

2019 CARIS 1 Report

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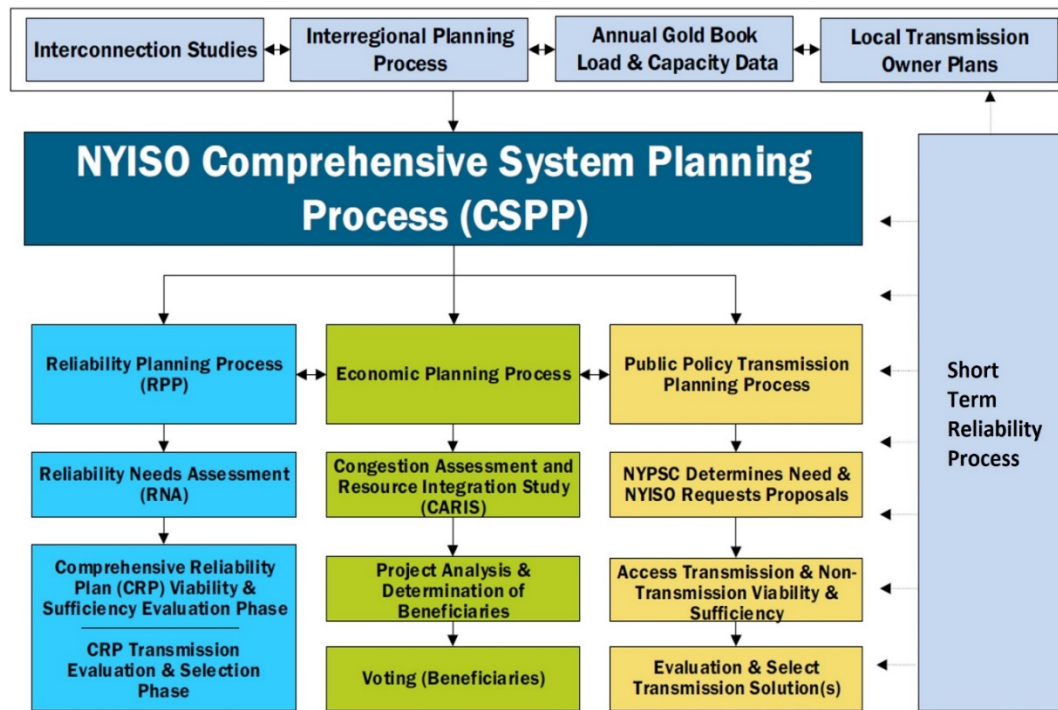
Business Issues Committee

June 24, 2020

Agenda

- **Background and Objectives of NYISO’s Economic Planning Process (“Congestion Assessment and Resource Integration Studies”, or CARIS)**
- **2019 CARIS Phase 1 Development**
- **2019 CARIS Phase 1 Results**
- **Next Steps**

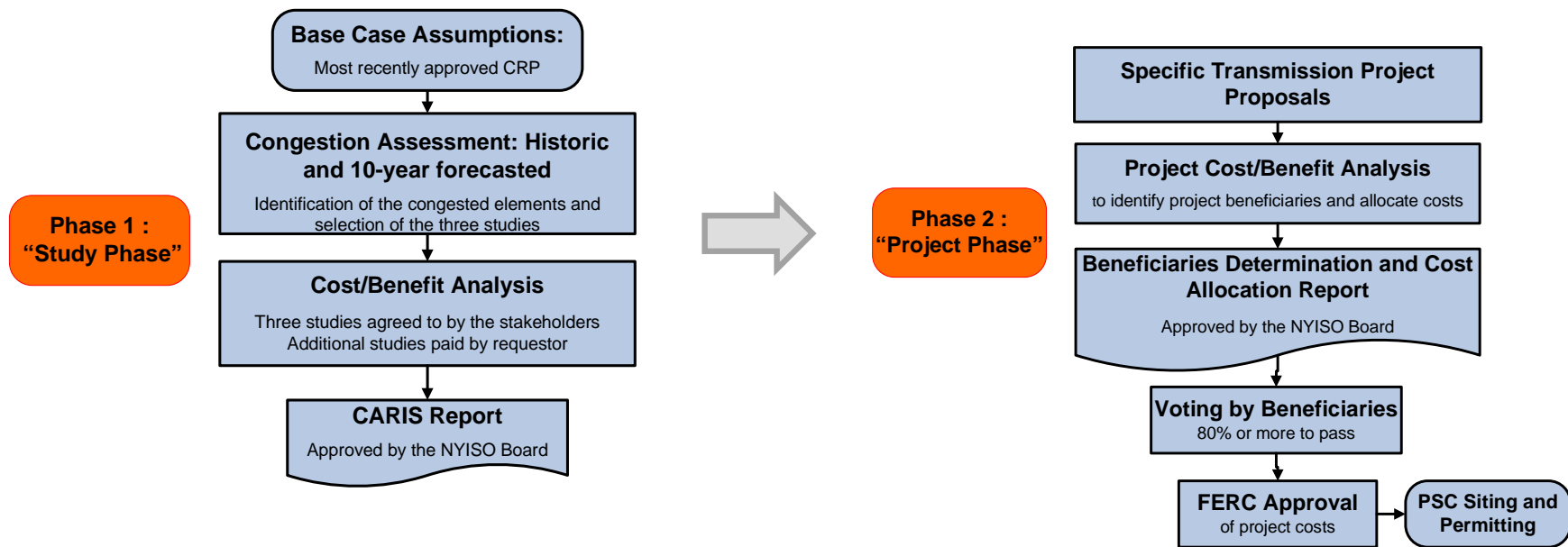
NYISO Comprehensive System Planning Process



CARIS Phase 1 Objectives

- **Identify and report congestion**
 - 5-year “historic” congestion
 - 10-year “projected” congestion
- **Provide information to stakeholders, developers & other interested parties**
 - Select top congested transmission elements
 - Project benefits of relieving the most congested elements or groupings using generic solutions
 - Identify factors that produce or increase congestion

CARIS Phase 1 Process



CARIS Phase 1 Development

- **Starting point for 2019 CARIS Phase 1 Base Case was the 2018 CRP**
- **Base case assumptions were developed for the Study Period (2019-2028) pursuant to CARIS procedures and in collaboration with stakeholders at ESPWG**
 - 2019 Gold Book Load and Capacity Forecasts
 - Fuel price and emission cost forecast were locked down as of August 1, 2019
 - Transmission model from the 2018 CRP with actual operating limits
 - Resource changes were implemented pursuant to base case inclusion screening rules

CARIS Phase 1 Development

■ Base Case Key Assumptions

- Transmission upgrades
 - Empire State Line Project /Western New York Public Policy project (2022)
 - NYPA rebuild of Moses-Adirondack 230 kV circuits (2023)
 - AC Transmission Public Policy projects Segments A and B (2024)
 - Expanding monitoring and securing of lower voltage system consistent with NYISO operations
- Resource Assumptions
 - Cricket Valley Energy center modeled in-service (2020)
 - Indian Point 2 and 3 are retired (2020/2021)

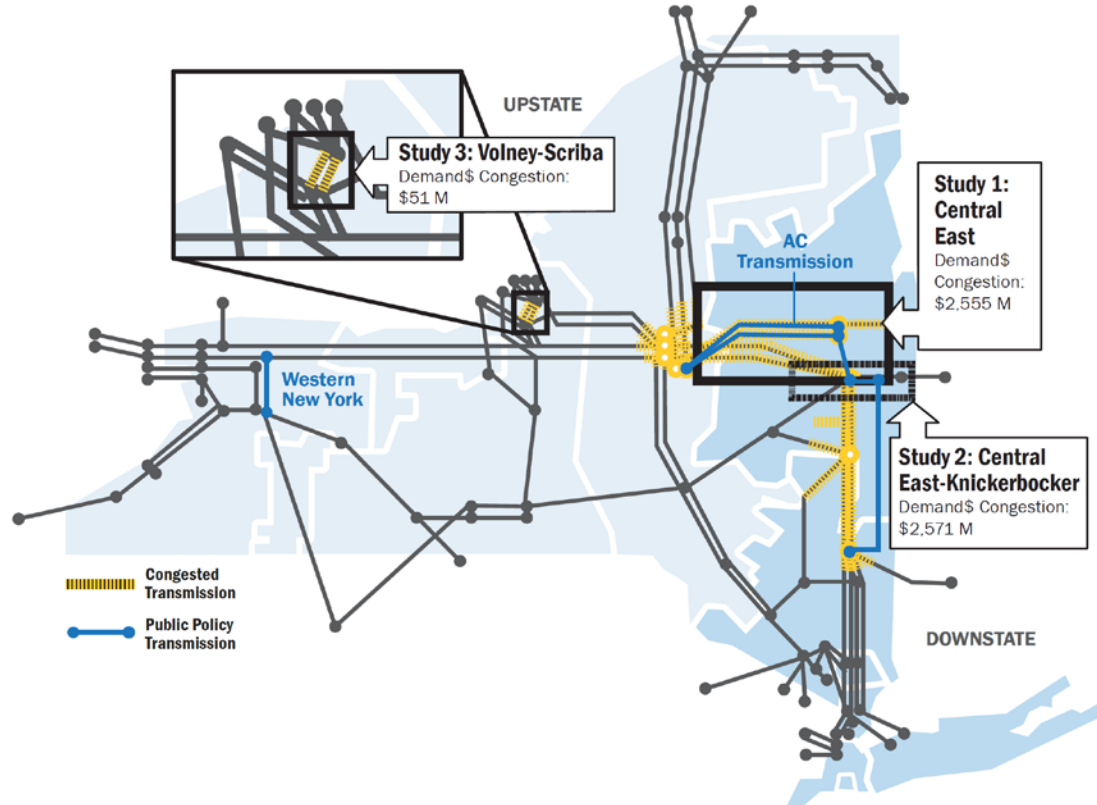
CARIS Phase 1: Selection of Studies

- **Rank and group elements based on five-year historic and 10-year projected Demand\$ Congestion**
 - Historic Demand\$ Congestion data drawn from NYISO's posted congestion reports
 - Forecasted Demand\$ Congestion estimated using General Electric's Multi-Area Production Simulation (MAPS) software
- **Select three study areas based on potential ten-year projected production cost savings**

Historic and Projected Demand\$ Congestion (\$M)

Constraint Group (Nominal \$M)	Historic					Projected									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
CENTRAL EAST	1,136	915	641	598	540	668	508	521	411	183	188	84	84	114	167
DUNWOODIE TO LONG ISLAND	155	138	164	88	133	41	36	28	25	25	31	25	26	25	28
LEEDS PLEASANT VALLEY	42	111	63	101	9	2	1	2	3	3	-	-	-	-	-
EDIC MARCY	7	0	32	125	107	-	-	-	-	-	-	-	-	-	-
DUNWOODIE MOTTHAVEN	40	2	2	30	65	8	9	10	7	5	14	13	14	18	15
CHESTR SHOEMAKR	-	-	-	-	-	9	34	79	68	52	-	-	-	-	-
GREENWOOD	13	19	31	18	62	12	10	6	6	6	8	8	10	11	10
PACKARD HUNTLEY	7	41	54	30	41	-	-	-	-	-	-	-	-	-	-
PACKARD 115 NIAGBLVD 115	-	-	-	-	-	85	53	29	0	0	0	-	-	-	0
NIAGARA PACKARD	18	22	44	12	9	19	16	10	0	-	0	-	-	-	-
EGRDNCTY 138 VALLYSTR 138 1	20	18	8	17	20	6	5	3	2	5	4	5	4	5	4
NEW SCOTLAND LEEDS	9	32	13	18	5	0	-	-	0	0	-	-	-	-	-
N.WAV115 LOUNS 115	-	-	-	-	-	2	2	3	4	4	13	10	13	12	11
VOLNEY SCRIBA	0	1	0	1	1	6	7	6	7	7	6	5	7	9	9
NORTHPORT PILGRIM	-	-	-	-	-	6	4	9	10	8	5	4	5	4	4

2019 CARIS Study Groupings



Project Benefits

- **Implement transmission, generation, demand response and energy efficiency generic solutions for all six studies**
 - Feasibility of each solution is not evaluated
- **Estimate the potential benefits associated with relieving congestion for each solution type using GE-MAPS production cost simulation software**
- **Per the NYISO's Tariff, benefits are limited to NYCA-wide Production Cost Savings for the purpose of assessing project economics**

Four Generic Solutions for the Three CARIS Studies

Generic Solutions			
Studies	Central East (Study 1)	Central East-Knickerbocker (Study 2)	Volney-Scriba (Study 3)
TRANSMISSION			
Transmission Path	Edic-New Scotland	Edic-New Scotland-Knickerbocker	Volney-Scriba
Voltage	345 kV	345 kV	345 kV
Miles	85	100	10
GENERATION			
Unit Siting	New Scotland	Pleasant Valley	Volney
Blocks	340 MW	340 MW	340 MW
DEMAND RESPONSE			
Blocks	Zone F : 100 MW Zone G : 100 MW Zone J : 200 MW	Zone F : 100 MW Zone G : 100 MW Zone J : 200 MW	Zone F : 100 MW Zone G : 100 MW
ENERGY EFFICIENCY			
Blocks	Zone F : 100 MW Zone G : 100 MW Zone J : 200 MW	Zone F : 100 MW Zone G : 100 MW Zone J : 200 MW	Zone F : 100 MW Zone G : 100 MW

Project Costs

- **Generic Solution Costs** are simplified values developed using low, mid and high unit cost estimates for each solution type
- **Transmission costs** were drawn from cost estimates submitted in the NYSDPS's AC Transmission proceeding and other third-party sources
- **Generator costs** for a combined cycle unit as presented in 2016 Demand Curve Reset study
- **Energy Efficiency costs** were based upon the cost data presented in Comprehensive Energy Efficiency Initiative (Case 18-M-0084)
- **Demand Response costs** were developed based on Proceeding on Motion of the Commission to Develop Dynamic Load Management Programs (Case 14-E-0423)

Ten-Year Production Cost Savings for CARIS Studies (\$2019M)

Study	Ten-Year Production Cost Savings (\$2019M)			
	Transmission Solution	Generation Solution	Demand Response Solution	Energy Efficiency Solution
Study 1: Central East	115	103	17	1,061
Study 2: Central East-Knickerbocker	117	110	17	1,061
Study 3: Volney-Scriba	22	137	9	530

Benefit/Cost Analysis

- **Present Value of Production Cost Savings is calculated over the Study Period using a discount rate of 7.08%**
 - Discount rate is equal to an average of the Transmission Owner's Weighted Average Cost of Capital (WACC) (weighted by 2018 load (GWh))
- **For the Transmission and Generation Solution Costs, Overnight Costs are multiplied by a Capital Recovery Factor (CRF)**
 - Assumes a levelized generic carrying charge of 16% for transmission and generation solutions and a discount rate of 7.08%, resulting in the CRF of 1.16
- **Benefit/Cost Ratios are reported for each solution, based upon 10 years of projected NYCA-wide Production Cost Savings (CARIS primary metric) compared to the estimated 10 years of project costs**

Generic Solutions Benefit/Cost Ratios (Low, Mid and High Cost Estimates)

Study	2019-2023			2024-2028		
	Low	Mid	High	Low	Mid	High
Transmission Solution						
Study 1: Central East	0.37	0.25	0.20	0.18	0.12	0.09
Study 2: Central East-Knickerbocker	0.37	0.25	0.20	0.18	0.12	0.09
Study 3: Volney-Scriba	0.44	0.30	0.24	0.52	0.35	0.28
Generation Solution						
Study 1: Central East	0.15	0.11	0.09	0.26	0.20	0.16
Study 2: Central East-Knickerbocker	0.15	0.11	0.09	0.24	0.18	0.15
Study 3: Volney-Scriba	0.20	0.15	0.12	0.44	0.33	0.26
Demand Response Solution						
Study 1: Central East	0.08	0.06	0.05	0.11	0.08	0.06
Study 2: Central East-Knickerbocker	0.08	0.06	0.05	0.11	0.08	0.06
Study 3: Volney-Scriba	0.17	0.13	0.11	0.25	0.19	0.15
Energy Efficiency Solution						
Study 1: Central East	0.32	0.24	0.19	0.43	0.32	0.26
Study 2: Central East-Knickerbocker	0.32	0.24	0.19	0.43	0.32	0.26
Study 3: Volney-Scriba	0.41	0.31	0.25	0.55	0.41	0.33

Additional Benefit Metrics

- **Additional benefit metrics report the change between the generic solution-case value and the base case value over the ten-year study period**
 - For 2019 CARIS Phase 1, these include changes to generator payments, load payments, TCC payments, electric loss costs, ICAP costs and emissions
 - For information only

Additional Benefit Metrics

10-Year NYCA Change*

Study	Solution	LOAD PAYMENT	NYCA LOAD PAYMENT	EXPORT PAYMENT	GENERATOR PAYMENT	NYCA GENERATOR PAYMENT	IMPORT PAYMENT	TCC PAYMENT	LOSSES COSTS
TRANSMISSION SOLUTIONS									
Study 1: Central East	Edic-New Scotland	\$215	\$112	\$103	\$233	\$214	\$20	(\$212)	(\$25)
Study 2: Central East-Knickerbocker	Edic-New Scotland-Knickerbocker	\$264	\$141	\$123	\$271	\$251	\$20	(\$206)	(\$16)
Study 3: Volney Scriba	Volney-Scriba	(\$54)	(\$72)	\$18	\$384	\$398	(\$15)	(\$432)	\$13
GENERATION SOLUTIONS									
Study 1: Central East	New Scotland	(\$117)	(\$176)	\$59	(\$88)	(\$11)	(\$77)	(\$26)	\$17
Study 2: Central East-Knickerbocker	Pleasant Valley	(\$109)	(\$163)	\$55	(\$61)	\$13	(\$74)	(\$38)	(\$17)
Study 3: Volney Scriba	Volney	(\$228)	(\$313)	\$85	\$122	\$234	(\$111)	(\$319)	\$55
DEMAND RESPONSE SOLUTIONS									
Study 1: Central East	F(100) G(100) J(200)	(\$69)	(\$70)	\$1	(\$51)	(\$47)	(\$4)	(\$15)	(\$3)
Study 2: Central East-Knickerbocker	F(100) G(100) J(200)	(\$69)	(\$70)	\$1	(\$51)	(\$47)	(\$4)	(\$15)	(\$3)
Study 3: Volney Scriba	F(100) G(100)	(\$29)	(\$30)	\$1	(\$23)	(\$21)	(\$2)	(\$5)	(\$1)
ENERGY EFFICIENCY SOLUTIONS									
Study 1: Central East	F(100) G(100) J(200)	(\$1,316)	(\$1,497)	\$182	(\$1,165)	(\$1,002)	(\$163)	(\$99)	(\$64)
Study 2: Central East-Knickerbocker	F(100) G(100) J(200)	(\$1,316)	(\$1,497)	\$182	(\$1,165)	(\$1,002)	(\$163)	(\$99)	(\$64)
Study 3: Volney Scriba	F(100) G(100)	(\$612)	(\$715)	\$103	(\$562)	(\$475)	(\$87)	(\$43)	(\$12)

*Values in red indicate a reduction or savings

Additional Benefit Metrics

10-Year NYCA Emissions Change*

Study	Solution	SO ₂		CO ₂		NO _x	
		Tons	Cost (\$2019M)	1000 Tons	Cost (\$2019M)	Tons	Cost (\$2019M)
TRANSMISSION SOLUTIONS							
Study 1: Central East	Edic-New Scotland	2,071	\$0	455	\$3	381	(\$0)
Study 2: Central East-Knickerbocker	Edic-New Scotland-Knickerbocker	2,189	\$0	650	\$4	465	(\$0)
Study 3: Volney Scriba	Volney-Scriba	203	\$0	163	\$1	(387)	(\$0)
GENERATION SOLUTIONS							
Study 1: Central East	New Scotland	615	\$0	1,319	\$8	738	\$0
Study 2: Central East-Knickerbocker	Pleasant Valley	563	\$0	1,149	\$7	462	\$0
Study 3: Volney Scriba	Volney	(303)	(\$0)	1,718	\$10	632	(\$0)
DEMAND RESPONSE SOLUTIONS							
Study 1: Central East	F(100) G(100) J(200)	6	\$0	(173)	(\$1)	(221)	(\$0)
Study 2: Central East-Knickerbocker	F(100) G(100) J(200)	6	\$0	(173)	(\$1)	(221)	(\$0)
Study 3: Volney Scriba	F(100) G(100)	(52)	(\$0)	(77)	(\$0)	(66)	(\$0)
ENERGY EFFICIENCY SOLUTIONS							
Study 1: Central East	F(100) G(100) J(200)	(153)	(\$0)	(11,177)	(\$61)	(4,043)	(\$0)
Study 2: Central East-Knickerbocker	F(100) G(100) J(200)	(153)	(\$0)	(11,177)	(\$61)	(4,043)	(\$0)
Study 3: Volney Scriba	F(100) G(100)	(14)	(\$0)	(5,234)	(\$29)	(1,567)	(\$0)

*Values in red indicate a reduction or savings

Additional Benefit Metrics

Capacity Market Impacts

Study	Solution	MW Impact (MW)			
		J	G-J	K	NYCA
Study 1: Central East	Transmission	0	0	0	0
	Generation	54	81	29	220
	Energy Efficiency	142	212	77	574
	Demand Response	122	182	66	493
Study 2: Central East-Knickerbocker	Transmission	0	0	0	0
	Generation	54	81	29	220
	Energy Efficiency	142	212	77	574
	Demand Response	122	182	66	493
Study 3: Volney Scriba	Transmission	0	0	0	0
	Generation	54	81	29	220
	Energy Efficiency	36	54	19	145
	Demand Response	30	44	16	120

Study	Solution	ICAP Saving (\$2019M)	
		V1	V2
Study 1: Central East	Transmission	0	0
	Generation	66	524
	Energy Efficiency	173	1,345
	Demand Response	149	1,158
Study 2: Central East-Knickerbocker	Transmission	0	0
	Generation	66	524
	Energy Efficiency	173	1,345
	Demand Response	149	1,158
Study 3: Volney Scriba	Transmission	0	0
	Generation	66	524
	Energy Efficiency	44	347
	Demand Response	36	288

2019 CARIS 1 Scenarios

Scenario	Description
High Load Forecast	Higher penetration of electric vehicles and electric heat pumps
Low Load Forecast	Higher energy efficiency levels achieved
Higher Natural Gas Prices	Derived from 2019 EIA AEO High Forecast
Lower Natural Gas Prices	Derived from 2019 EIA AEO Low Forecast

Key Findings: Base Case

- The results are consistent with prior CARIS studies, solutions studied offered a measure of congestion relief and production cost savings
- Transmission projects studied did not result in B/C ratios in excess of 1.0, based on generic cost estimates and production cost savings only.
- The Base Case includes the selected AC Transmission Public Policy Projects starting in year 2024. As expected, the congestion level decreased substantially with the AC Transmission projects in-service as compared with prior study years. Central East is still, however, the most congested transmission corridor over the ten-year study period (2019-2028) because of high congestion during the five-year period preceding the AC Transmission projects (2019-2023).

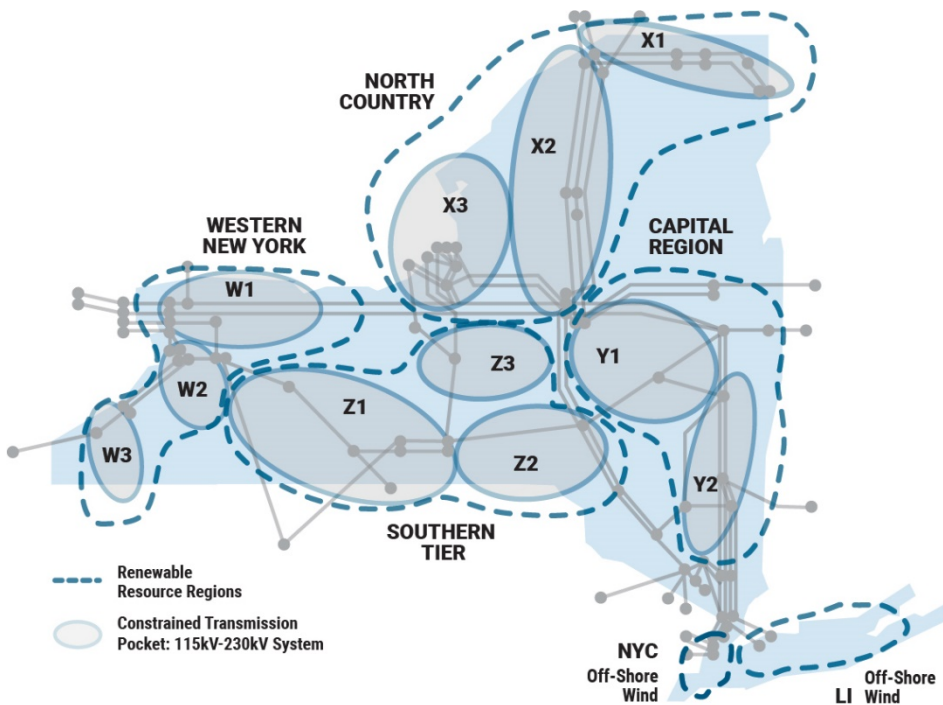
2019 CARIS1 70x30 Scenario

- The CLCPA mandates that 70% of New York’s end-use energy consumption be served by renewable energy by 2030 (“70x30”), including specific technology-based targets for distributed solar (6,000 MW by 2025), storage (3,000 MW by 2030), and offshore wind (9,000 MW by 2035)
- The “70x30” scenario models these targets through 2030 for two potential load forecasts and identifies system constraints, renewable generation curtailments, and other potential operational limitations
- The 70x30 Scenario is not intended as a roadmap for compliance with the mandates of the CLCPA, but does provide insights into renewable generation pockets that are likely to form due to limited transmission capability in the areas where wind and solar resources are likely to be constructed
- Renewable capacity build-out assumptions were developed in collaboration with stakeholders utilizing the NYISO interconnection queue as a reference point

70x30 Scenario Key Assumptions

- All coal plants retired by 2021
- “Peaker” rule replacements corresponding to local Compensatory MW additions identified in 2019-2028 CRP
- Modeled up to approximately 15,000 MW utility-scale solar, 7,500 MW behind-the-meter solar, 8,700 MW land-based wind, and 6,000 MW offshore wind total capacity
- Approximately 1,000 new transmission contingencies were added as identified in the MAPS/TARA contingency screening process

Key Findings: 70x30 Scenario



- **Western New York (Pocket W):** Western New York constraints, mainly 115 kV in Buffalo and Rochester areas
- **North Country (Pocket X):** Northern New York constraints, including the 230 kV and 115 kV facilities in the North Country
- **Capital Region (Pocket Y):** Eastern New York constraints, mainly the 115 kV facilities in the Capital Region
- **Southern Tier (Pocket Z):** Southern Tier constraints, mainly the 115 kV facilities in the Finger Lakes area
- **Offshore Wind:** offshore wind generation connected to New York City (Zone J) and Long Island (Zone K)

Key Findings: 70x30 Scenario

- The “70x30” scenario represents possible resource portfolios that are consistent with state-mandated policy goals. Results show that renewable generation pockets are likely to develop throughout the state as the existing transmission grid would be overwhelmed by the significant renewable capacity additions.
- In each of the five major pockets observed, renewable generation is curtailed due to the lack of sufficient bulk and local transmission capability to deliver the power. The results support the conclusion that additional transmission expansion, at both bulk and local levels, will be necessary to efficiently deliver renewable power to New York consumers.
- The level of renewable generation investment necessary to achieve 70% renewable end-use energy by 2030 could vary greatly as energy efficiency and electrification adoption unfolds.
- Two scenarios with varying energy forecasts and associated renewable build-outs were simulated. Both scenarios resulted in the observation that significant transmission constraints exist when adding the necessary volume of renewable generation to achieve the 70% target.

Key Findings: 70x30 Scenario

- Given that the 70% renewable target is based on the level of end-use energy, energy efficiency initiatives will have significant implications for the level of renewable resources needed to meet the CLCPA goals. For this assessment, utilizing an illustrative set of various renewable sources, nearly 37,600 MW of renewable resources was modeled to approximate a system potentially capable of achievement of the 70x30 policy goal at the base load forecast. By comparison, nearly 31,000 MW of renewable resources were added to cases with demand reduced by energy efficiency polices.
- The large amount of renewable energy additions to achieve the CLCPA goals would change the operations of the fossil fuel fleet. Overall, the annual output of the fossil fleet would decline. The units that are more flexible would be dispatched more often, while the units that are less so may be dispatched less or not at all. In addition, sensitivity analysis indicates that if the statewide nuclear generation fleet retired, emissions from the fossil fuel fleet would likely increase; the degree of that impact is dependent on the timing of nuclear retirements and the pace of renewable resource additions.

CARIS Phase 2 Objectives

- **Evaluate specific projects designed to reduce congestion identified in CARIS Phase 1**
 - Production costs savings must exceed project costs over first ten years of operation
 - Sum of LBMP savings (for zones with savings) over first ten years of operation must exceed project costs
 - Cost allocation and cost recovery through the NYISO tariff for qualified transmission projects that receive 80% vote of the identified beneficiaries
- **Perform Additional CARIS Studies for all interested parties and for all solution types**

Stakeholder Engagement

- **2019 CARIS 1 Kick-Off at June 25, 2019 ESPWG meeting**
 - Reviewed key assumptions
- **Reviewed Base case results at Sep. 6, Sep. 11, Oct. 4, Nov. 4 and Nov. 18, 2019 ESPWG/TPAS meetings**
- **Reviewed 70x30 scenario case results at Feb. 27th, Mar. 16th, Apr. 6, and Apr. 23, 2020 ESPWG/TPAS meetings**
- **Reviewed draft Report at May 4 ESPWG/TPAS meetings and May 22, 2020 ESPWG meetings**
- **Reviewed final Report at June 4, 2020 ESPWG/TPAS meeting**

Next Steps

- **Post comments from Independent Market Monitor**
- **Seek approval at July 1, 2020 Management Committee**
- **Seek approval from Board of Directors at the July meeting**
- **Post Board-approved Report on NYISO Website**
- **Conduct Public Information Session**
- **If requested by a Market Participant, proceed with CARIS Phase 2 consistent with Tariff and procedures**

Questions?

CARIS Data Catalog

Previously presented at ESPWG

September 11, 2019

[CARIS Preliminary 70 x 30 Scenario Development](#)

October 4, 2019

[CARIS Scenario Load Forecast Development](#)

[CARIS 1 70x30 Scenario ESR Modeling](#)

October 23, 2019

[CARIS 70x30 Scenario Assumptions and Calculation](#)

November 18, 2019

[Preliminary Scenario Results \(High/Low Gas Prices and Loads\)](#)

February 27, 2020

[Review of Assumptions and Resource Mix](#)

March 16, 2020

[Preliminary Scenario Load Constraint Modeling, Nuclear Sensitivity and Additional Results](#)

April 6, 2020

[Preliminary Base Load Constraint Modeling, Nuclear Sensitivity and Additional Results](#)

April 23, 2020

[Constraint Modeling, Energy Storage Sensitivity and Additional Case Results](#)

May 4, 2020

[2019 CARIS Draft Report - 70x30 Section](#)

Previously presented at ESPWG (cont.)

May 22, 2020

[CARIS Draft Report, Appendix, & Data Tutorial](#)

June 4, 2020

[CARIS Report and Appendix](#)

Posted to ESPWG Meeting Materials

March 16, 2020

[Monthly Case Energy Output MWh – Updated](#)
[70x30 Build Out Scenario Load](#)

April 6, 2020

[Case Output By Type and By Zone](#)
[Monthly Case Type Energy MWh](#)
[70x30 RE Buildout Base Load](#)
[Preliminary 70x30 Scenario Pocket Map](#)

April 23, 2020

[Case Output By Type and By Zone](#)
[Case Output By Type and By Pocket](#)
[Monthly Case Type Energy MWh](#)
[Monthly Average Zonal LBMP](#)
[Hourly Information By Pocket](#)

May 22, 2020

[Hourly Wind Solar Curtailments By Pocket](#)
[Hourly Zonal Net Load](#)
[Fuel Forecast](#)

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

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

