTR-SHOEMAKR_138	-	-	-	23	11	32	26	23	1	1	0	0	1	2	1	1	1	2	1	2	1	1	1	1	2
VOLNEY SCRIBA	0	1	1	4	1	6	6	7	5	5	6	4	5	5	5	5	5	6	5	6	4	5	5	5	5
NEW SCOTLAND KNCKRBOC	-	-	-	-	-	-	-	-	17	7	2	4	8	4	4	5	4	3	5	5	1	1	1	1	0
UPNY-ConEd	-	6	-	0	4	-	-	0	1	1	1	1	2	3	3	3	2	2	2	2	2	7	6	8	12
SGRLF-RAMAPO_138	-	-	-	-	-	-	-	-	6	4	3	3	3	3	2	3	3	3	3	4	3	6	5	3	2
NORTHPORT PILGRIM	-	-	-	-	-	8	7	4	3	2	1	1	1	2	2	2	2	2	2	2	3	3	2	3	3
GREENBSH-STEPHTWN_115	-	-	-	-	-	0	0	0	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2

*Discount rate of 7.05% applied for all years

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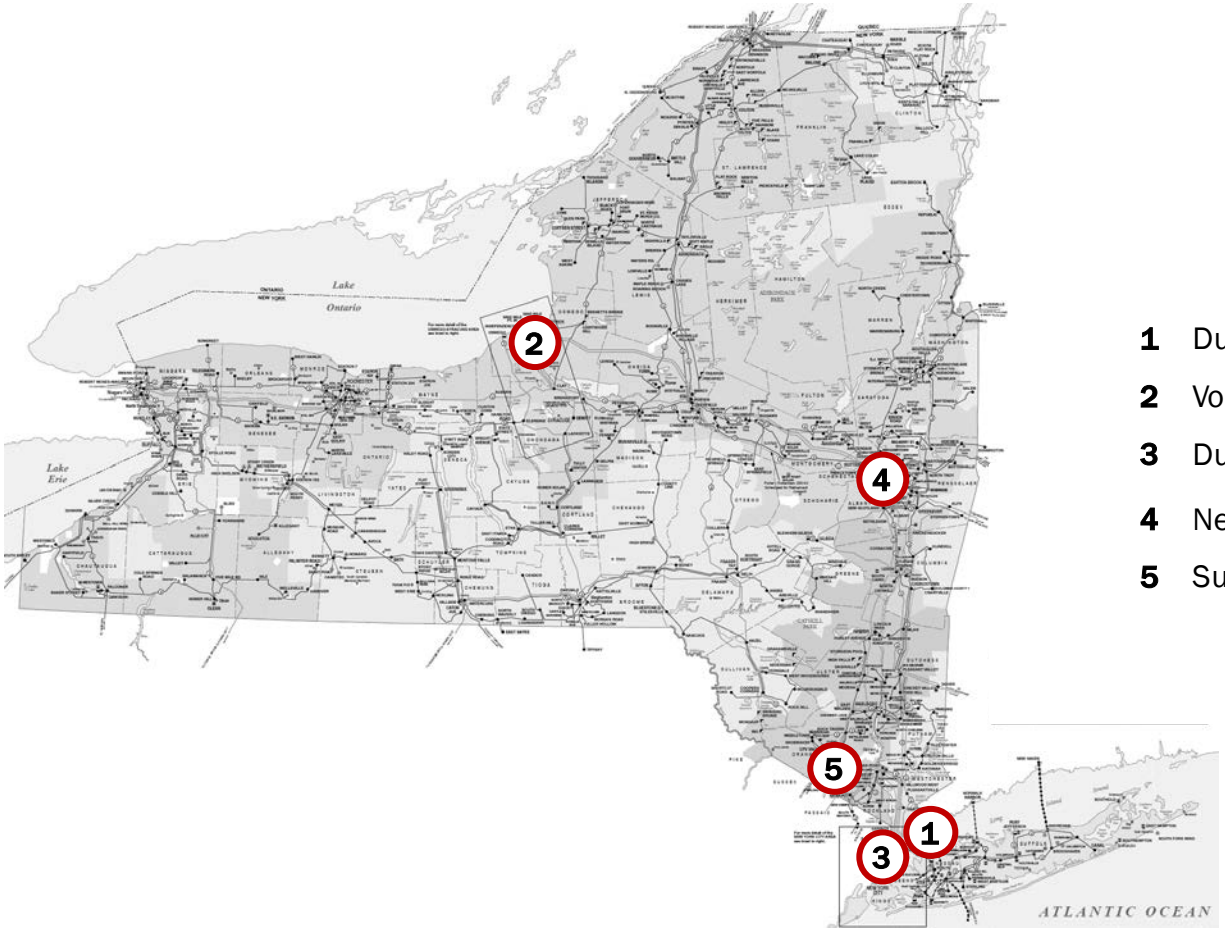

Constraint Evaluated

1. Dunwoodie – Long Island 345kV
2. Volney – Scriba 345kV
3. Dunwoodie – Motthaven 345kV
4. New Scotland – Knickerbocker 345kV
5. Sugarloaf – Ramapo 138kV

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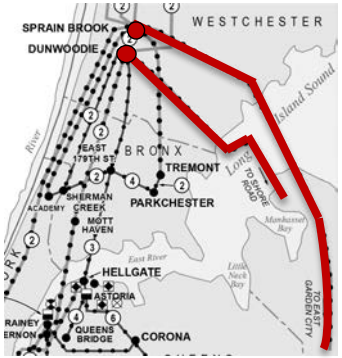
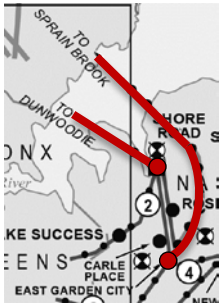
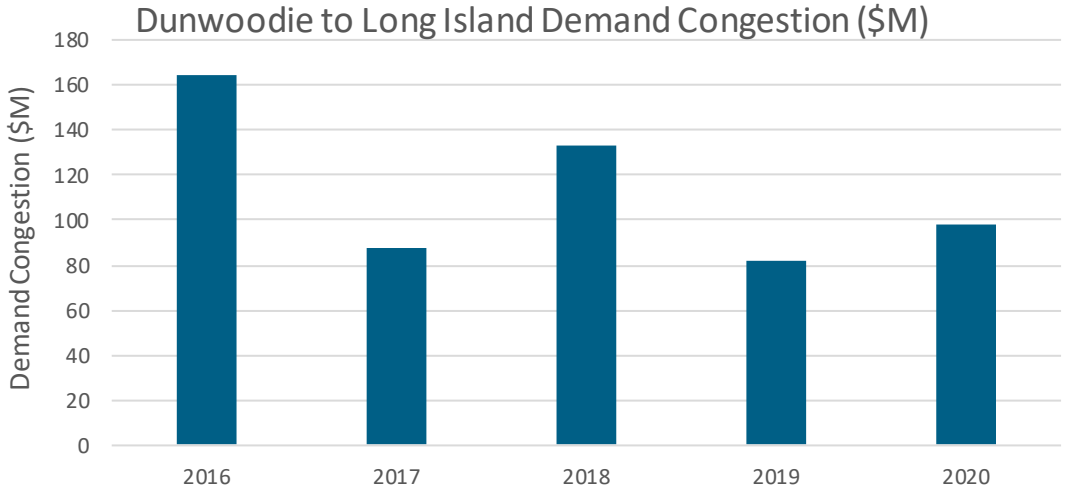
Dunwoodie – Long Island 345 kV

Transmission Information & Historic Congestion





	Y49	Y50
Type	Single Circuit 345kV	
Normal Op. Rating	637/693 MW	656/741 MW
Contingency Op. Rating	900/940 MW	916/977 MW
Length	~26 Miles	>10 Miles
Owner	NYPA	Con Edison/LIPA



- **The congestion on this path is due to the outages of parallel lines.**

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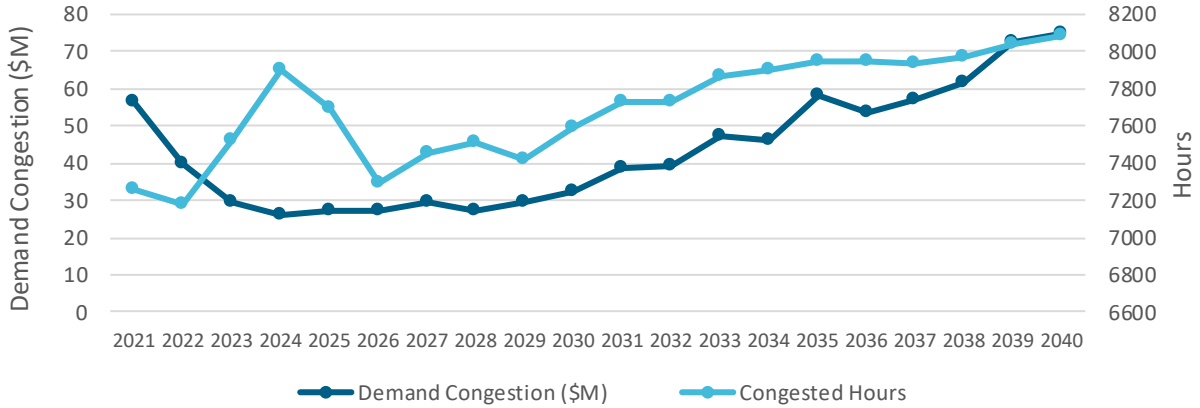
Dunwoodie – Long Island 345 kV

Transmission Information & Projected Congestion



- For 2021-2022, the series reactor on Y49 is in service all year-round, which causes heavy congestion on Y50.
- Starting 2023, the series reactor on Y49 is bypassed during summer, which reduces congestion on this path. Congestion is observed on both Y49 and Y50 instead of being concentrated on Y50 as in the first two years.

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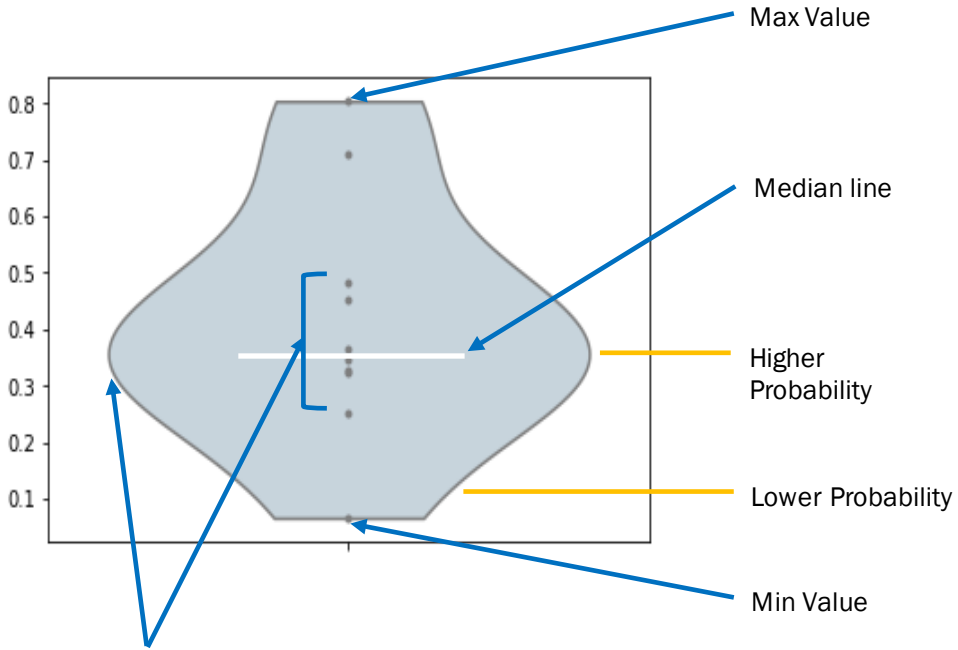
Violin Plot



Data Points that are closely grouped have larger kernel density estimate (KDE), which results in a bulge in the violin plot

- A violin plot is a hybrid of a box plot and a kernel density plot, which shows peaks in the data. It is used to visualize the distribution of numerical data. Unlike a box plot that can only show summary statistics, violin plots depict summary statistics and the density of each variable.
- The Kernel Density Estimate (KDE) shows the distribution shape of the underlying data.
- Wider sections of the violin plot represent a higher probability that members of the population will take on the given value; the skinnier sections represent a lower probability.
- Shaded area of the violin plot represents all the points in the population.

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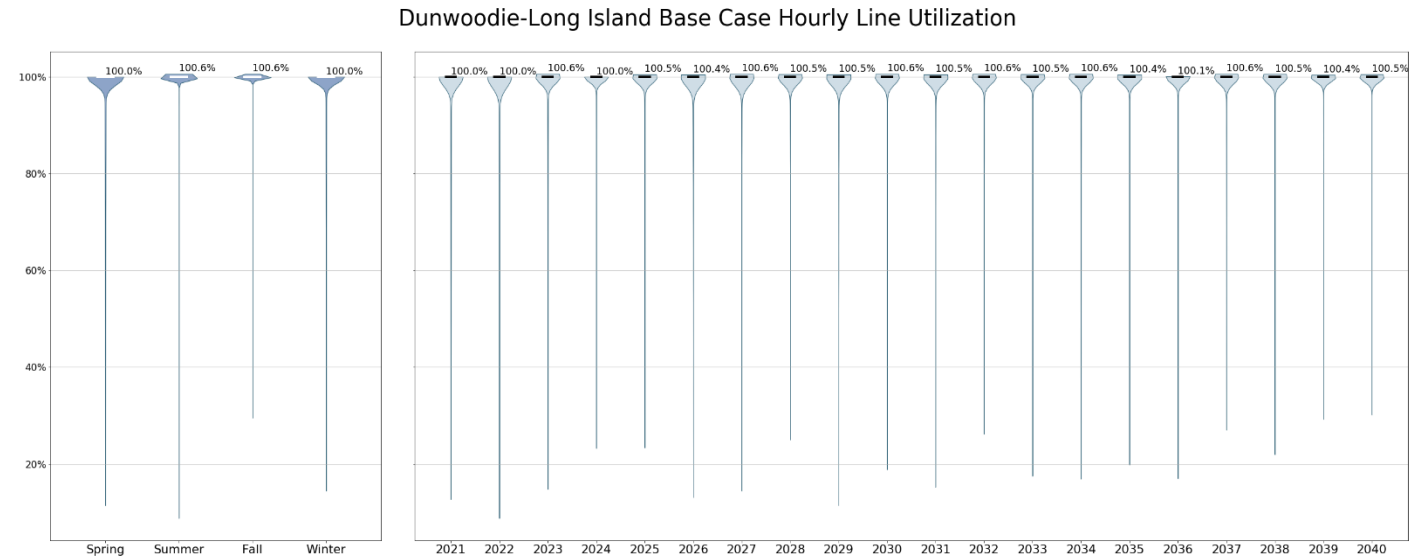
Dunwoodie – Long Island 345 kV



- The flow on this path is heavily utilized toward the facility limit throughout the year due to the price difference across this constraint.

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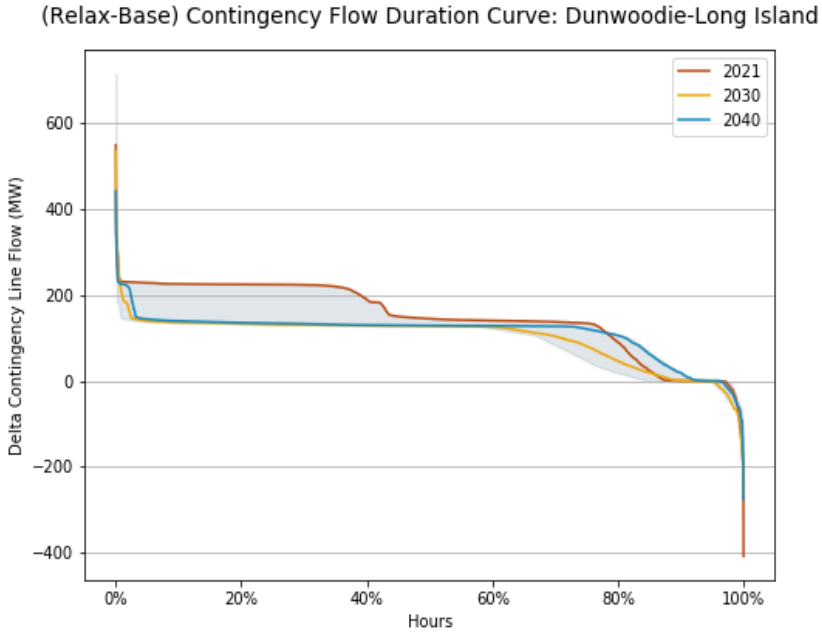
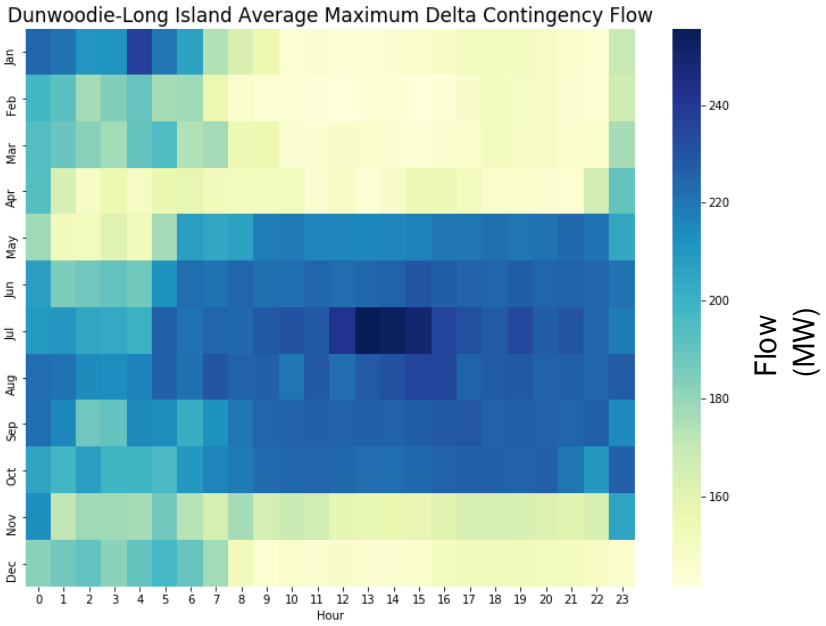
Dunwoodie – Long Island 345 kV





- Interface flow increases especially during high peak hours.

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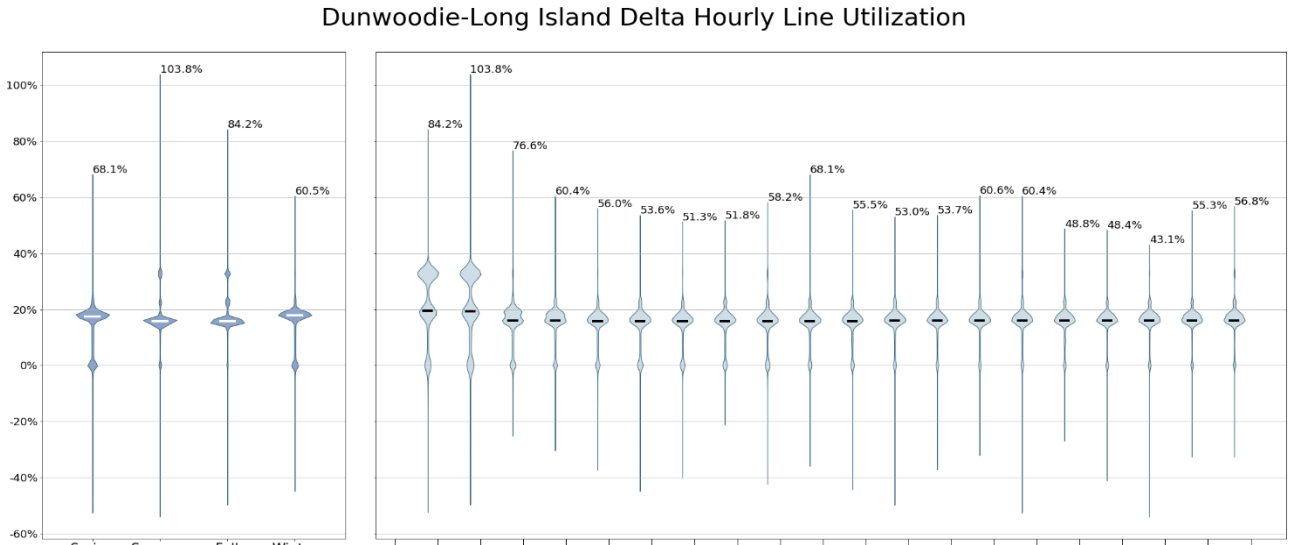
Dunwoodie – Long Island 345 kV



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Freed Energy (GWh)	1291	1205	920	941	868	811	843	860	846	871	871	899	935	928	942	929	959	951	971	981

- Production Cost savings for relaxing this constraint is $65 million over 20 years.
- Relaxed case has on average approx. 18-20% increased flow.

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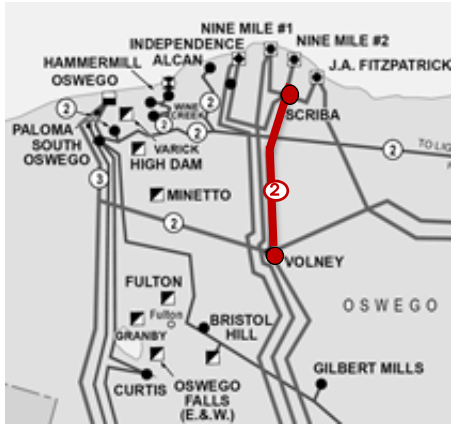
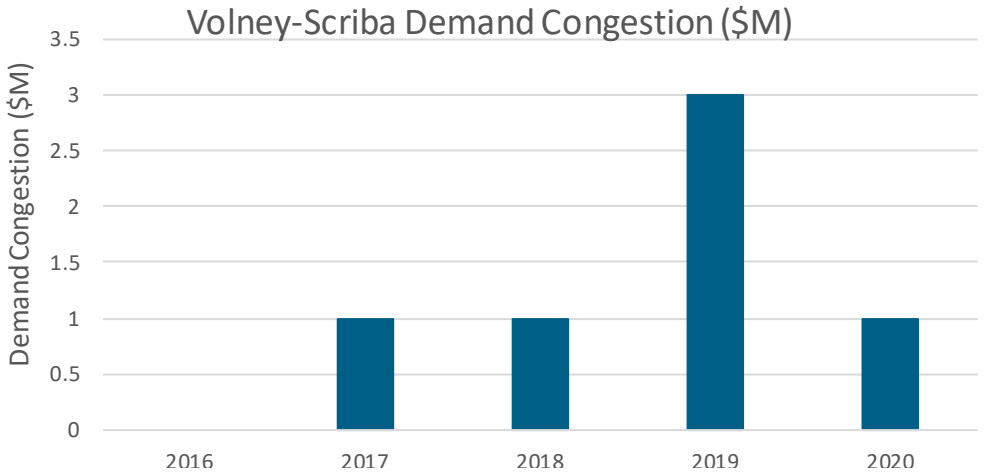
Volney-Scriba 345 kV

Transmission Information & Historic Congestion





Type	Single Circuit 345kV
Normal Op. Rating	1200/1474 MVA
Contingency Op. Rating	1396/1626 MVA
Length	~9 Miles
Owner	National Grid

- The two parallel 345kV lines have different ratings. Limiting constraints occur securing the line with the lower rating for loss of the other.

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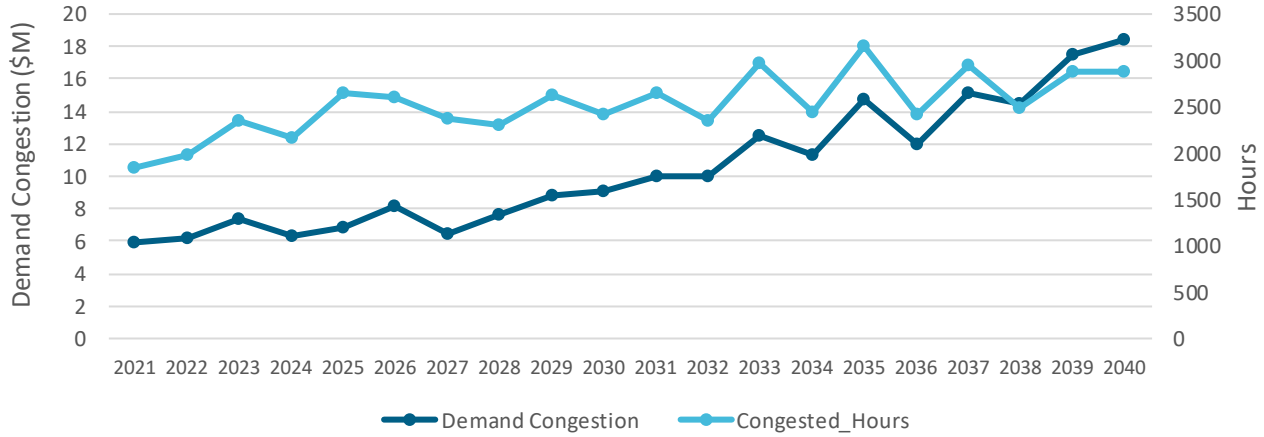
Volney-Scriba 345 kV

Transmission Information & Projected Congestion



- The driver for projected congestion is the same as historical congestion
- Resources in Oswego County located upstream of Volney-Scriba constraints are the primary driver of the congestion

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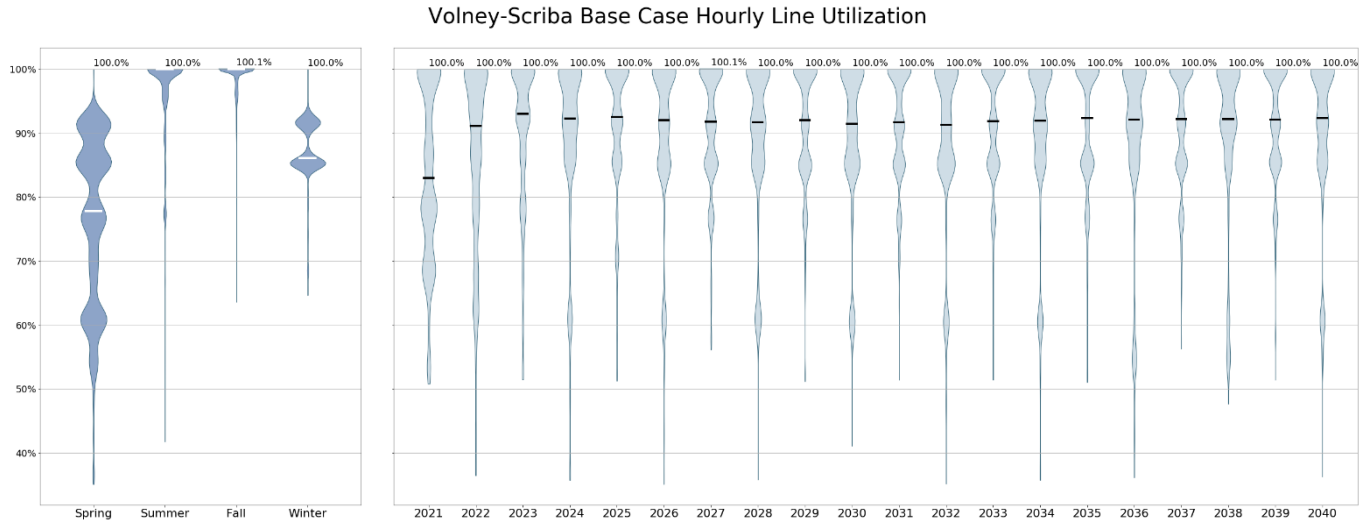
Volney-Scriba 345 kV



- Congestion primary occurs during the summer period when the seasonal rating is lower.
- This path is mostly congested during the summer and fall period.

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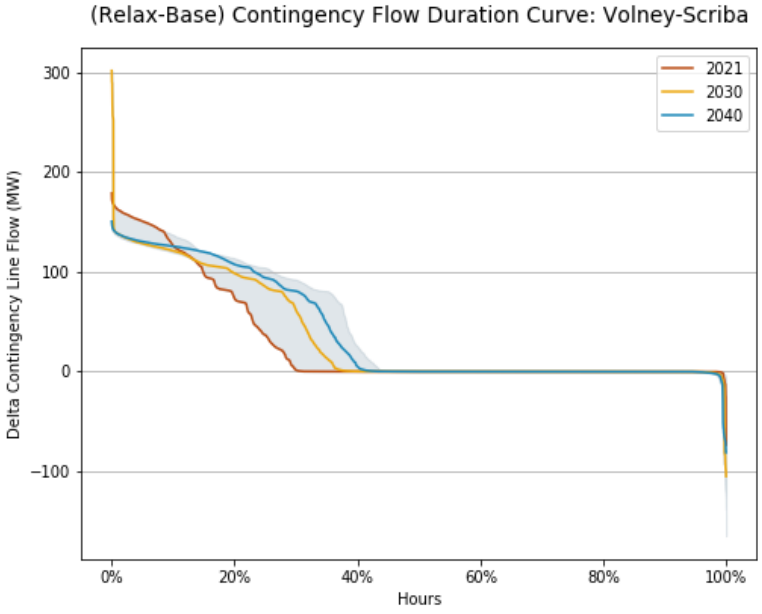
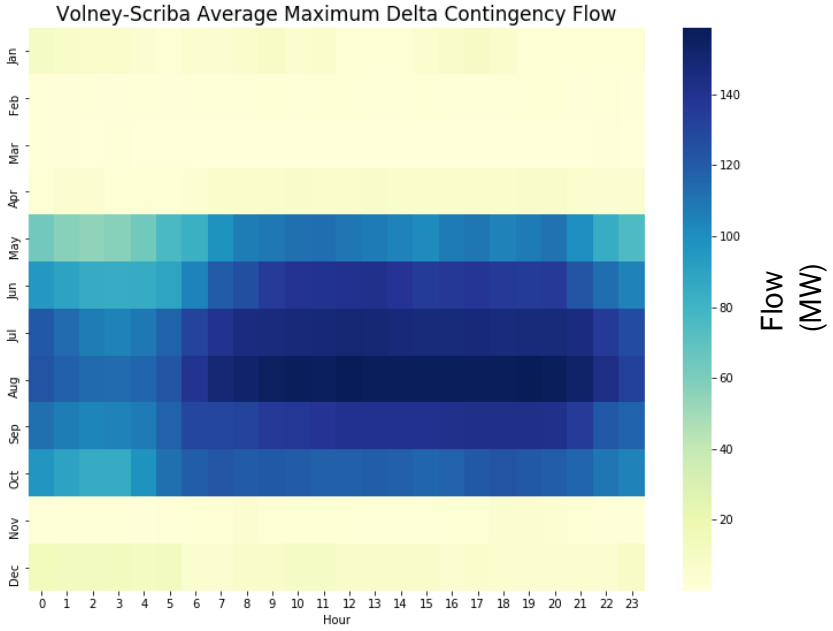
Volney-Scriba 345 kV

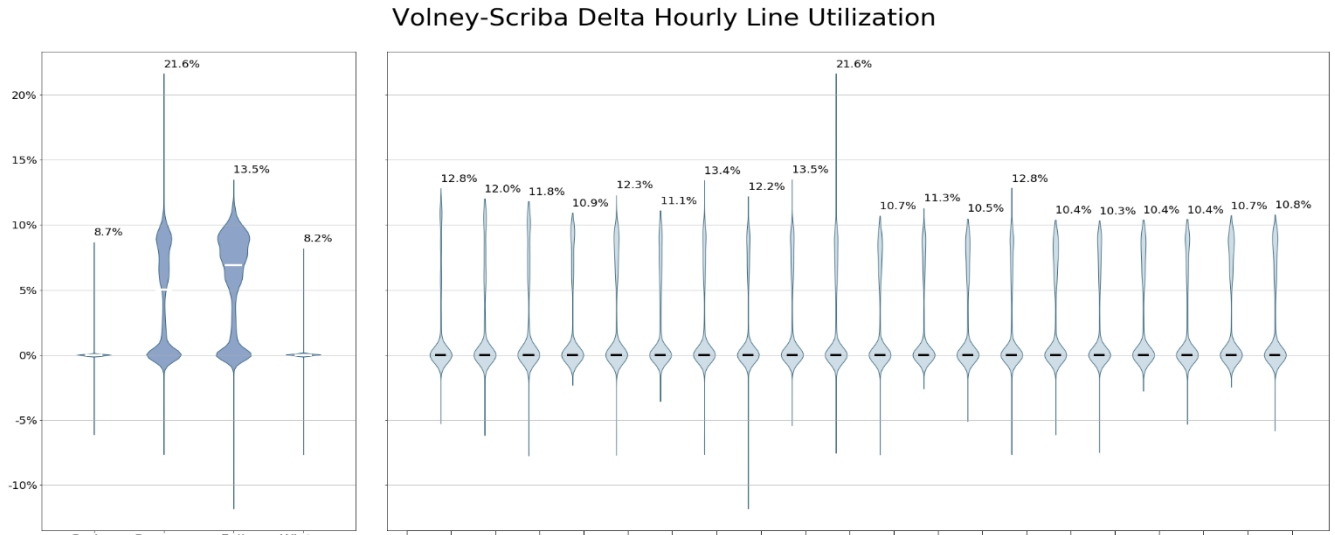




- Largest flow delta (Relaxed – Base) occurs during peak load period.

New York ISO

Volney-Scriba 345 kV



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Freed Energy (GWh)	252	287	312	301	350	304	273	263	285	300	323	278	326	277	359	293	350	300	373	339

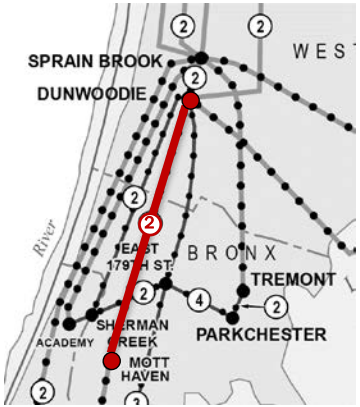
- Production Cost savings for relaxing this constraint is $123 million over 20 years.
- Relieving congestion on this path results in higher flows in the summer and fall seasons

Freed Energy = $\sum_{h=1}^{8760}[Max(Relax\ Case\ Flow)_h - Max(Base\ Case\ Flow)_h]$

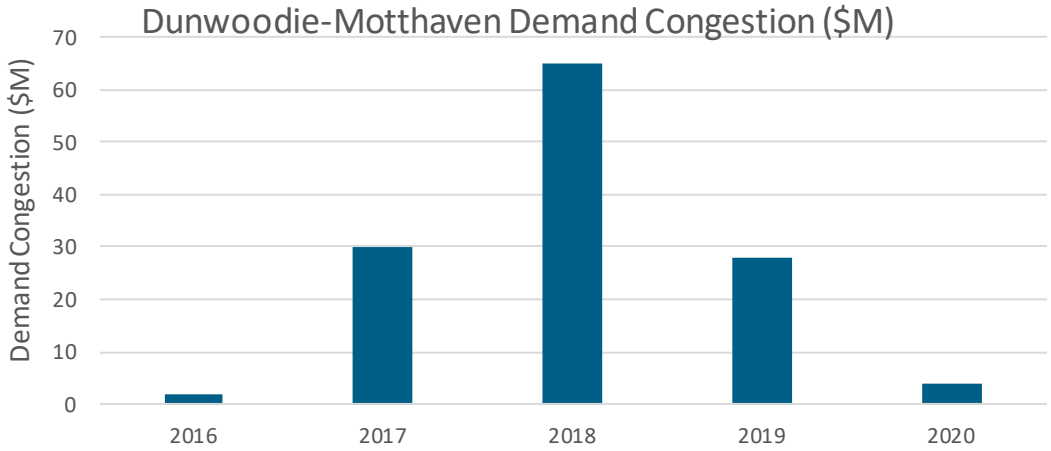
New York ISO

Dunwoodie – Motthaven 345 kV

Transmission Information & Historic Congestion



Type	Double Circuit 345kV
Normal Op. Rating	707/741 MVA
Contingency Op. Rating	1066/1083 MVA
Length	~12 Miles
Owner	Con Edison

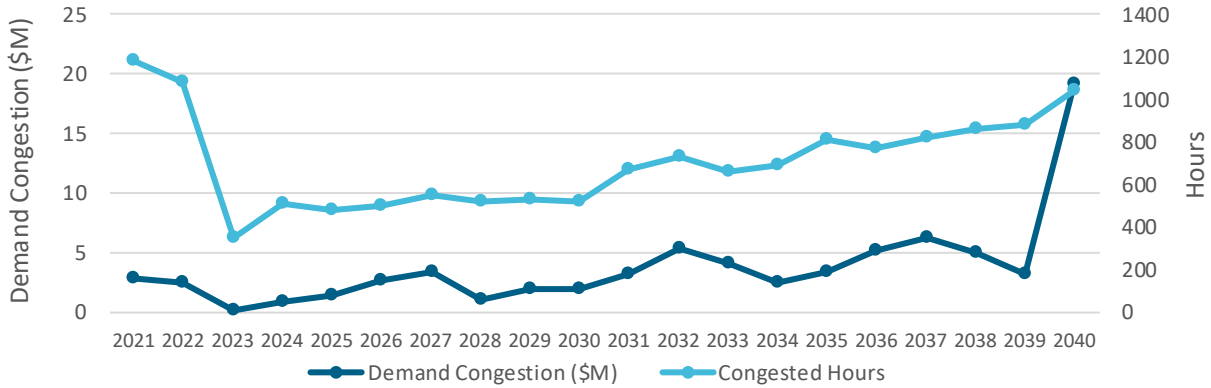


- **The congestion on this path is due to the expiration of the ConEd/PSEG Wheeling Agreement in May 2017 and outages of parallel lines.**

New York ISO

Dunwoodie – Motthaven 345 kV

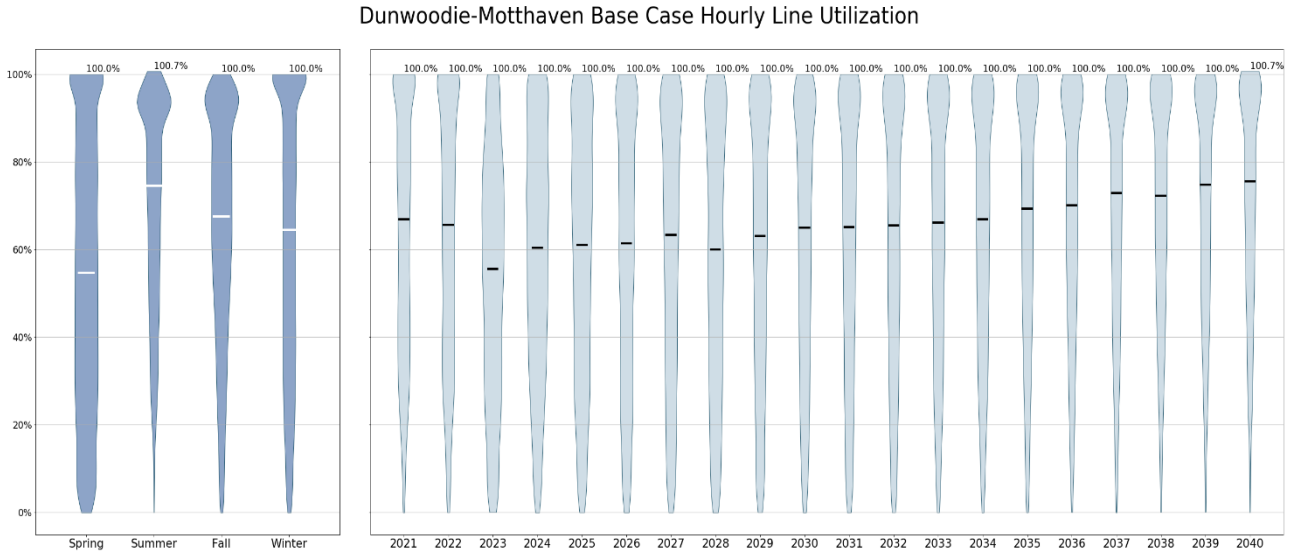
Transmission Information & Projected Congestion



- The congestion on this path is mainly due to the contingency for loss of the parallel 345kV lines

New York ISO

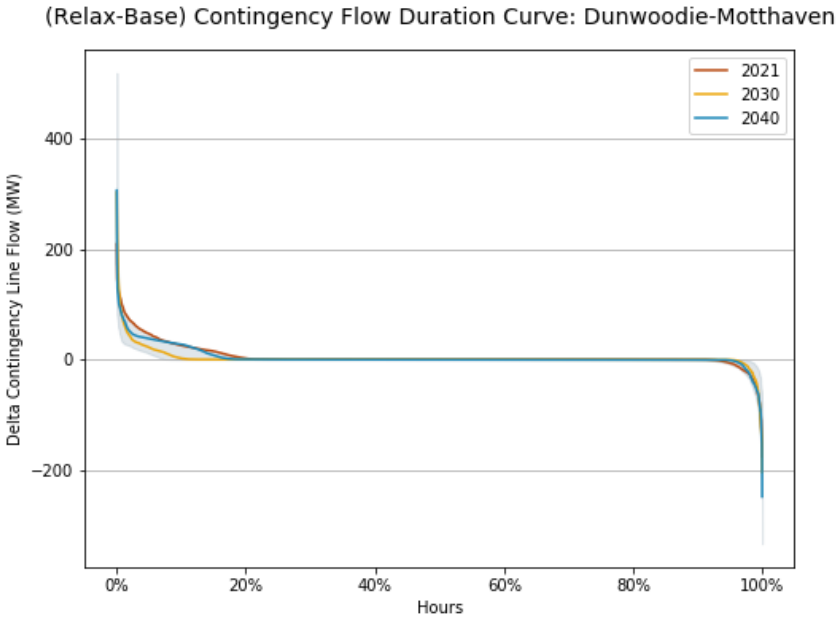
Dunwoodie – Motthaven 345 kV

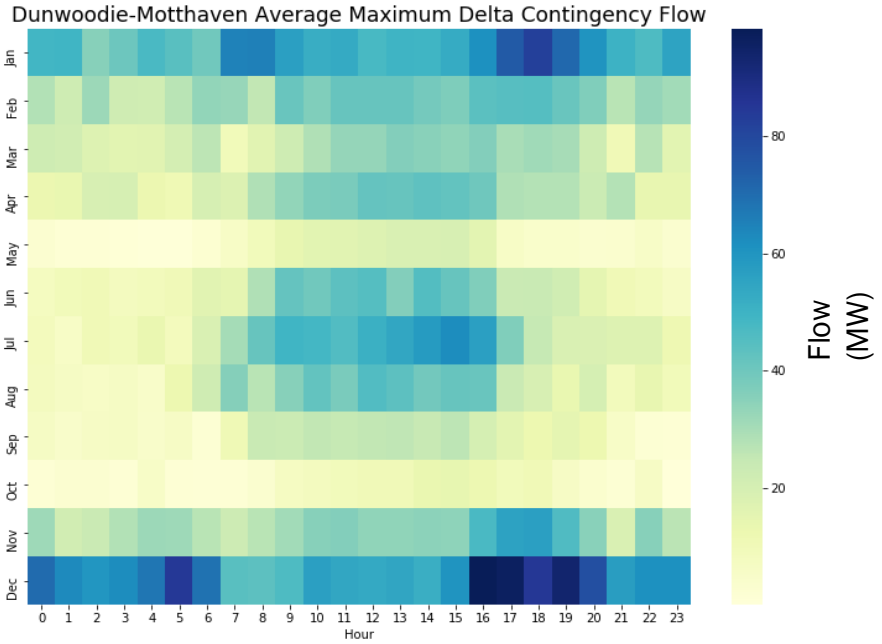


- The average flow tends to increase in the outer years with the load growth.
- Higher line utilization in summer and fall is driven by lower seasonal ratings than in spring and winter

New York ISO

Dunwoodie – Motthaven 345 kV





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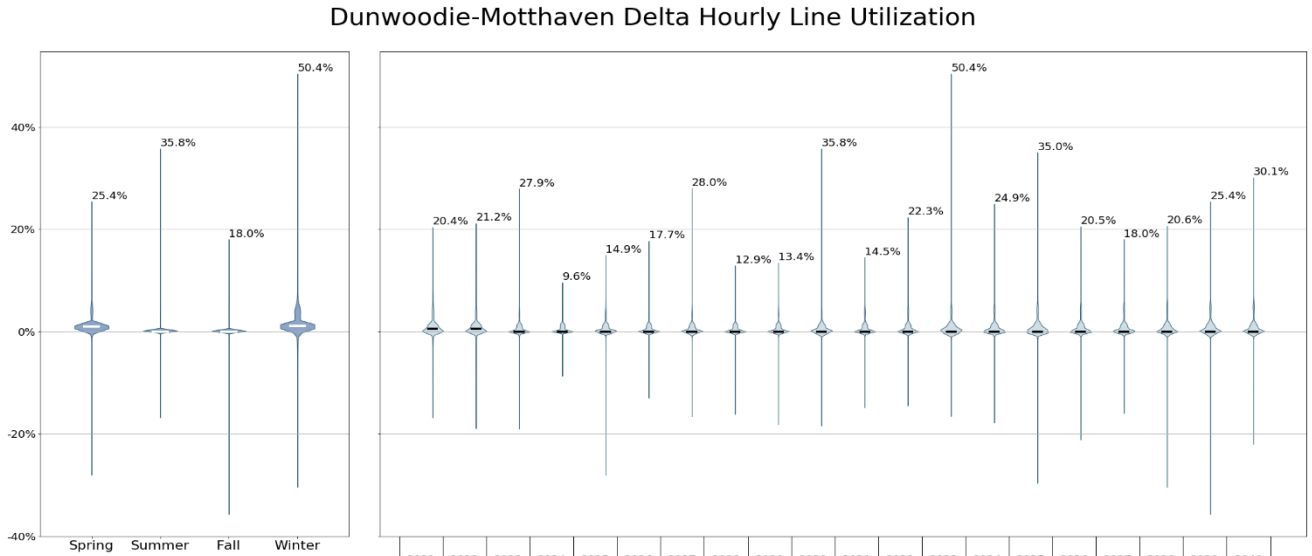
Dunwoodie – Motthaven 345 kV



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Freed Energy (GWh)	45	40	5	9	8	14	16	10	10	17	13	17	20	19	23	19	23	34	21	35

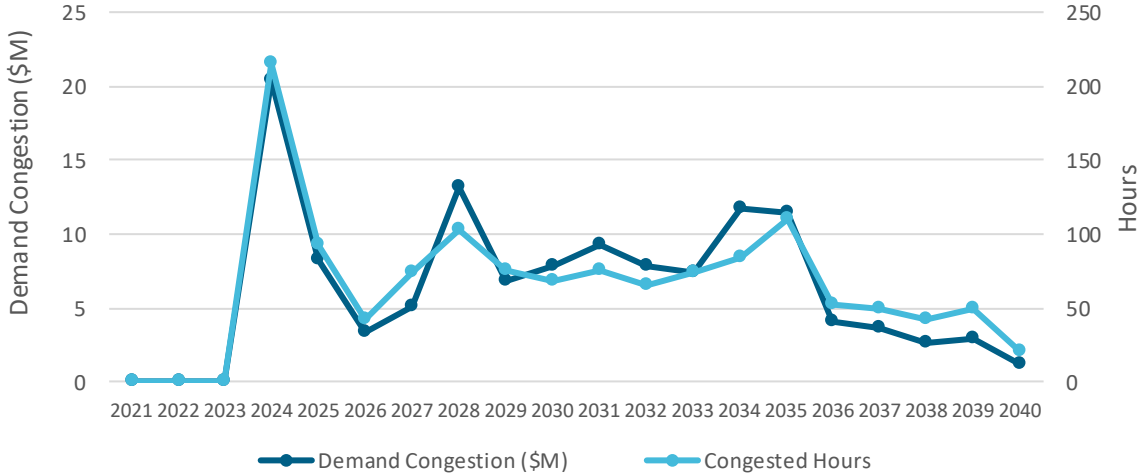
- Production Cost savings for relaxing this constraint is $30 million over 20 years
- There are still constraints downstream of Motthaven once this constraint is relaxed.
- Flow increases slightly in the winter when limits are relaxed.

New York ISO

New Scotland – Knickerbocker 345 kV

Transmission Information & Projected Congestion

Type	Single Circuit 345kV
Normal Op. Rating	1423/1852 MVA
Contingency Op. Rating	
Length	~12 mile
Owner	National Grid



- The congestion on this path is due to the AC Transmission public policy projects being placed into service, which diverts more flow to this path.

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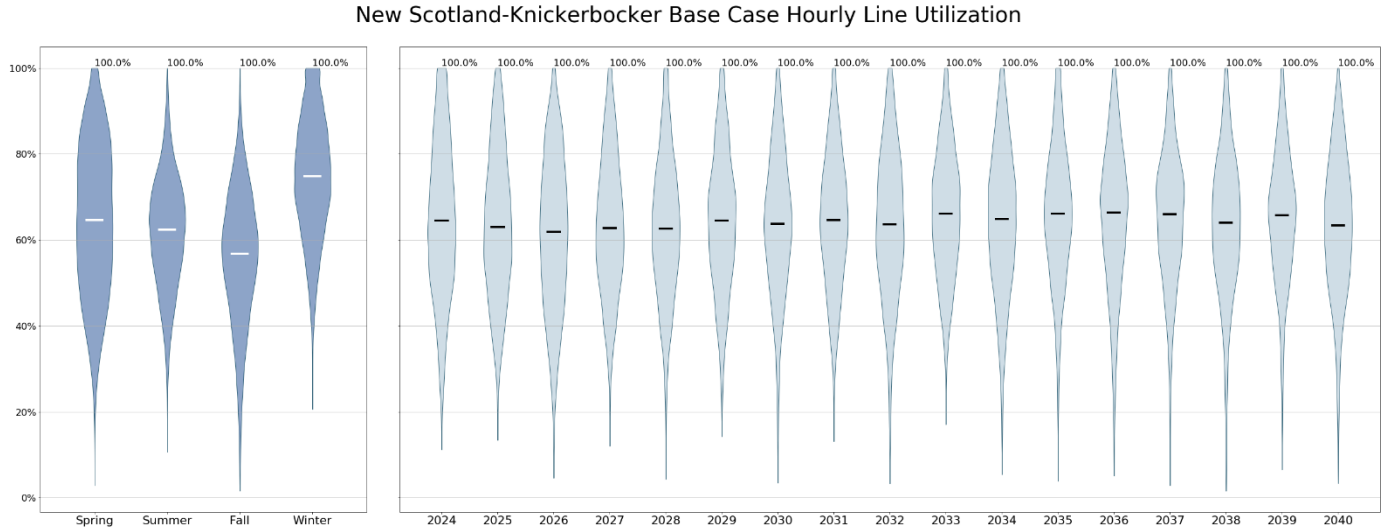
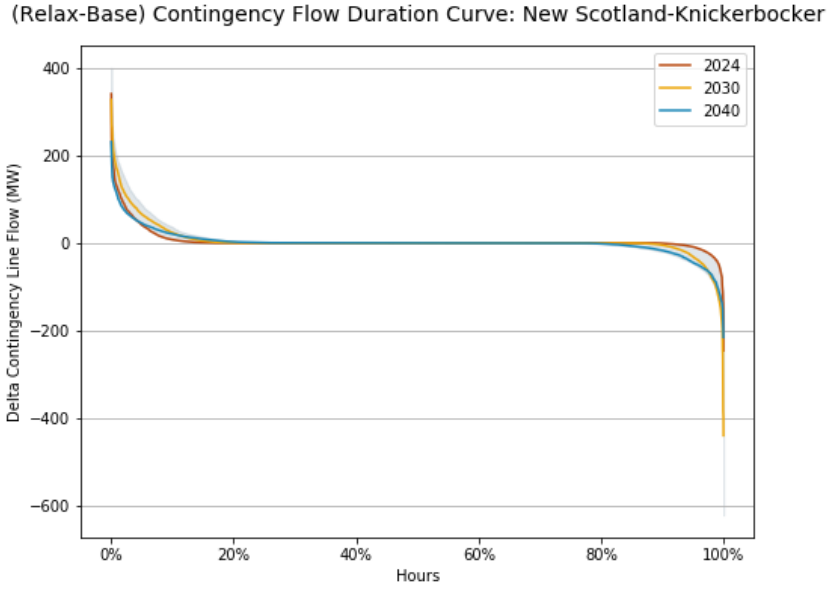
New Scotland – Knickerbocker 345 kV

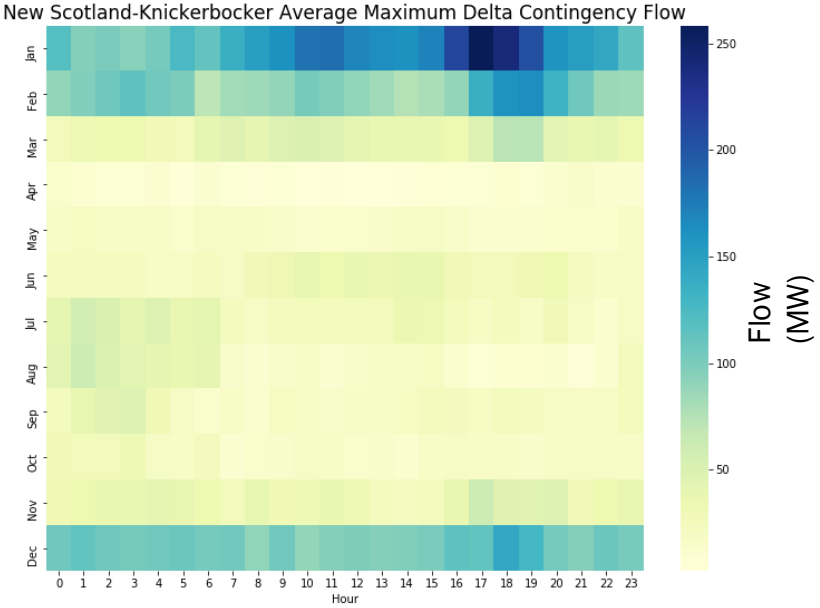


- The flow utilization is higher in winter than in the summer mainly due to the Marcy South Series Compensation (MSSC) bypass in winter, while it is in service during summer period.

New York ISO

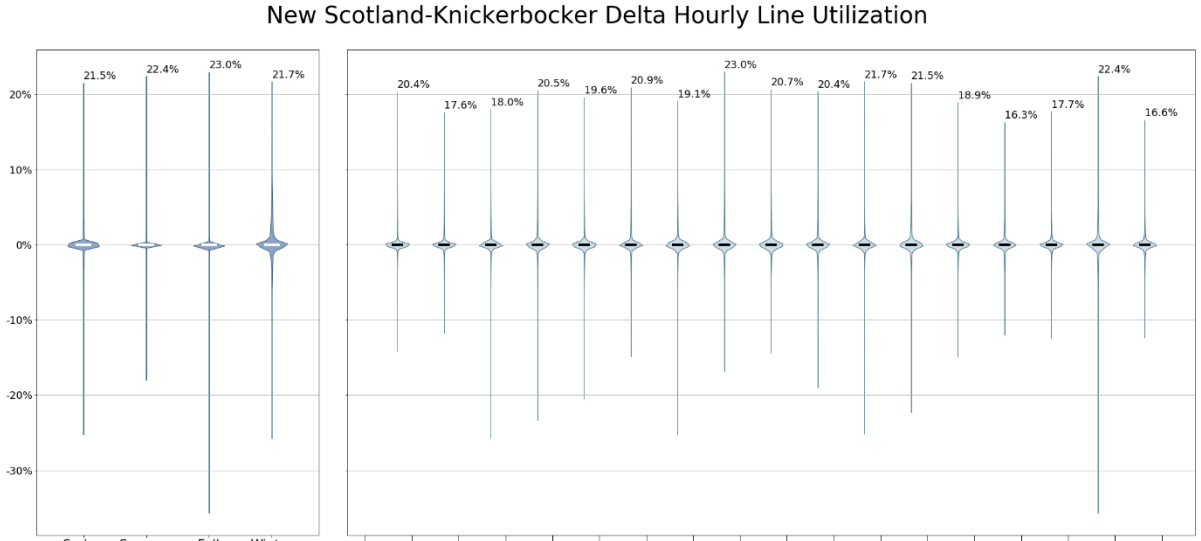
New Scotland – Knickerbocker 345 kV





New York ISO

New Scotland – Knickerbocker 345 kV



	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Freed Energy (GWh)	35	29	19	29	19	32	34	57	61	37	30	40	26	23	20	8	4

- Production Cost savings for relaxing this constraint is $25 million over 17 years.
- Relaxing this constraint will put more pressure back on the Central East interface and downstream constraints.

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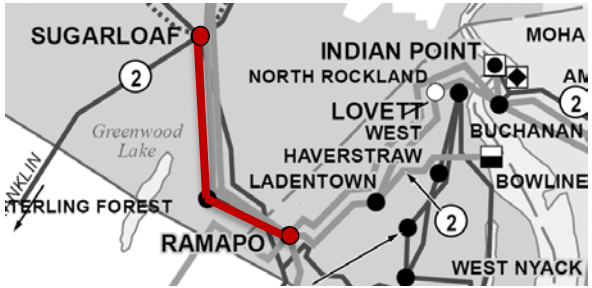
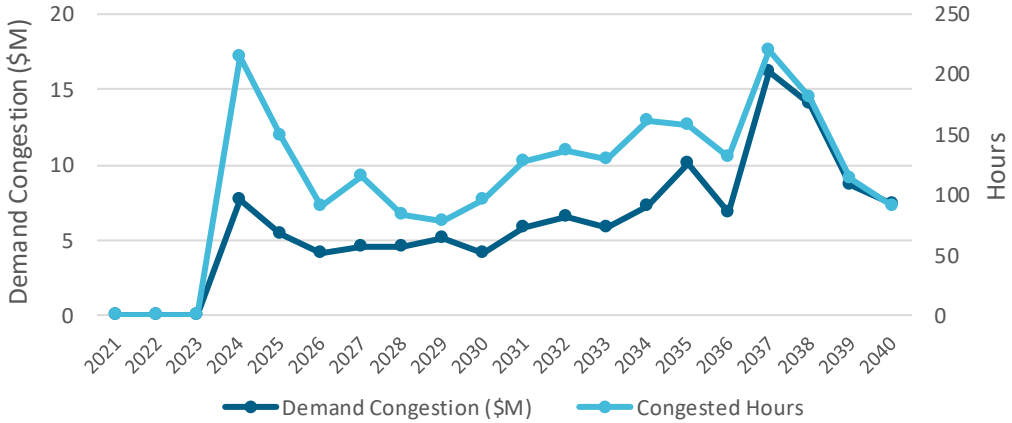
Sugarloaf – Ramapo 138 kV

Transmission Information & Projected Congestion



Type	Single Circuit 138kV
Normal Op. Rating	236/282 MW
Contingency Op. Rating	270/309 MW
Length	~ 17 miles
Owner	O&R



- The congestion in the future years starting 2024 are primary driven by congestion shifted to local transmission downstream of the Segment B project of AC Transmission Public Policy projects placed into service (with the addition of Rock Tavern to Sugarloaf line).

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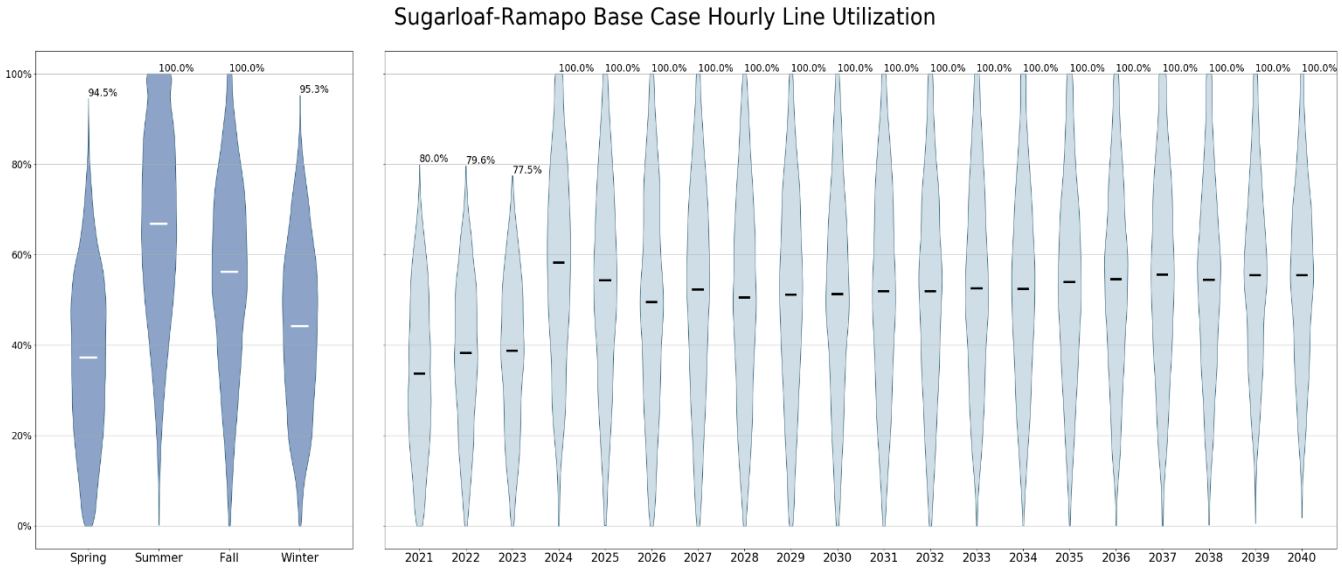
Sugarloaf – Ramapo 138 kV



- The flow utilization in this path significantly increased with a portion of Segment B of the AC Transmission Public Policy project in-service.
- Higher flow utilization in summer and fall occurs because the seasonal rating is lower than in winter.

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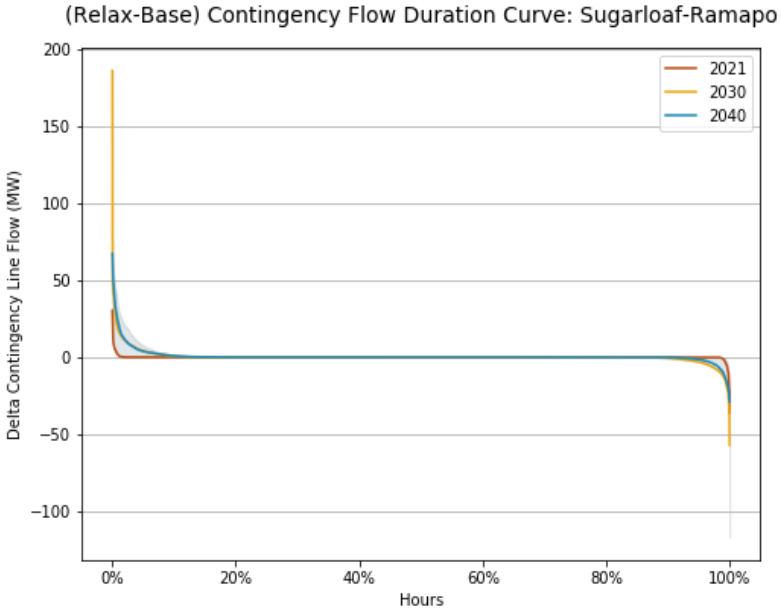
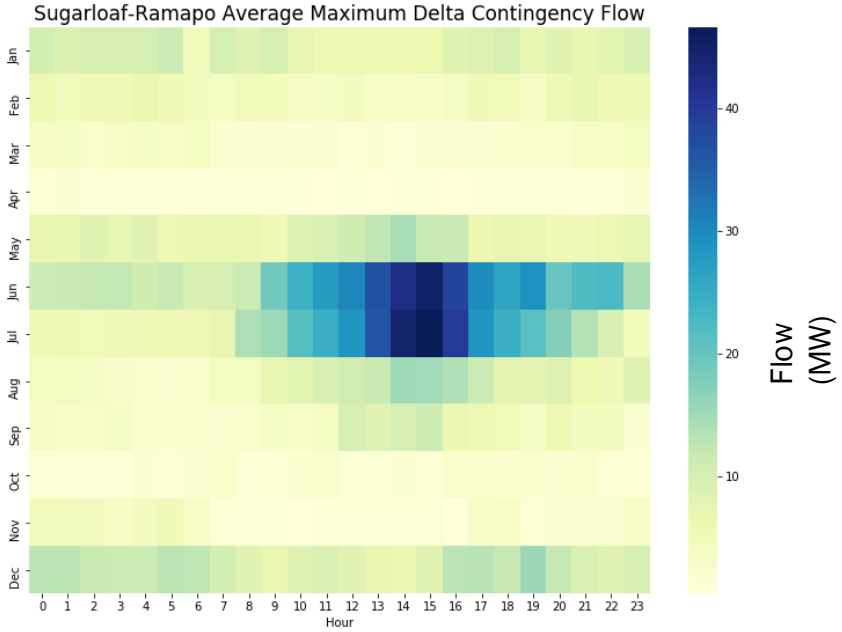
Sugarloaf – Ramapo 138 kV





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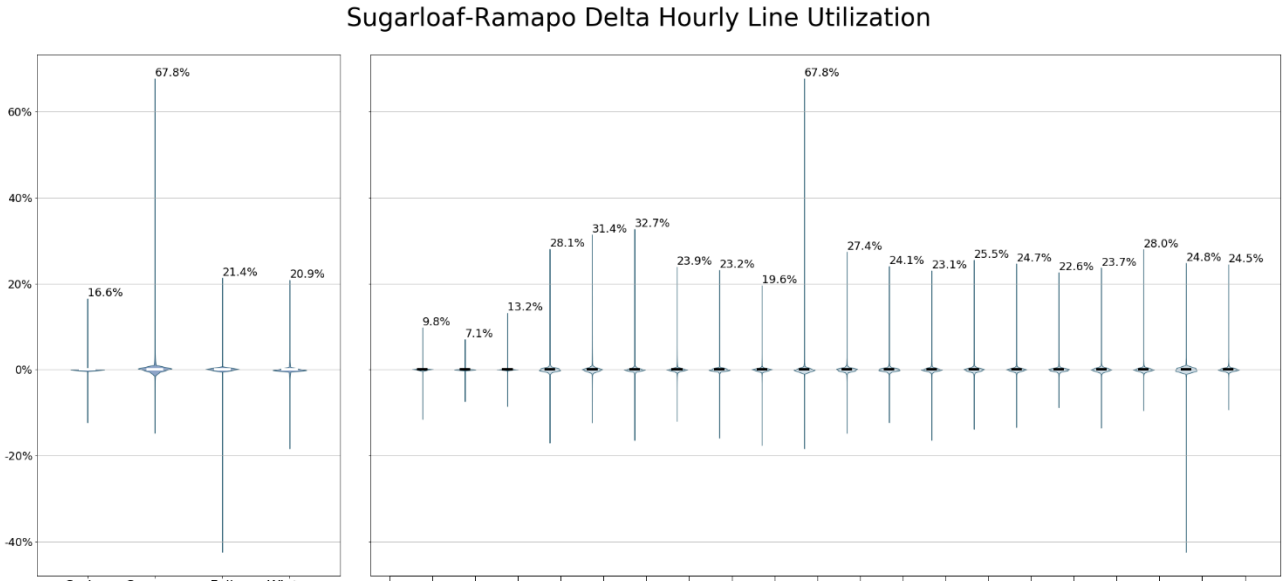
Sugarloaf – Ramapo 138 kV



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Freed Energy (GWh)	0	0	0	6	6	1	2	1	2	2	5	6	4	3	4	5	8	6	4	4

- Production Cost savings for relaxing this constraint is $23 million over 20 years.
- Constraints are only binding for less than 3% of the year; thus low levels of freed energy are experienced when constraints are relaxed.

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Next Steps

Next Steps

- **Contract Case**
  - Congestion & relaxed simulation analysis results
  - Renewable generation pocket identification
  - Energy deliverability results
- **Policy Case**
  - Final refinements of capacity expansion model
    - Marginal capacity value curves
  - Capacity expansion preliminary results presentation

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Questions, Feedback, Comments?

- Email additional feedback to: JFrasier@nyiso.com

2021-2040 Outlook Data Catalog

ESPWG/TPAS Presentations

May 20, 2021
- Model Benchmark Results

September 22, 2021
- System & Resource Outlook Update

October 25, 2021
- Capacity Expansion Model Primer
- System & Resource Outlook Update

November 19, 2021
- System & Resource Outlook Update

December 19, 2021
- System & Resource Outlook Update

January 25, 2022
- System & Resource Outlook Update

February 9, 2022
- System & Resource Outlook Update

Final Reports

2022 Release

Data Posted to ESPWG

- Assumptions Matrix v1
- Capacity Expansion Assumptions Matrix v1
- Contract Case Renewable Projects
- Emissions Price Forecast
- Fuel Price Forecast
- Capacity Expansion Assumptions Matrix v2 (Redline)

New York ISO

Our Mission & Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

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